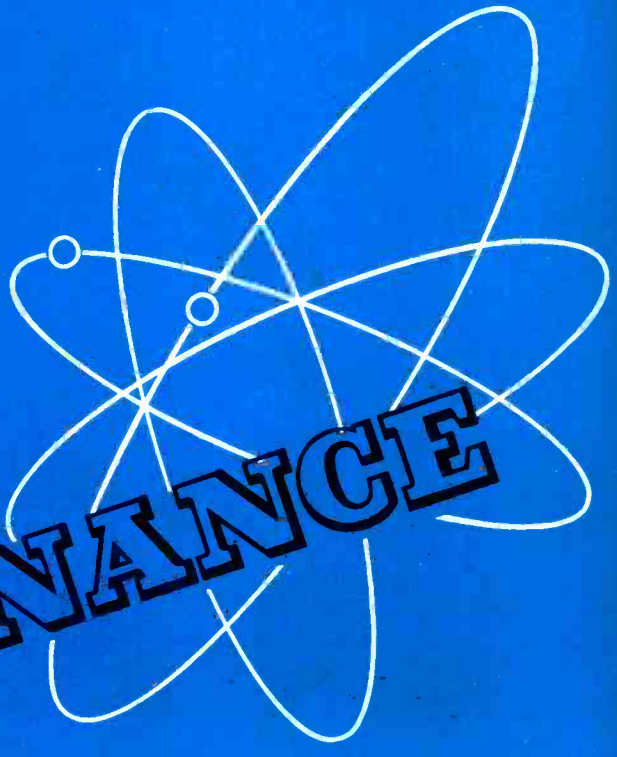
RADIO MAINTENANCE



JANUARY 1946

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RADIO MAINTENANCE

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ELECTRONIC
MAINTENANCE

Volume 2 JANUARY 1946 Number 1

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The PROBLEMS OF

By John F. Rider

RADIO MAINTENANCE MAGAZINE will be glad to publish your views on this subject as well as those of Mr. Rider. In particular, we would welcome any information from existing associations as to their membership, dues, aims, and accomplishments. Address all your communications to the editor.

THE past decade and a half has witnessed numerous and hectic attempts to form radio servicemen's associations. Analyzing what has been accomplished in the light of what is required, the most liberal evaluation does not permit any conclusion other than that the success attained is not equal to the need. This does not mean that the men concerned in honest efforts of the past did not try to do their best, for most certainly they did. Such being the case, it must mean that something else was lacking. That something else is what shall be discussed in these pages.

The writer has had the opportunity upon numerous occasions to witness the trials and tribulations accompanying the attempts to organize such associations. Usually at the outset the activity seethes with determination and vigor; then as time passes or when some difference of opinion develops, the constancy of purpose wavers and the boiling cauldron becomes a simmering teapot. This has happened time and again, over many years. In every case a certain pattern of events became evident that was responsible for the lack of continued desire for, and interest in the association. Recognition of this repetitive pattern and a desire to call it to the attention of the industry for what it may be worth is the reason for this dissertation. . . . Now that the repair group have tasted the fruits of success during the war years, they certainly should be interested in ways and means of perpetuating the decent livelihood it required a war to produce.

To make this presentation logical and useful, it is necessary first to establish what is wanted and why it is needed. As you can readily understand, what will follow appears as one man's opinion, although it does reflect the thinking of many people with whom this subject has been discussed over a period of many years. Everybody who reads these words may not agree with them, but that does not matter at the moment. It is much more important to crystalize the problem so that all can see it in the same way. If that can be done, it will be a good start. The inability, or perhaps to be more truthful, the lack of desire to see eye to eye on a matter of mutual interest is more often than not the reason why so many puzzling situations pertaining to human relations arise and appear beyond solution. Why the Association?

Does the radio repair industry require an association? . . . This question has been voiced many times before. Each time it is answered in the affirmative, but the

ORGANIZATION

THE FIRST OF A SERIES OF ARTICLES ON THE RADIO SERVICING INDUSTRY BY ITS MOST EMINENT AUTHORITY.

desired association does not make its appearance. To dwell at great length here explaining why an association is needed by the radio repairmen of this nation seems foolish. It should be sufficient to mention in brief just a few of the more important reasons and to devote this space to the clarification of the numerous issues which usually arise and defeat the effort.

To start with, there are five fundamental reasons why the repair industry requires an association. These are, (1) restoration of public confidence; (2) the establishment of a

respectable and fitting level of income; (3) the development of a solid front which is necessary to combat undesirable legislation; (4) to deal with programs, operations, or situations developed within the radio industry which seem detrimental to the welfare of the repair group, and (5) to cope most readily and easily with the technical problems arising from the technological advancements of the war.

Admittedly these reasons are not new. As justifications for the need for an association, they have existed for years and efforts have been made to form associations. Withal the results have not been satisfactory, so the most natural question to ask is, "Why not?" . . . Strangely enough the answers are simple, but happen to concern such subjects which are not readily admitted or talked about.

Common Understanding Absent

Granting that radio repairmen have realized the existence of numerous troublesome situations, a paramount weakness in past association effort has been the refusal on the part of the members to understand that the problems *affect all.*

There must develop a concert of thought among those actively engaged in the repair of radio and related equipments. *All* must realize that each man has a responsibility to his fellowman as well as to himself when all are threatened by the same thing. The failure to realize this does not place "the other man" in a precarious position—it places every man on the same spot.

Comparatively small differences in financial income of repair shops has created a class distinction among the membership of some associations. Naturally these are not discussed openly, but they are evident as the undercurrent of thought in many expressions. In entirely too many instances men have felt that certain issues did not affect them; their financial level placed them beyond danger. . . . They felt that only the biggest of the big issues were of interest. The remainder of the items were the concern of the other members—the smaller fry. . . .

It is true that in most cases success is attributable to the individual effort, zeal, and initiative. . . . But just as isolationism has been forever banished from this earth, just so

must isolationism between people who have common interests in an industry be banished for the common good. When a cloud is placed upon the operations of an industry as a whole, it means that *every man* in that industry—large and small *operator alike*—is under suspicion. When some new threat to existence appears upon the horizon, it becomes a matter of general concern. Of course, it will take longer to beat down the financially stronger man than the weaker man, but the result is inevitable.

There is an old saying that you must make friends while on the way up the ladder, because you never know when you may need them on the way down. The permanence of financial success never is assured; it cannot be perpetuated by either political or religious decrees. Neither can its continued existence be predicated upon weak competition. The

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THE PROBLEMS of ORGANIZATION

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successful individual who is a member of an industry demonstrates his vision and good business sense by recognizing the individual part he plays in the industry, but also by recognizing the obligations he has to others who are members of the same industry.

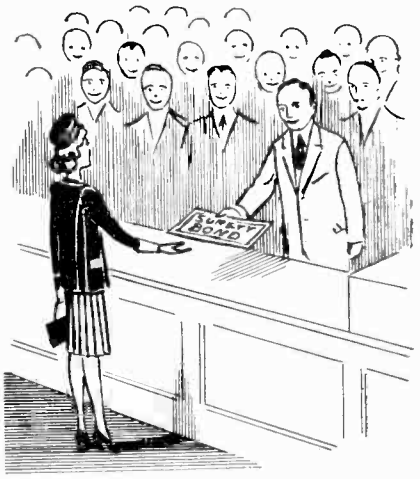
The reverse also is true. Proper understanding of the problem must be demonstrated by those whose financial success has not yet reached the desired height. An appreciation of the issues of mutual interest does not mean an attempt to institute such a program that will tend to throttle the more successful individual to reduce his level. The writer has seen this tried upon occasion and effect was a foregone conclusion; it defeated the very purpose of the organization. Not only did it eliminate the stronger man who could help lead the organization, but the very existence of such thinking was contrary to the basic requirements for bringing such an association effort to fruition.

Eliminate Personal Issues

A weakness created in many associations has its root in an attempt to use the association as a means of settling personal differences—to get revenge. Maybe it appears childish in the eyes of some who don't agree when it is stated that when the main issues are sufficiently great, such things as personal feelings must go by the board. We know of corporation executives who try by every artifice to beat one another in business, yet annually take cruises together. That makes business sense. Maybe the sense of values is different at various financial levels, but if it is, it would not be so bad for the lower income-bracket men to emulate some of the tactics of the other group.

Don't for one moment think that this preaches brotherly love in business, but if the man you don't like personally can lend support to an industrial program by being a member in good standing of the association which serves you both, and he is willing to work for mutual benefit—it is unsound financially to bicker and disagree purely on a personal basis. This goes on in country clubs, in political associations, and the like, but invariably the result is the same: a general weakening of the organization structure—and no personal satisfaction.

Time and again two men, each capable, have come to a disagreement—usually on a relatively unimportant topic—and have split an existing association wide open. Each man has his following and two associations come into being, where previously there was one. Now neither has enough strength to accomplish anything. Activity is half-hearted, interest wanes gradually until only a shell of what could have been is left. To prevent the attainment of aims badly needed by many family men simply because two individuals don't agree, is ridiculous; yes, one may go so far



as to say that it is stupid. . . . Yet it has happened too many times!

It is understandable that men in a group may disagree upon policy, but stubbornness should not be a dominant influence in deciding the final action. Common sense should dictate the nature of the compromise. All life is a matter of give and take. It is important always to remember that there can be three sides to a question—your side, the other fellow's side, *and the right side!*

You Get Out What You Put In

The writer's experiences in association effort are of long standing and one of the saddest commentaries which can be made is that too many men want to get more out of an association than they put into it. . . . It just can't be done. . . . You get out just what you put in. You can't expect the other man to do all the work. Being a better speaker, writer, diplomat, or leader, he may be willing to carry the ball in the game, but if he must do it all alone, he'll be tackled so fast that he will not find the opportunity to accomplish anything useful.

The issues which face the repair fraternity in the radio field are serious; only whole-hearted, concerted effort and the support of all will enable the attainment of the goal. Constructive criticism is extremely valuable, but constructive work is more useful. Associations don't "just grow like Topsy," especially when they have today's many obstacles to overcome.

It is very flattering to an outside lecturer to draw an attendance of hundreds at an association meeting, but when he learns that the usual meeting attracts thirty or forty people, then he realizes that there is no real strength in that association or in the ability of his listeners to accomplish or utilize the ideas he has presented.

As a general rule, the leaders in association effort are not only honest, but they represent the man who has initiative, understanding, ambition and imagination—in general—ability. Usually such a man is already doing well in his repair work and is smart enough to see that a good association will help him continue and even improve his economic level. Such individuals are vital to associations, but more than one has told the writer that he was ready to throw in the sponge and "let the bunch" fight their own battles; he would take his chances purely on his own ability. Followers are many, but leaders are few. . . . Yet leaders must be available to point the way, set the pace, and carry the fight. To lose the services of such a man because of a conscious and deliberate effort to coast on the other man's work is not shortsightedness—it is total blindness to all personal interests and gain.

You Can't Operate Without Money

The writer has attended many meetings called for the purpose of starting associations. Everything progressed in an enthusiastic and energetic manner and everyone had high hopes of accomplishment, until the matter of dues was raised. With continued vim and vigor the proposals poured forth and then ran the gamut from five dollars per year to the tremendously high figure of two dollars per month. And having raised the question of dues the discussions then revolved around what would be obtained for the money paid into the treasury.

In our opinion herein lies the fundamental weakness of all past association effort, even those which have survived. Perhaps extenuating cir-

cumstances can be found for the past, but most certainly not during the past three years or the next two to come. There is no sense in being blind to the realities of life. The radio repair industry cannot expect any endowments either to permit operation of its associations or to enable it to form that real association which is vital to its success. Moreover, it must cease expecting *donations of various kinds*, such as time on the air, meeting places, announcements of meetings, programs and the like. . . . *It must pay its own way. . . . It must fight its own battles with its own money. . . . It cannot develop the prestige it so badly needs as long as it continues to accept hand-outs. . . . It cannot demand respect* from even its own members, let alone the public, the judiciary of any municipality, or others with whom it may come in contact, if it is an organization without funds.

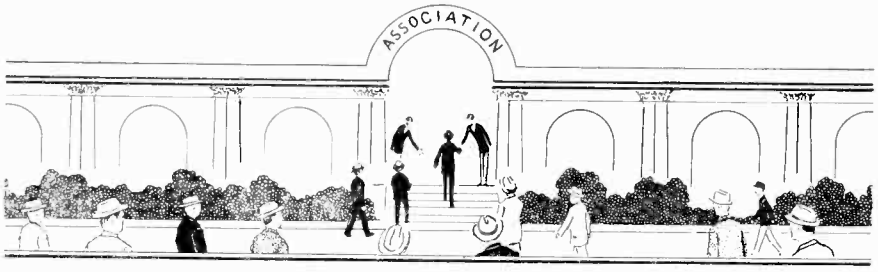
Each and every member must realize the full meaning of the financial needs of such an organization, whether it is new or old. Its demands are greater when it is new than when it has reached a semblance of stability, but young or old it NEEDS MONEY TO GET ITS JOB DONE.

Each member has a right to expect his association to give him a return as a member of that association. If the association is to command respect, if its name and emblem is to have meaning to the public thus establishing public confidence in each member, *each member must be willing to bear the cost.* This means that every member must pay his share to furnish the necessary funds for the required operations. The collective return obtained in this manner is many times that which would be obtained if each man spent ten times the amount he pays in dues.

In order that an association combat unfair legislation, indictment of its members as a whole, and in other ways perform its required functions, each individual member must display a thorough understanding of his individual responsibility to his fellow members in the association. He does this by his willingness to pay such dues as are warranted by the association needs.

The lack of adequate funds, with which to do what is necessary to serve the members, is an insurmountable handicap and can be identified as being responsible for the mediocre results obtained by the most honestly conducted associations. We understand only too well that a radio repairman's association cannot be a wealthy association in the true sense of the word, because it does not have enough men to draw on. But the industry as a whole has had profitable years between 1942 and 1945 and will have two more such years during 1946 and 1947. Now is the time to make the necessary readjustments of the financial structure of the existing associations so that they will become financially stable and so be in a position to put forth the necessary effort to gain the public's confidence—to establish the justification for a fair service charge—to gird themselves for what developments may ensue when the radio man must embrace washing machine, refrigeration, and home appliance servicing in addition to radio.

Many problems are in the future—one of them being municipal licensing. Whether the radio repair industry agrees or disagrees is beyond discussion at this moment, but whichever it is, the attempt to influence the decision in the desired direction will call for not only lip service, but money too. In truth there is no one to fight the serviceman's war but the serviceman. Individually, he is a straw in the wind of chance; collectively, through an association, he can be a voice, but not if the association is financially weak. It is sad that money is so important, but it is a fact which will not be changed for a long time to come.



Maybe you're wondering about the writer's impression of suitable dues for a radio repairman's association. Frankly it is high; not because we feel that it should be high as a limiting agency, but because it must be high. It should be no less than $1.00 per week, and need not be higher than $2.00 per week for full voting members, the exact figure being dependent upon the number of men in the local association, with adjustment for student and other non-voting members. We admit that this is a substantial sum annually as dues go, but bearing in mind the job which must be done and the limited number of men to draw on for financial support—there is not much choice.

Eliminate Diversity of Aims

Somewhat associated with the shortage of funds generally prevalent in associations has been another cause for conflict. This has been membership by individuals who do not have direct common interests. One need not stretch his imagination too far to visualize everybody in the entire radio industry as being eligible for membership in the repair group. Of course, such has not been the case in general, but in many instances many different interests were permitted to join because they represented added revenue, prestige of one kind or another, possible patronage, etc. Having divided interests, there could not be a common meeting ground of ideas directed towards the betterment of the primary membership. In line with the developments in the radio industry, which incidentally have already cast their shadows before them, it is understandable now what is considered a radio repairman's organization can become an electronic maintenance and allied appliance maintenance organization.

Having decided that it is an organization of maintenance personnel —with the necessary recognition of those maintenance outfits who also merchandise, but which are not primarily merchandising outfits — it should accept all who fill the bill, yet limit the roster to those who will derive material benefits (other than technical information) from the association. The willingness to embrace the maximum number of people in such an association is to be admired, but some sort of a line of demarcation must be drawn, otherwise there will no longer be a community of interests. The sign of successful association effort is the increase in membership with minimum or no resignations.

The sound businessman recognizes his operating capabilities. He knows how much business he can do with his capital. The sound maintenance association also must recognize its operating capabilities and not attempt to bite off more than it can chew, or try to encompass organizations which are beyond the boundaries of the association. Again, it is a matter of comprehending the meaning of mutual interests and not weakening an asso-

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TELEVISION RECEIVER

This is the first of a series of planned articles presented to help the radio serviceman to understand the problems involved in television receiver maintenance.

Courtesy Allen B. DuMont Labs., Inc.

Figure 1. Modern television receiver in typical home, showing suitable arrangement for viewing by small group.

Courtesy R C A

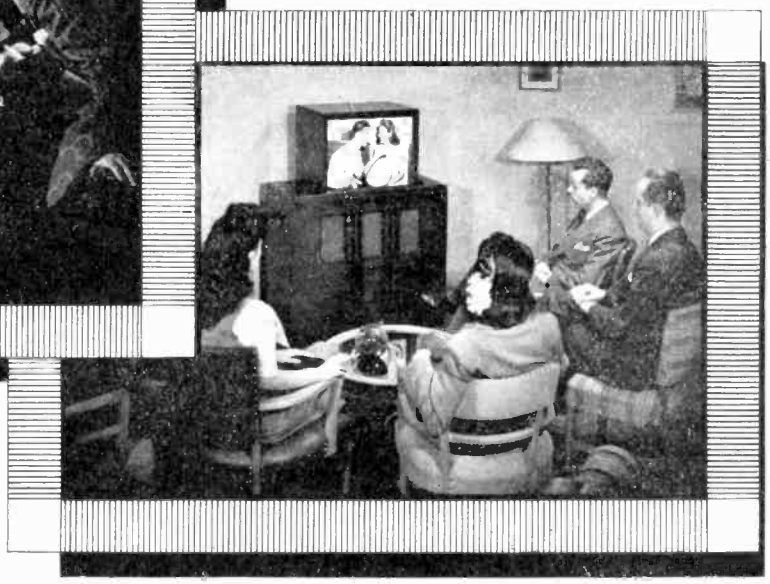


Figure 2. Comfortable surroundings and convenient location of television receiver make for greater enjoyment of programs.

WITHOUT a doubt, the year of 1946 will bring television into full swing. On this premise, one of the first questions that arises is "How will television affect the radio serviceman?" Many servicemen feel that television is so complicated that it will be a long while before they can hope to service and install television receivers properly.

Stop and think over these few points. Approximately 99% of the men who are now capable of servicing television receivers are directly associated with television manufacturers because the manufacturer realizes the scarcity of such skilled personnel. This leaves the field wide open to newcomers. But you can learn proper television procedures and techniques just as your present competitors have.

Suppose you just let television slide by or put it off. It will not be long until your customers are saying, "I'm not going to take this set to John Doe. He can't repair television sets, but the fellow across the street can. He must be the more clever chap. He'll get my business."

Not only will he get the business you now have, but he will be making a much better profit. In the first place, the majority of the component parts cost more—the cathode-ray tube alone is expensive, capacitors to handle higher voltages are expensive, better transformer construction is expensive, and a satisfactory antenna installation costs from $25 to $200, depending on the conditions. This means greater total sales and, therefor, greater profit. In the second place, the television serviceman can demand more money for his servicing because it requires a better trained man. Thus, not only will the television man have a better reputation, but he will net a larger profit from the whole field of radio servicing. The first of these articles concerns installation because that is the duty the serviceman will first be called upon to perform.

A proper television receiver installation is greatly different from that of a broadcast receiver. As far as the dealer is concerned, his responsibility for a broadcast receiver installation ends when he delivers it to the house and plugs in the power cord. This has resulted from the advent of built-in antennas and the good conditions surrounding long-wave local reception. However, even with the models which are designed for all-wave reception and require some form of antenna, it is still usually left to the customer to design and install it, sometimes with the recommendations of the dealer.

The customer is so trained in these conveniences that even in selling F-M receivers, it is a tough job to convince him that a special antenna is necessary.

With television, the proper antenna is even more necessary, and the dealer will have to convince his customers that this is so, without making them think he is just trying to make an added sale.

It is true that a makeshift television antenna can be used with reasonably good results in areas of high

INSTALLATION

By J. H. Ruiter

ALLEN B. DUMONT LABORATORIES, INC.

signal strength close to the television transmitters. This antenna can be made from a length of a twisted pair. The end of this pair farthest from the receiver is untwisted for a length equal to ¼ the wavelength of the television band to be received.* These two ends are then spread out in opposite directions to form what is known as a dipole antenna by surrounding them horizontally from curtain rods, pictures or the like, and the other end of the twisted pair is used as a lead-in to the set.

This make-shift antenna is, of course, not as desirable as a commercially constructed antenna because it results in a weak signal and it does not add to the beauty of the room.

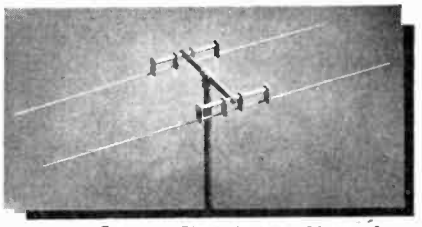
For television, the proper antenna must be used for consistently good reception because the power output of most stations is relatively low at the present time, and the losses are greater with higher frequencies. In other words, to obtain the highest possible signal-to-noise ratio, a good commercial antenna, well installed, is necessary. This becomes more necessary as the distance of the receiver from the transmitter is increased.

The customer is usually unaware of this and it is the duty of the dealer to sell the customer on a good installation. Once sold, the antenna installation must be engineered for the specific location. When the dealer arrives at the customer's home to install the receiver he should find out where the customer wants the set placed. It is his responsibility to either approve this location, or to point out to the customer how it can be improved.

The customer who buys a television receiver will be interested in the best location for use, both for his family and guests. He will not appreciate having to shift all the furniture around in his living-room just to accommodate guests. The receiver should fit in with his present furniture and should not look out of place. Figures 1 and 2 show two typical arrangements that permit good screen visibility.

These are some of the considerations which should be discussed fully with the customer before the installation is made. Even before the sale is made, the dealer should visit the home of the prospective customer to ensure his buying the proper model and cabinet design. A little knowledge of interior decorating would be very helpful to the dealer at this point. Such a suggestion as setting a large table model on the floor to use the top as an end table is sometimes welcome. Also, the position of the electrical outlets in a room does not need to affect the decision as to where the set is to be placed, since cords may easily be lengthened or an extra base plug installed by a properly authorized electrician.

Once the correct position for the receiver has been settled, the location of the antenna should be determined. As a prerequisite for this particular part of the job, the dealer should make a careful investigation to determine whether any city ordinances restrict the height, construction, or installation of antennas. In the smaller cities and towns there is less likelihood of restricting ordinances than in the larger cities such as New York. Also, installations in public buildings or apartment houses may be restricted by rules of the owner incorporated into the lease. Even though there may be no restrictions on such installations, a good word and a cigar for the superintendent have been found to be of considerable help.



Courtesy Shur Antenna Mount, Inc.

Figure 4. Commercially available mounting of dipole and reflector. Construction of radiator and reflector supports provides for simple adjustment for optimum spacing.

