Study Group 3

ELECTRONIC FUNDAMENTALS

Service Practices 5:

HOW TO ERECT ANTENNAS

Service Practices 6:

HOW TO REPAIR AND POLISH CABINETS

RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York, N. Y.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 5

HOW TO ERECT ANTENNAS

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A SERVICE OF RADIO CORPORATION OF AMERICA
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Service Practices 5

INTRODUCTION

An *antenna* is a device usually made of wires or other conductors for the purpose of transmitting or receiving signals. The purpose of this Service Practices booklet is to give you some practical information about *radio receiving antennas,* and when and how to install them. Television antennas are discussed later in this course.

As we said in Service Practices 4, most radio receivers today are made with antennas already built in. Most of these receivers give satisfactory service without any additional antenna. However, there are some places in this country where good radio reception is not possible without installing an additional antenna — even for some of the receivers that already have built-in antennas. So, when a case comes up in which an external antenna is needed, you will be expected to know how to install one.

5-1. THE PURPOSE OF A RECEIVING ANTENNA

The purpose of a receiving antenna is to pick up the signals sent out by broadcasting stations and carry them to the receiver. A radio broadcasting station sends out what we will call *radio waves.* (Later in this course, we will discuss them more accurately. At that time, you will learn why we call them radio waves now.) These radio waves, in passing a radio antenna, produce potential differences on the antenna; this causes antenna currents to flow.

Not only does the receiving antenna pick up the signals from the station you want to listen to, but it also picks up signals from other stations, near and far from your receiver. When your receiver is turned on, and you tune to a particular station, the tuned circuits of your receiver select, from all of these radio signals, the signals of the station you want to hear. Antennas themselves may be tuned to a particular signal frequency. An example of this is any TV antenna that you have seen. Yet, even in the case of a tuned antenna, other signals are present in some amount, and it is necessary for the tuned circuits of the receiver to reject the unwanted signals and accept the signals of the wanted station.

The amount of signal voltage that the antenna picks up is determined by four main factors:

1. The amount of power transmitted by the broadcasting station; the greater the power, the stronger is the signal.

2. The distance the receiving antenna is from the transmitting antenna; the nearer they are to each other, the greater is the signal.

3. The efficiency of the antenna; the more effective the antenna is in picking up wanted radio signals, the greater is the signal volt-

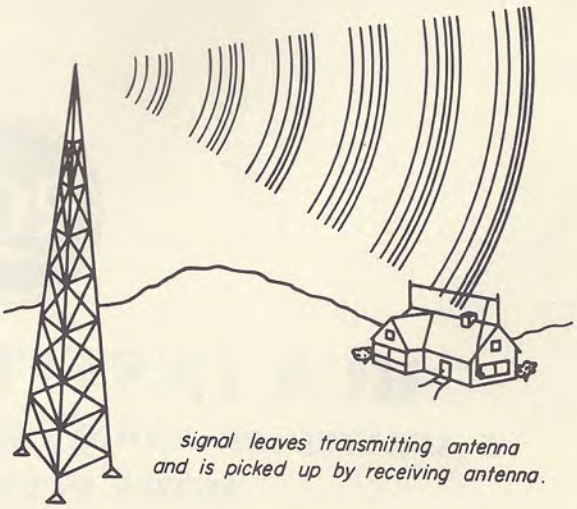


Fig. 5-1

age across the antenna, and, it follows, the greater the antenna currents will be.

4. What signal-absorbing mass is between the transmitting antenna and the receiving antenna.

The last factor sometimes makes an external antenna necessary. While antenna theory is the subject of a later Theory Lesson, you should know now why something between the broadcasting station and the receiver should affect signal strength. So, let us compare the transmitting antenna of a broadcasting station with a lighthouse. In Fig. 5-2, we see a lighthouse radiating its light beams to all points of the compass. On a clear night, its light can be seen for miles around. Very close to the lighthouse, the light is very bright; but the farther we get from it, the less bright is its light, until there is only a dim pinpoint of light many miles away.

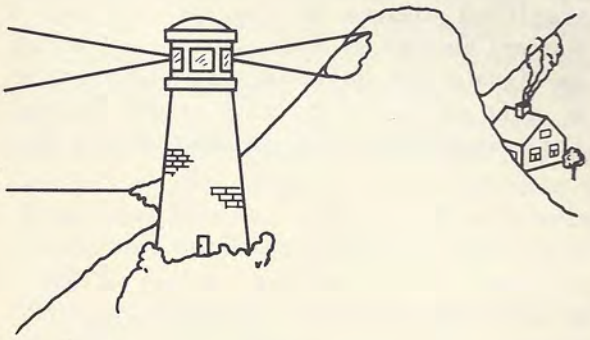


Fig. 5-2

However, on the land side of the lighthouse, there is a steep hill. People who live down on the other side of the hill cannot see the light at all, even though they live only a mile away from the lighthouse. To be sure, on certain nights when the clouds hang just right, they can see a reflected glow, which tells them that the light is lit — but that is all.

In much the same way, broadcasting transmitting antennas radiate their signals. The nearer we are to a transmitting antenna, the stronger is the signal. Very close to a broadcasting station, you can measure the signal in volts, while if your receiver is some distance from the transmitter, the signal may be measured in microvolts. A receiver very close to the transmitting antenna sometimes has to be protected by certain devices to prevent the high signal voltage from damaging the receiver. A receiver some distance from the transmitter may need to amplify the signal more, in order that it may be heard. Yet, people who live reasonably close by, but with hills or mountains between them and the transmitter, find that the signal is very weak, except on certain days when they get a reflected wave from the sky. People who live in valleys often have difficulty getting satisfactory reception on nearby radio stations that are outside of the valley.

Town and city people who live near tall, steel-framework buildings have the same trouble receiving signals when the buildings are between them and the wanted station. As shown in Fig. 5-3, the people who live in house *A* have difficulty in receiving signals from Station *Y*, although they get excellent

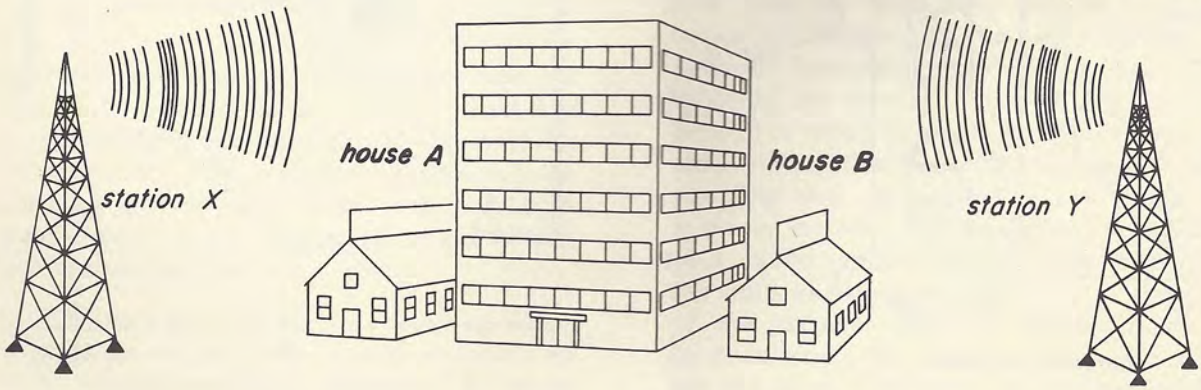


Fig. 5-3

reception from Station *X*. On the other hand, people who live in house *B* get excellent reception from Station *Y* and have quite a lot of trouble receiving Station *X*.

Hills and mountains, particularly those with large amounts of iron and other minerals, absorb radio signals. That is why people who live where hills and mountains interfere with reception are good prospects for external antennas. And the people who live in large towns and cities, with homes located near tall steel-framework buildings that absorb and block radio signals, are equally good prospects. In this booklet, you will learn how a simple external antenna may help to improve radio reception in these cases.

5-2. TYPES OF ANTENNAS

For our purposes, we can divide receiving antennas into three main classes: built-in antennas (part of the receiver), indoor antennas (not part of the receiver), and outdoor antennas. This booklet is not concerned with built-in antennas. However, you will find them discussed completely in a Theory Lesson on antennas later in this course.

Practically anything that is capable of conducting electricity may be connected to a receiver and act as an antenna. In fact, one of the tests that servicemen use in testing an old-fashioned radio, designed for an outside antenna, is to place a finger on the antenna post with the set turned on and the volume turned up to see if the set plays. In such a case, the serviceman uses himself as an antenna to intercept radio signals and to bring them to the receiver. A short length of wire connected in the same manner will work in much the same way. The commonest form of outdoor antenna used for radio receivers is called the *Marconi antenna,* which looks like an inverted L. Figure 5-4*a* shows a Marconi antenna. If you look at the drawing, you will see that the greater length of such an antenna is called the *flat-top* (the long side of the L), while the shorter length, leading from the flat-top to the receiver, is called the *lead-in.* The length of the antenna is the sum of the length of the flat-top and the length of the lead-in. A ground return is an important part of the Marconi antenna, as the simplified diagram in Fig. 5-4*b* shows. A Marconi antenna is most efficient in picking up signals that travel in a direction that is at right angles to the axis of the flat-top. For example, if the flat-top portion of a Mar-

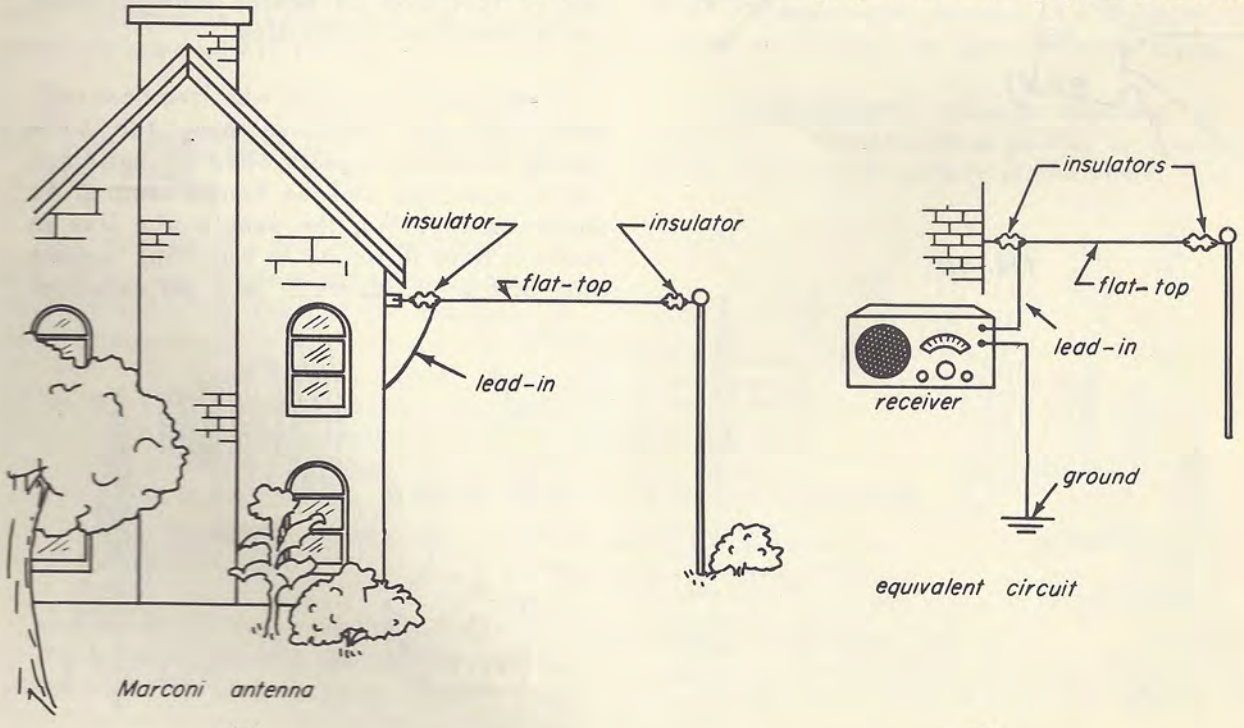


Fig. 5-4

coni antenna is run in a line from north to south, it will be best able to receive signals coming from the east or the west. It will receive signals coming directly from the north or from the south with decreased efficiency. This is a point to remember. We will speak of it again shortly.