Assuming that these restrictions are kept in mind, there are only two other considerations: (1) get the antenna as high as possible so it will pick up the greatest signal; (2) economize on lead-in as much as possible, particularly if co-axial cable is used, because of cost of the lead-in and because of losses in signal strength. The two most popular lead-ins at the present time are co-axial cable and twisted pair. "Co-ax" is without a doubt the more efficient but it is also the more expensive. It is not excessive to pay twenty-five cents a foot for certain types. Therefore, it is reasonable to suppose that most installations will be made with twisted-pair, unless the signal strength is particularly low. If this is the case, co-axial cable should be used in the lead-in. In every installation it should be remembered that the average twisted-pair used as a lead-in results

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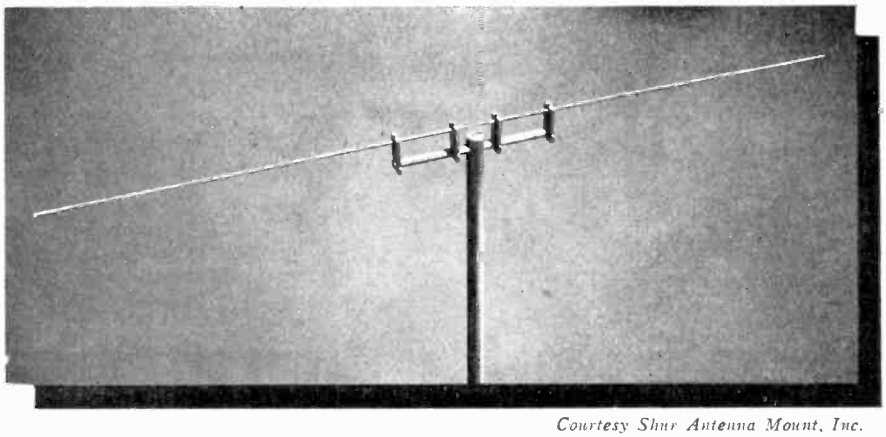

Courtesy Shur Antenna Mount, Inc.

Figure 3. Simple, efficient dipole mounting for television antenna. This is one of numerous types commercially available.

*See "Antennas for F-M & Television" in Radio Maintenance, October 1945.

TELEVISION RECEIVER INSTALLATION

→ From Preceding Page

in losses of 20% or more in lengths of 100 to 200 ft.

If the signal strength is generally good in the area, then convenience can also be considered in locating the antenna. If it is too difficult to work on the roof of a house, the antenna may sometimes be installed in the attic. The direction in which the antenna is to be placed should be determined before final installation. This can usually be done by setting up a make-shift antenna in the same room as the set and rotating it. The plane giving the best reception on all stations, or optimum on most stations can be found and noted so that the permanent antenna may be fixed in the same plane. The position thus found for a half wave antenna is usually that plane in which the antenna is perpendicular to the wavefront of the received signal. This is, of course, true for half wave receiving antennas at all frequencies. It is more necessary at television frequencies because of the short antenna and because of the usually weak signals. In some cases, however, it has been found that a direct signal was relatively weak whereas a reflected signal from a large object such as a standpipe or bridge is very strong. In such instances, it is advisable to locate the antenna in such a position that it cuts the maximum number of *reflected* waves, i.e., perpendicular to the reflected wave.

Selection of Antenna Type

It is difficult to predict what antenna system will be recommended by the manufacturers of television receivers for use with the new frequencies assigned for television by the Federal Communications Commission. However, we can be reasonably sure that some form dipole antenna will be used, although it may be necessary to use two or three dipoles of different lengths, and have facilities at the receiver to switch antennas as the stations are changed. The dipole antenna usually consists of two metal tubes extending in opposite directions. They are usually painted with aluminum, and overpainted with a black weather-resistant paint. These rods are cut, or if they are telescoping tubes they are adjusted to one quarter the wavelength of the signal to be received. They are supported by a metal frame from which they are insulated by grommets and they have a hole at one end for the passage of a bolt to provide connection to the lead-in. Figure 1 illustrates an assembled, commercially available, dipole antenna. The antenna shown in this figure is a single dipole. The double dipole consists of two single dipoles, generally for different frequencies, mounted on a pole with one above the other, and separated by approximately one quarter wavelength. The like poles of each of these two dipoles are connected in parallel by a metal strip, and the lead-in connections made midway between the two dipoles to minimize phase shift.

A reflector is often employed to increase the strength of the signal at the antenna. The reflector may be employed with either a single or double dipole and is respectively a single or double reflector. The reflector consists essentially of the same elements as the receiving antenna and is mounted one tenth wavelength behind the antenna, as shown in Figure 4. The reflector is one solid tube one half wavelength long instead of being two one-quarter wavelength pieces. Usually, too, it is slightly longer than the overall length of the antenna. The reflector is particularly helpful in combating "ghosts" because it increases the antenna signal strength and gives a higher ratio of direct signal to reflected signal. A "ghost" is the name given to a dim but noticeable outline which appears to the right of a televised image in the shape of the image itself. Under poor conditions two or three "ghosts" may be in evidence. They are usually caused by reflections of the direct signal from large objects such as standpipes, bridges, buildings, or large gas tanks. Since the reflected signal travels a greater distance than the direct signal, the ghost appears after the true image. Also, when receiving signals in a weak signal area, the reflector is frequently necessary to obtain the maximum signal.

The antenna to be used in a specific installation can best be determined by trying first a single dipole, then a double dipole, and then adding the reflectors if necessary. The use of the simplest possible antenna to give satisfactory results is recommended unless the next addition to the antenna makes such a definite improvement that it can be regarded as necessary. When the proper antenna has been determined it should be permanently

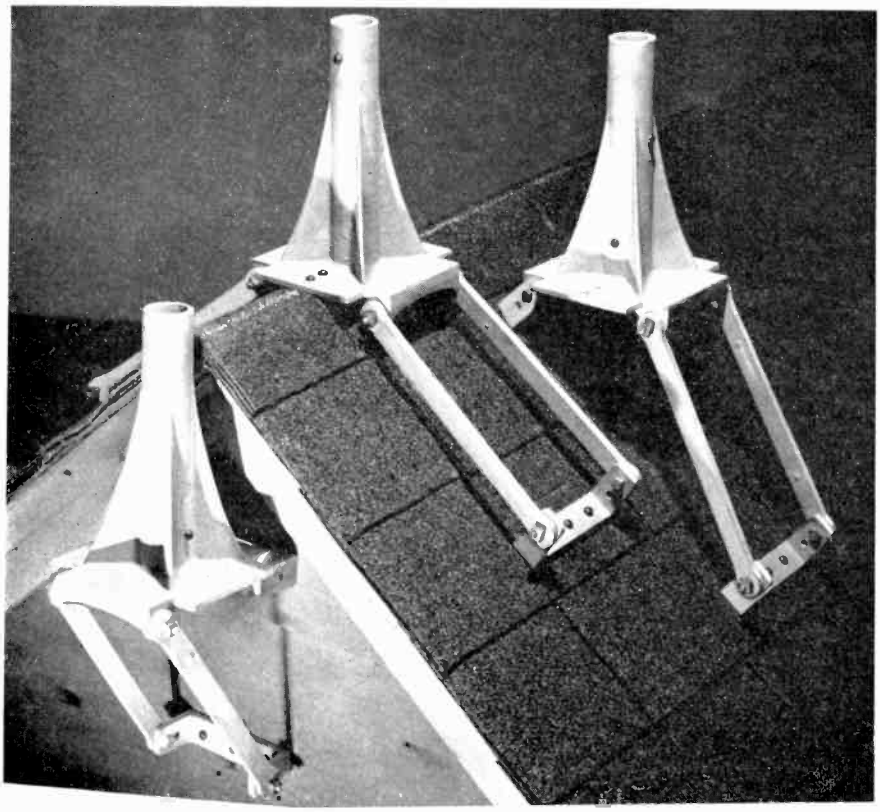

Figure 5. All-purpose mounting bracket for mounting television antenna pole. As pictured, this bracket is readily adaptable for mounting on a roof, or on a vertical surface, such as the side of a house or chimney.

assembled, the lead-in securely fastened, and the assembly mounted in place. If the attic is selected as the proper location all that is necessary is to secure the antenna support frame in its permanent position allowing as much head-room as possible. Economy of lead-in is a consideration in determining the location. In other words, do not locate the antenna at the opposite end of the house from the receiver if possible.

Roof Installations

This will probably require the use of an extension ladder. Work on ladders definitely entails a certain amount of danger and should never be attempted by one man. The principles of safety first on ladders should be carefully observed. First the ladder should be set at a sufficiently large angle against the house to prevent its toppling over backwards. The workman should always remember that he should keep at least three steps down from the top of the ladder so that he always hangs on with one hand and works with the other. A helper should always be at the foot of the ladder to hold it and to prevent slipping. As much work should be done from the inside of the house as is feasible. A few of the accessories useful for installing a television antenna are shown in Figure 5. These brackets are mounted by bolts through the roof or through the side of the house and supported on the inside by pieces of 1" x 6" to distribute the strain on the siding. The installation of the roof brackets indicates the flexibility of this form of mounting.

Sometimes it is quite necessary to fasten the antenna pole to the chimney of a house or to the side of a brick house. If this is the case, holes are drilled in the proper places into the brick with a star drill and expansion sleeves are inserted. The bracket is put in place and lag bolts are inserted through the brackets and into the sleeves which are already in place. They are tightened up with a heavy wrench. The remainder of the assembly is the same. In positioning the antenna on a roof so that it is secured in the proper plane, it is often advisable to have an interphone or inter-communication system between the installation man who takes his position at the receiver and the helper who takes his position at the antenna. In this way, the man at the set can determine the position of the antenna for the most satisfactory signal. The helper then secures the antenna in that plane.

After the antenna is installed, the next step is to run the lead-in down to the receiver. In the case of antennas installed in the attic, it will probably be most convenient to take the lead-in outside of the house, run it down-stairs, and then run it inside again. There are several considerations here. One is to run the lead-in through the shortest distance in order to save cables and prevent loss, and another is that people do not like to see wires run down outside of the *front* of the house. Therefore, it is advisable to place the antenna near one side of the house, the side to which the receiver is nearest, and run the lead-in down the side, back into the house, and around the base board to the receiver.

To run the lead-in out of the house in the attic requires that a hole be bored through the side wall. This

Figure 6. Simplest method of finishing up the end of a co-axial cable type of antenna lead-in.

hole should be bored with a brace and bit. It should be slightly larger than the lead-in cable. The hole should be bored from the inside out holding the brace and bit so that it is bored at an angle of 45° downward. The lead-in is then fed through the hole and is drawn up reasonably tight. The point at which the lead-in passes through the house wall is marked and tape is applied to the lead-in starting below the point where it starts to pass through the side wall and gradually increasing the diameter of the lead-in until at the point it passes through the house it completely plugs the hole. Both the tape and the angle will minimize the rain or snow which might get into the attic through this hole. From the living room of the house a hole should also be bored from the inside out to receive the lead-in at that point. This hole also is bored downward and tape is applied on the outside to plug the hole when the cable is brought through. When the cable is in the room with the receiver, it should be run around the base board to the receiver. It can be held in place along the base board with insulated staples.

Enough slack should be allowed at the receiver end of the lead-in to enable the receiver to be moved for regular cleaning periods. It is the usual custom to terminate the lead-in in a polarized plug. To attain the proper match between the antenna and its lead-in and the receiver, better results are sometimes attained if a low value resistor is connected across the antenna input to the receiver. It is advisable for the installation man to experiment with each antenna by terminating it successively with resistors of 50, 75, 100, and 150 ohms. As the antenna is terminated with each of the resistors the received signal should be noted and the correct termination selected. In some cases, no termination of the antenna lead-in is required.

There are two acceptable practices for finishing up the end of co-axial cable. One is to cut back the rubber insulation around the braid as far as necessary. Then by using a scriber or an ice-pick, unweave the braid back to the insulation. This opened braid is then tinned and may be soldered to a lug or inserted into the proper terminal of the polarized plug. See figure 6.

The other method is also to cut back the insulation. The entire end of the cable is then quickly dipped into a lead pot and thus tinned. By scoring the braid at the desired point with a knife, it may then be peeled off without the undesirable fraying of the braid. Connection may be made to the braid by wrapping two or three turns of a length of tinned solid wire around the braid and quickly soldering to it. Care should be taken to apply only as much heat as is necessary to prevent the melting of the resinous dielectric, since a short circuit may develop.

When the installation of the receiver is complete, it is necessary for the dealer to check the operation of the set on each station in the area to be sure that all the adjustments are correct. This is most advisably done when the stations are on the air with their test patterns. The stations in your area will have a definite test pattern schedule and it will be necessary for you to acquaint yourself with that schedule and plan your installations accordingly.

The following is a complete outline of the controls the serviceman will adjust or check. Some of these controls may be changed, done away with, or be in a different location than those described herein, but these seem likely from past experience. Future information on television receiver designs is not yet available,

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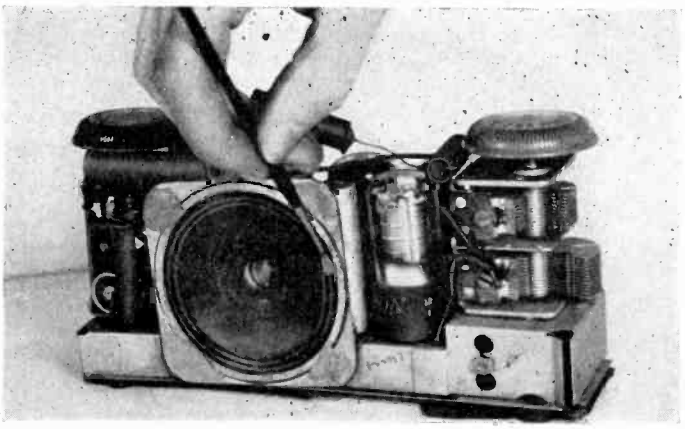
Maintenance of Receivers with SYNTHETIC BASS CIRCUITS

If one of these receivers gets into your shop, you will



need information such as this to get it working properly

By Warren E. Juttle

ONE OF THE CIRCUITS that will come in for its share of popularity, and rightly so, is the synthetic bass circuit. Developed in 1941 by F. C. Shepard, it utilizes a new principle to achieve a desired result. The circuit is fully protected by patents, and bids fair to become a necessity in order that the smaller sets may have an improved bass response. Obviously, with some manufacturers using it, others will have to follow.

Before describing the maintenance problems attendant upon such a circuit, it is first necessary that we describe the principles upon which this revolutionary circuit works. First, let it be definitely stated that this is not a "bass boost" circuit in any sense of the word whatsoever. No amount of bass boosting will make the average four or five inch speaker used in the smaller sets sound like the high quality of reproduction available from a good 10-, 12- or 15-inch speaker, properly baffled. It is a fundamental principle of acoustics that it is impossible to radiate low frequencies in sufficient volume to adequately portray a wide-range signal from a diaphragm or cone of small dimensions mounted in a small cabinet. It can be shown mathematically that for a horn to efficiently couple a speaker to the air in a room, a mouth width of approximately eighty inches is needed in order to radiate frequencies as low as 30 cps. This is shown by the use of the large "bathtub" speakers used in theatre sound systems.

It is well known to those versed in the elements of hearing that the ear introduces distortion which compensates for extreme levels of sound intensity. The human ears automatically adjust themselves for variations in sound intensity, just as the eyes function on a logarithmic basis as a form of protection against variations in light intensity.

If the ear cannot actually reproduce the lowest sounds, how then can we hear these sounds? This can be partially explained by stating that the ear, under the influence of the lowest frequencies, generates a series of harmonics of these sounds, all of which bear a definite relation to the sounds themselves. This harmonic series gives us the impression of actually hearing these low frequencies. If, then, it could be possible to introduce a series of frequencies which bear the same definite relationship to the fundamental, the ear would presumably transmit the same intelligence to the brain for this group of frequencies as it would if it had actually heard the fundamental and distorted it within the ear before transmitting that intelligence to the brain.

It has been shown by experimental observation that this distortion is largely composed of the odd harmonics so that a 40-cps sound generates 120-cps, 200-cps, and 280-cps vibrations, etc., in the ear. Keeping this in mind, let us take the case of the small speaker in a small table cabinet. Very few 5-inch speakers will put out much of a sound at 40 cps, yet the other frequencies can be radiated fairly well. If a circuit can be designed to predistort the low frequencies in approximately the same proportion as the ear would do, the brain will receive the same response from the low frequencies, even though these frequencies do not actually reach the eardrum.

This is just what the circuit under consideration does. Aside from the main object of the circuit, it also has other advantages. By reducing the frequency range, the *apparent* power output is greater for the same *actual* power output. By reducing the low frequencies delivered to the speaker, the cone travel is decreased and the resultant "breakup" of the cone is avoided. Another advantage of the circuit is occasioned by the use of some degeneration, which will compensate to a large extent for cabinet resonance. And, in addition, this circuit has the unique property of automatically varying the amount of low-frequency predistortion as a function of the level of the signal output. This means that when the volume is lowered, the low-frequency distortion is greater, giving more apparent bass. which is just exactly what is desired, even to the extent of requiring bass-compensating volume controls.

Figure 1 shows the circuit as used to give all these advantages. V-1 operates with a small amount of bias. Under this condition it is predisposed to create more distortion, which is what is desired. V-1 being a pentode, most of the distortion is in the odd-harmonic series.

The R-5, R-6, C-5 network furnishes a positive feedback, essentially at the low frequencies, due to the presence of C-5 which by-passes the high frequencies to ground. C-3 supplies a certain amount of hum voltage from the plate supply to the screen grid of V-1, which creates a hum voltage on the plate of V-1 which is out-of-phase with that normally appearing there. C-4 furnishes negative feedback to decrease effects of cabinet resonance, and to further stabilize the operation of the amplifier. The capacity of C-6 is critical, as it determines the frequency of maximum feedback through the R-5, R-6, C-5 circuit. C-7 is the normal by-pass across the output transformer primary. R-3 serves to increase the bias on V-1 in the presence of signals of higher volume, thus reducing the tendency of the tube to create distortion, and consequently, reducing the amount of synthetic bass introduced into the circuit.

Maintenance

We come now to the servicing problems of this circuit, and the methods of curing faults resulting from change in value of the components.

First among possible troubles is the stiffening of the speaker cone due to drying out. If the set seems to lack bass, a good first step is to correct this condition. Connect an audio oscillator to the input of the amplifier, and drive the speaker heavily at its resonance point, as may be determined by the frequency at which the cone makes its maximum excursion. Then, being careful that the voice coil is kept dry at all times, brush the cone with nail polish remover or acetone, lowering the oscillator frequency as the cone resonance frequency is reduced. This should be repeated a sufficient number of times to permanently reduce the cone resonance frequency to the desired point, which for very small speakers is approximately 120 cps. If the circuit is employed with large sets in cabinets, the resonance frequency should be reduced to as low a point as possible, 60 cps being a good minimum point for 12-inch speakers. This is an important step, and other work in improving the performance is useless without doing this operation first or at least checking the resonant frequency thoroughly. In case the speaker has been replaced, this operation is an absolute necessity.

If it is apparent that other service work has been done on the receiver, or if the speaker has been changed, it is necessary to determine the phasing of the feedback connection to the voice coil. To do this, disconnect R-6 from the cathode of V-2, and apply a signal of approximately 400 cps to the input. Now, disconnect C-4 from the voice coil. The signal should increase appreciably. If it decreases, reverse the connections to the voice coil—that is, connect C-4 to the side that was grounded, and ground the side of the voice coil circuit to which C-4 was previously connected. Reconnect R-6 to the cathode of V-2.

In case of failure of any resistors, be sure to replace them with the exact value previously used. If they have been burnt until the value markings are not discernible, and no service notes are available, the values of R-5, R-6, and R-7 can be determined as follows: Secure some means of varying the line voltage from 105 to 125 volts, such as a variable transformer, or make up a unit from an old power transformer, as shown in Fig. 2. The phasing of the secondaries must be

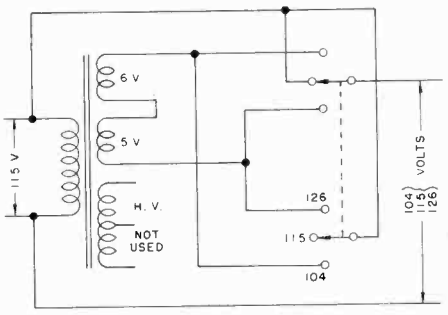


Fig. 2 Method of hooking up a power transformer to use as a source of 104, 115, and 126 volts for general testing use as well as for the use outlined for making adjustments to synthetic bass receivers.

checked when the unit is assembled, and the output measured with a voltmeter. After making the correct connections, label the switch, and it will be a serviceable instrument thereafter.

With the variable voltage source connected, turn the set on again, with no A-F signal applied. Supposing that R-7 has been burnt out, and that the resistance marking is not discernible, set the line voltage at 105, and select a value for R-7 that will just keep the set from oscillating.

R-5 and R-6 are both of approximately the same value, and if one of them should fail, it should suffice to replace it with another resistor of the same value as the other of the pair. If both have been burnt up, they should be replaced by selecting a pair of values which will just keep the set from oscillating with the line voltage at 125.

The value for C-6 should be determined carefully in case of failure by increasing the line voltage to 125, and selecting a condenser which will cause the set to oscillate at a point about 20 to 30 cycles below the speaker resonance frequency. When correctly adjusted in all its components the set with 125-volt supply should just start oscillating when the speaker cone is thumped with the fingers, the oscillations dying out immediately thereafter.

With these suggestions, it is felt that the serving problems attendant upon this type of circuit should be simple ones.

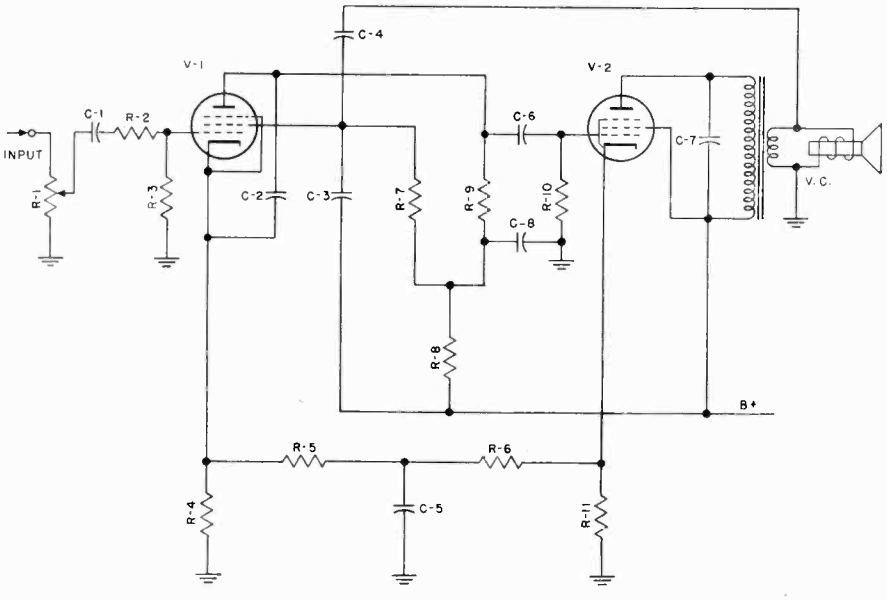


Fig. 1 Typical schematic of audio section of receiver using the synthetic bass circuit.

RADIO MAINTENANCE

Servicing Aircraft Bonding, Shielding and Antenna Systems.

IF you can service a home radio receiver, you can also service an aircraft receiver — that is, if the trouble is in the receiver. There is the catch: a pilot may tell you his receiver is not working properly when the trouble is actually in the antenna or bonding system or the ignition shielding harness. Even so, it is still up to you. Fortunately the required trouble shooting, although more extensive since it involves all these things, is still within your scope.