There are other outdoor antennas that we will discuss later in this Services Practices booklet when we discuss special purpose antennas.

5-3. STATIC

We mentioned before that the antenna picks up signals from unwanted stations as well as the wanted frequencies. This is no great disadvantage, because, with a good tuning system, we can select the station that we wish to hear. In fact, if the antenna did not pick up other stations, we would have to have a different antenna, or a different receiver, for each station that we wished to listen to. However, a receiver antenna also picks up a lot of noise, called *static,* which is almost impossible to tune out. Some static has natural causes. For example, you find that a radio is very noisy in a thunderstorm, because of the lightning discharges that occur during the storm. It is also possible to have noise from heat lightning. What is more, it has been established that sun spots cause noise in radios. Other noises are caused by different kinds of electrical apparatus; for example, dial telephones, electric shavers, buzzers and bells, automobile ignition systems, elevators, X-ray machines — in fact, any type of electrical device that is capable of producing a spark. You may have noticed the brushes of an electric motor sparking as the motor turned. You may have watched a man use an electric-arc welding machine. If you ever had the misfortune to try to listen to a radio near an electric-arc welding machine in operation, you know that electricity, in jumping the gap, can sound like thunder in your loudspeaker. These electrical disturbances we call *man-made static.*

The fact that the antenna picks up noise signals as well as radio signals presents us with a very interesting problem. We know that we can tune out unwanted radio signals, and we also know that it's practically impossible to tune out noise. Yet we would like our radios to be as free from noise as as they are from unwanted radio signals. Fortunately there are ways to get rid of some noises. Some of these ways will be discussed in this and other Service Practices booklets.

5-4. SIGNAL-TO-NOISE RATIO

When a radio signal is very great and the noise signal is small, we hear only the radio signal and we don't hear the noise signal at all. When both signals are of the same strength, we hear both the radio signal and the noise signal at the same time. When the noise signal is great and the radio signal is small, we hear only the noise signal and we don't hear the radio signal at all. Servicemen compare the efficiency of antennas by comparing the pickup of radio signals with the pickup of noise signals. They speak of the *signal-to-noise ratio.* This means that they find out how many times greater the desired radio-signal voltage is than the noise-signal voltage. When the desired radio-signal voltage is many times the voltage of the noise signal, there is a high signal-to-noise ratio, and reception is practically noise-free. However, when the signal level is low and the noise level is high, then the signal-to-noise level is very low, and reception is very noisy.

Let's see why this should be so. We'll compare it with something almost everyone has experienced. Let's suppose that you and a friend are at a movie or at a show of some sort and you are sitting down front. You hear the show very well and you are not at all bothered by the fact that there is someone hammering on a display out in the lobby of the theatre. Just as you are well settled to enjoy yourself for the evening, an usher comes down to your row and he tells you that you are sitting in seats that are reserved for some other people. So you and your friend look around for other seats and the only ones you can find are in the back of the theatre. So you settle yourselves in these seats and prepare once again to enjoy the show. However, the hammering that you did not hear down front, because of the

volume of sound from the stage, is much clearer to you and louder, while the volume of sound from the stage is much lower because you are farther from it. As a result, you find that you no longer enjoy the show as much as you did because of the hammering.

Let the sounds from the stage that you want to hear represent the *signal* and the sound of the hammering represent the *noise*. We can compare this situation with the signal-to-noise ratio. When you sat down front, the signal was very loud because you were close to it, and the noise was very low because you were far from it. So you can see that, in the first position, the signal-to-noise ratio was high. As a result, you enjoyed the show because it was practically noise-free. But, in the second position, in the back of the theatre, the signal (the sound from the stage) was very much lower because you were far from it, while the noise (of the hammering) was very much higher because you were close to it. So, in this second position, you can see that the signal-to-noise ratio was very low, and as a result, you did not enjoy the show because of the noise.

5-5. REDUCING NOISE

There are two major ways of reducing noise. The first, is to try to reduce or eliminate the noise at the source by working on the machinery that makes the noise and seeing what can be done to prevent it from radiating noise. Reduction of noise at the source of the noise is the subject of a later Service Practices booklet. The second way to reduce noise is to try to reduce it at the receiver. Perhaps, from the discussion of the show and the hammering, you may have an idea of the method used to reduce noise at the receiver end.

In the theatre, we found we had to be far from the noise and close to the signal in order to enjoy the show. Naturally, we can't all live near a radio station. Frankly, you wouldn't want to, because you might have difficulty in listening to any other station. Sometimes, it is possible for us to find a place where the signal-to-noise ratio is high for most of the stations that we want to hear, and place our radio there. For most of us, there is no problem. However, there are many cases in which it is difficult to find a place in the house or apartment where the signal-to-noise ratio provides good reception on most stations. In areas where there are a good many noise problems, servicemen sometimes use a battery-operated portable radio and carry it around the house or apartment, looking for a spot with a good signal-to-noise ratio. If they don't find a spot in the house, they walk around outside the house looking for the spot where reception is best. They may find, for instance, that reception is excellent on the roof, or out in the backyard near the apple tree, or in the middle of the street outside, but these are unlikely places for installing a radio. So, the next best thing to do is to bring the conditions that exist in these places to the radio. This can be done by means of an outside antenna. Just erect an antenna in a spot where there is high signal-to-noise ratio and bring this good signal to the radio. This Service Practices booklet tells you about the installation of high-signal-to-noise ratio antennas.

5-6. ANTENNA EFFICIENCY

We measure the efficiency of antennas by their ability to pick up wanted radio signals and little noise — in other words, by their signal-to-noise ratio. A good antenna, therefore, is one with a high signal-to-noise ratio, and a poor antenna is one with a low signal-to-noise ratio. There are several factors that affect antenna efficiency. (In discussing the factors that affect antenna efficiency, we have in mind the simple, basic inverted-L type [Marconi] antenna. However, what we say about this antenna is true of most antennas.) The first factor that affects antenna efficiency is the length of the antenna. The longer the antenna, the more signal volt- it picks up and the stronger is the signal that reaches the radio receiver. There are practical limits to this, however; if we make an antenna too long, we tend to cause the radio receiver to be less selective and, as a result, stations tend to interfere with each other more than they would with a normal-length antenna. Remember that the

length of the antenna is the length of the flat-top added to the length of the lead-in. It is desirable to have the flat-top longer than the lead-in because the lead-in tends to pick up noise more than the flat-top does. The average antenna has a 50-foot flat-top and a 25-foot lead-in. These figures, of course, may be varied somewhat without making much difference to reception.

Another factor that affects antenna efficiency is the height of the antenna — the higher the antenna, the better the reception. There are several reasons for this. One of the most important of them is that the higher the antenna, the farther it is, as a rule, from the source of noise, particularly if that noise comes from equipment inside the house. However, there are practical limits to the height of the antenna. Most high antennas require the use of antenna masts. So, the higher the antenna, the longer the mast, and the more difficult and expensive is the installation, particularly if the mast is to withstand storms and high winds.

We have already indicated the third factor. It is the placement of the antenna. The efficient antenna is one that is placed where there is a high signal-to-noise ratio. Sometimes, this is much easier said than done. However, let us assume that a source of noise exists in a building next to the one where we are installing an antenna, as shown in Fig. 5-5*a*. If we place the antenna as shown in the figure, with the lead-in running as it is pictured, we will have a low signal-to-noise ratio. This is because the antenna, which includes the lead-in, is placed closer to the source of the noise. Now look at Fig. 5-5*b*. We have placed the antenna away from the source of noise, with the result that we have a higher signal-to-noise ratio than we had before. Notice in the second panel that the lead-in, which picks up noise and signal, is brought down so that it is as far away from the source of noise as is possible.

The efficiency of the antenna is not only affected by its placement with respect to the source of noise, but also with respect to metal and other grounded or ungrounded surfaces. For example, an antenna that runs near a metal-top roof, a metal gutter, a rainpipe, or the metal girders of a steel-framework building loses a lot of its efficiency in two ways: one, because the metal surfaces absorb the radio signals, and two, because metal surfaces tend to radiate to the antenna any electrical noises that originate inside the building.

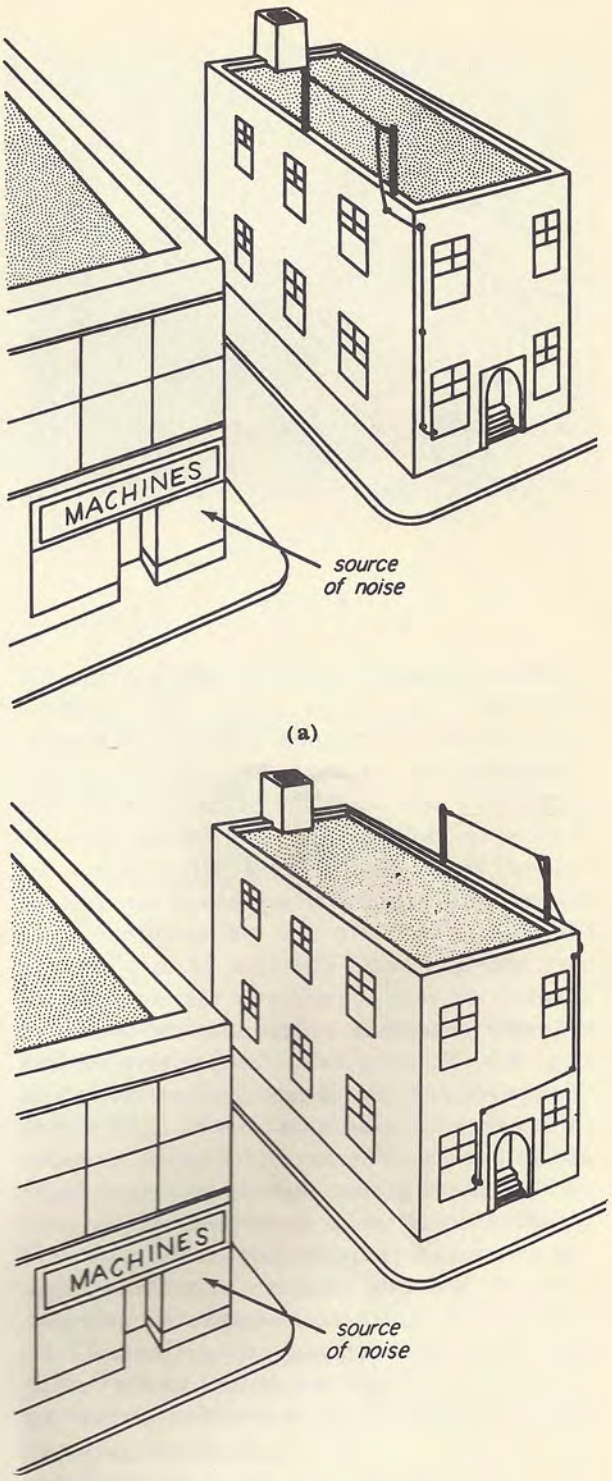


Fig. 5-5

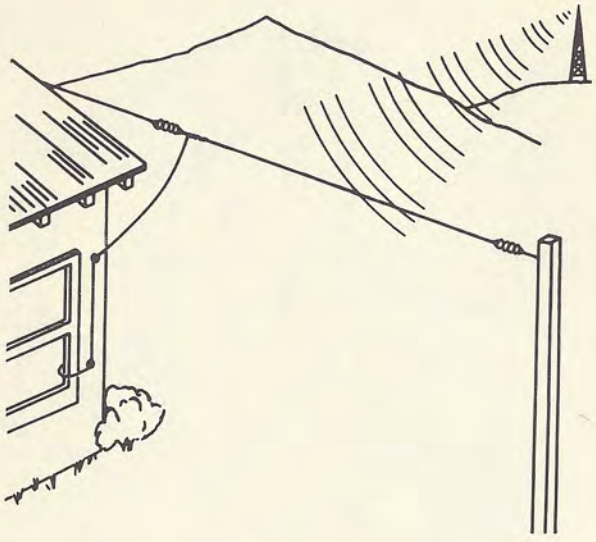
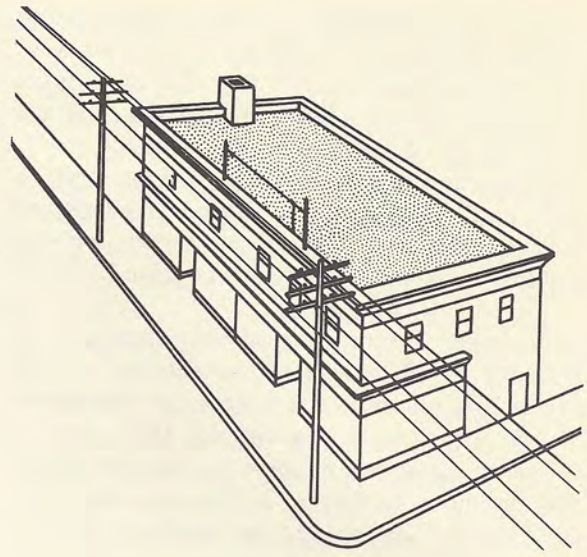


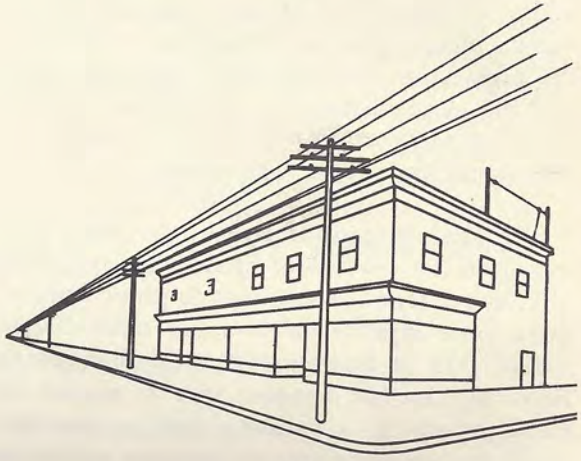
Fig. 5-6

As mentioned earlier in this booklet, the direction in which the antenna flat-top runs also has an effect upon antenna efficiency. Remember that we said that a flat-top picks up signals best when the signals are at right angles to the axis of the flat-top and receives signals with least efficiency when the signals are travelling along the line of its axis. There are two ways in which we may use this fact. The first is to place the antenna so that it receives the wanted signal with maximum efficiency, as shown in Fig. 5-6. However, we can use this method to improve only the reception from those stations that are in the same line at right angles to the flat-top. The second way we may use the direction of the flat-top to improve the signal-to-noise ratio is to point the ends of the antenna in the direction of the source of noise in order to reduce the noise pickup. Figure 5-7*a* shows an antenna that runs parallel to some overhead power lines. If the power lines radiate any noise, as they often do, the antenna is in a position to pick up the maximum amount of noise from the power lines. To correct this condition, we can change the position of the flat-top so that it points toward the power lines and is at right angles to them. In this position, the antenna picks up the minimum of noise from the power lines, with an improvement in signal-to-noise ratio.

Another very important fact that affects antenna efficiency is the use of a good



(a)



(b)

Fig. 5-7

ground return. This requires a firm connection to a grounded surface, such as a cold-water pipe or a steam-radiator pipe or to a pipe or metal rod driven into moist earth. *Never connect a ground lead to a gas pipe.* The lead from the ground connection to the radio receiver should be short as possible, because ground leads pick up noise just as easily as do antenna leads.

Warning: Do not connect a ground lead to an a.c.-d.c. receiver, unless the manufacturer has provided a binding post or grounding lead, plainly marked, for a ground connection. Should you ignore this warning, you will not only "blow" the power-line fuse, but you may also damage the receiver.

There are two other factors that are

likely to affect antenna efficiency. One of these is antenna resistance and the other is antenna leakage. Resistance may be introduced into the antenna by poor connections in the antenna system. For example, if the wires of the antenna flat-top and the lead-in are twisted together to make connection, within a very short time oxides and other impurities will tend to produce a poor electrical connection. When this happens, the signal currents picked up by the flat-top have more difficulty passing to the lead-in wire, and a portion of the signal current is lost. Another place where signal losses may occur due to resistance is at the lead-in strip (where the antenna is sometimes brought into the house), and at the ground connection.

Loss of signal due to leakage may be caused by using poor insulators. The best insulators are made of Pyrex glass or highly glazed porcelain. Other insulators may act as high-resistance conductors and, particularly in wet weather, permit the signal currents to travel directly to ground without going through the radio receiver.

5-7. PREPARATION FOR ERECTING OUTDOOR ANTENNAS

Before erecting an outdoor antenna, it is necessary for you to decide where to place it, what will support the flat-top, how to bring the lead-in to the receiver, and where to run the ground lead. Use the facts given in the discussion of antenna efficiency to help you to make your choice. Once you know where the antenna is going, you can decide on the equipment you need to install one. There is no way in which this lesson can tell you just what to buy, because no two antennas are exactly alike. For most simple outdoor antenna installations, a kit of parts may be purchased from a radio parts distributor. Find out the name of one or two distributors in your area. You can probably do this by referring to the yellow pages (business listings) of your telephone directory.

A typical antenna kit, as shown in Fig. 5-8 consists of:

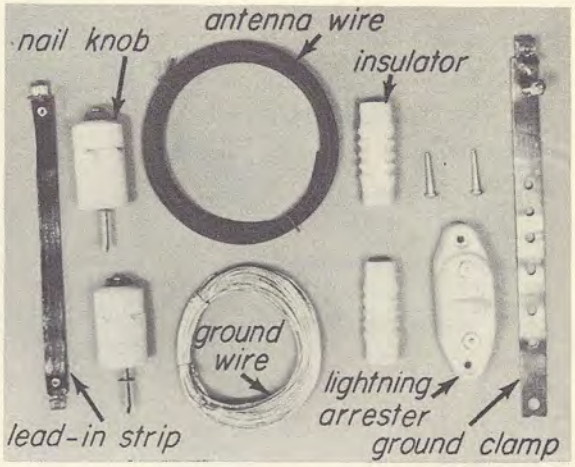


Fig. 5-8

100 feet of antenna wire

40-50 feet of rubber-covered ground wire

lightning arrester

ground clamp

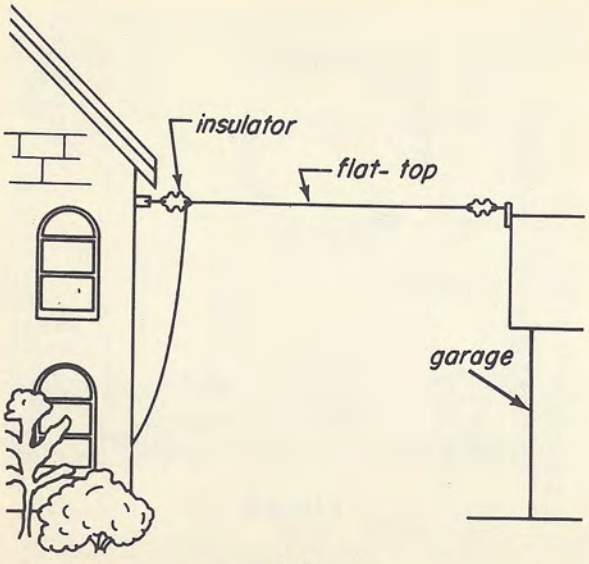
lead-in strip

2 insulators

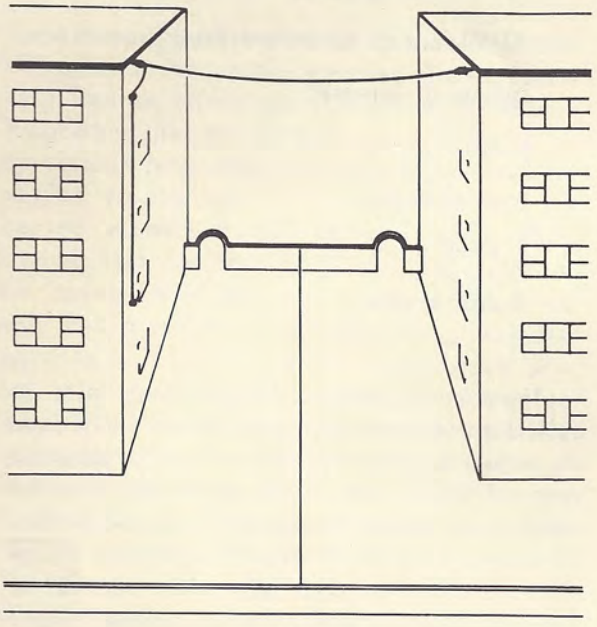
2 nail knobs

In some catalogs, the antenna wire is called *aerial wire* because, in the early days of radio, the flat-top portion of the antenna was called the aerial. Antenna wire may be solid or stranded. If solid, it should be No. 14 enameled wire. If stranded, it should consist of seven strands of either No. 22 or No. 24 bare copper wire. In areas where high winds are common, heavier wire is sometimes used. In most cases, such wire must be ordered separately. The lead-in and ground wire should be of the same gauge as the antenna wire — about No. 14 copper wire. The other parts will be discussed more completely when we come to them.