The Pilot and His Radio

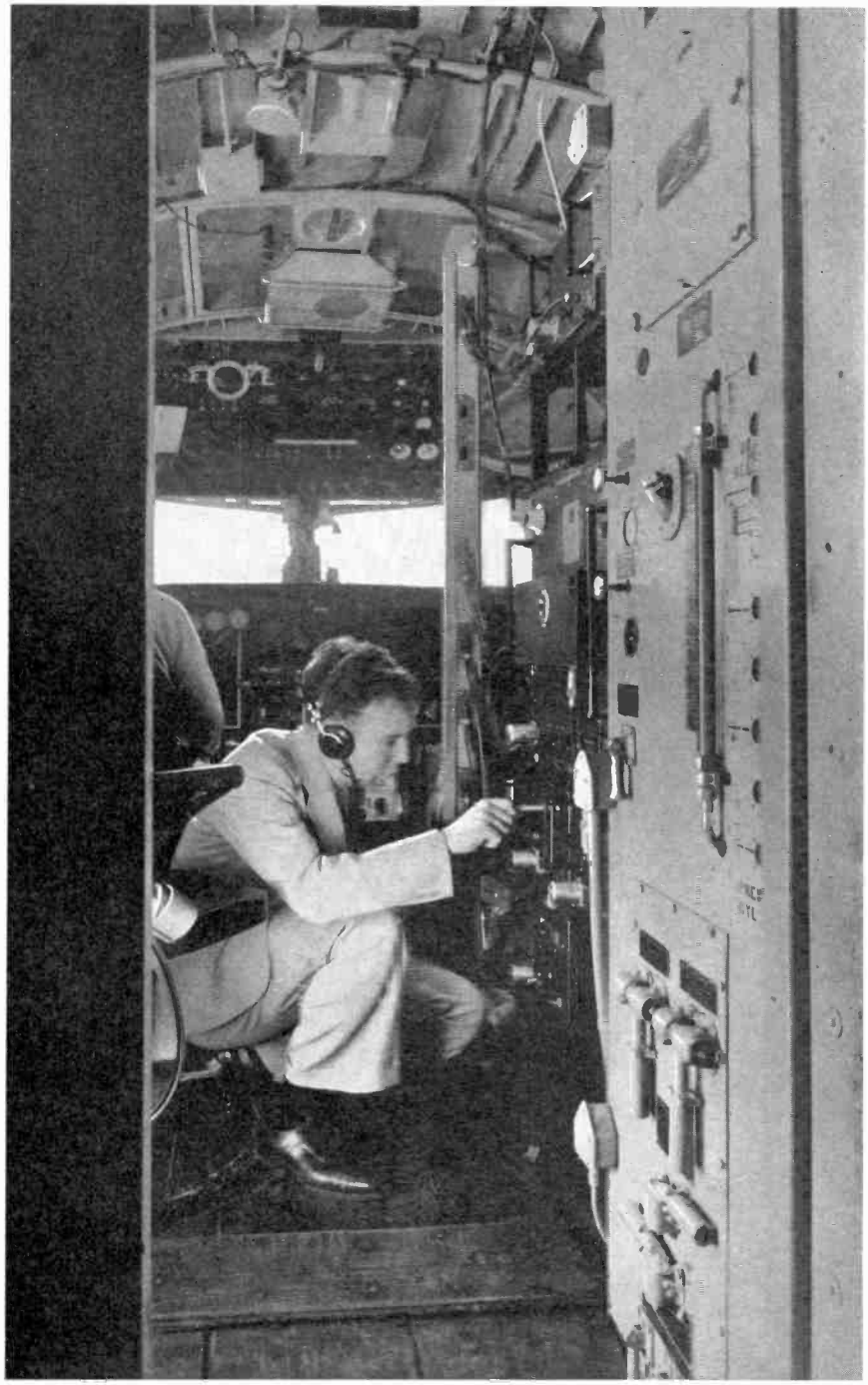
Nineteen times out of twenty the pilot's complaint will be familiar: weak or noisy signals. Weak reception of the radiotelegraph A and N radio beacon signals causes dangerous errors in navigation that may cause a crack up; a fadeout means the pilot is completely hung up on his flight course with a forced landing imminent. Therefore, since these symptoms spell danger, any serviceman dealing with them must discover and eliminate the trouble completely, whether he is aviation trained or not.

The first thing to do with a faulty aircraft receiver is the same thing you do with any other kind: bench test it, and if it isn't right, make it so. Then re-install it on the plane and if trouble shows up there try to isolate the trouble as follows:

1. Dead set; power pack.
2. Noisy set; shielding system.
3. Weak signals; antenna or bonding systems.

If you stay tuned in to an aeronautical ground station while testing aboard the plane you may assume its transmitter to be okay.

Transmitter troubles develop in flight in reverse order; the pilot calls a ground station and is told his signals are weak, or fade or die out completely. The step by step remedy is the same as with receivers: bench-test the set, hook it up on



Western Electric Co. Photo

Fig. 1. Testing the radiotelephone aboard a Douglas DC-4 superairliner.

IN Aviation

By Lt. Myron F. Eddy, U. S. N. Ret.

the plane again and if troubles show up check power supply, aerial, bonding and shielding. To do that you have to know the parts with which you are dealing. Explanations follow.

Trouble Shooting Aircraft Antenna Systems

The antenna system aboard aircraft consists of one or more aerials, with all the metal parts of the plane metallically bonded together to form a counterpoise in lieu of ground.

You may find one type antenna used for transmitting, another on the same plane connected to receiver only. Wind, weather and man cause all sorts of trouble to develop in these installations and the more you learn about the types, how they are mounted and hooked up, the better chance you will have to quickly spot the opens, grounds and faulty contacts that curse the pilot in stormy flight. Snow, rain, sleet, and dust leave their marks and call for frequent between-flight inspection, drying out, and overhaul.

There are two general classes of antennas, or aerials: the fixed type and the trailing-wire type. Of the fixed type there are three styles: the rod, mast or vertical pole; the doublet; and the loop. There are also two kinds of trailing or "depending" wire antennas: one is suspended from beneath the plane and made to trail down and aft by reason of a streamlined lead weight attached to the free end; the other, a more recent development, is the sleeve type.

The mast antennas are mounted upright, usually above and behind the engine. The doublet is usually a stranded phosphor-bronze wire strung between wing tips; sometimes to the tail. The loop antenna is generally built into the interior of the wings or housed in the fuselage; it is used in conjunction with the radio direction finder, or "radio compass", not for transmission. Many advantages are rightfully claimed for each type.

The minimum requirements of a commercial transport plane as to radio equipment probably consist of a radiotelephone receiver and a radiobeacon receiver. For using an antenna with this equipment, metal poles and metal-centered strut-shaped wooden masts have both been found satisfactory. However, if ice accumulates on the mast, the strength of the signals received will be decreased. Also, ice-coated masts become a source of danger to the plane. On the other hand, the doublet type introduces so great an error in the reception of radiobeacon signals that it is not used for this purpose.

The loop antenna is only installed if a radio compass is to be provided. The Army and Navy have used trailing or "depending" wire aerials for years and continue to do so, particularly on the larger planes. The length, and therefore the capacity, of the trailing aerial can be controlled by the operator at will, by reeling in or out. Where a long antenna is required, this or the sleeve type must be used. The sleeve type is a development of the older Army-Navy type and seems likely to supersede the original form of trailing aerial, except possibly on some military craft. The trailing-type antenna possesses greater ability to pick up incoming signals than the smaller fixed type, but has the disadvantage of being inoperable on the ground unless strung out to a pole. This makes it undesirable for "commercial" aviation.

When a trailing type antenna is part of the equipment, a spare antenna and weight are usually carried. Every plane equipped primarily with a trailing wire antenna should carry in addition some form of fixed auxiliary antenna and some form of emergency antenna. The auxiliary antenna is desirable in maintaining communication while approaching for a landing after the trailing antenna has been reeled in. The emergency antenna is desirable in the event of a forced landing. The antenna reel used with the trailing antenna must be kept insulated from the metal part of the aircraft. This is usually accomplished by mounting the reel on an insulating panel.

If the metal reel is employed, the bolts used to secure it should be

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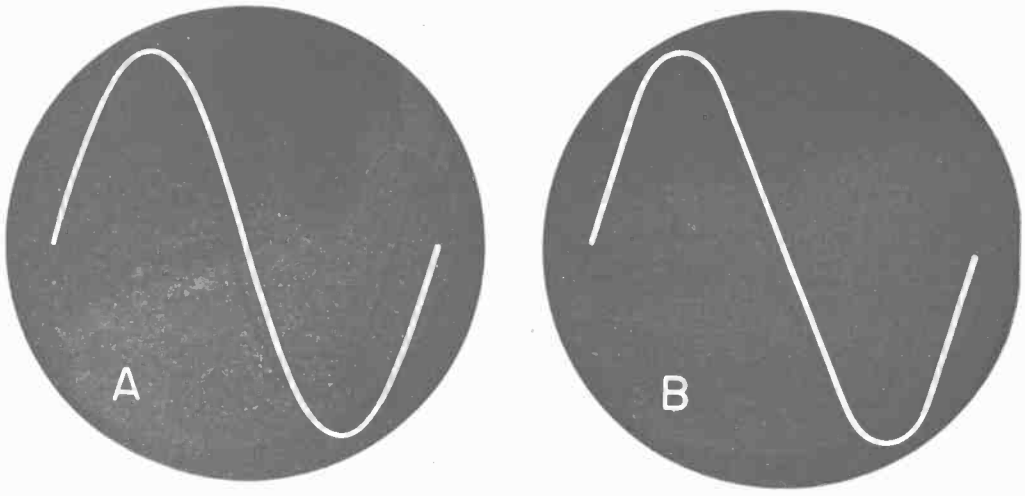
Pan American Airways Photo

Fig. 2. A Pan American Airlines Radio Mechanic bench-testing aircraft dynamotor.

Using the Oscillograph for Distortion Measurement

By C. G. McProud

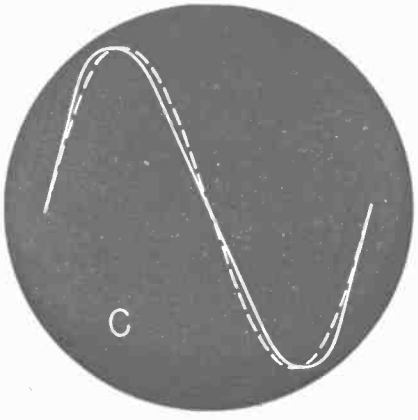


Can YOU tell the difference between the patterns A and B? Pattern A is a pure sine wave as seen on the 'scope; pattern B is the same wave with 10 percent second harmonic distortion. Apart, they look very much alike. But when they are superimposed, as in C, the differences are readily apparent. The dotted line is the pure sine wave and the solid line is the distorted wave. This article tells how to detect one percent harmonic distortion with the 'scope.

THE AMOUNT OF DISTORTION present in the output of a radio receiver or of any other sound reproducing system determines whether or not it is pleasing to the ear. It may be amplitude distortion, in which the frequency characteristic of the reproduced sound is different from that of the original signal, or it may be harmonic distortion, in which case the output contains frequencies that were not present in the original signal.

A certain amount of amplitude distortion can be tolerated. In fact, the effect of a tone control is to create amplitude distortion so the reproduction sounds "mellow". However, it is harmonic distortion that makes the reproduction unpleasant, or harsh. The amount of this distortion that can be tolerated in a good system is in the order of one percent. Above that, a person with a trained ear would judge the reproduction poor.

Still another type of distortion to which considerable attention has been given is intermodulation. The same factors that cause harmonic distortion also cause intermodulation distortion, but measurement of harmonic distortion at the higher audio frequencies is somewhat difficult. Intermodulation distortion is the name given to the inter-action between two (or more) frequencies that are transmitted simultaneously. Intermodulation distortion is somewhat easier to measure, and it can be shown mathematically that the ratio between measured intermodulation and measured harmonic distortions for the same amplifier is approximately 3½ to 1. In other words, a system showing a harmonic distortion of one percent will indicate an intermodulation distortion of about 3½ percent.



Both intermodulation and harmonic distortions are measured by the use of pure tones. For measurements of harmonic distortion, the signal source must contain harmonics of well under 0.5 percent to make valid measurements on systems which have distortions of less than one percent. Furthermore, to measure harmonic distortion, a wave analyzer or a series of filters must be used. It is not possible to detect waveform distortions of much under five percent by observation on the screen of a cathode ray oscillograph, in spite of the suggested use of the 'scope for this purpose.

However, while elaborate measur-

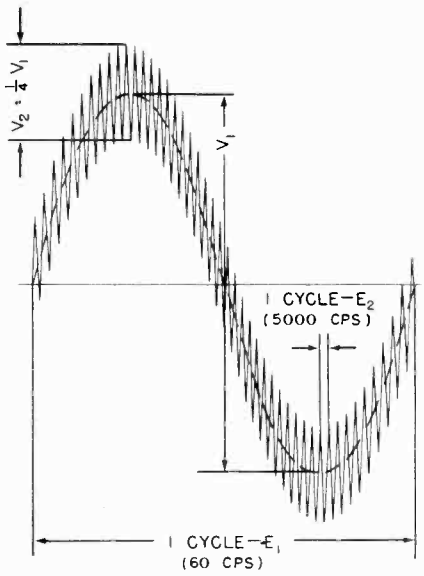


Fig. 1. 'Scope pattern of test signal, composed of a high frequency superimposed on a low frequency.

ing methods are also used for the intermodulation measurement, it is possible to determine the harmonic distortion percentage with considerable accuracy by means of very simple equipment, using the 'scope as the indicator. It is the purpose of this article to expound this method, and to point out its advantages.

The proposed method will permit the user to measure intermodulation distortion of an amount that corresponds roughly to one percent harmonic distortion with a visual indication of 25 percent of the measuring scale. In addition, it is possible to determine by inspection whether the distortion is caused by a single-ended stage or a push-pull stage, and whether it is caused by improper bias or by excessive input signal.

Principles of I-M Measurement

Before describing the method, it is advisable to outline the principles under which the measurements are made. A signal consisting of two different frequencies, widely separated and not harmonically related, is fed into the input of an amplifier. During the process of amplification, these frequencies acquire a certain amount of intermodulation, and if they are separated at the output and analyzed, it will be found that one of them will have some of the components of the other. Practically, the signals used are 60 cps and 1000, 2000, 4000 or 8000 cps. Both are fed into the input, with the lower frequency signal four times the amplitude of the higher frequency. The output of the amplifier is terminated with the proper load impedance. The output signal is passed through a high-pass filter, leaving a high-frequency signal with some 60-cps amplitude modulation impressed on it. The signal is rectified, and the 60-cps component measured as a percentage of the higher frequency carrier. This gives a figure which is the percentage of intermodulation distortion.

When using the oscillograph as an indicator for I-M distortion measurement, a similar test signal is used, the frequencies being 60-cps and 5000-cps; the output signal is filtered just as for the metering method. However, rather than measuring the modulation on the 5000-cps signal, it is observed on the 'scope, and the necessary information can be gleaned from the pattern presented.

In order to clarify this entire description, a number of 'scope patterns are reproduced. Figure 1 represents the test signal, consisting of a 60-cps wave with a 5000-cps wave superimposed on it. Note that this is a distinction between the test signal caused by combining two frequencies, and a signal resulting from a modulating process. A 5000-cps signal *modulated* with a 60-cps wave would appear as in Fig. 2. As a comparison, it might be stated that Fig. 2 represents 100 percent intermodulation distortion. To avoid any modulation in the combining process, it is essential that no non-linear elements, such as poor transformers, be used in this part of the circuit.

To illustrate the action of an amplifier upon the test signal, Fig. 3 shows the output signal resulting from a condition of amplifier overload. The dotted lines represent the maximum signal level that can be passed through an amplifier without distortion. As the amplitude of the test signal is increased, the limits begin to flatten off the peaks of the 5000-cps "fringe" on the 60-cps wave. In Fig. 4, the 5000-cps wave has been straightened out by the filtering pro-

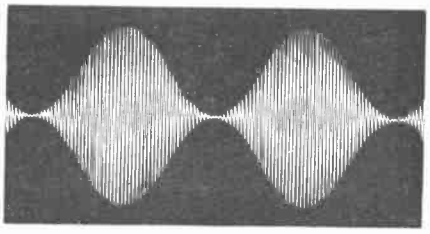


Fig. 2. 'Scope pattern of a 5000-cps wave modulated 100% by a 60-cps wave.

cess which removes the 60-cps wave, but the remaining signal still has the notches caused by the flattening of the fringe on the peaks of the test signal, as shown in Fig. 3. This is the sort of signal that is applied to the 'scope in the visual method, and no further operations on the signal are necessary. However, when measuring intermodulation distortion, the 5000-cps signal is rectified, and the resultant modulation impressed upon it is measured as a percentage of the signal amplitude.

The advantage of the 'scope as an indicator, for qualitative rather than quantitative work, is fairly well shown by comparing Figs. 4 and 5. The notches in Fig. 4 are relatively deep, and readily visible; yet when the A-C component of the modulation is actually *measured*, the resultant is a very small percentage. For 'scope use, it is a definite advantage to have an indication of this sort, and the

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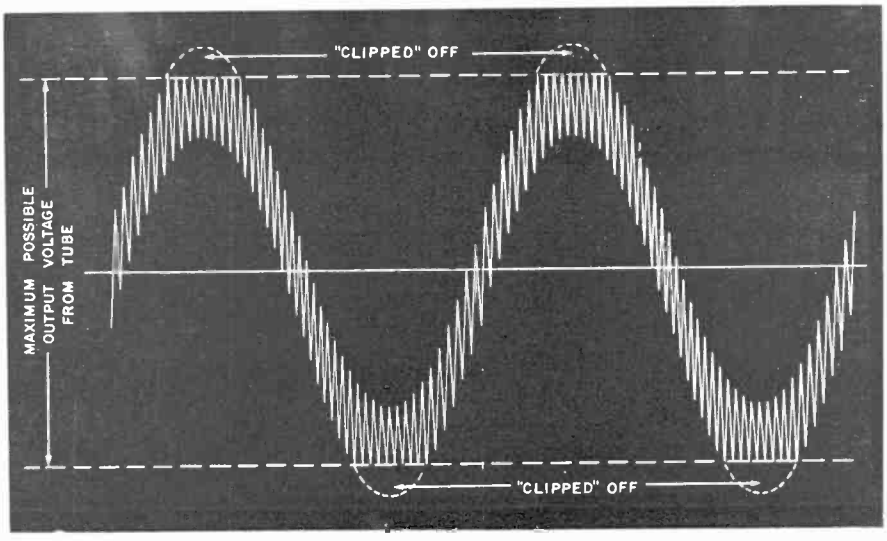

Fig. 3. Test signal after passing through amplifier, with distortion resulting from overload. Note clipping of fringe on peaks of 60-cps wave.

USING THE OSCILLOGRAPH

→ From Preceding Page

'scope is capable of indicating certain characteristics that a meter will not show.

Figure 6 shows the effects obtained with a single tube amplifier stage to which the test signal is applied. In (A), the operating point for the grid bias is less than normal. By applying the test signal to the grid of the tube, the developed plate signal indicates the flattening of the fringe, as in Fig. 3. Below this is shown the 5000-cps signal after the 60cps component has been removed by filters. When the 5000-cps signal is applied to the 'scope, the horizontal sweep is synchronized at 30 sweeps per second, which permits the portrayal of two complete cycles of the 60-cps wave. Returning to the 5000-cps signal, it will be noted that there are only two notches, and that they are both on the same side of the pattern. This is the type of indication caused by incorrect bias on a single tube amplifier stage. In (B), the grid bias is shown to be correct, but the amplitude of the test signal exceeds the permissable grid swing of the tube. This causes a flattening of the fringe on both peaks of the test signal, and the 'scope pattern shows two notches on the top and two notches on the bottom. The successive notches are one-half cycle of the 60-cps signal apart. This pattern is characteristic of the distortion due to excessive signal amplitude on a single ended stage.

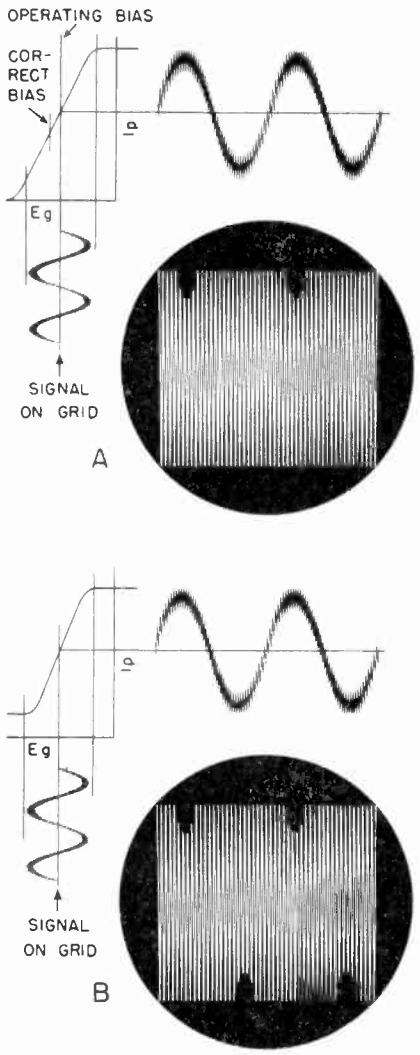

Fig. 6. Plate-current vs grid-voltage curves, and type of indications resulting from single tube with (A) insufficient bias, and (B) excessive input signal.

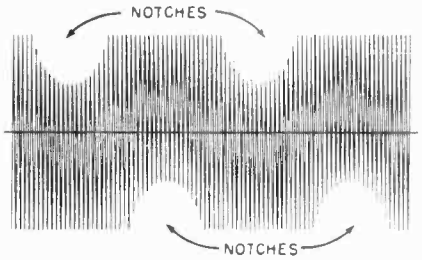

Fig. 4. Distorted output signal with 60-cps frequency filtered out.

Fig. 5. Wave form of rectified output signal, showing only the modulation envelop.

In Fig. 7(A), the test signal is shown as applied to a push-pull stage which is operating at incorrect bias. The fringe is flattened on the positive peaks of both tubes, with a resultant pattern showing four notches, on alternate sides of the pattern, making it similar to Fig. 6(B). Figure 7(B) shows the pattern resulting from a push-pull stage operating with correct bias, but which has an excessive signal applied to the grids.

These are the basic patterns, but it must not be supposed that they are all the patterns which can be obtained. Various conditions exist in which combinations of the basic patterns will modify the resultant somewhat. A flat tube in one socket of a push-pull stage, with the other tube operating with insufficient bias will give notches as in Fig. 6(A) on both sides of the 5000-cps frequency band. However, the important thing to remember is that the circuits should be adjusted to obtain the maximum output with a fixed limit of notch depth.

The statement offered at the beginning of this article that this method of measurement would make it possible to measure down to one percent harmonic distortion needs some elaboration. It is not within the scope of this article to show the mathematical analysis of this type of measurement. It should suffice to say that by comparing distortion indications by this method with measurement of harmonic distortion using laboratory equipment on over fifty different amplifiers has shown that when the notches have a depth of one-fourth of the amplitude of the filtered 5000-cps pattern, the harmonic distortion is approximately one percent.

To make the method easy to use, therefore, it is advisable to mark a series of lines on the face of the cathode-ray tube as shown in Fig. 8 to furnish guide lines for alignment of the pattern and for adjustment of notch depth. The method of use will be described later.