An antenna kit, together with a small pulley, a length of light rope, and some long tacks (equipment similar to that used by telephone company installation men when they run telephone wire inside a building for a telephone installation) is sufficient for simple antenna installations like the ones shown in Fig. 5-9*a* and *b*.



(a)



(b)

Fig. 5-9

5-8. ERECTING A SIMPLE INVERTED-L ANTENNA

A simple inverted-L antenna, as shown Fig. 5-9*b*, may be erected in the following steps:

Step 1. Fasten one end of the antenna wire to one of the insulators, as shown in Fig. 5-10.

Step 2. Feed a length of light rope through the hole in the other end of the insulator and tie it securely to the chimney.

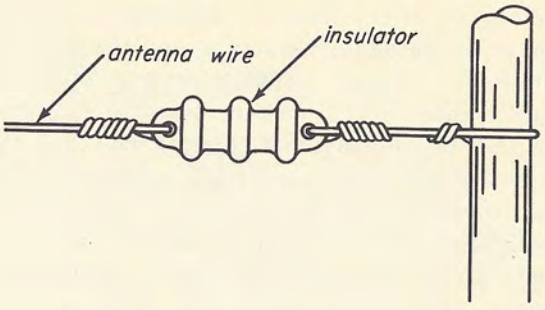


Fig. 5-10

Step 3. Measure how far from the chimney end the lead-in wire will be attached so that it does not scrape against the side of the roof on its way down to the receiver.

Step 4. Solder the lead-in to the flat-top at this point. Before soldering, make sure that you have made a very tight mechanical joint between the lead-in and the flat-top wire. If the flat-top wire is enameled, scrape the enamel away with the back of your penknife blade or with fine sandpaper before making the joint. Then solder the joint.

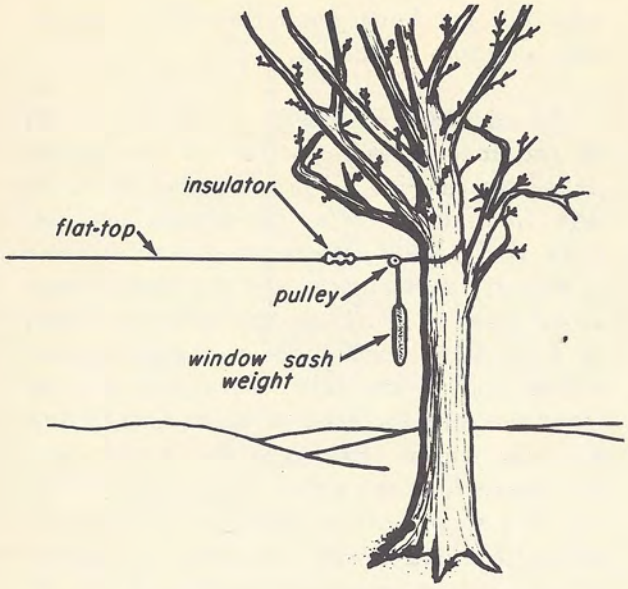
Step 5. Measure off, on the antenna wire, the amount that you plan to use for your flat-top. Then allow about 6 to 8 inches more wire for fastening the wire to the other insulator.

Step 6. Fasten the free end of the flat-top to the other insulator.

Step 7. Thread a length of rope through the other end of the insulator and tie it securely.

Step 8. Fasten the pulley to the roof of a barn, garage, or some other building that is convenient for this purpose.

Step 9. Thread the free end of the rope through the pulley wheel and pull the flat-top taut. Then tie the free end of the rope to the barn or garage. If the far end of the flat-top is attached to a tree instead of to a barn or garage, tie the pulley to the tree with sufficient length of rope so that the antenna is completely free from the branches and leaves of the tree, as shown in Fig. 5-11. In this case, instead of tying the free end



typical installation of an outdoor antenna with one support flexible

Fig. 5-11

of the flat-top rope to the tree, use a counterweight, like an old-type flatiron or a window sash weight, at the end so that the antenna will not snap when the tree sways in the wind. In such an installation, use the type of pulley that does not permit the rope to jam.

Step 10. With a porcelain nail knob, fasten the lead-in to the side of the house near the roof, as shown in Fig. 5-12. Leave a little slack between the nail knob and the flat-top so that the connection will not be broken during a storm.

Step 11. Fasten the lead-in to the casement of the window that is to be used for bringing the antenna into the house, as shown in Fig. 5-13. Make sure that the lead-in is taut between the two porcelain insulators so that it does not sway with the wind. Otherwise, the lead-in will sway back and forth from the building, and, particularly in wet weather, may cause fading in the receiver.

Step 12. Measure off, on the free end of the lead-in, the distance between the porcelain insulator and the lightning arrester.

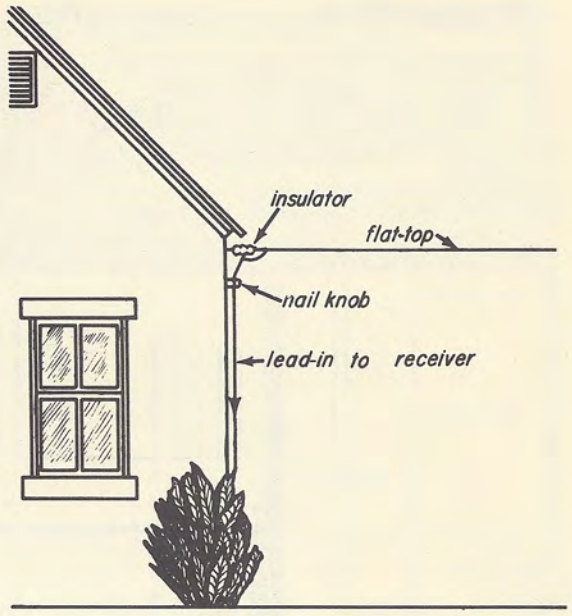


Fig. 5-12

Without cutting the lead-in wire, strip off about one-inch of insulation, as shown in Fig. 5-14*a*. Make sure that the exposed wire is clean and wrap it at once around

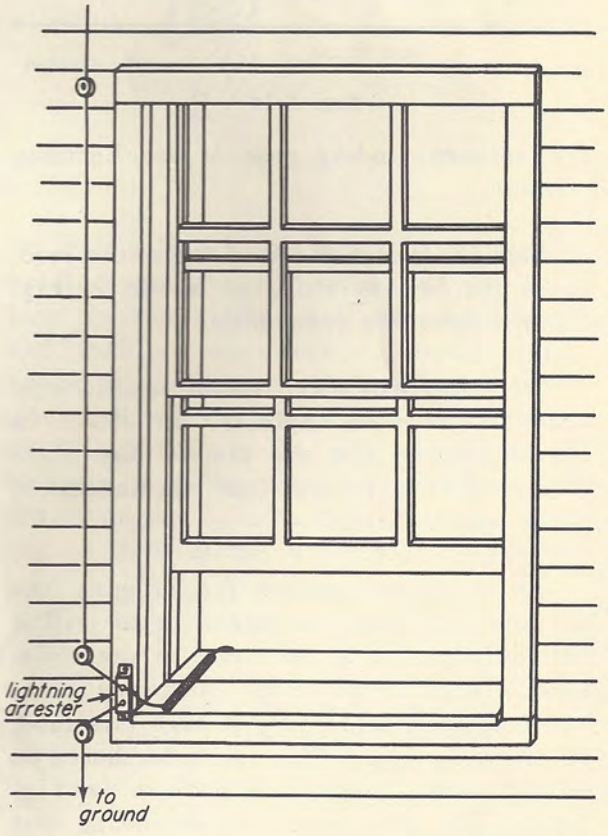
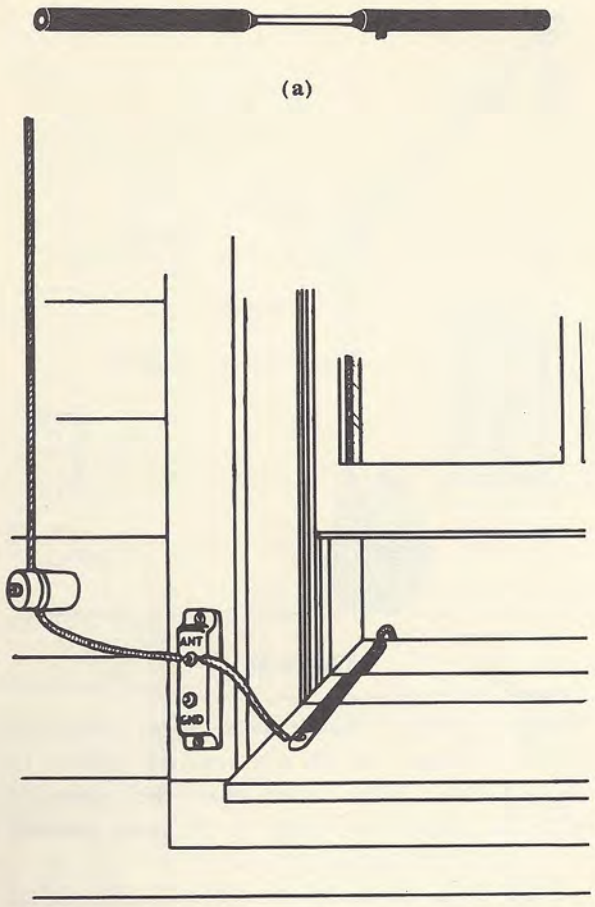


Fig. 5-13



(a)

(b)

Fig. 5-14

the antenna binding post of the lightning arrester.

Step 13. Fasten the free end of the lead-in to the lead-in strip, as shown in Fig. 5-14*b*. Solder this connection.

Step 14. If possible, run the lead-in strip under the window molding, as shown in Fig. 5-14*b*, so that the window may close easily without cutting into the insulation of the lead-in wire.

An alternate method for bringing the antenna lead into the house is to drill a hole in the side of the house at the cellar level, insert a porcelain insulating tube, and feed the lead-in wire through this tube, as shown in Fig. 5-15*a*. The hole should be drilled with a star drill (shown in Fig. 5-15*b*). The hole should be drilled so that its direction is slightly upward from the outside toward the inside so that a heavy rain will not force water through the porcelain tube into the cellar.

In addition, a little loop should be left in the lead-in wire outside of the house, as shown in Fig. 5-15*a*, to permit water to drip from the wire to the ground outside. It is also a good idea to wrap several turns of electrician's tape around the lead-in wire at the point of entry into the tube, as shown in Fig. 5-15*c*, and to do the same at the inside end of the tube. This will help to block the tube and prevent water from getting into the cellar. Bringing the lead-in into the house from the cellar requires the drilling of a small hole in the floor at the point where the lead-in wire comes up to connect to the radio, as shown in Fig. 5-15*d*. A ¼-inch hole is usually sufficient.

Step 15. If you have brought the antenna lead-in through a window that is close to the receiver, a short length of lead-in wire should be sufficient to connect the inside terminal of the lead-in strip with the binding post or antenna lead from the radio. The connection at the lead-in strip should be soldered. If the receiver is some distance from the lead-in strip, it may be necessary to run a wire from the lead-in strip to the receiver. Ordinary lead-in wire is unsuitable; servicemen frequently use stranded single-conductor fixture wire. This wire may be obtained in several colors from stores that sell electrical lighting fixtures. If possible, select a color that matches the woodwork. Tack the wire to the molding with long tacks, similar to those that upholsterers and telephone installers use. Don't let your wiring sag and don't let the tacks cut into the wiring. A good example of such wiring is the wiring done by telephone installers. If you follow their example you can't go wrong.

Step 16. Select the nearest good grounded surface, such as a cold-water pipe, a steam-radiator, or a ground rod driven into moist earth. If the installation is in a private house, and there is a cold-water tap outside the house, run a ground to the pipe to which the cold-water tap is attached. Otherwise,

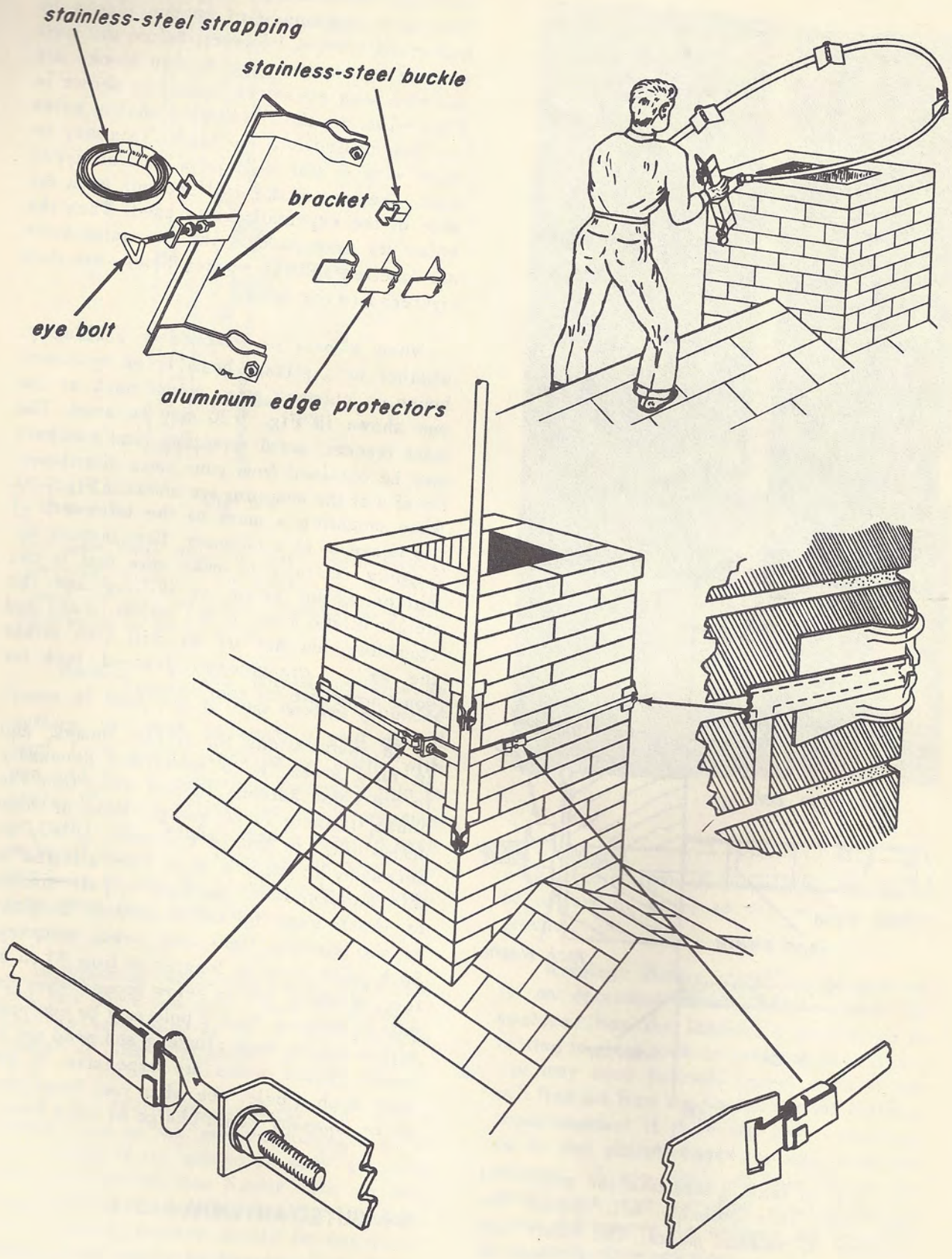
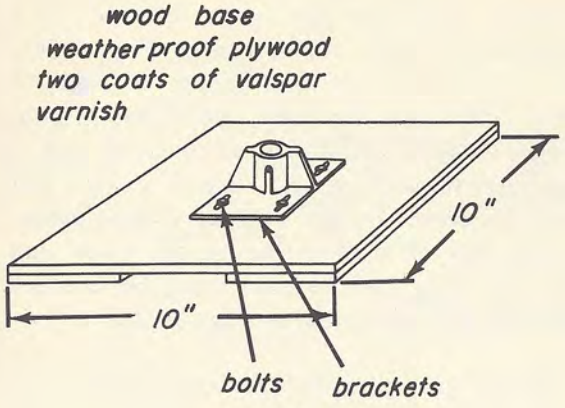
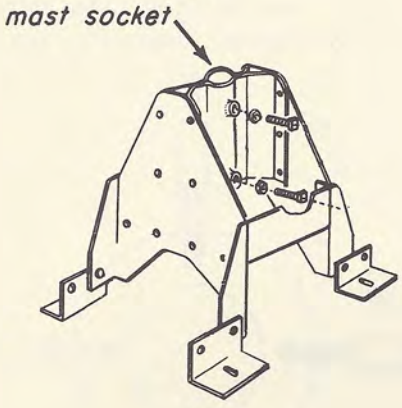

stainless-steel strapping
stainless-steel buckle
bracket
eye bolt
aluminum edge protectors

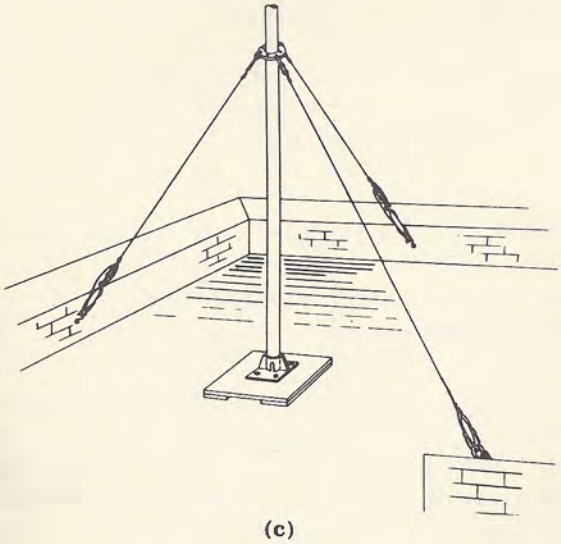
Fig. 5-20



(a)



(b)



(c)

Fig. 5-21

mast. When a mast rises ten or more feet above its base support, guy wires should be used to prevent it from swaying in the wind. The mast may be made from steel or duraluminum pipe. A single section mast is usually made from 1-3/8-inch pipe. If additional sections are used, they may be of 1-5/8-, 1-7/8-, and 2-1/8-inch sections. Your radio parts distributor can supply you with 8- to 12-foot mast sections that fit into each other like the sections of a telescope and with all of the hardware and wire necessary for erecting an antenna mast. It is impossible to give you complete instructions for the erection of all types of antenna mast; there are many different types that may be mounted in many different ways. However, the following paragraphs will supply you with some helpful information, should you have need to erect a tall mast.

On flat or peaked roofs, masts require a base support so that the mast does not dig a hole in the protective covering of the roof. Figure 5-21*a* shows a base support of the kind used on flat roofs. This type is also used to support the base of a mast that is erected on the ground. Figure 5-21*b* shows one type of bracket used for supporting masts on a peaked roof. In most cases, a mast mounted on the peak of the roof should be limited to no more than one 12-foot section. Do not use any base supports that require nails or screws to be driven into the protecting cover of the roof. Base supports are usually held in place by friction and the guy wires. Figure 5-21*c* shows one way of using the flat base support.

The wire used for guying must be able to withstand the pressure of high winds and the weight of ice forming on the antenna itself. The RCA Service Company uses a 42-strand galvanized wire made up of seven woven ropes of six strands each, capable of withstanding 600 pounds pressure. Your distributor may have a wire with fewer but heavier strands that will serve your needs. At least three guy wires should be used to support a mast so that the mast is supported no matter in what direction the wind blows. The greater support from the guys should be such as to oppose the wind, as shown in Fig. 5-22.