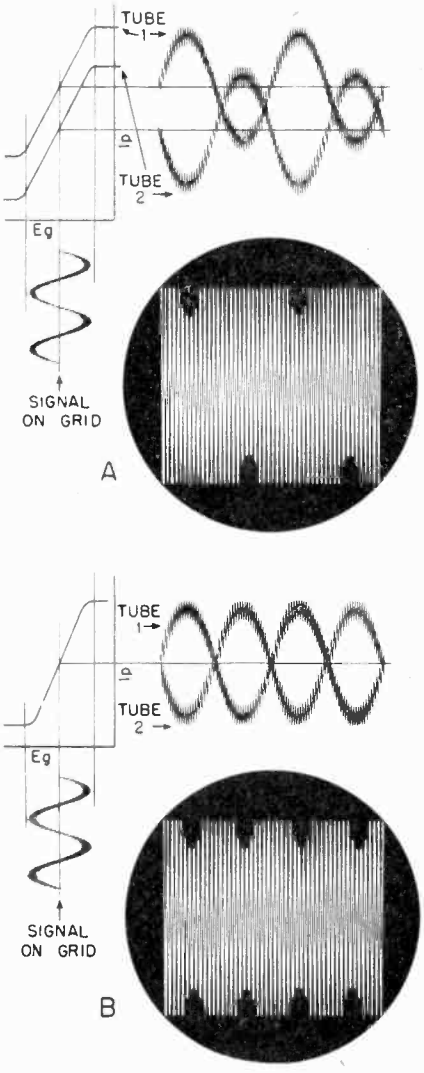

Fig. 7. Plate-current vs grid-voltage curves, and type of indications resulting from push-pull tubes with (A) insufficient bias, and (B) excessive input signal.

Source of Test Signal

One of the advantages of this method of measurement is that no elaborate equipment is necessary for generating the test signal. The frequencies do not necessarily have to be essentially free of harmonics as they do in the case of the harmonic distortion method. It is only necessary to have a source of 5000 cps, and a source of 60 cps, both of which have less than five percent distortion. This limit is well within the capability of almost any audio oscillator for the high frequency, and in most cases within the limits for the A-C power supply, unless certain types of voltage regulators are used. It is not even necessary that the frequency of the 5000-cps signal be known accurately, 5000 having been selected as an arbitrary value, being well removed from the 60-cps line frequency, and not harmonically related to it.

The method of combining the two frequencies to form the intermodulation test signal is shown in Fig. 9, which shows a complete unit, including the audio oscillator. The values for the components are shown in the accompanying list of parts. The first section of V-1 is the oscillator, operating on the resistance-stabilized principle. C-2 and L-1 determine the output frequency, C-2 being selected to obtain a suitable value. Although as mentioned before, the frequency is not critical. A value should be selected for R-1 which is 9/10 of the resistance at which the tube just starts to oscillate. This resistance will vary with the coil used for L-1; if the coil has a high Q, the value of R-1 will be about 0.75 meg. The second section of V-1 is an amplifier, transformer coupled to the combining and metering circuits. S-1 has three sections, each with three positions. The left position is marked CAL 60; the center position is marked CAL 5000; and the right position is marked USE. In the left position S-1A substitutes a 500-ohm resistor R-5 for the output impedance of the amplifier; S-1B connects the 60-cps voltage to the combining circuit, and S-1C switches a 15,000-ohm resistor in series with the meter to enable the 60-cps voltage to be adjusted to a level 12 db higher than the 5000-cps signal. R-11 is an attenuator in the output circuit to furnish control of the amplitude of the output signal. R-15 enables adjustment of the 60-cps voltage, while R-6 is used for adjusting the level of the 5000-cps signal. The power supply is conventional, using a replacement transformer with a 24-volt tuning motor winding to supply the 60-cps voltage necessary. The center tap of the oscillator-amplifier filament supply is connected up on the voltage divider as an aid in reducing hum in the 5000-cps signal. S-2 is provided to disconnect the output of the generator from the equipment under test, and is merely a refinement.

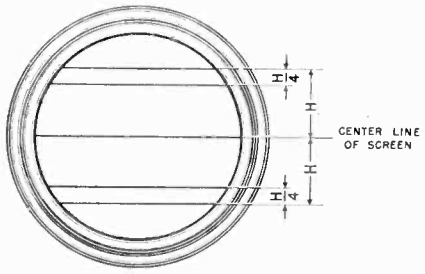

Fig. 8. Lines on screen of C-R tube to simplify measurements of intermodulation distortion.

It will be noted that resistances have been selected to keep the impedances in the combining circuit as constant as practicable, although other refinements in the selection of potentiometers and switching circuits would have done this to a greater degree. Again, however, it was not felt that it was necessary to complicate the generator unnecessarily. The important thing to remember is that in a system of this type, the source of the signal must remain the same from day to day, so that the relation between the two frequencies will remain fixed. By using the same equipment constantly, the indications obtained will be comparable.

Methods of Use

To use this method, the generator is calibrated as follows: Set S-2 to

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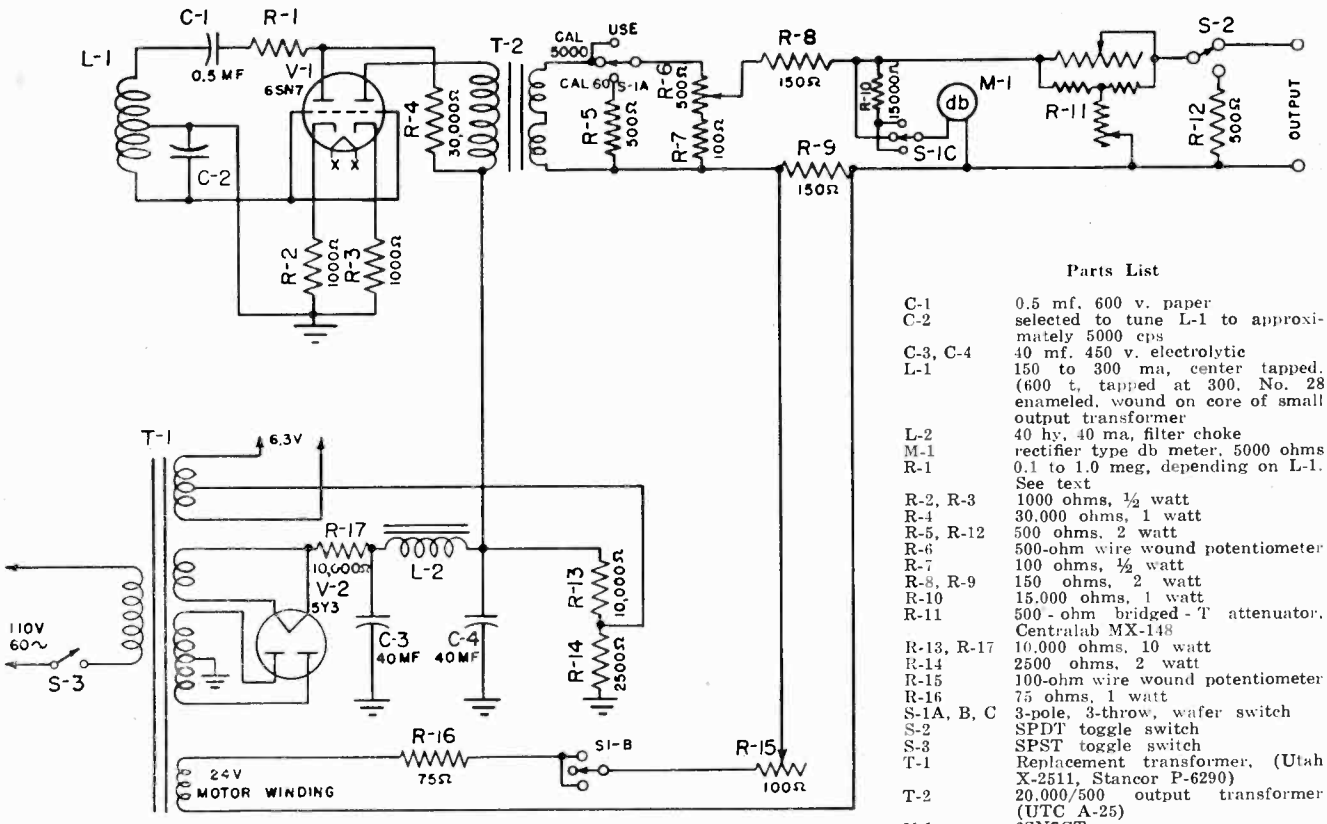

Fig. 9. Schematic of generator for producing intermodulation test signal.

Parts List

C-1	0.5 mf. 600 v. paper
C-2	selected to tune L-1 to approximately 5000 cps
C-3, C-4	40 mf. 450 v. electrolytic
L-1	150 to 300 ma, center tapped. (600 t, tapped at 300. No. 28 enameled, wound on core of small output transformer
L-2	40 hy, 40 ma, filter choke
M-1	rectifier type db meter, 5000 ohms
R-1	0.1 to 1.0 meg, depending on L-1. See text
R-2, R-3	1000 ohms, ½ watt
R-4	30,000 ohms, 1 watt
R-5, R-12	500 ohms, 2 watt
R-6	500-ohm wire wound potentiometer
R-7	100 ohms, ½ watt
R-8, R-9	150 ohms, 2 watt
R-10	15,000 ohms, 1 watt
R-11	500-ohm bridged-T attenuator, Centralab MX-148
R-13, R-17	10,000 ohms, 10 watt
R-14	2500 ohms, 2 watt
R-15	100-ohm wire wound potentiometer
R-16	75 ohms, 1 watt
S-1A, B, C	3-pole, 3-throw, wafer switch
S-2	SPDT toggle switch
S-3	SPST toggle switch
T-1	Replacement transformer, (Utah X-2511, Stancor P-6290)
T-2	20,000/500 output transformer (UTC A-25)
V-1	6SN7GT
V-2	5Y3GT

CONTROLS

By E. E. Johnson

CONTROL ENGINEER, INTERNATIONAL RESISTANCE CO.

ED. NOTE: If it takes you an hour to repair a volume control that costs you only sixty cents to buy, the cost to the customer is certain to be greater than if you had replaced it. And if you DO repair a control that has already lived three-quarters of its normal life, you cannot guarantee that it is "as good as new," no matter what you do to it. In spite of this, there are times when you MUST make a repair, even if only to give the customer temporary use of his set. This article gives you some pointers on these repairs.

WHILE the repair of components such as volume controls is not considered the best practice by servicemen or control manufacturers, there are times when such service is necessary.

Suppose, for example, Mr. Customer dashes into the shop one day and shouts, "Look, Doc, I'm moving out to the farm tomorrow and I've gotta' have this blankety-blank radio fixed right away!"

Or suppose we run across some old "jallopy"—and we've worn our legs down to the ankles dashing around town trying to find an "exact replacement." And we didn't find it! . . .

Well it may be we *can* repair the old control. It's worth a try.

Causes and Cures

Frequently encountered control troubles which are sometimes possible to correct without immediate replacement include noisy controls, open turns on wire wound controls, and inoperative switches. Unless the control is completely burned out or worn out, it is usually worthwhile to try one, or a combination, of the following simple remedies.

NOISY CONTROLS. If a set is not operated for a considerable period of time, the volume control may become noisy merely because of dirty contacts. Very often the "rapid rotation cure"—nothing more than turning the control very rapidly from one extreme of rotation to the other a number of times—will clean the contacts and eliminate the noise.

If this does not do the trick, try cleaning the contact by applying a few drops of Carbona and then rotating the control.

If neither of the above methods is successful, the control has probably been burned or suffered some mechanical damage and should be replaced.

OPEN TURNS ON WIRE WOUND CONTROLS. Many of the older radios were equipped with the wire wound type of control. If all winding is intact except an open turn or two on a control of this kind, the turn can sometimes be bridged by soldering. However, the wire used on most of these controls will not take solder, and the only thing that can be done is bury the end of the wire in a large mass of solder. This can hardly be classed as the best workmanship, but may be the only expedient if no replacement control is available.

INOPERATIVE SWITCH. If the volume control switch is not operating, the control should be taken out of the chassis and the switch cover removed. We can determine whether the trouble is electrical or mechanical by throwing the switch toggle with the finger and then connecting the terminals of the switch to a continuity meter. If this check shows that the switch is electrically defective, a new switch should be installed, following the manufacturer's instructions carefully.

If the continuity meter test proves the switch to be in good condition electrically, it is possible that the switch arm has been bent and is not exerting correct leverage on the switch toggle. In this case, it is a simple matter to bend the arm back into proper position to establish switch action.

Emergency Replacement of Control by Change of Circuit

During the war, IRC published a little booklet which outlined several ideas to help servicemen keep home radio sets working, despite parts shortages. Although this book is now out of print, some of the suggestions it contained may be worth repeating

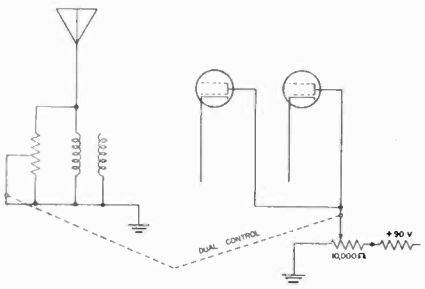

Figure 1A

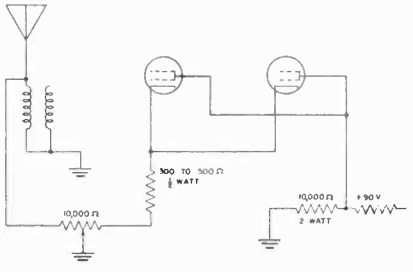

Figure 1B

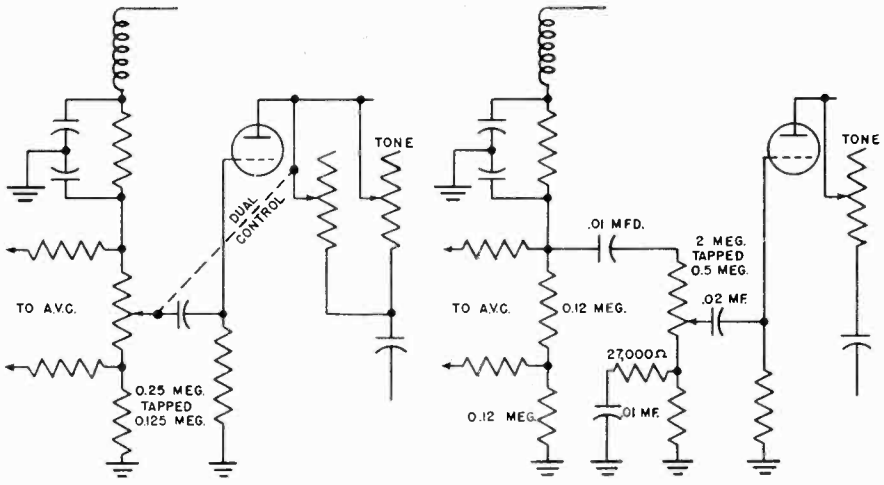

Figure 2

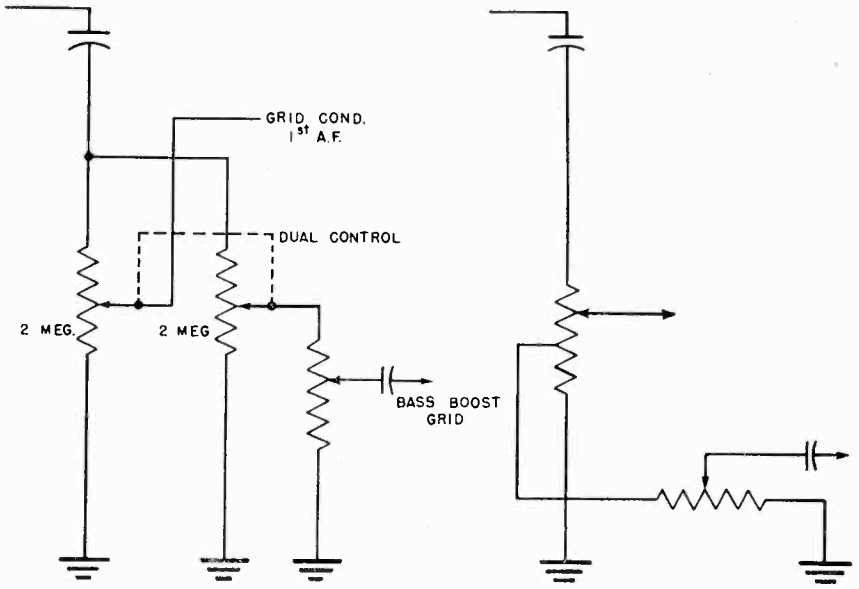

Figure 3

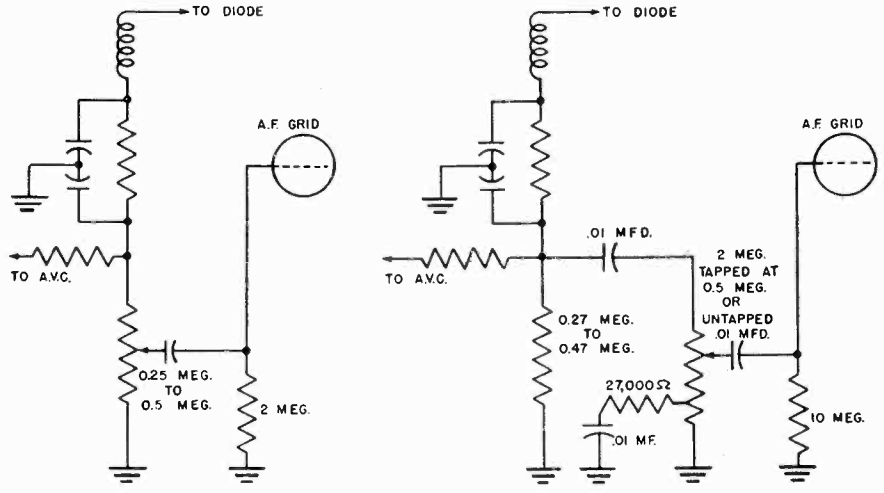

Figure 4

here, because we may still be faced with a shortage of certain components for some time.

DUAL CONTROL IN SCREEN AND ANTENNA CIRCUITS. Remove the old control and replace screen section with a fixed 2-watt resistor equal to the value of that section in ohms (usually 10,000 ohms, Type BT-2). Replace the dual control with a single 10,000-ohm control (IRC Type DS14-116). Figures 1A and 1B show the original circuit and changed circuit.

DUAL CONTROL WITH ONE SECTION FOR BASS COMPENSATION. This system of obtaining bass compensation is used in several receivers. It is difficult to obtain dual controls at the present time and a substitute circuit can be used. A very satisfactory circuit is one which uses a single control which is tapped. Figure 2 shows the original circuit and the changed circuit. At the time this change in circuit is made, the volume control can be removed from the diode circuit as shown by replacing the old volume control with two fixed resistors (BTS, BTA, or BT2), each having as near one-half the value of the volume control as the preferred list of resistors will allow.

DUAL CONTROL WITH ONE SECTION CONTROLLING BASS-BOOST CIRCUIT. This is another circuit using a dual control which can be replaced with a single control with a center tap, and still have very satisfactory operation. Since one section of the dual control is used only to supply voltage to the bass-boost circuit, this can be done very satisfactorily by means of a tap on a single control.

This circuit change is made by removing the original control and replacing it with a single 2 meg. control tapped at 1 meg. (IRC Type D18-139X), as shown in Figure 3.

REMOVING CONTROL FROM DIODE CIRCUIT. It is a well known fact that the diode current should not be allowed to flow through the volume control, as this is one major source of noise. This circuit change is shown by Figure 4. The new circuit not only eliminates diode current from the control, but also eliminates grid current as well. If desired, either a tapped or untapped control may be used.

EMERGENCY REPLACEMENT OF CONTROLS BY FIXED RESISTORS. In the case of diode or audio controls with no tap, which are completely "gone" and for which no replacement can be had, the radio need not be left inoperative. If the control has a switch that is operating, leave it in place; if not, remove the control entirely. Remove

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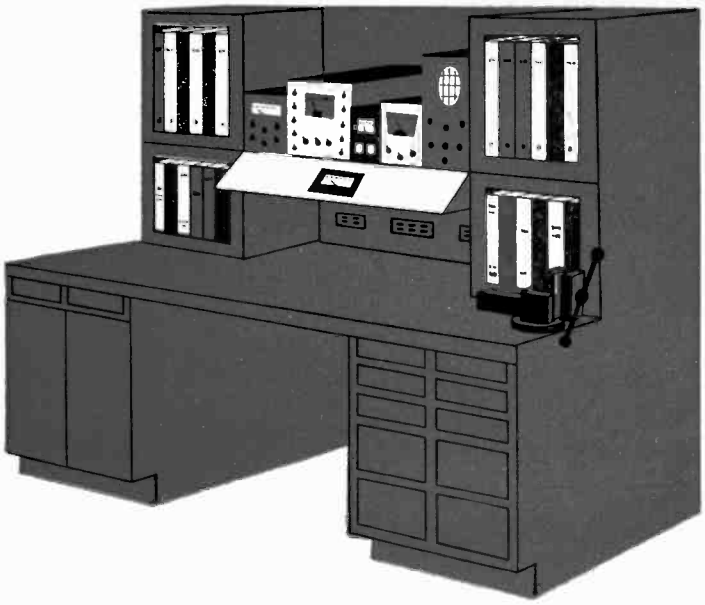
The Radio Service Bench



The Radio Service Bench will be a regular department from now on. Each month, under this heading, matters of interest to Radio Shop Men will be discussed.

By James G. Rapp

WHILE extensive advertising will initially attract customers to the radio service shop, the eventual number of satisfied patrons will be determined wholly by the quality and cost of the work done at the service bench. As the serviceman's time is the most important factor in pricing nearly all repair jobs, high grade service work at a reasonable cost to the customer and a fair profit to the serviceman can only be accomplished by the efficient operation of a systematically planned work center. Accepting these facts, the serviceman who hopes to prosper, or even survive, in the highly competitive days approaching will wisely evaluate his bench and associated equipment for its ability to effectively handle postwar servicing.

First, consider the dimensions of the bench itself. The height should allow a comfortable and natural working position of the arms and body when standing. An unsatisfactory height for working in a sitting position can be remedied somewhat by using a draftsman's type adjustable stool. The width of the work top must accommodate large combination and television chassis without overhang or crowding, yet keep in mind that test instruments are mounted on a back panel and will have to be within convenient arm's reach. A length of 6 ft. is most popular for a one-man bench. This size gives plenty of room for any conceivable job and still permits the serviceman seated at the center to reach the extremes of the bench without rising. In addition, there is more of a tendency to keep this size work top clear of useless odds and ends. When deciding dimensions, remember that a compact, neatly kept bench, planned to handle efficiently one job at a time, will turn out more work with less effort than a large bench cluttered with used parts, several disemboweled radio chasses and a scattering of seldom needed tools that have to be constantly moved around while working. If extra space is needed, use an auxiliary work bench separate from the main service bench.

The test equipment is most logically mounted on a back panel within eye range. The meter panel should slope at an angle perpendicular to the line of vision when the serviceman is seated and looking directly at the center of the test board. This arrangement gives a natural reading angle, reducing eyestrain and lessening the chance of inaccuracy in reading the meters. Place those instruments that are used frequently, such as the volt-ohm-milliammeter and the tube tester, at the center of the test board to be within a convenient range of the eyes as well as the arms. A handy item, often lacking in repair shops, is a test speaker with a universal output transformer to match all power tubes and a substitute field coil tapped for all commonly used values. Direct access to the voice coil leads of this speaker should also be provided for those sets having the output transformer mounted on the chassis, or for use as a substitute in checking open voice coils.

To reduce time and labor, the idea of having the most frequently needed items within handiest reach will also have to be carried out in disposing of tools and replacement parts. For instance, if replacements are to be kept in bench drawers, paper and electrolytic condensers needed in the majority of repair jobs should be in the top drawer methodically arranged for easy identification. Audio and power transformers, not so often needed will be in the bottom drawer, etc. A representative stock of tubes (not necessarily the main stock) should be kept at the bench for substitution test and quick replacement of defectives. A suggested place for the tubes is in cabinets built at either end of the bench underneath. Tools can be mounted on strips fastened on the inside of the cabinet doors, or if the bench is installed in a corner of the room, a tool mounting panel can be fastened on the side wall and covered with some type of door to conceal the tools and improve appearance.