Guys should be equally spaced about a mast. For that reason, guy rings have six holes, as shown in Fig. 5-23*a*. Three or four equally spaced guy wires may be attached to these holes, as shown in Fig. 5-23 *b* and *c*. The guy ring slips freely on the mast and

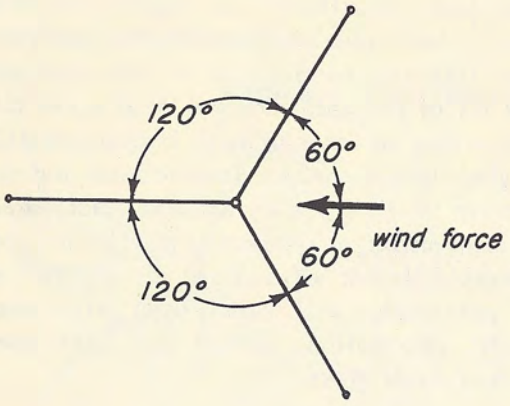


Fig. 5-22

usually rests on the lower section of a telescoping joint, as shown in Fig. 5-23*d*. When there is only one length of mast, a mast collar may be used, as shown in Fig. 5-23*e*. A mast collar cannot be used with a steel mast because the screw cannot cut into the steel. In the case of a steel mast, a hole may be drilled through the mast, and the guy ring can be supported by a steel bolt and nut, as shown in Fig. 5-23*f*.

Each guy wire is attached to the guy ring, as shown in Fig. 5-24*a*. Note that the end of the guy wire is taped down to prevent unraveling. A thimble, shown in Fig. 5-24*b*,

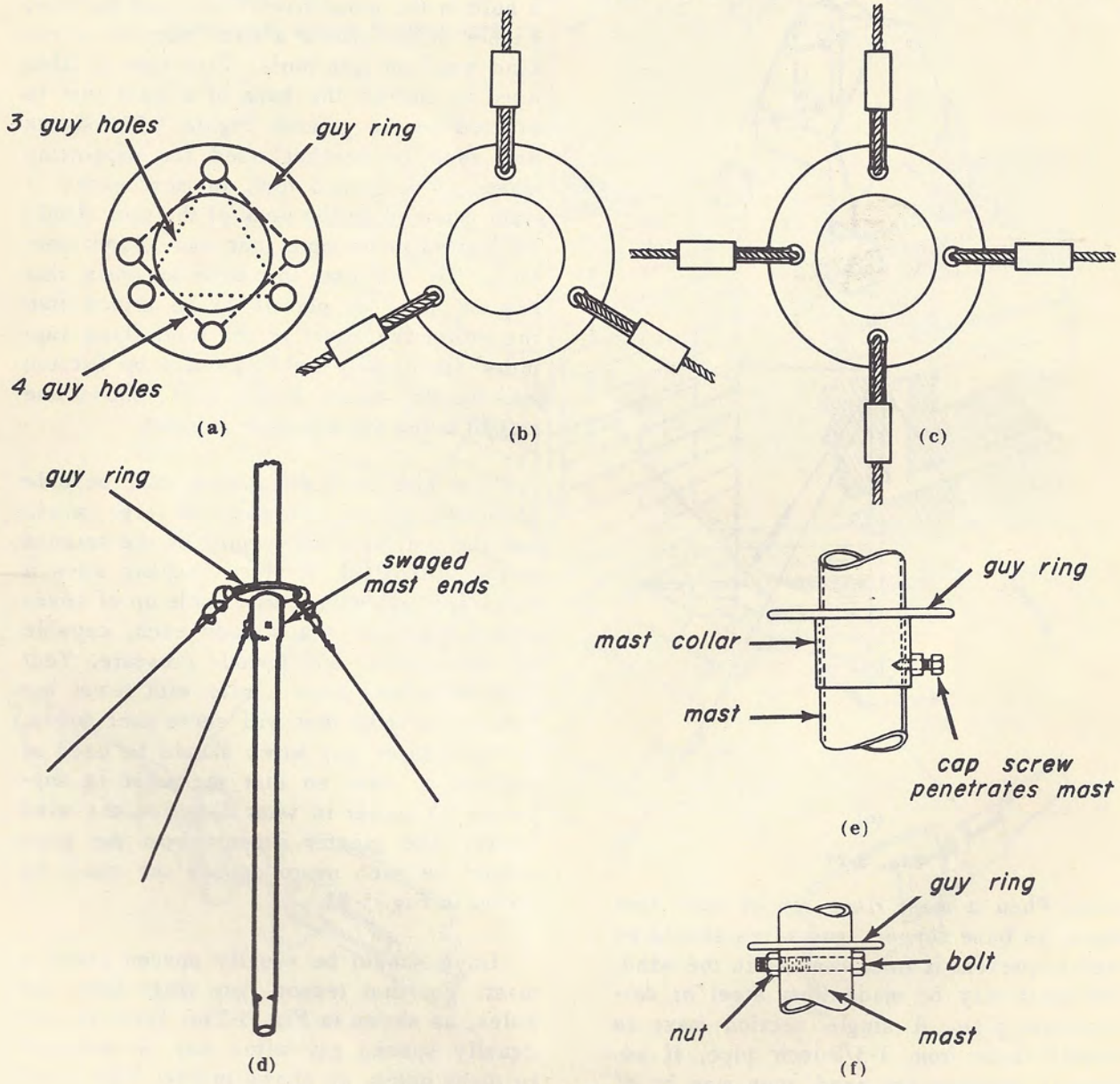
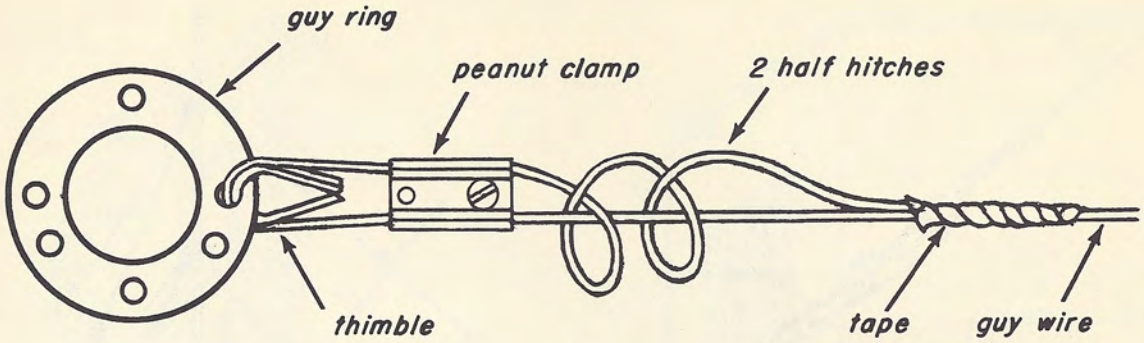
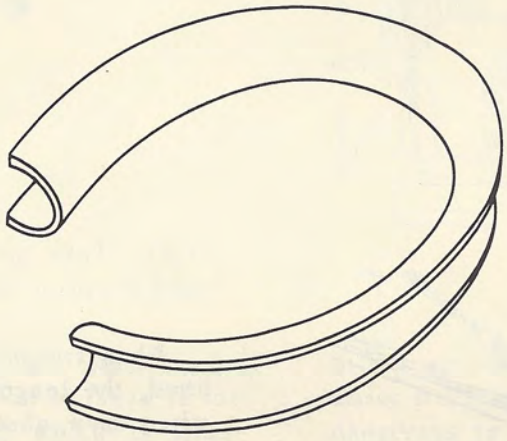


Fig. 5-23



(a)



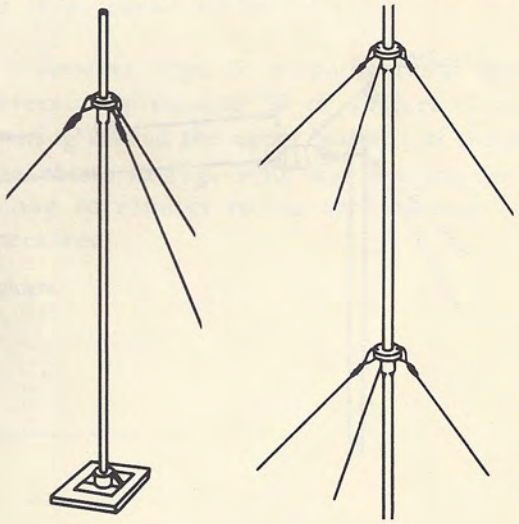
(b)

Fig. 5-24

is used for each guy to prevent too sharp a bend in the wire. A cable or *peanut* clamp is used to fasten the wires together and to prevent slipping.

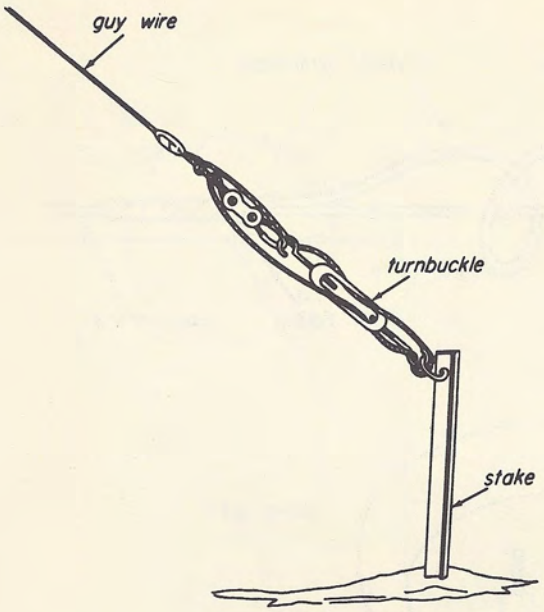
A general rule of guying is: *The higher the guy wire is placed on the mast, the less is the tension on the mast and the greater is the pressure that it can withstand.* If the guy wire is placed too near the top, however, the mast is apt to buckle in the middle. A single set of guy wires is usually placed about two-thirds of the way up from the base, as shown in Fig. 5-25*a*. Masts more than 18 feet tall should have two sets of guys, as shown in Fig. 5-25*b*. Masts of more than 35 feet should have three sets of guys. However, very tall masts are not very practical because they may require special supporting towers.

Guy wires are attached to the mast before it is erected. A turnbuckle is attached to the free end of each guy wire, with the turnbuckles in the open position, as shown in Fig. 5-26*a*. A roof hook anchors each of the guys, as shown in Fig. 5-26*b*. If anchored to the ground, the turnbuckles are fastened to stakes driven as shown in Fig.

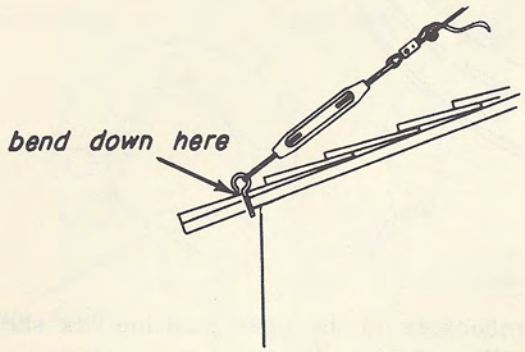


(a) (b)

Fig. 5-25



(a)



(b)

Fig. 5-26

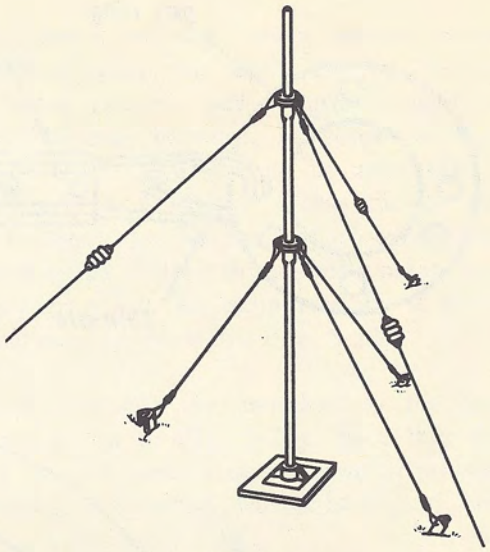


Fig. 5-27

5-26*a*. Take up on each turnbuckle evenly until the mast is firmly in position.

When two or more sets of guy wires are used, the length of each of the longer guy wires may absorb some of the signal. In such cases, break up the length of the longer guys by inserting insulators, as shown in Fig. 5-27.

5-10. SPECIAL ANTENNAS

Several types of antennas, other than the

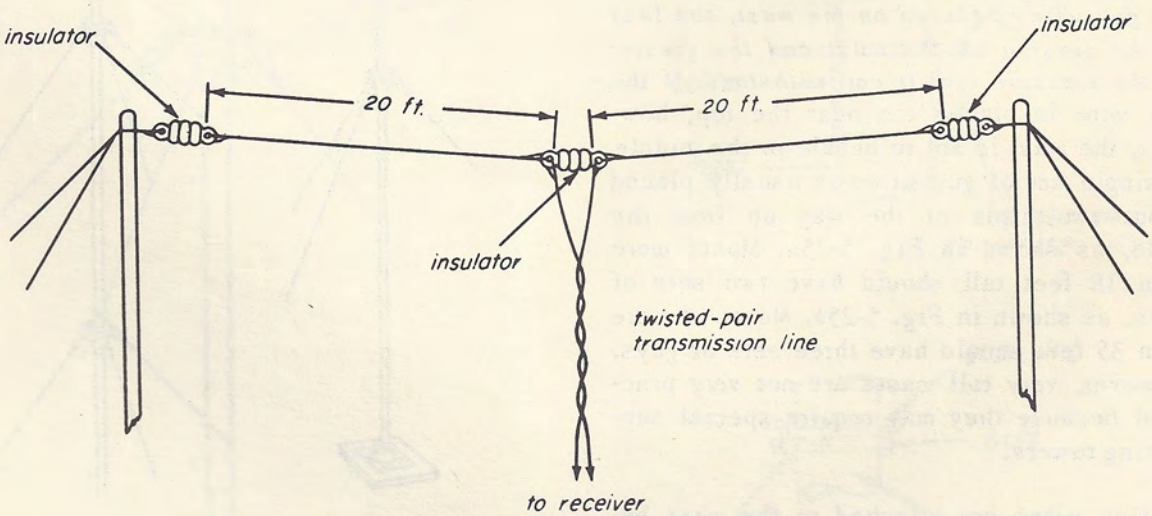


Fig. 5-28

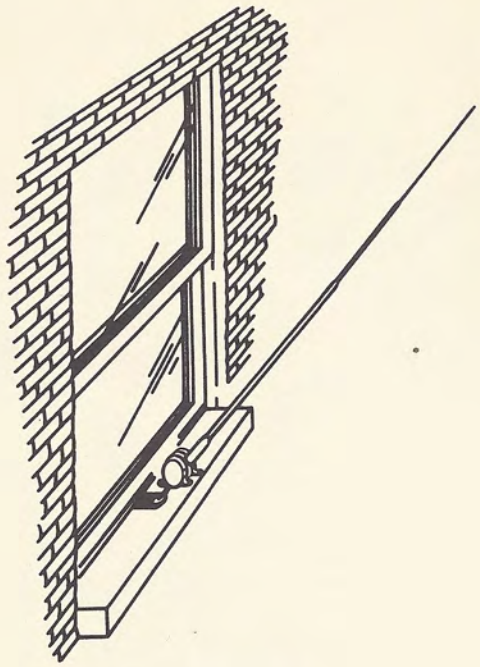


Fig. 5-29

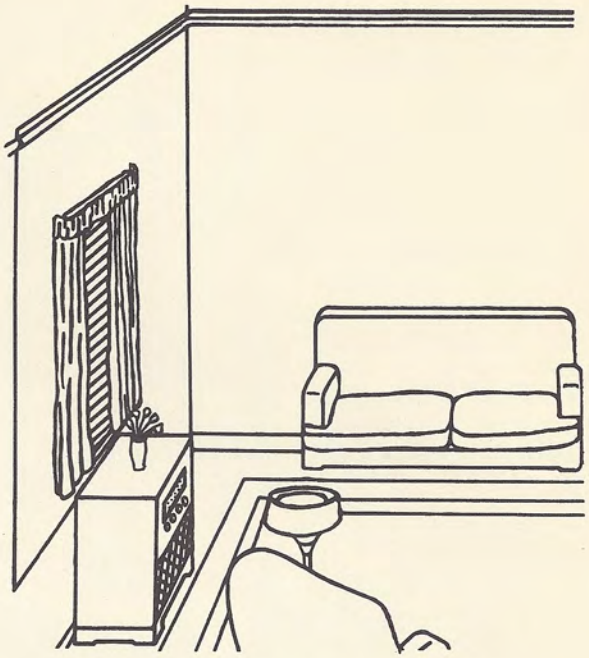


Fig. 5-30

Marconi inverted-L type, are used in installing radio receivers. One of these is the *doublet* type of antenna, which is illustrated in Fig. 5-28. Applications of this type of antenna are discussed completely in a later Service Practices booklet on noise reduction. Doublet antennas usually come in kit form with complete instructions for their installation. Figure 5-29 shows a *whip-type* antenna, similar to those used in automobile radios, but designed for mounting to the window casement in cases where other outdoor antennas are either not practical or not permitted.

5-11. INDOOR ANTENNAS

In private homes, it is possible to erect a Marconi inverted-L type antenna in the attic. For places where it is impractical or dangerous to go up to the roof to erect an antenna, the indoor Marconi antenna may give satisfactory service. In some cases, it is possible to carry the lead-in wire between the inner and outer walls of the house. If this is not possible, it may be necessary to bring the antenna lead-in from the attic down the side of the house to the window closest to the radio receiver and to lead it in as explained before.

Another type of indoor antenna may be erected by running 30 or 40 feet of fixture wiring around the upper molding of the room, as shown in Fig. 5-30, and bringing one end down to connect to the antenna post of the receiver.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 6

HOW TO REPAIR AND POLISH CABINETS

RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

HOME STUDY SCHOOL

350 West 4th Street, New York 14, N. Y.

Service Practices 6

INTRODUCTION

Just as a man beams on the shiny finish of his new car, or a housewife admires the gleaming whiteness of a new refrigerator, so does the owner take pride in the perfection of a brand new radio, radio-phonograph, or TV cabinet. The new owner is critical of the slightest scratch or dent — no dust or fingermark should mar the beauty of its finish. (After a short time, when the newness has worn off, no one is likely to notice a minor scratch that seems a major defect when the set is new.) When there is a scratch or dent on a new cabinet, the customer may demand that the instrument be exchanged for one that is unmarred in any way, or he may even return it and ask for his money back. It is not at all unreasonable for a customer to expect to receive a cabinet that is perfect in every way. After all, that is what the customer pays for. In fact, in the same situation, we might be tempted to do the same thing.

When a radio, phono-radio combination, or TV set is housed in a console cabinet, the chances are that one of the deciding factors in the selection of the particular make and model was the appearance of the cabinet and its ability to blend in with the customer's furniture. In such a case, the customer has good reason to expect that the cabinet will live up to all his expectations. Even a minor damage may cause the customer to lose some of the natural pride in owning his new instrument. When that happens, you have a mighty unhappy and dissatisfied customer — one who may cause you much time, work, and worry.

For this reason, large radio and television-service organizations maintain cabinet repair and refinishing shops to remove marks caused by handling, to repair cabinets that have been damaged in shipment, and to handle the cabinet refinishing work brought in by their servicemen. However, in most cases, when a smaller dealer or a serviceman is confronted with a cabinet that is scratched, dented, chipped, or otherwise marred, he may return the cabinet to the factory for repair, he may send it to a local cabinet maker for repair, or he may repair and polish the cabinet himself. The first two choices are usually costly and time-consuming, so many servicemen have learned how to handle their own cabinet work. In this way, they can give their customers quicker and better service in removing defects from new cabinets. What is more, servicemen find that the ability to handle simple cabinet repair and refinishing jobs gives them another source of income. This lesson is designed to show you some of the methods used by servicemen and large service organizations to handle cabinet defects.

Do not fool yourself into thinking that all of the jobs discussed in this booklet are going to be easy to do. Some of them are, of course. Others, however, require care, skill, and experience, which you will acquire after you have spent a lot of time learning by trial and error. Don't practice on the customer's cabinet; practice on an old cabinet or an old piece of furniture of your own. Then, don't take on a job until you are sure that you can do it. When you are sure that you can do a professional-looking job—then, and then only—it is safe to take on work from your customers. You won't lose customers by saying that you can't do a particular cabinet repair. After all, you are a radio and TV technician first and foremost. But you will easily lose customers by saying that you can repair a particular cabinet and then falling down on the job.