Service manuals have to be within reach for reference on some jobs and the best place for them is on shelves extending across the bench above or on either side of the test panel. If the manuals are placed so the bottom of the back binding projects about an inch from the shelf, they can be grasped for removal without rising from your stool.

Plenty of artificial light must be directed on the bench to prevent shadows and eyestrain. While lighting arrangements will have to be worked out for each bench, it may be said in general that shaded fixtures ought to be used with shades directing the light downward toward the back of the bench and in no case should any direct light reach the serviceman's eyes.

The makeshift temporary wiring

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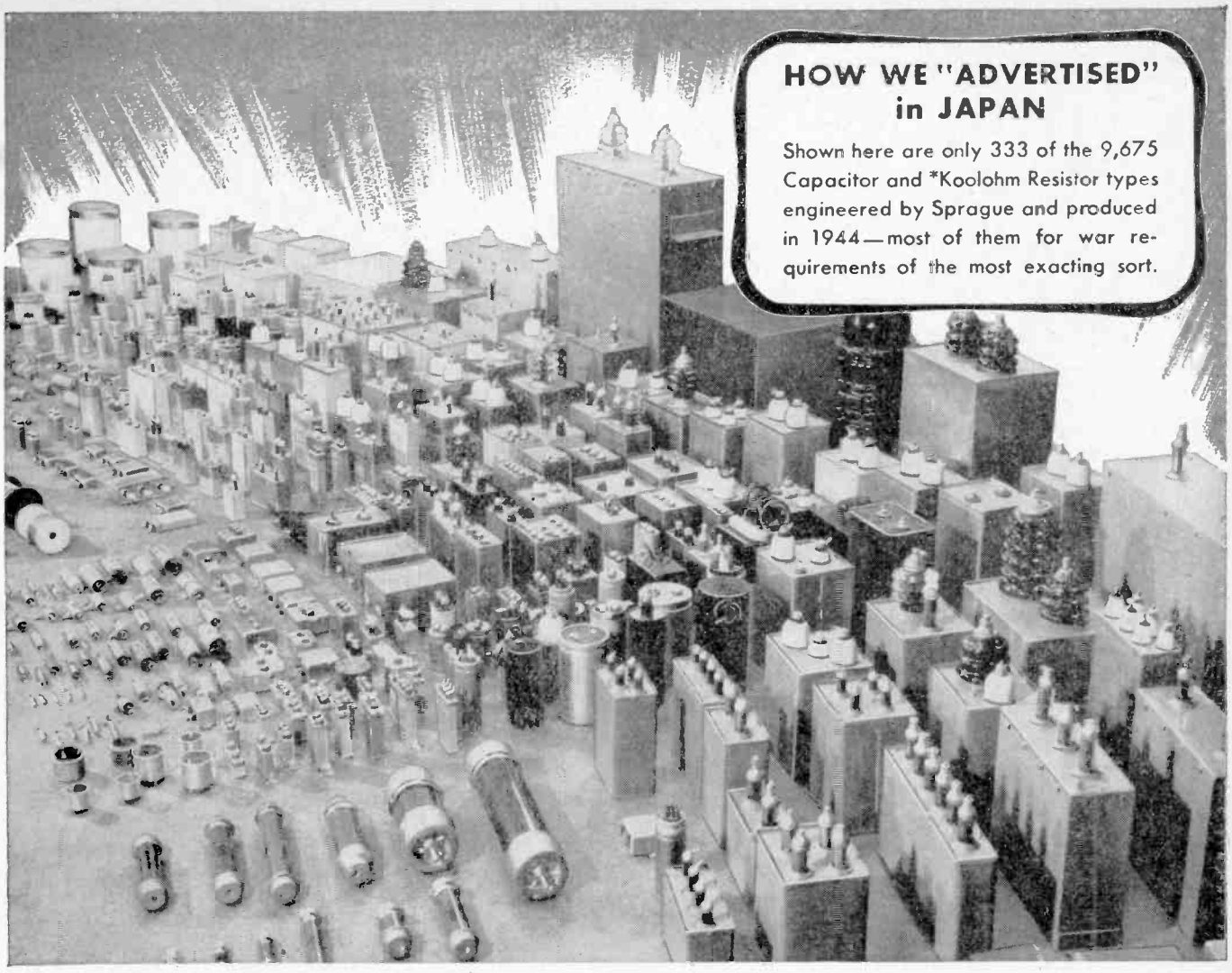

FROM RADAR TO THE ATOM BOMB AND VT FUZE

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CAPACITORS FOR EVERY SERVICE, AMATEUR AND EXPERIMENTAL NEED

USING the OSCILLOGRAPH

→ From Page 17

OFF; turn S-1 to 5000 CAL and adjust R-6 to obtain a 0 db reading on the meter; turn S-1 to 60 CAL and adjust R-15 to obtain a 0 db reading on the meter (due to R-10, this 0 db reading is actually +12 db); turn S-1 to 5000 CAL and recheck the setting of R-6 for 0 db reading. The generator is now calibrated, and ready for use.

Connect the apparatus together as shown in Fig. 10, keeping in mind the impedance matching required at the input of the amplifier. R-20 in this figure is chosen as the correct load impedance for the amplifier under test, and it must be capable of dissipating the entire power output of the amplifier. The meter is any suitable output meter. The high-pass filter referred to may take any of several forms. The most efficient and workmanlike way to remove the 60-cps component would be by the use of a full section high-pass filter designed for an impedance of about five times the output impedance of the amplifier, and to use it bridged across the terminating resistor R-20, building-out the impedance to match the filter by means of R-21. The value of R-21 is determined by the formula

$$R = Z_f - \tfrac{1}{2}Z_o$$

where R is the value for R-21, Z_f is the impedance of the filter, and Z_o is the output impedance of the amplifier. The constants for the high-pass filter are shown in insert A of Fig. 10 for an impedance of 5000 ohms.

However, when the frequencies are as widely separted as 60 and 5000, it will suffice to use a small condenser and a resistor as shown in insert B of Fig. 10. This will practically eliminate the 60-cps signal from the output, and leave the 5000-cps signal essentially unattenuated.

Adjust the controls of the oscillograph to obtain a trace of suitable intensity, properly focussed, and set the sweep control to approximately 30 sweeps per second. Set the SYNC switch to 60-cps, if such a position is provided; otherwise, connect a 6.3-volt source of 60-cps to the sync binding posts and set the SYNC switch to EXT. Having thus connected the equipment, adjust the controls of the amplifier to the conditions under which it is to be measured. Temporarily put a jumper across the high side of the filter of Fig. 10. Reduce the setting of R-11 to minimum and

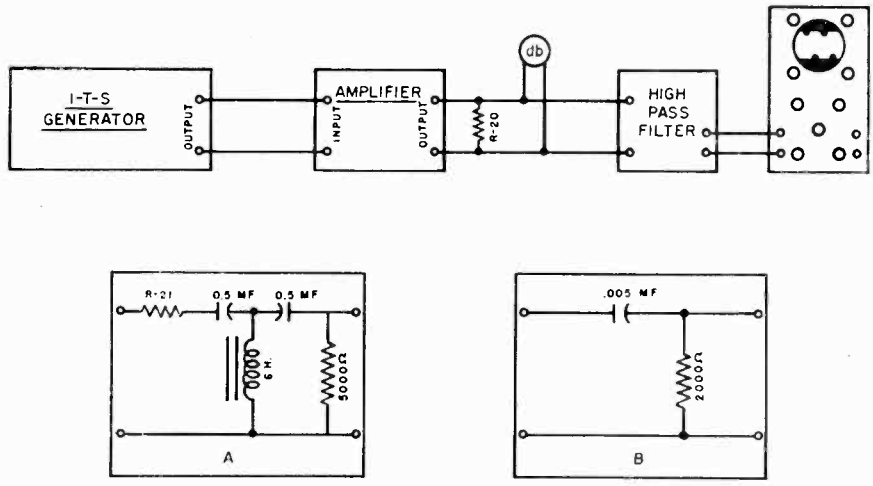

Fig. 10. Circuit for using ITS generator and oscillograph for distortion measurement. See text for values of R-20 and R-21.

turn S-2 to ON, applying a signal to the amplifier. Turn S-1 to 60 CAL and increase the output signal by means of R-11 to obtain a signal of suitable amplitude on the screen of the 'scope. Adjust the sweep controls on the scope to give a pattern of two complete sine waves, and set the SYNC control to hold this rate of sweep. Remove the jumper from the filter.

To make measurements, turn S-1 on the generator to USE, and simultaneously adjust R-11 on the generator and the vertical gain control on the 'scope to keep the upper and lower edges of the pattern on the limit lines drawn on the screen. As the signal level is increased, the notches will appear in the pattern as previously described. Keeping the edges of the pattern on the limit lines, adjust R-11 and the vertical gain control simultaneously to the point where the notches just touch the 25 percent lines. Observe the output signal at this point. This may be considered as the level at which the harmonic distortion is one percent, which is a suitable maximum of distortion for good quality equipment.

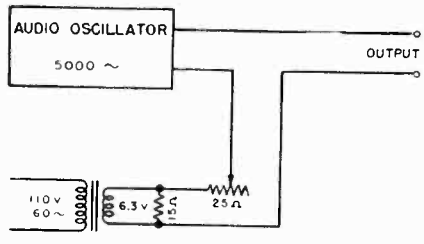

Fig. 11. Method of providing test signal without special equipment.

Suggested Uses

It must seem as though this entails a lot of work just to determine the point at which the harmonic distortion is one percent. However, there is more to this system than that. For example, in the substitution of parts or tubes, it is convenient to know whether it is better to use a 2000-ohm resistor in the cathode circuit of an amplifier stage, or to use 3000 ohms. Connect up this apparatus and note at what level the 25-percent notches appear with different resistor values, or use a variable resistor. The value which gives the greatest output signal with the 25-percent notch is the correct one to use. The same method applies even to tubes, transformers, plate and screen resistors, and to all types of bypass condensers. In short, this system makes a very flexible tool for aiding in repair or in new construction.

In the construction of amplifiers, the exact choice of components is sometimes quite difficult without elaborate equipment for measuring the performance as the work progresses. Even with laboratory measuring methods, the indications are seldom continuous. This method permits the builder to connect the test signal generator and an oscillograph to the amplifier under construction and have the advantage of seeing continuously the results of his work. By putting variable resistors in the circuits of an amplifier, it is possible to change the values over any range desired, selecting as final the ones which give the greatest output signal with the 25-percent notches. And in addition to that advantage, the type of indication furnished will aid in curing faults in the design. It is suggested that all stages be adjusted to obtain patterns such as shown in Figs. 6 (B) and 7 (B). This will result in each stage operating at the optimum grid bias point.

A PAGE DEVOTED TO LETTERS FROM OUR READERS

Burgett Radio Repair Service
4955 N. Western Ave., Chicago

Gentlemen:

I have just put together the electronic probe as described in the July issue of Radio Maintenance. In the construction of this apparatus, I have made some changes which might be of interest. They are as follows:

1. Use the VoltOhmyst as is, without internal changes or additions. Instead of using an added 1000-ohm potentiometer, use the regular zero adjustment on the front panel to balance out the 0.9-volt contact potential.

2. Connect a shielded lead to the tip of a phone plug, with the shield grounded to the sleeve of the plug. This eliminates the one-megohm resistor used in the voltmeter lead.

3. Connect the other end of the shielded lead to the 5.5-megohm resistor in the probe, and connect a .02 mfd condenser from this junction to the shield.

4. Connect the cathode of the 955 to the shield, and connect to it a 6-inch lead with an alligator clip on the other end. This is used to make connection with the chassis.

5. Connect the heater terminals of the 955 to a small portable 6-volt battery. This method has the advantage of not coupling A-C voltages into the sensitive circuits. The other parts of the probe construction are as shown in the July issue.

Cordially yours,
N. Burgett, Mgr.

Kyoto, Japan

Gentlemen:

Reference to your letter announcing the forthcoming monthly issue of Radio Maintenance Magazine. Enclosed you will find money order for three dollars ($3.00) for two year subscription.

Look forward to January issue.

Sincerely,
Alexander C. Wagenfohr

Bennett's Radio
4112 Oak Lawn Ave.
Dallas, Texas

Gentlemen:

Once in a lifetime something comes along to give one a pleasant shock, erupting as it were, during the dullest portion of the daily humdrum of making a living and forcing us to take off a little time to collect our thoughts which were thus so rudely scattered before we can realize what happened.

Imagine our surprise in opening the daily post to find what the envelope plainly said **might** be more advertising to be a bang-up good job of a magazine that does, and can continue to, appeal to the serious minded electronic technician. Here at last is a vehicle that we can get on and go travelling.

You didn't ask for any criticism on the magazine, on its name "Radio Maintenance," on its size or mechanical get-up. Yet we trust that this letter of criticism will be appreciated, for it is not critical in that we are showing you wherein you have given birth to errors, but it is complimentary criticism. Complimentary to you who have brought it out and criticism of the industry that has not brought out this item long before. You are to be congratulated on the effort, it has long been needed just as we have long needed a good solid Radio Servicemen's organization which is nationwide and of such strength and amalgamation as to influence and include all the men who make their living by electronic servicing, regardless what specialty each might pursue.

You have asked for opinions on the trade, on the business, and on the industry, as they concern the problems of the service man. We have long sought the consummation of a national association of service men, and at one time in the past were actively engaged in assisting the formation of the several local and national associations. Twenty-four years' experience in this business has brought out many angles. Would you be interested in hearing some of them?

Likewise after so many years of taking 'em apart and putting 'em back together, one becomes mighty disgusted at the very, **very** inefficient way most of the radio chasses are engineered, the way cabinets are made, the utter disregard for accessibility of parts and workability of units. We would like to contribute our ideas on short cuts, deletion of inefficient engineering, "what's wrong with whose line" and words of wisdom to the oncoming super-duper deluxers and the boys who are going to design them. If we are to judge the future by the past, every radio above a two-tuber will be a jungle of hard-to-service parts and full of wildcats and poison, not to mention the cuss words needed.

For instance, why did the record changer boys make all their changers so that the service man has to unscrew the hold down bolts, remove the entire changer from the cabinet and lose all the loose mounting springs in the process, just in order to either replace a crystal or the rubber tone arm bushings? AND—why didn't they invent a floating mounting that was an integral part of the changer board so that you

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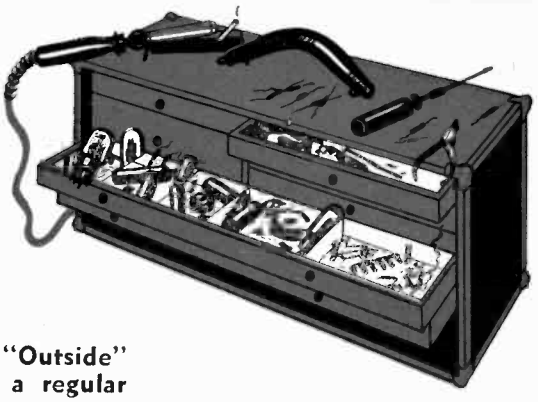
Service Kit



The author here discusses certain interesting aspects of "Outside" servicing work. These discussions will be continued as a regular feature in future issues under the above heading.

By Peter Markantes *

FROM present indications, the number of men who will enter the field of radio servicing within the next year will be considerable. The majority of discharged servicemen who have had training in radio and radar while in the armed forces are availing themselves of the scholastic provisions of the G.I. "Bill of Rights" to further their education.

Since a very considerable portion of this group is intending to start service shops or to become servicemen, a few hints on the service kit may be welcome.

One of the most controversial questions in the field of radio servicing concerns this "on the spot" servicing out of the kit. The problems associated with servicing and repairs in the customer's home are numerous. No two men will have similar ideas on what constitutes servicing and what constitutes repairs. Some radio shop owners make it a definite policy never to service a set in the customers' home — others endeavor to not only service it but to locate troubles and effect repairs on the spot wherever possible. This is particularly true in the country, where time, distance, rubber and gasoline make a difference in one's attitude. Regardless of policy there are some cases wherein it is necessary to carry at least a part of the work into the house. Pulling a set, analyzing tests for purpose of an estimate, checking tubes, installing or repairing an antenna, locating and correcting house noises, and making minor repairs such as on call back against guarantee, all constitute sufficient reason for properly equipping the service kit. Also bear in mind the economics wherein an hour a day saved makes more dollars.

In order to be prepared adequately for every service call, the country serviceman requires a small truck, station wagon or panel sedan — equipped as a radio shop on wheels. It costs money but it will make money.

The $64 question then becomes "What equipment and what material shall I carry?"

Of major importance is a tool kit that is equipped with all types of tools that conceivably will be needed. Some servicemen prefer two small kits instead of one large one — or a "reserve" on the driver's seat of the car. Although it might appear on first thought that a metal box with compartment trays would be ideal, there actually are numerous disadvantages to begin with, metal boxes are very handy instruments for scarring polished hardwood floors, table legs, etc. Moreover, those "removable" trays sooner or later will be knocked out of shape and stick. For my money, a fibre tool bag, similar to those used by electricians and plumbers is more useful. These bags will absorb considerable punishment in addition to providing enough room for all required tools plus a few parts and tubes.

As for the type and number of tools in the service kit, most men develop their own ideas; the constant tendency being to get more. However a few suggestions may not be amiss.

In addition to the standard tools such as screw drivers, socket wrenches, pliers, etc., it is worth considering the purchase of the following:

A soldering iron of the quick heating type — and, of prime importance, an accident proof stand that completely covers the metal portion of the iron.

Another worthwhile item is a screw driver with blade small enough to fit knob set screws. I am not referring to the popular type with vest pocket clip, but rather to a driver with a 16" blade and hand sized grip. This tool will start the most stubborn set screw since it is long enough to be gripped away from the face of the cabinet.

A large (four-cell) flashlight, or better still an emergency light of the type that will sit on the floor and illuminate a good sized area, is another useful piece of equipment to carry in the "kit on wheels."

On the theory that preventive measures are more effective than remedial ones, the author constructed, and has used for years, a very handy gadget that has paid for itself a hundredfold. In essence, it is simply a fused, multiple current tap. (See Fig. 1).

By using five-amp., or at the most, ten-amp., fuses, the risk of blowing the customer's fuses is lessened. Be generous with the cord — use at least thirty feet of it so you do not make it necessary to work close to an outlet. Provide enough outlets so that not only the set under test and the soldering iron, but all line operated equipment can be plugged in with a minimum of fuss.

Flashlights of the "pen-lite" type are very useful for exploring dark corners of a chassis — however, a full sized trouble lamp with at least a 60-watt bulb is very handy. (The number of homes suffering from poor lighting is surprising.) A couple of alligator or battery clips soldered to the guard of the lamp are advisable since they can be used to clip it to the chassis and free both hands.

Portable type test equipment is of course, required. No hard and fast rules ought to be laid down on the number and types to be brought into the customer's home. However, it is obviously impracticable to bring in a tube tester, signal generator, signal tracer, 'scope, etc., so that all eventualities may be taken care of.

For my part, a combination tube tester and multitester is the most versatile instrument. This, together with the tool bag is quite enough to bring into the house. Repairs that would require the use of other test

*Chief Shop Instructor, Melville Radio Institute

instruments are best performed in the shop, and it is up to the outside service man to sell this idea to the owner — with gestures.

Some men prefer to include in their service kit some wood working materials — stain, stick shellac, crack fillers, etc., — so that cabinets may be refinished. This is an excellent idea and always makes a good impression on the customer. However, my advice is to skip it unless you have had enough experience doing this kind of work to make it good; otherwise the hazards of a botched job are great.

In general, the selection of parts to carry on a service call depends upon the serviceman's experience. Once the approximate age of the ailing receiver has been established, it is possible to bring enough of a variety of tubes to make sure of having the correct replacement. (Sometimes you can get this information over the phone before starting out. Then again, sometimes you can not get any "accurate" information. So you had better go well heeled).

For example, a set fifteen years or more old will most always require types such as 26's, 24A's, 80's, 27's, 45's, 35's and possibly, 12A's, 2A3's, and 71A's. The number of sets using these tubes is surprisingly large.

Sets about ten years old will most likely use 80's, 47's, 57's, 58's, 55's, 56's and possibly 53's and 59's. Around this time, types such as 2A7, 2B7, 2A6 made their appearance also.

Receivers made a few years previous to the start of the war will generally use the 6.3v types such as 77's, 78's, 75's, 76's, 41's, 42's, 6A7's, 85's, 6B7's, etc. Rectifier tubes will be found to be type '80 in the majority of sets using the above types, although 5Z3's were gaining increasing popularity.

Should the set be of the universal type and about ten years old, the tube complement will generally consist of types such as 25Z5's, 77's, 78's, 6A7's, 76's, 75's, 43's, and occasionally 36's, 37's, 38's, and 39's.

In D-C districts, receivers will likely use 32's, 33's and 34's in addition to some of the types mentioned in the first group.

With the advent of the octal based tubes, tube replacements become involved.

Rectifiers like 5U4G's, 5V4G's 5X4G's, 5Y3G's, etc., became popular.

6A7's, 77's, 78's, etc., were replaced by their octal based counterparts, 6A8G's, 6J7G's, 6K7G's, etc.

Metal types were also introduced sometime ago, and although interchangeable with their glass equivalent in a number of cases, it means that twice the number of tubes must be carried along in your repair car.

All this is by way of avoiding that necessity if the tube problem can be solved in the case of very old sets by carrying along only about a dozen types. If the set is of more recent vintage, something like fifty different types must be made available to the man with the service kit.

With the exception of such items as coils, tuning condensers, etc., the parts replacement problem is a little easier. Paper and electrolytic condensers will generally be around .0001, .0005, .001, .005, .01, .05 and .1 for the former and around 2, 4, 8 or 16 mfd's for the latter. In only a few cases will exact duplication be required. Resistors of 1.0, 0.5, 0.25 and 0.1 megohms, and 50,000, 25,000, 10,000, 5,000 and 1,000 in the ½-watt size are the most popular. If the lower values are carried in the 1 watt size also, the resistor kit is more versatile.

"Pots" generally will be in the neighborhood of 1,000 to 25,000 ohms

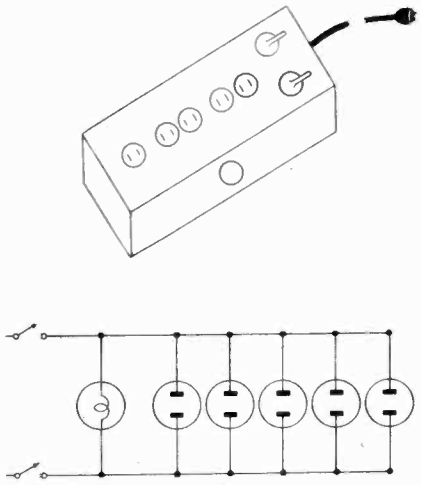


Figure 1

for the older receivers and from 0.1 to 2 megohms for the newer types. Some of the more recent sets require pots with one or two taps, but even with this complication, about 24 different sizes will be sufficient. Since they are not bulky, it is easy to carry an adequate stock. (Some manufacturers are making sets of eight that will replace any control.)

From the foregoing, it can be seen that a parts kit can be put together with some assurance that proper parts will be on hand when needed.

In the case of replacement of major components like power transformers, audio transformers, speakers, etc., the repairs are best effected if the set is removed to the shop, since these items are too bulky to be carried along. In addition, exact replacements are almost always required; moreover, it is more profitable not to stock large numbers of these items. Purchase them from jobbers when needed.

Of course, if the customer could be prevailed upon to furnish you with the make and model number of the radio, the problem of bringing along the correct parts would be greatly simplified since parts lists are available in service manuals.

However, repairmen who have had any amount of experience will testify that the average set owner can offer surprisingly little information about his radio. The serviceman can generally learn that the ailing radio is of a "blank" (no-name) manufacture purchased in 1934 ("can't understand what's wrong with it—haven't had a bit of trouble with it since I bought it!") As for determining the model number, apparently only about one customer in ten has any idea where to look for it—and even this one can't find it because that "nasty dust is an inch thick all over the chassis!"

Occasionally, the customer can be induced to give an accurate and specific description of the ailment and so furnish a clue as to the source of trouble. In many cases, however, this is a very discouraging and misleading process since most customers are extremely vague about receiver performance—or lack of it. (Ask any doctor how many of his patients give him any information except that "they feel sick all over").

An ample supply of plug and cartridge fuses should also be included in the service kit. Fuses will get blown no matter how careful you are. And one of the quickest ways to rile a customer is to leave him without electricity while you dash wildly about trying to find a hardware or electrical shop.

Another problem to be overcome in servicing in the home is the problem of adverse working conditions. Certainly it can never be argued that the serviceman is not under a handicap when he has a set and speaker spread out on the floor, surrounded by tube checker, multitester, signal generator, soldering iron, tool kit, etc. The customer who owns expensive furnishings (and if you don't think

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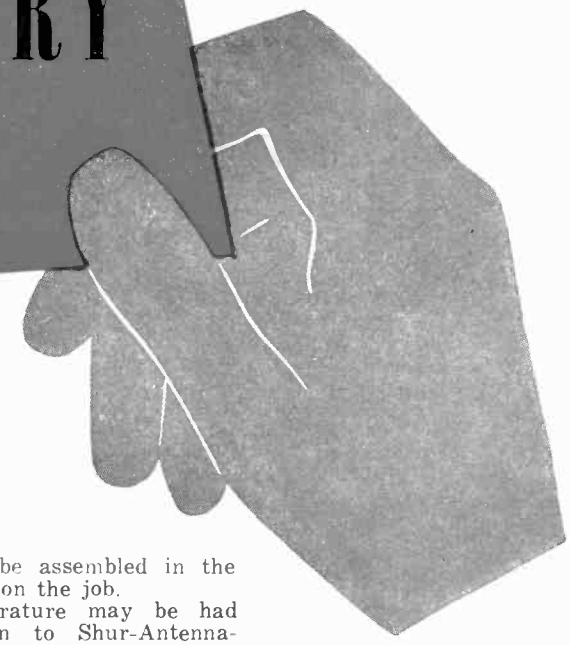
THE INDUSTRY PRESENTS

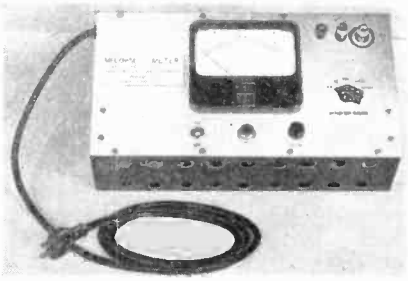


MEGOHM METER

A new Megohm Meter, Model 1500, in the range from four hundred thousand ohms to a hundred thousand megohms in five ranges on a single-scale, 4-inch meter is announced by Communications Measurements Laboratory.

Weighing only eight pounds, this instrument is adapted for use in laboratories or in production lines where it is necessary to measure and test in widely scattered localities. Among its uses are: measuring of leakage resistance of insulating materials, condensers, coaxial cables, wiring harness, motor and transformer windings. Model 1500 is also recommended for determination of moisture content of wood, paper board, plastics, textiles, and other materials in which electrical resistance is a function of moisture content. It is clear that this instrument is extremely stable despite line voltage fluctuation. A change in line voltage from 90 to 130 volts produces a change of less than 3 per cent in meter reading at mid-scale. A single zero re-set adjustment is provided for all ranges, and drift after warm-up period is substantially zero.

Line voltage: 115 volts, 60 cycles. Descriptive bulletin available from Motor Division, Communications Measurements Laboratory, 120 Greenwich Street, New York 6, New York.



ANTENNA KITS

Shur-Antenna-Mount, Inc. announce a complete H-F antenna service for installations.

The Shur INTERCEPTOR, a two element beam array for FM and television, is featured. Consisting of a hardwood mast, dural elements, and synthane supporting insulators, the INTERCEPTOR is engineered for ease of tuning. Tunable factors are: spacing, polarization, impedance, orientation, reception pattern, and element length. Shipped knocked-down, the array can be assembled in the shop and tuned on the job.

Complete literature may be had upon application to Shur-Antenna-Mount, Inc., 272 Sea Cliff Avenue, Sea Cliff, New York.

ELECTRIC CIRCUIT TESTER

A handy, inexpensive, all-purpose electrical circuit tester in a vest-pocket size was recently announced. With tip and shell made of clear plastic, and with insulated test points, it can test voltages from 60 volts A.C. to 550 volts A.C. or D.C. by variable light intensity. It can be used for testing electric appliances, locating blown fuses, testing A-C lines, polarity of D-C, grounded side of A-C or D-C circuits, spark plugs, and cable tests, and for many other uses.

Manufactured by Ne-O-Lite Mfg. Co., Rockford, Illinois.

CATHODE RAY TUBE

A new economical cathode ray tube requires only 2500 volts accelerating potential, therefore cutting power supply cost considerably. It provides a high luminosity 5¾" by 4¼" screen image adequate for several lookers-in. Regarded as an important step toward low cost television it is already in quantity production by Allen B. Dumont Laboratories, Inc., 515 Madison Avenue, New York.

A NEW POWER SUPPLY

A compact power supply for battery portables is again available, it is announced by General Transformer Corporation. For use with four to six tube portable receivers, it has a complete set of sockets for all standard battery plugs. Place it in the battery compartment, connect the plugs, and the set is ready for operation.

Manufactured by General Transformer Corporation, 1250 West Van Buren Street, Chicago 7, Illinois.

TURBO-THERM EXTRUDED INSULATED WIRE

William Brand & Company announces production of a thermo-plastic insulated wire.

The outstanding feature of this wire is its greatly enhanced resistance to high temperatures, whereby the usual deficiencies of shrinkage incident to soldering operations, and the flow and loss of insulation, incident to finally-assembled "potting" operations, are eliminated.

This wire possesses the general characteristics of plastic insulation in its total resistance to the effects of oils, organic solvents, acids, alkalies, sunlight, ozone, and oxidation.

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PLEASE PLACE YOUR ORDER WITH YOUR REGULAR RADIO PARTS JOBBER. IF YOUR LOCAL JOBBER CANNOT SUPPLY YOU, KINDLY WRITE FOR A LIST OF JOBBERS IN YOUR STATE WHO DO DISTRIBUTE OUR INSTRUMENTS OR SEND YOUR ORDER DIRECTLY TO US.

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.....Net price **$18.75**

The New Model CA-11

SIGNAL TRACER

Simple to operate . . . because signal intensity readings are indicated directly on the meter!

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker — with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

Features:

- ★ SIMPLE TO OPERATE — only 1 connecting cable — NO TUNING CONTROLS.
- ★ HIGHLY SENSITIVE — uses an improved Vacuum Tube Voltmeter circuit.
- ★ Tube and resistor-capacity network are built into the Detector Probe.
- ★ COMPLETELY PORTABLE — weighs 5 lbs. and measures 5" x 6" x 7".
- ★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
- ★ Provision is made for insertion of phones.

The New Model 450

TUBE TESTER

SPEEDY OPERATION assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

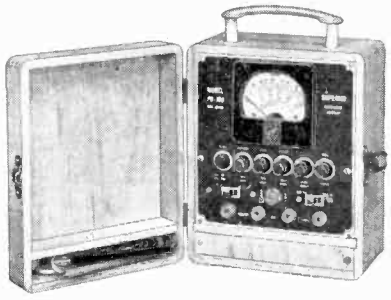
The model 450 comes complete with all operating instructions. Size 13"x12"x6". Net weight 8 lbs. Our Net Price..... **$39.50**

Specifications:

- Tests all tubes up to 117 Volts including 4, 5, 6, 7, 7L, Octals, Loctals, Bantam Junior, Peanut, Television, Magic Eye, Hearing Aid, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, etc. Also Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.
- NOISE TEST: Tip jacks on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- Works on 90 to 125 Volts 60 Cycles A.C.

The Model PB-100

VOLT-OHM-MILLIAMMETER



Features:

- ★ Push Button Operation
- ★ Direct Reading
- ★ Housed in Portable Oak Cabinet
- ★ No External Source of Current Required

Specifications:

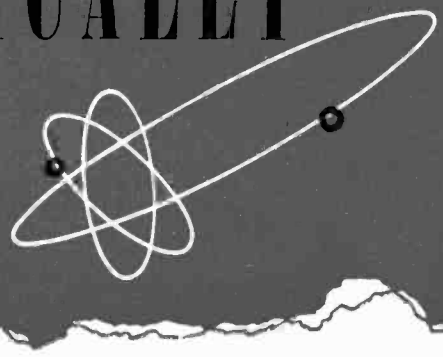
6 D.C. VOLTAGE RANGES: 0 to 5/25/50/250/500/2500 Volts
5 A.C. VOLTAGE RANGES: 0 to 10/50/100/500/1000 Volts
5 OUTPUT METER RANGES: 0 to 10/50/100/500/1000 Volts
3 D.C. CURRENT RANGES: 0 to 10/250 Ma. 0 to 2.5 Amp.
3 RESISTANCE RANGES: 0 to 10,000/100,000 Ohms, 0-1 Meg.
3 DECIBEL RANGES: —10 to +15; 0 to +35; +30 to +55.

Model PB-100 comes housed in a hand-rubbed oak cabinet, self contained battery, test leads and instructions. Net price..... **$28.40**

SUPERIOR INSTRUMENTS CO.

Dept. RM 227 FULTON ST., NEW YORK 7, N. Y.

ELECTRONICALLY SPEAKING



A BONDED DEALER PLAN has been announced by Raytheon. A. A. Akeroyd, Distributor Sales Manager of Raytheon Manufacturing Company, has announced the details of a plan by which radio servicemen throughout the country may successfully counteract the unfavorable publicity of such articles in the nation's press as "The Radio Serviceman Will Gyp You If You Don't Look Out," which appeared in Reader's Digest. This plan provides for the bonding of selected dealers and servicemen with the object of guaranteeing their work to the customer.

Each will be given a certificate identifying him as a "Bonded Electronic Technician." His work and the quality of materials will be guaranteed for a period of ninety days. This guarantee will be posted prominently with the information that it is backed by the underwriters, Western National Indemnity Company, which is a part of a group of insurance companies with assets of over $133 million. If the dealer or serviceman cannot or will not fulfill the guarantee, the underwriters will arrange to have the work done elsewhere without cost to the set owner.

The certificate will state that the dealer is bonded to (1) guarantee all radio repair work for 90 days, (2) use only parts of recognized quality in repair work, (3) not charge more than the list price for parts installed, (4) keep repair charges at a fair and reasonable level, and (5) perform only such work as is necessary or authorized. Allied Radio, distributors of Raytheon tubes in the Chicago area, presented the plan at the first of a series of meetings to be held for the purpose of familiarizing the trade with this plan.

A PIG WHISTLE RADIO system is now under consideration in Washington. It is somewhat similar to the British System except the consumer would have to put a nickel in the slot each day to eliminate a pig whistle superimposed on the broadcast. The whistle would prevent non-payers from enjoying the program.

ELECTRONICALLY SPEAKING, bet you don't know what a JETEC means? It means Joint Electron Tube Engineering Council of the Radio Manufacturers Association. Among other things, they are going to coordinate all engineering matters relating to the standardization of electron tubes. — Good luck JETEC, we need this sort of thing.

F-M RECEIVER SALES are headed for a boom, according to Sylvania's latest survey. The survey shows a tremendous demand for F-M sets. Market estimates run as high as $600 million with perhaps as many as 10,700,000 sets being sold. People definitely want F-M. — Ask Petrillo.

LARGE TELEVISION servicing contracts have become a possibility. With the successful demonstration of a department store installation at Gimbel's Philadelphia, television as a means of merchandising has been introduced to the public. The televising equipment was installed and operated by the RCA Service Department.

CONTINUOUS TAPE recording equipment servicing and installation should increase in the near future. Jefferson Travis is making extensive preparations to expand its distribution of this type of equipment on a world-wide basis.

INDUSTRIAL DESIGN is entering the radio field. Scott Radio Laboratories had Walter Dorwin Teague, the New York industrial designer, design a dial and dial front for their new receivers. Look for amazingly rapid progress in the merchandising sciences.

THE WALKIE-TALKIE of war fame will be walking and talking its way into civilian use from now on, according to our friend Mr. Jett of the FCC. He estimates that at least 25 thousand of these civilian two-way radiotelephones will be licensed this year. The license will not be hard to get and there are just two "don'ts." First, don't use it for hire; that is, don't charge money for sending a message or two for a neighbor. Second, don't go commercial broadcast.

The Texas rancher will be able to call his neighbor up to fifteen miles away across the plains, while the Colorado farmer may find that the Rockies cut his range. In more crowded localities there will be some interference and some waiting for a free channel, but since as many as 100 different frequencies can be allocated to any one area, the neighborhood boys and girls will still be able to talk often and late.

What all this means to the radio serviceman remains to be seen. In suburban areas, the shop man may end up by buying one to tell his field man to go fix Mrs. Jones' walkie-talkie so she can tell her husband dinner is ready.

A NEW ANTENNA PLANT is to be constructed by the Camburn Products Company. Whether for F-M, A-M or television, and how it will serve our needs still remains a mystery. Please — ?

NATIONAL RADIO WEEK was honored by radio servicemen all over the country in November. Let's hit it even harder this year. If we boost National Radio Week and National

Radio Week boosts the radio industry of which we are the merchandising representatives, it follows that we are also boosted.

IMPROVED SERVICE DATA will be forthcoming in 1946, judging from bulletins received so far. It appears some excellent service data is to be presented this year by the popular manufacturers for their more complex equipment. In fact some proposals are in the mill for manufacturers to send out field representatives who will instruct dealers and servicemen in some of the special maintenance problems which will probably arise. This idea is by no means philanthropic; it is good business sense to have radios serviced in the field and not at the factory.

THE AVALANCHE of sales literature now coming through indicates that there will very shortly be plenty of radios on the market. Certainly, most of the pre-war manufacturers have now launched their 1946 sales campaign. Probably small store owners will be the last to receive radios from the popular manufacturer. The initial market for these manufacturers is the larger distributors, such as the department stores, supply houses, and chain stores. This seems to leave the radio store owner in open competition with those who can advertise, have modern sales facilities and are handling the popular name sets at a wide discount.

What about cheap midget sets? After examining current price lists it is plain that the day of the $6.95 midget is gone because the labor and component costs will not return to their pre-war level. Some $10.00 units will be distributed early this year; these will be the lowest priced midgets in 1946.

There was very slow movement of the relatively high-priced midgets on the market in October and November. The manufacturers of these first midgets and the dealers who quickly bought them expected the public to "break down the doors" in their rush to procure them. In one case, one all-too-optimistic dealer placed these new sets and associated packing paraphernalia close to the door so that the rest of the store would not be affected by the rush at the radio sales counter! By now these dealers have all learned that the customer will not buy a high priced midget which is no better than the $9.95 pre-war unit made by the popular manufacturers. There is also a natural suspicion about unknown manufacturers which hinders the sale of these radios even at competitive prices. We find that the servicemen who have a number of the higher priced midgets in stock are concerned over the problem of selling these radios before the lower priced, stylishly designed, more popular units reach the market.

On the other hand, radios which have combination features will "sensationalize" the market; whether they remain or not will depend on the consumer; he may want his radio to do more than just reproduce entertainment! — These radios may have time clocks, colored light indicators, automatic station changers and many other features which may create various headaches for the serviceman. (In the prescribed manner, design engineers as usual will probably show little sympathy for the radio serviceman in their layout of component parts and the mounting methods employed in these "fancies"!)

EXCELLENT TELEVISION programs are planned for 1946, according to a review of press reports. These include news events, complete plays, motion pictures, comedy sketches and some high-pressure advertisements.

The home sets will probably be

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Radio Maintenance in Aviation

→ From Page 13

separated by at least 2 inches from the bolts which secure the panel to the aircraft. The reel should be ruggedly mounted and provided with a ratchet stop and a locking arrangement which will permit it to be secured in any position desired. The entire reel should be well shielded from any possible contact with the high-voltage leads.

A fair-lead is used to guide the antenna from the reel through the bottom of the fuselage. It also provides electrical contact between the antenna and the transmitter or receiver. There should be an air space of 2 inches between this fair-lead and any metal part of the aircraft. The inside diameter of the fair-lead must be sufficient to allow the antenna weight to be drawn entirely through it into the fuselage of the plane.

Efficiency of Antennas

The efficiency of the entire transmitter is affected by the efficiency of the antenna circuit; that is, the greater the ratio of power output to power input in this circuit, the more effective will be the range of the transmitter. The power delivered to the antenna is equal to the square of the antenna current multiplied by the effective resistance of the antenna.

The effective resistance is the total or combined resistances existing in the antenna. These are known as ohmic resistance, radiation resistance, and dielectric absorption. Ohmic resistance is offered by the antenna wires, ground wires, condensers, coils, etc., in the antenna circuit. This ohmic resistance is governed by the physical properties of the circuit. The length and position of an antenna and the bonding system of the plane, together with the frequency, determine the radiation resistance. At the fundamental frequency the radiation resistance is maximum. This resistance is decreased as the antenna is loaded. Dielectric absorption is caused by any metal part of the plane being between the antenna and the bonding system. It increases as the circuit is loaded.

The effective antenna resistance, usually refered to simply as antenna resistance, can be determined by substituting a dummy antenna, made up of a suitable inductance, capacity, and a calibrated variable resistance, for the antenna of the airplane.

Inspecting Antennas

The antenna system should be inspected at regular periods, such as at the time of top engine overhaul, or at least every sixty days. All electrical and mechanical connections should be inspected and tightened; all insulators and fair-leads should be wiped clean of any dirt or grease which may have accumulated. Reel out the antenna and inspect it for broken strands. If broken strands are observed, replace the entire antenna (RCA type MI-5912 wire, has been especially designed for this service and is coated with a special lubricant). Do not clean the wire with carbon tetrachloride or any other kind of solvent. Inspect the drag unit and replace it if it has become damaged.

The antenna reel should function with a minimum of oiling or attention. If oil is used, it should be used sparingly and should be of a grade that will not congeal at the lowest temperature at which the plane will be used. Univis No. 40, a Standard Oil product, congeals at -47 degrees C., and is recommended for this service. Do not allow oil to get on the back steel mounting plate as it may cause the pin which locks the reel to slip.

Suggestion: Unless the antenna wire is retracted before landing, the wire and drag unit may be lost or damaged. In order to prevent this difficulty many pilots clip a spring type wooden clothespin on the throttle whenever the antenna is extended, serving as a reminder to reel in the antenna before landing. The clothespin is moved from the throttle to the reel when the reeling-in operation has been completed.

Shielding Aboard Aircraft

Ignition snielding consists of so connning the electrical fields of the ignition system that no interfering "signal" or electircal disturbance can be set up by induction in the radio receiving circuit or heard in the receiver. Shielding constitutes an important installation problem due to the increased use of highly sensitive receivers. The difficulty of the problem lies chiefly in the electrical and mechanical design of the arrangement for shielding that must be employed to be effective both ways between the ignition circuit or circuits of the radio set. The use of a rod or fixed pole antenna also increases the difficulty of shilding.

Every radio man knows that whenever a spark discharge occurs in an electrical circuit, high frequency oscillations are set up and create an electro-magnetic effect which is appreciable at some distance from the circuit. If the discharge is highly damped as in the case of spark ignition circuits, the oscillations involve a very wide range of frequencies and a tuned radio receiving set will pick out and amplify those frequencies to which it is resonant. Consequently the ignition circuit can be responsible for a prohibitive amount of noise in the receivers.

The low tension wire systems on the plane may also be responsible for

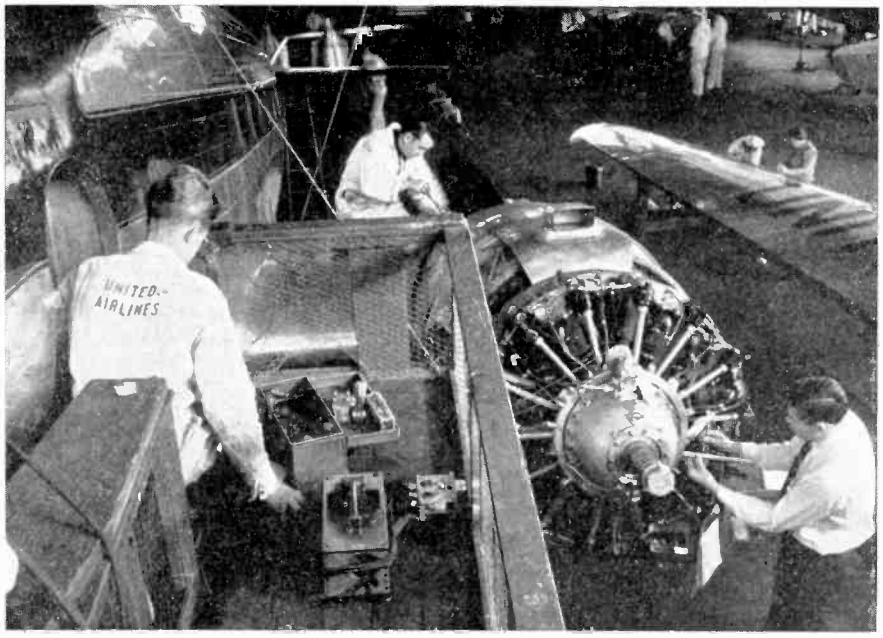

Figure 5. United Airline Mechs testing an ignition harness.

radio noise. Radio frequency interference from sparks at the commutator of the generator may be transmitted along the low tension systems and unless the wires of this system are effectively shielded, this interference will be audible in the receiver. Furthermore, unshielded lighting and instrument wires may pick up high frequency energy from the ignition or generator circuit due to the fact that the shielding of these circuits is never perfect. This energy is then distributed over the whole low tension wiring system and may cause serious trouble. Consequently the only satisfactory practice is to completely shield all wires on the ship. In addition a 4 M.F. condenser across the regulator and also a can cover for the generator field lead on the voltage regulator will eliminate noise from these sources.

You will find that on most airplanes the high tension system is shielded as follows: The magnetos are completely inclosed in metal housings. The majority of magnetos now on the market have metal housings with openings in them which may or may not be covered by insulating material such as bakelite plugs. In such cases it is necessary, and usually sufficient, to cover the openings with sheet metal so formed as to make firm contact with the housing at several points. One company has developed a completely shielded magneto especially designed to eliminate the disturbances arising inside the magneto housing and to facilitate the grounding to this housing of the shielding on the leads. These magnetos are now available to the public. This company also furnishes cans to be used with the semi-shielded magnetos.

The leads from the magnetos are to be inclosed in a continuous metal sheath. These are now made available by manufacturers in the form of ignition harnesses, provided with woven shielded auxiliary leads which may be used on various types of motors. Where the wires emerge from the magneto housings the braid shielding is to be fastened to the housings. Frequently such leads emerge through an insulating block can. It is advisable to solder these to this can all around the hole through which the wires emerge, and, as mentioned above, this block should be covered with a sheet metal braid.

Complete ignition harnesses, which are encased in flexible conduits, are available. Shielded high tension cables, which enables those familiar with the requirements of adequate ignition shielding to construct their own ignition harness, are also available.

The braiding or pipe should make contact with the engine metal at as many points as may be convenient. Contact is to be made by short pigtails or wires which are bolted or soldered to the framework of the engine. Unless such pigtails have been woven as an integral part of the braid, they must be soldered to the shielding. Great care should be taken not to injure the insulation of the wiring either by heat or by the corrosive action of the soldering flux. An alternative to soldering a connection to the shielding is to lay the pigtail or wire along the shield and wrap tightly with #20 bare soft copper wire.

SPARK PLUGS. The origin of the most severe disturbances due to the ignition circuits is at the spark plug itself and it is quite essential that the plug be shielded completely. Makeshift attempts at shielding of this part may result in incomplete elimination of radio noise, in overheating of the plugs, short-circuiting the ignition system and general unsatisfactory operation. Shielded plugs have been designed especially for use on radio equipped planes and these have proved satisfactory through an extended period of operation on many leading airlines. For those operators who prefer to use a standard unshielded plug, there are available many styles of shielded covers for plugs which have been designed to effectively suppress interference arising from the plugs.

LOW TENSION SYSTEM. As has been stated above, it is quite essential to inclose all low tension wires in braided shielding. The battery itself must be inclosed in a metal box, as required by Civil Aeronautics Administration regulations, this box being grounded by short leads to the frame of the ship. All braiding should be run as close to the terminals of the wires as is possible without creating the danger of a short-circuit. Ground connections should be made as near to all terminals as may be consistent with minimum length of ground leads. It is also necessary to ground the shielding to metallizing strips or to the "Ground" at intervals of 14 to 20 inches.

INSTRUMENT BOARD. A metallizing strip must be installed along the back of the instrument board. This strip is to be connected to each longeron, in a metal plane, or to the longeron metallizing strips in a wooden plane. The metal cases of all instruments on the board are to be connected to the metallizing strip. The metallic lines, tubes and wire shielding shall also be connected to this strip, and such lines, etc., shall be grounded at intervals of 14 to 20 inches. It is also desirable that metal covers be provided for all switches and instruments connected in the low voltage circuits.

If a metal instrument board is used, the metallizing strip may be dispensed with. The board is connected to the longeron ground system and the various connections mentioned above are made to the board. Care must be taken to see that all contacts at the connections are clean and firm.

COIL IGNITION. The majority of engines used at present are fired by magneto ignition systems to which

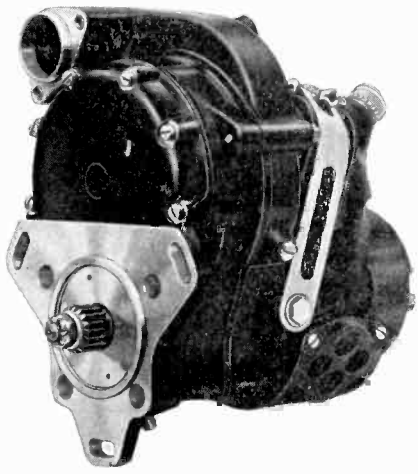

Figure 3. Scintilla Magneto. A good machine but one of the possible sources of receiver noise trouble.

the above directions specifically apply. With installations employing coil ignition it is advisable to follow the same general principles and shield all wiring present. It is sometimes believed that this is not necessary but unless complete shielding is used it will often be found impossible to obtain satisfactory reception with a high gain receiver.

How to Test for Shielding

The best test for radio shielding is an actual trial of the assembly mounted on the airplane engine. If the radio receiving set is suitably installed on the airplane, with an antenna of at least 6 feet extending vertically above the fuselage, adjusted to maximum sensitivity this can be accomplished in a practical way. The receiver should have an

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Radio Maintenance In Aviation

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overall voltage amplification of the order of 1,000,000 to 3,000,000. If the shielding is complete, no ignition noise should be heard in the headphones (connected in the output of the receiver) for all engine speeds and for all tuning adjustments of the receiver. In this test, it is understood that the engine is functioning normally in every way(that is, spark-plug gaps properly adjusted, etc.,). that the noise level in the receiver output due to atmospheric disturbances is normal, and that the airplane itself is suitably bonded and all auxiliary apparata, such as generators, voltage regulators, and every circuit in which a spark occurs, are effectively shielded. A good test, with a receiver installed, is to shake the plane and listen for "poor contact noises" of the bonding system.

DO NOT HAYWIRE A SHIELDING SYSTEM. It quite often happens that some small town radio serviceman is called upon to repair or replace parts of a shielding system because of the damage done as the result of a crackup. In this case, where repairs must be improvised to insure receiver receptivity until permanent repairs of the plane are made, be guided by the following fundamental, horsesense must: the shielding system MUST eliminate noise without impairing the operation of the part or circuit shielded. In other words, you must NOT box up anything on the airplane in such a way as to increase fire hazard or decrease engine power or efficiency.

The Bonding System

By bonding is meant the interconnection of all metal parts of the aircraft by means of good electrical conductors. Aside from the necessity of bonding in order that the metal parts of the plane may collectively constitute a suitable counterpoise of sufficinent capacity to make it a proper substitute for the "ground" in the antenna circuit, bonding is necessary for the elimination of certain causes of noises in the radio receiver and as a prevention against fire. If the plane is not bonded, or is ineffectively bonded, objectionable noises may be heard in the receiver caused by sparks occurring between two metal members having a difference of potential due to having collected charges of static electricity. Varying resistances between vibrating or rubbing parts also will cause noises in the receivers.

Bonding of airplanes is best accomplished during their manufacture or assembly at the factory. Both the Army and Navy have issued technical orders specifying the correct and most effective manner of bonding.

Electrical connections of approximately the same or less resistance than those of the metal parts joined, are made by soldering, bolting, or clamping connecting strips between them. Small masses of metal are banded by a single strip of metal braid or ribbon. Shielding cables, piping, tubing, brace wiring, and any long metal members are bonded at each end, and at intervals of 36 inches or less, and at any point where there is less rubbing or vibrating contact with another member. An exception to this rule occurs in certain instances where bonding is impracticable as in the case where diagonal brace wires cross one another. In cases like this, rubbing contact is avoided by suitably insulating the parts from each other, preferably at, or near, the point of natural contact. If two long members run parallel and in contact with each other, they should be held firm by clamping, or taping, between bonding strips. In using bonding braid, care should be taken to prevent fraying; if a hole is to be drilled in it, the braid should be first dipped in solder. All braid-to-hraid contacts should be soldered. All joints should be flexible enough to prevent being broken by expansion and contraction; in every case the metal parts must be joined before any protective coating is applied. Rosin solder flux is used, except in soldering to a steel member when paste may be used, but this paste should be cleaned off immediately. In wings of wood-and-wire construction, a strip of copper is placed along each spar; all internal and external wires, fittings and conduits of the wing are connected to this. All control surfaces, control wires, tanks and pipes must make a proper contact to the main metal part of the plane.

Government and factory inspectors examine all this work as it is done. During subsequent overhaul or repairs incident to service, the bonding system is maintained intact or replaced according to the original requirements, and then tested to see that every portion of the bonding system is of equally good conductance.

Airline radio servicemen overhaul the bonding system whenever troubles develop in normal operation or as the result of a crackup. "Outside" servicemen should try to follow the foregoing overall instructions when called upon to remedy defects in the bonding system of private planes.

In metal airplanes it is quite essential that the various parts of the ship be connected by low resistance paths and a certain amount of bonding will sometimes be required in order to achieve this. The resistance between metal parts which are in contact may be rendered high by a protective shellac or other coating or by oxide films. Contact surfaces between each of the parts should be scraped bright and clean and after having been forced into tight contact a new protective coating applied along the outside of the joint. Wherever there is any uncertainty as to a satisfactory connection at a contact it should be by-passed by a copper bond. Parts that are welded together need no attention as welded joints are of low resistance. The shields on lighting wires should be bonded every 14 to 20 inches.

In wooden wings a metal strip 1/4" x 1/64" or larger is fastened along the front and rear spars from fuselage to wing tips and these strips are interconnected to the internal

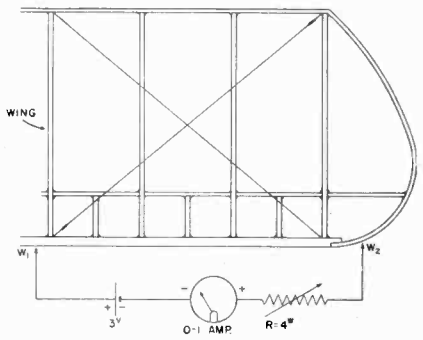

Figure 4. Test rig for bonding system.

brace wires at each drag brace, to the external brace wires and fittings where these wires and fittings come into the wing, and to each other by similar strips which run from front to rear strips along each drag brace.

Wherever control or brace wires, or other movable or semi-movable parts come into casual contact with each other, or with other metal parts of the ship, it is necessary either to furnish insulation at the point of uncertain contact or else to bond the parts together. Crossed wires may be insulated from each other by passing one wire through a hole at one side of a flat insulating washer and the other through a similar hole in the opposite side of the same washer. Small button or egg type insulators (such as micarta spacer wrapped with tape) may be used to

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Electronically Speaking

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sold through the larger retailers for the most part of 1946, with the serviceman getting a kit or two from manufacturers who are grooming the serviceman's market. Only well-trained servicemen should buy these kits because television is complex and the circuit adjustment and alignment require a thorough knowledge of television circuit theory, although to certain ex-Radar men these kits will be simple because of the circuit similarities.

Large picture type home television units may be available very soon for less than three hundred dollars.

However, most servicemen seem to expect little income from the television field in 1946. Although television will definitely be on the market it looks as if the manufacturers' field representatives and appointed agencies will handle much of the installation and service work, at least at first.

Little of the home equipment available in 1946 will lend itself to apartment house installation. Manufacturers will no doubt guarantee their equipment only if the antenna furnished by them is used. Input (R-F) circuits have not been standardized to an extent whereby equipment of different manufacturers can be paralleled. As a result, independent, especially designed antenna systems are required. Very few apartment house owners will permit a large number of outside lead-ins (especially if there is already available a built-in antenna system) coming from the roof, nor will he allow numerous guyed dipole assemblies supported from the rooftops. Because of these difficulties with apartment house installations, the first lot of equipments will probably be sold to the owners of private houses.

The serviceman who has not investigated V-H-F circuits should not try to repair television sets until he either digests a study guide or takes an advanced servicing course.

By 1947, manufacturers will probably designate their service stations; they may dispatch a field engineer to qualify the serviceman before allowing him to repair equipment outside the factory. Both the business integrity and the skill of the serviceman will probably be investigated to assure the manufacturer that he has dependable representatives. ↑ ↑

RADIOMEN'S OPINIONS

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didn't have to unscrew the untold number of long bolts of g.o.k. what kind and style before you could get the mech out of the cabinet?

The above is just one thought out of ten thousand more. Why don't the design engineers consult with the man who has torn down more of their machines than they ever thought were made? Why doesn't the design engineer come down and go to work for some good shop and put in a year doing what we have done so he can get the other slant on his handiwork? Well anyway, that is just an "opinion" by indirection.

Your magazine is good, and it can continue to be good. You can make it excellent if you care to take up the burden of preaching the building-up of our business in the electronic industry by just and equitable means, by giving us good sound information, and by striving toward a national organization of the technical group who make the industry's wheels turn.

Wishing you the best of luck, and thanking you for sending me Radio Maintenance, I am

Sincerely,

Porter T. Bennett

The Problems Of Organization

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ciation by diversification.

What the writer has in mind is the following. Many men who read these lines have experienced keen disappointment because they could not accomplish what they thought should have come to pass—the corraling of large merchandising organizations, which operate service departments, into local maintenance organizations.

Calling a spade a spade, the fundamental aim of a repairman's organization is to help the small independent operator. The large merchandiser who employs many men, has numerous stores, sells a wide variety of merchandise and is acknowledged to be a large organization with high credit rating, can not derive any appreciable benefit from the association. He not only is willing to stand on his own principles and practices, but actually can do so very successfully.

To attempt to bring such an outfit into the fold on the grounds that unless all maintenance outfits are in the association it cannot prosper, is fallacious. Such very large outfits will never come in and cannot be expected to, but their absence will not detract from the possible benefits to be derived by the independent nor in any way restrict the possible success of the association.

Big business is possessed of a certain abount of ego, for which it can't be criticized greatly. It takes much for a business to grow big, and once there it thinks big. So the most sensible thing to do is to forget it and carry on as if big business did not exist.

Local Associations Not Sufficient

Looking at the overall association picture through the eyes of the local association is fraught with danger. The perspective is too narrow. That has been and still is a major obstacle in the path of general acceptance of the association idea. The numerous issues affecting the repairmen which must be solved are, in the main, national in scope. Consequently, the kind of association which is required must be national in scope. This in no way limits the operations of the presently existing local associations; it simply means that they must alter their way of thinking in order to embrace a much broader concept of the subject.

Each individual sees his own problems through his own eyes; naturally he is blinded slightly to the problems of the other man. And if the other man always is out of sight because he is located in a different part of the nation—well—out of sight is out of mind. Yet these same thousands of men located in all parts of the nation have common problems. The public is everywhere—that same public which has once before demonstrated that it responds in like fashion to the same news, regardless of where it is published—New York or Seattle or Galveston. When during the years of 1930 to 1941 so much was being written about the low income of radio repairmen, the story was the same in small towns and in large cities.

When the agitation for municipal licensing started, the stories were on the lips of the public in many parts of the nation. In other words, very few if any major issues are really local matters. They are local only to the extent that they are discussed locally. Every municipal action taken in one town as a possible means of remedy becomes known in other parts of the nation very soon after it has

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DeYoung DOES IT THIS WAY

Ithaca Radio Dealer makes his bid for new era in radio merchandising

By Eugene A. Conklin

BEN DeYOUNG of Ithaca, New York, has completed his idea of a modern, efficient, post-war service shop which closely follows the recommendations of designers who have planned and executed radio service establishments of the future.

Analyzing this establishment, one first notices the exterior. The sign — chemically treated so that it glows at night with a phosphorus background — prominently stresses the fact that DeYoung is capable of handling not only current radio models but television receivers as well.

The windows are excellent for display purposes, each being equipped with a multi-colored lighting system which will furnish various shades of illumination when desired. The doors open automatically when a customer steps in front of them during the service day.

Entering this service establishment the patron finds that it is divided into three parts. The service bar itself is located at the left side of the store. The test bench is to be found along the wall with liberal window space provided so that servicemen may have ample daylight illumination and ventilation.

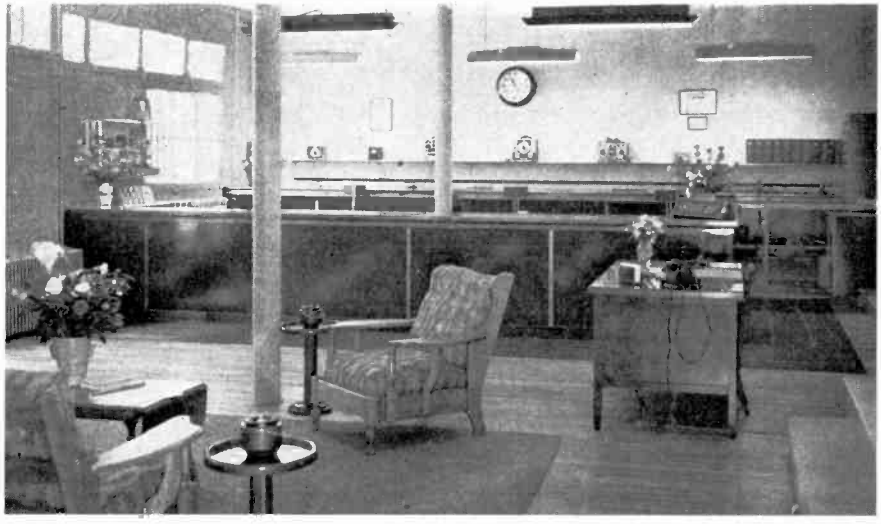
At one end of the service bench may be found a group of reference manuals, and a customer card file can be noted in the background. Directly underneath the test bench is a row of shelves on which components and tubes are placed. Atop the bench are the various service instruments, including a test analyzer, signal generator, ohmmeter, and various other testing devices. Fluorescent lamps overhead provide suitable illumination.

The second section of the service unit consists of the receptionist's desk. A telephone makes it possible for the receptionist to handle all incoming calls without any member of the service force being disturbed. A smaller desk, housing the shop typewriter, is placed nearby. DeYoung has so placed the receptionist's quarters that it is possible for her and any member of the service force to converse with one another by merely leaning over the service department counter. Such an arrangement makes it possible for the receptionist to head off any customer who appears to be in need of service before he or she reaches the counter and claims a busy serviceman's attention.

A third section is rather unusual in design. It resembles a rest lounge in a busy department store, with a number of easy chairs in evidence. A busy housewife laden with shopping bags or a busy executive appreciates the convenience offered by the davenport located in the middle of the service lounge. All the comforts of home are provided in this lounge — smoking stands and a reading rack filled with current magazines. Windows are placed at various intervals throughout the service reception room and, in addition, an air-conditioning system is functioning at all times.

A loading platform behind the establishment makes it a simple matter for the shop truck to stop and make its deliveries to the service department with few steps.

One serviceman, at least, has provided an unusually spacious and dignified service unit for radiomen to consider before completing their own plans.



Interior of DeYoung establishment, showing modern and simple arrangement.

Television Receiver Installation

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but let us assume that the dealer starts out with a properly aligned receiver of present design.

Tuning in Television for Checking

The controls readily available to the user should be operated as follows:

1. Turn the *power* switch on and allow about one minute for the tubes to warm up.
2. Adjust the *intensity* control so that a large white rectangle can barely be seen.
3. Switch the *band selector* to the frequency of the desired station.
4. Tune in the station with the VERNIER TUNING control.
5. Increase the sound VOLUME control until the station is heard.
6. Adjust the VERNIER TUNING again for the best balance between sound and picture.
7. Adjust the Focus control.
8. Adjust the CONTRAST and INTENSITY controls simultaneously to result in a picture which presents a suitable contrast between the black and white shades of the picture.

It is quite possible that during shipping some of the more permanent controls were jarred or changed from their correct position. If this happened, it will be necessary to adjust them before checking the normal operating controls. These controls are located on a panel at the back of the instrument; the controls and their functions are listed below:

1. Horizontal Position — this control moves the entire picture to the right or left so as to center it in a horizontal direction in the viewing screen.
2. Vertical Position — this control moves the picture up and down vertically so as to center it in the proper viewing position. (The use of the two positioning controls is obvious.)
3. Horizontal Size—this control adjusts the width of the picture to the full aperture of the viewing screen. It is independent of the operation of the positioning control, and has no effect upon the vertical position or size.
4. Vertical Size—this control adjusts the height of the picture so as to fill in the full aperture. The viewing screen of the current television receivers is correctly proportioned so that when the picture fills the screen, the ratio of height to width (aspect ratio) is correct, and the screen correctly reproduces the original action as seen by the camera.
5. Horizontal Sweep Frequency—controls the rate of sweep of the horizontal scanning generator. This is essentially a vernier control, and as all transmitters will use the same scanning frequency, the receiver circuits are adjusted (broadly) to the proper sweep rate.
6. Vertical Sweep Frequency — controls the frequency of the vertical sweep generator. Both sweep frequency controls should be adjusted to produce a suitable picture with the synchronizing control (if provided) set at a minimum. After the sweep controls are properly adjusted, the synchronizing control should be advanced to hold the picture steady.
7. Synchronizing control — may or may not be provided. This control adjusts the voltage applied to the synchronizing circuits in order to lock the picture in a steady position. The synchronizing pulses are sent by the transmitter as an integral part of the television signal.
8. Linearity Control — may or may not be provided. If present, this control adjusts the linearity of the horizontal sweep generators so that the picture maintains its proper balance between the right and left halves. When properly adjusted, the center of the test pattern should appear at the center of the viewing screen, and both halves should be symmetrical.

Although most of the above described controls are provided in current television receivers, they are generally mounted either on the back apron of the receiver, or in some other position where they are not normally used while operating the receiver. The dealer should make certain that they are all properly adjusted after the set is well warmed up, but there is no necessity to instruct the customer as to their whereabouts or as to their adjustment. Once adjusted they may be expected to retain their settings indefinitely unless some component failure changes the operating conditions.

To make the installation of a receiver complete, it is the duty of the dealer to teach the customer how to operate his set to achieve the best results. This must be taught very patiently by the dealer. He should have the customer vary the settings of each of the controls to be certain that he knows what effect is produced in the picture. All of this leads to a satisfied customer which is the best kind of advertising. If any literature is made available on this subject by the manufacturer, it will be the duty of the dealer to see that this reaches his customers' hands at the time of installation. In addition to the literature and the demonstration on the correct operation, it is extremely important that the dealer emphasize the fact that to avoid burning the screen on the cathode ray tube, the INTENSITY control should be kept at the minimum setting which will give good clear pictures. Also, in case one of the sweep circuits should develop a flaw and a narrow line appear either vertically or horizontally across the face of the tube the INTENSITY control should be turned to a minimum and the set turned off immediately.

The final duty of the dealer is to caution the customer against the extremely high voltages to be found within the cabinet of a television receiver. Point out the danger to him of electrocuting himself if he tries to make his own repairs. The high voltage may vary from 2,000 to 10,000 volts, depending upon the model. On the other hand, it is very necessary, too, that you do not scare him so much that he tells you to take the set out. This is going to the extreme. However, if he is really worried you should point out that there is no necessity for worrying about the high voltage as long as the chassis stays within the cabinet and the back is left on. You should also add that there is no danger from fire because in most current designs the manufacturer has properly fused the receiver so that if a short circuit should develop the power is automatically shut off.

Also, it is wise to point out that to protect inquisitively minded people such as tinkerers and children, most manufacturers have built in an interlock or safety switch which immediately shuts off the power when the back is removed from the set. Both the fuses and the interlock should, in my opinion, be incorporated in all television receivers, but the dealer had better be sure of his set before he talks about it.

Having completed the installation of the television receiver and instructed the customer as to its operation, the dealer may turn his attention to the next installation. Until such a time as the receiver requires some servicing, it should continue to perform properly. In succeeding articles of this series, other aspects of television servicing will be taken up so that when the call for service comes in, the well informed maintenance man will know what to do in the presence of an inoperative or poorly performing television receiver.

Radio Maintenance In Aviation

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hold the wires apart instead of the washer. This method of insulating the wires where they cross is to be preferred to bonding by means of a soldered lead as the flux used in soldering has a corrosive action.

It has been found that turn-buckles and tie rod terminals sometimes offer considerable resistance to the flow of high frequency currents. Such equipment should therefore be tested with the circuit tester described below and wherever a high resistance is found it should be by-passed by a copper bond.

In wooden fuselages a metal strip equivalent to that used in the wings is fastened along each longeron. This strip should extend from the engine to the tail surface making good electrical contact with the engine base and with each metal part and fitting along its length, branch strips being used if necessary. All water, gasoline and oil lines should be grounded to the frame at frequent intervals. Rubber hose joints should be by-passed by copper braid bonds.

The metal hinges of rudder, elevators, ailerons, etc., must be bonded across and the control wires attached to such parts must be bonded to the hinges. The whole is to be connected to the "Ground" which means making one electrical circuit of all metal parts. The method generally used is to place braid about 2 inches wide on the control wires near the thimble and wrap with waxed and shellacked cord, then pigtail length of braid to an effective "Ground" contact. If soldering is attempted it must be done with due care on account of possibility of weakening control wires.

How to Test Efficacy of Bonding

The final test of the efficacy of bonding and shielding together can be made only by noting in the receiver the degree of electrical noise with the ship in actual flight. However, for purposes of maintenance, inspection and trouble location it will be quite helpful to employ tests as follows: A circuit tester consisting of a battery operated buzzer or bell using a voltage of less than 10 volts is used to determine whether there is a low direct current resistance between adjacent parts. Contact is conveniently made to the parts by the use of stout, sharp pointed electrodes. When one electrode is placed on either side of a joint the buzzer should buzz with a normal sound. If the buzz is irregular or absent it is a sure indication that the resistance of a joint is too high. Head telephones are not to be used in making tests of this type. All bonds and joints throughout the metal framework of the plane should be tested in this way.

A test-rig consisting of a 2 volt storage battery, a low-resistance rheostat or variable resistance, and an ammeter having a low-reading scale of from 0 to 2 amperes connected in series with leads of about No. 14 copper wire, can be used to determine the efficiency of bonding. In making a test, short-circuit the terminals of the test leads and adjust the rheostat until the ammeter registers 1 ampere. Then separate the terminals and close the circuit by applying the terminals to various different metal parts of the airplane, noting the ammeter reading. If at any time the ammeter reads less than 0.9 amperes, the bonding is considered unsatisfactory. Fluctuation in the reading when testing the moving control surfaces will also indicate an unsatisfactory connection in the bonding system.

THE SERVICE KIT

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they are expensive, just knock over a lamp or scratch a chair sometime!) will not, as a rule, feel too comfortable about seeing this paraphernalia scattered about his living room.

Also, you have to consider the difficulty of working with the set owner's hot breath on your neck. This is the time and the place to make friends, influence a customer. Talk to him. Let him talk to you—but explain with a grin that it is costing him money. Then, after laboring for an hour to locate an intermittently open by-pass condenser—just try to charge a fair price when the customer watches you replace a part which he, quite correctly, divines costs you no more than 25c! Of course it will be argued that the customer can be convinced he is being charged properly if the repairman explains that costs such as overhead, traveling, labor, etc., must be figured when setting a price. But why make this necessary? The less selling at this stage the better. Talk first, then work.

However, talk if you must. It's part of the job. To the average customer technical terms like "I-F transformers," "coupling condensers," "bleeder resistors," etc., are meaningless. (But there are exceptions—notable exceptions.) Of much greater import is the fact that the radio sounds much better than it has for a long time and it is guaranteed to remain that way for at least ninety days.

Another factor is that it is not generally possible to determine in advance the length of time required to effect a repair. If the serviceman is going to spend more than thirty minutes in the customer's home, it is conceivable that he can upset the customer's household routine. This means either that arrangements must be made to do the work later, at the customer's convenience, or do it in the shop.

However, repairmen located in rural areas who must answer service calls at a considerable distance from their place of business must bear in mind the cost of two round trips if the set is to be removed and serviced in the shop. These men call back at some *mutually* convenient time to complete the "service" job which becomes a "two-call repair job."

A service call on a "guaranteed job" is another case in which repairing is sometimes more advantageously done on the spot. Aside from the fact that such jobs are almost always "gratis," the chances are excellent that the defect is a minor one.

On these calls as on every other call the purpose of "the man with the service kit" is to fix it right then and there. If for any reason this is not feasible, he must take little time on this call to get it set in the customers mind as a shop repair job instead of home servicing job.

The Problems Of Organization

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happened. Many times the action taken in one place is established as a precedent for similar action in another. In reality this entire radio repair problem is a national problem and must be treated on that basis.

Now the reason for raising this question at this time is that many local associations have been formed with the unwritten understanding that their interests are purely local and unless this line of thinking is altered, much conflict can be looked for if an attempt is made to broaden this local viewpoint by calling for some sort of national effort, especially when it may mean expenditure of funds.

To evaluate properly the needs for an association, some thought must be given to the possibility of enforced licensing of radio servicemen. This subject will be discussed in a later issue.

REVIEW OF TRADE LITERATURE

THE Clarostat Postwar Catalog will be off the press soon. It features flexible glass-insulated power resistors, miniature heating elements, sound-system controls, plug-in voltage-dropping resistors and ballasts. It will include the new Ad-A-Shaft controls whereby a minimum stock of units with an assortment of shafts can take care of a wide range of requirements. A copy of this catalog can be had by addressing Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

Another postwar catalog, a seven pager called "Post-War Radio Products," describing the first of many new parts, kits and equipments is to be released shortly by the McMurdo Silver Co. This company expresses the belief that many of these items may go far toward obsoleting technique heretofore considered standard. The catalog presents a Model #900 "VOMAX" Volt-Ohm-MA DB-Meter/Dynamic Signal Tracer for postwar receiver design and servicing at $59.85. Also shown in the pamphlet are the Model #901, Resistance Bridge, Precision Wheatstone Bridge .01 ohm through 10 megohms; the Model #902 Laboratory capacitance and Power Factor Bridge; Model #903 Absorption Frequency Meter and the Types #400 and 401 Shepherd-WIIJ U.H.F. Tuning Units. For a copy of this catalog address the McMurdo Silver Co., 1240 Main Street, Hartford 3, Conn.

Belmont Radio has published a handy little four page bulletin on instructions for installation, operation, and service of radios. This pamphlet includes paragraphs on setting the Pushbuttons; Antenna and Ground; Conditions Affecting Reception; Service Data for Professional Service Man; Technical Data and schematics. Send for your copy by addressing the Belmont Radio Corp., 5921 W. Dickens Ave., Chicago 39, Ill.

The Jensen Technical Monograph #5, on Horn Type Loud Speakers, priced at 25c and published by the Jensen Radio Mfg. Co., is the fifth in a series intended to bring about a better understanding of fundamental considerations having to do with:

(1) The proper choice and use of loud speakers and loud speaker systems.

(2) Reasonable expectations of the art of sound reproduction and reinforcement.

(3) Associating and correlating the links in a sound reproducing system.

In this little magazine (8½" by 11") the reader will get a physical picture of sound transmission and propagation with a horn. Included are: horn action; horn shapes; practical horn constructions; response frequency characteristics of horn loud speakers together with 16 diagrams.

You may write General Cement Co., Rockford, Ill., for a copy of their catalog on Radio Dial Bell, Drive Cable and Cabinet Repair Guide. The latter guide includes general instructions for cabinet repairs; takes in all phases of Cabinet repair work designed for Radio Service Technicians and Furniture Repairers. Incorporated in these kits are features for mak-

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Radioautobiographies

SAMUEL J. SHIMSHAK

FROM Samuel J. Shimshak, of Jersey City, N. J., we have this month's first biographical sketch, for which he receives $10 to cover the cost of the photograph; and the engraving of his picture will be sent immediately. Here is his story:

"I was born. That was in May 1905. After a reasonably normal childhood, I arrived at the point of reading all the available wireless publications by the time I was eleven. I lived in a house with gas only, but I had my room rigged up with batteries and flashlight cells, and a 'secret' door-opener consisting of an electric lock which was actuated by inserting a nail in a certain spot in the door, closing the circuit.

"At 14, I was on the air unofficially with a ½ inch spark coil swiped from a Ford ignition system. Fords were not safe in my block. These coils also had dandy condensers in them, which saved me money. I graduated through various rigs, such as rotary gaps and the like, until CW.

"At 16, I was one of the youngest to pass the test for a commercial wireless operator, first class, in New York. I took off my shorties and put on my first pair of long trousers and smoked a pipe so as to look more like a grown-up man (I was only 5'4" in height) when I went on my first assignment as a radio operator on a tanker for Socony. Pop had to sign a waiver of responsibility since I was so young or I could not go. I pleaded until he finally gave in.

"Then I became Assistant Engineer for a radio manufacturer and spent many sleepless nights taking the bugs out of that set. Later I went into manufacturing with some partners, and although we made a fine set, we lost our shirts as we did not know how to merchandise. This caused me to get a job in a hurry, so I became an outside repair man for Macy's, and remained there in several capacities for eight years. When I accumulated enough money, I went into business again with my own service shop which attracted a terrific 'jitterbug' following when I pushed records. When the war came along I wanted to be a radio operator again, but family pressure kept me at home. I closed the shop and went to work on radar in the engineering department of Western Electric Co.

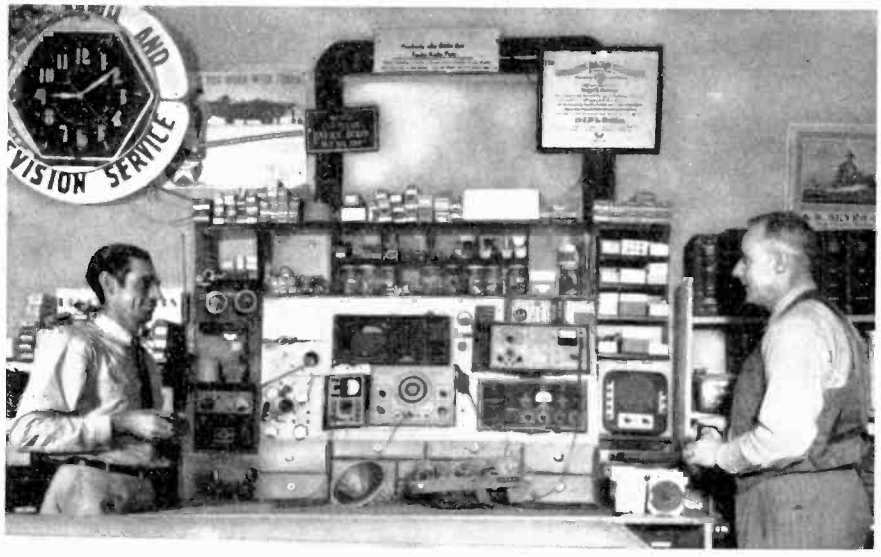
"From now on, who knows? Maybe I shall go back to my shop, maybe not. But in any event, radio has been an interesting and profitable life work so far, and I expect to stay in it."

H. B. MATTHEWS

Brief, but to the point, is this story from H. B. Matthews, of Houston, Texas. His story is like that of many who have entered radio from other fields, and found it to their liking. Matthews says:

"I was a stationary engineer, but during the worst of the depression I was no longer a stationary engineer — I was out of work and could get none. Worse than that, I was really down and out, unable to pay my rent or buy groceries. One Sunday, I borrowed a neighbor's paper and I saw the advertisement of a rather well known radio institute. That determined me. I took their course, receiving my diploma in two years; then I started my radio work, six years ago.

"Just out of the hospital, flat broke, with no money and no stock, I started in radio . . . Now I have this shop, and a man working for me. I have about $3,000 in stock and I have bought three houses and six lots which are about three-fourths paid for, with sufficient rent from them to pay out the balance if the radio work can not do it. But it does not look as though they will have to pay for themselves — radio work keeps on and on. I can do the work,



I feel fine and weigh about 200 pounds, and I try to please the people.

"In achieving what success I have in the radio servicing business, I have tried to put the people first, then equipment and parts, and then my own interests. I have found that if you know your business and give good service you will be busy all the time."

Now, let's have your story — just the bare essentials if you like, and we will do the rest. Send a good photo of yourself and your shop, and tell us how you got into radio. If we can use your story, we will pay you $10 to offset the cost of the photos, and in addition, we'll send you the cuts after the magazine is printed.

CONTROLS

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all connections except those on the switch, and connect to a resistance network as shown in Figure 5.

This arrangement will make the set operative at a fixed comfortable room volume for most locations.

If control has a tone compensation tap, the same type of network can be used, as shown in Figure 5A.

In both of the above cases, R1 and R2 may be made up of several fixed resistors of equal or similar values, which in series equal the approximate value of the original control. These may be connected to a tap switch, if available, to give a fairly satisfactory variable control, as shown in Figure 6.

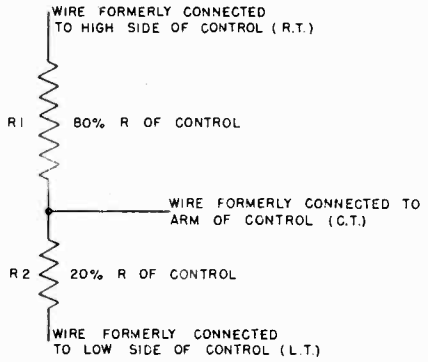

Figure 5

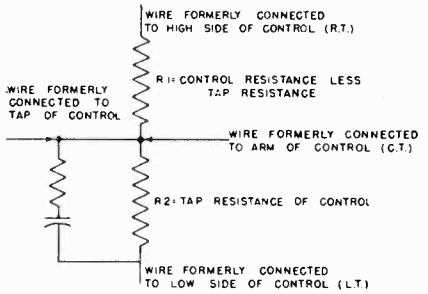

Figure 5A

Emergency Replacement of Controls by Mechanical Changes

USE OF OLD BUSHING AS SHAFT COUPLER. Cut off shaft and bushing from old control. Alter the shaft of the replacement control, and the end of the old shaft, as shown by Figure 7. The bushing should fit tightly over the shafts after they are fitted together as indicated in Figure 7A. If the bushing is loose, use a thin paper shim between the shafts. Insert the U-shaped wire as shown and bend over bushing.

USE OF "FEATHER" FOR SHAFT COUPLER. Cut off the old shaft and slot end as shown by Figure 8. Slot the end of the replacement shaft. Insert "feather" of metal in slots and solder in place.

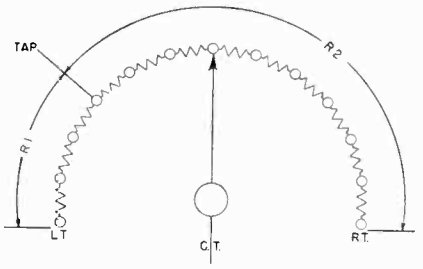

Figure 6

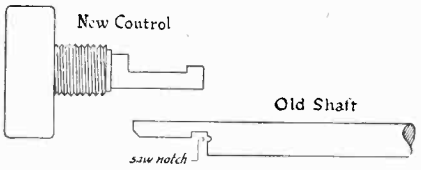

Figure 7

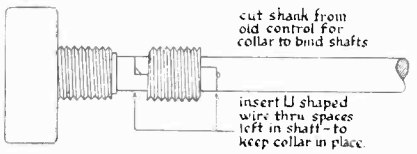

Figure 7A

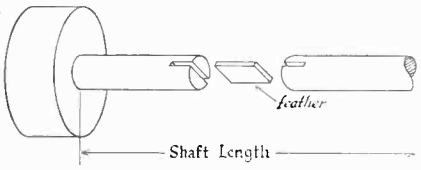

Figure 8

USE OF SLEEVE FOR SHAFT COUPLER. Cut off the old shaft and file to shape shown by Figure 9. File the end of the replacement shaft to fit the end of the old shaft. Place the two shafts together and slip over them a sleeve made from thin metal. Solder ends of sleeve to shaft to keep from pulling apart.

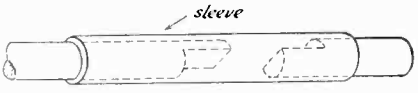

Figure 9

USE OF PINS FOR SHAFT COUPLER. Figure 10 shows another method of using part of the old shaft and fastening it to the replacement shaft by means of small picture frame brads. The ends of both shafts should be cut and drilled as shown.

When you make repairs based on any of these ideas, it is important that you supply your customer with a record of the changes involved. This data will then be available as a reminder to you, or helpful to other servicemen, if there is occasion to work on the equipment again.

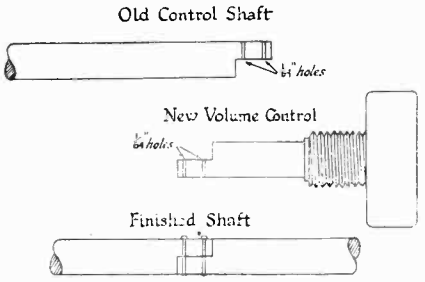

Figure 10

It should be borne in mind that the repair methods proposed here are simply emergency expedients and are in no case advocated where the original part can be obtained.

Review of Trade Literature

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ing practical repairs in a simple manner. The Catalog features the #900 Master DeLuxe Cabinet Repair Kit, priced at $6.75; it is listed as a kit with which all repairs can be made even for the most exacting customer. Spirit stains, varnishes, and enamels are included in the #900 kit. Also ask for the General Cement catalog on Card Displays for Radio & Electronic Parts, and catalog #146.

The Burgess Replacement-Guide for Battery Operated instruments, and the Burgess Replacement Guide for Portable & Farm Radios will be mailed on request. Address the Burgess Battery Co., Freeport, Ill.

Included in the Federal Telephone & Radio Corporation Technical Information Series, is a pamphlet in outline form on Pulse Time Modulation, which covers the broadest aspects of PTM technique. This is yours for the asking. Address FTR in Newark, N. J.

The pamphlet, DuMont Cathode-Ray Tubes for Television can be obtained by request from Allen B. DuMont Laboratories, Inc., Passaic, N. J.

Aerovox Corp. in New Bedford, Mass., has a handy little pamphlet on Aerovox Capacitors, Resistors and Test Instruments.

The Acme Battery Co., 59 Pearl St., Bklyn. 1, N. Y., will send you their battery catalog which includes Portable Battery data and Flashlight and Lantern Battery data.

Service Bench

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often rigged on service benches is a potential source of static and trouble. For that reason, have all your bench wiring of a permanent nature using cables and outlet boxes to comply with local electrical codes. A minimum of four duplex outlets is necessary. Power for auto radios can be brought from a concealed 6-volt storage battery or rectifier pack to convenient bench terminals, using heavy wire for low voltage drop. With a battery, a trickle charger can be connected to the battery for overnight recharging. In rural sections, 32 volt D.C. must be handy and in some cities and adjoining areas, 110 volt D.C. is necessary. These special voltages must be quickly available at duplex outlets marked to avoid error. All power circuits including the six-volt supply should be fused and metered.

Long and short outside antennas and a ground connection should terminate in insulated type combination banana-plug jacks and phone tip binding posts on the bench panel. An assortment of jumpers of various lengths with both banana plug and spring clip ends are handy for temporary connections.

Finally, consider the overall appearance of your work center. You can not expect to establish yourself as a professional serviceman and command professional prices in the coming period if this center presents the appearance of a cellar work bench. (EDITOR'S NOTE. A separate article, titled "A MODERN BENCH DESIGN" will be presented in the February issue.)

Repairing No-Name Sets

The huge pent up demand for new radio receivers, coupled with the delayed appearance of any quantity of new sets from reliable manufacturers —both oldtimers and newcomers to the field—has encouraged various lesser known manufacturers to hastily assemble odds and ends and place a questionable product upon the market. These off-brand sets can easily be spotted by the complete lack of a manufacturer's name. And they are being sold to eager customers who cannot wait for something better.

Sooner or later (more likely sooner) their doting owners will bring these "attic" radios in to the service shop for repairs. Now if the radio servicemen were organized and would band together, the proper thing might be to throw both the radio and its owner out of the shop faster than they came in. One gripe with these sets is that the appearance of any future trouble subsequent to its visit to the service shop will almost always be blamed on the serviceman's work and not on the manufacturer's original sloppy construction of the set, where it rightfully belongs.

While no service diagrams or information can be had from their makers, the majority of these off brand sets examined have used what might be termed a standard 5 tube AC-DC circuit. That is, a 456 kc superheterodyne using 12SA7, 12SK7, 12SQ7, et cetera, with a loop antenna in the input circuit and either a 450-ohm field coil speaker with the field as a filter choke, or a PM speaker with resistance-condenser filtering in the plate supply. Similar circuits are used by all the reliable manufacturers and their diagrams can be used for suggestions in replacing the various resistors and condensers.

These radios have poorly soldered joints and when the customer complains of fading, cut-off or noise, and where the cause is not otherwise readily apparent, the joints should be worked over with a hot soldering iron. This is a good idea on doubtful joints anyway to avoid future trouble. The electrolytic condensers are generally of inferior quality and have to be quickly replaced. A complaint of distortion or lack of volume or both will probably be caused by a leaky coupling condenser between audio plate and power tube grid or else a power tube bias resistor that has changed its value. The correct value to bias a 35L6 is 175 ohms, and for a 50L6, it is 140 ohms, both being 2-watt resistors. Most of the resistors used in these sets are a cheap type, probably rejects, and often being marked far from their true value, and generally of insufficient power handling ability. For instance, a resistor marked 250,000 actually measured 40,000 ohms. Hence, don't overlook checking the true values of resistors if tone and volume is unsatisfactory. ✓ ✓

NOTICE

Readers are invited to submit material for use in this department.

From $2.00 to $5.00 will be paid for each short item accepted—$10.00 for the best of the lot received during any one month. Full length articles may also be submitted and, if accepted, will be paid for at a rate to be agreed upon in every case.

Industry Presents

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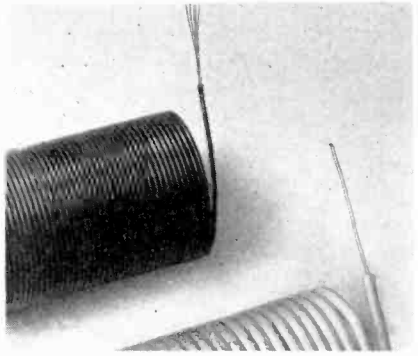
High dielectric properties accrue by virtue of its polyvinyl insulation values, in excess of 1000-volt breakdown strength per thousandth of an inch wall thickness.

Manufactured by William Brand & Co., 276 Fourth Avenue, New York.



NEW ELECTRIC WELDER

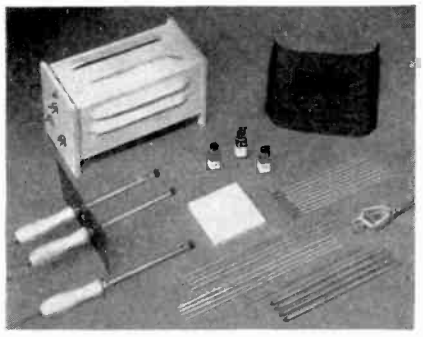
Announcement is made of a new electric welder operating from 110 volts, either AC or DC. The welder repairs iron, steel, cast iron, brass, bronze, copper, aluminum, etc. It fills in cracks and pits in metal castings. It builds up worn gears, shafts, etc. It can be used for melting, burning, cutting (on light metals), case hardening, hard surfacing, and tempering. In general use, the welder will handle metals up to ¼" in thickness.

Repair work of all kinds is easily done with the Welprod Welder. It is being used for repairs on electrical appliances, such as vacuum cleaners, fans, irons, toasters, and lamps, and on such office equipment as typewriters, calculating machines, checkwriters, steel files, as well as for repairs on automobiles, bicycles, sewing machines, air conditioning apparatus, coin machines, locks, farm equipment, etc. In tool and sheet metal shops the welder has many applications.

The welder simply plugs into the outlet, 110 volts AC or DC. It can be taken from job to job, inside or outside of the shop or home. There is no need to push heavy equipment around or bother with tanks and gases.

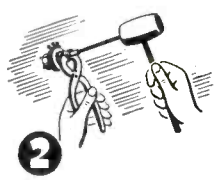
Operating cost is low. Current is only consumed while working. Lifting the torch from the work shuts the power off. It is claimed that approximate cost per hour is five cents.

It is manufactured by Welder Products Company, 321 Broadway, New York 7, New York.



N.U. SAV-A-SHAFT VOLUME CONTROLS

save work...time...material



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IRC PRESENTS

the "Book of the Year" FOR SERVICEMEN

Get your free copy from your IRC Distributor or write direct

UP TO THE MINUTE DATA ON IRC RESISTORS

Every well-posted Serviceman will want his own personal copy of this new IRC Service Catalog. Profusely illustrated with useful charts, diagrams, tables and product pictures, it contains the kind of material a busy man likes to have right at his fingertips.

Among the interesting features in this catalog you'll find the complete story on the new smaller size BTS (½ watt) and BTA (1 watt) resistors, as well as useful data on the entire BT and BW resistor lines. Now in RMA Preferred Number Ranges as standard Distributors' stock, these quality resistors are quoted at new low prices.

Also included are pertinent facts on IRC's "Century Line" of volume controls . . . 100 controls that will solve over 90% of your problems in this category. But these are only the highlights of this helpful new catalog. You'll want to see and read it all.

Make sure that you get your copy by stopping in at your nearest IRC Distributor or, if more convenient, drop a card to Dept. **28-A**

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