6-1. BASIC INFORMATION

Types of Cabinet Defects. Cabinets may

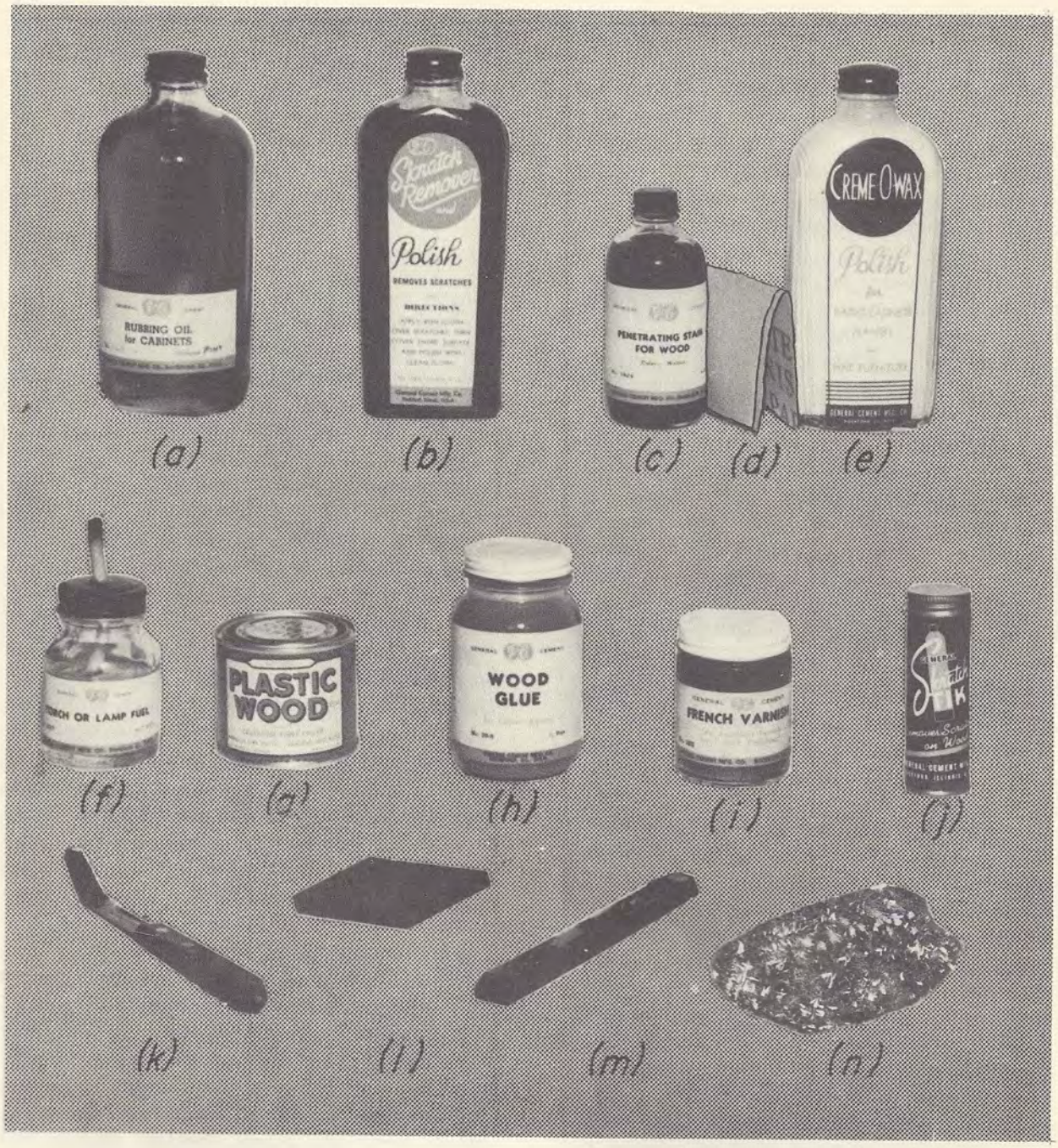
be defective in so many ways that all the defects cannot be listed here. Most defects are the result of accident, carelessness, or poor workmanship. They may be broken down into two main groups: *major* (great) defects and *minor* (small) defects. For example, broken legs, doors, and sides of wooden cabinets, broken parts of plastic cabinets, and large dents in metal cabinets are classified as major defects. New cabinets in such condition should be returned to the distributor or the factory for replacement. Repairing them is usually a job that is beyond the ability of even a skilled technician. Even manufacturers do not attempt to repair plastic cabinets, because a satisfactory repair cannot be made without showing and the cost of replacing the cabinet is usually so small that it does not pay to spend time in repairing it. On the other hand, certain scratches, dents, and stains may be classified as minor defects. A good rule-of-thumb is that any cabinet repair that may be done in a few minutes or with little effort is a minor repair, while any repair that requires a lot of time or effort may be classed as a major repair

The only reason we have for placing repairs in major and minor classes is so that you will know which repairs should be avoided until you have sufficient skill and experience to handle them. One thing you you will quickly discover is that a simple scratch or dent may easily turn out to be a major repair before you are through with it. For example, an apparently simple little scratch across the matched-grain panel of a console may seem, at first glance, like a job that can be done in a few minutes, but it may turn out that you need to refinish the entire panel. In many cases, the only time you'll really know whether a job is a minor repair is after you have done it.

Before attempting any cabinet repair, think of the cost in time, effort, and materials. For example, as we have already indicated, most plastic cabinet repairs are not worth the time and effort put into them. New cabinets can sometimes be bought for less than you would have to charge if you repaired the old one. If a customer paid 25 dollars in 1941 for a table model radio receiver, and you were to charge 10 or 15 dollars to refinish the wooden cabinet it came in, the customer would be unhappy – even though your charge might well be just a fair return for your work and materials.

Tools and Materials. The tools and materials needed to polish, touch up, repair, and refinish cabinets are discussed throughout this lesson. Shops that handle a lot of cabinet work may spend hundreds of dollars in power equipment and necessary materials. In the hands of skilled workmen, such shops are able to turn out first-rate cabinet work. However, it takes a good deal of cabinet work to justify the purchase of costly equipment. The individual serviceman or dealer gets along very nicely with some simple hand tools and purchases materials only as he needs and uses them. He does not burden himself with the expense of buying many expensive tools that he does not intend to use right away. As his volume of work increases, he buys additional tools. By the time he is handling considerable cabinet work, he has accumulated all the tools he needs to do the job.

The basic materials needed to touch up and repair cabinets are shown in Fig. 6-1. From left to right, they are: rubbing oil, spatula, alcohol lamp, wood glue, plastic wood, scratch-remover polish, French varnish, stick shellac, scratch stick, stain, steel wool, sandpaper, polish, and a felt pad. Most radio and television parts distributors can supply you with these materials individually and as you need them. They also carry kits, such as those shown in Fig. 6-2 *a* and 6-2 *b*. These kits contain practically everything needed to refinish cabinets completely. Until you are expert enough to successfully handle a large number and wide variety of cabinet repairs, one of these kits may supply most of the material you will need. Any of the materials included in such kits may be purchased in

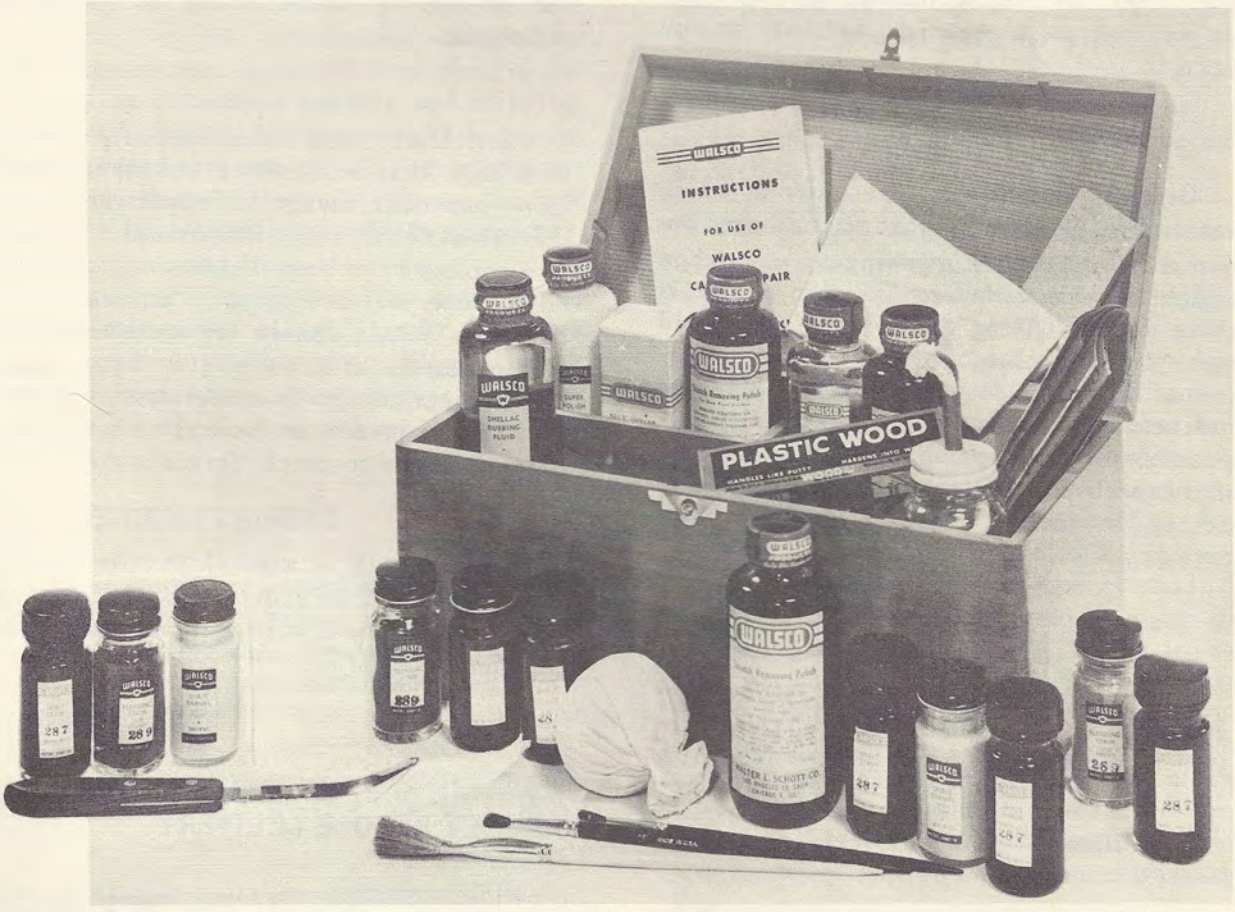


a. Rubbing oil
b. Scratch-remover polish
c. Stain
d. Sandpaper
e. Polish
f. Alcohol lamp
g. Plastic wood
h. Wood glue
i. French varnish
j. Scratch stick
k. Spatula
l. Felt pad
m. Stick shellack
n. Steel wool

Fig. 6-1. Refinishing Kit


Cabinet Repair Kit
WOOD GLUE
WALNUT ENAMEL
WHITE Refrigerator ENAMEL
DARK WALNUT STAIN
LIGHT WALNUT STAIN
SHELLAC STICK RUBBING FLUID
FRENCH VARNISH
FRENCH EMULSION
WALNUT FRENCH VARNISH

(a)


WALSCO
INSTRUCTIONS
FOR USE OF
WALSCO
PLASTIC WOOD

(b)

Fig. 6-2

large quantities and at a much lower unit cost than the cost of the same material when it is included in a kit. However, some of the materials tend to dry up and become worthless unless they are used up within a short time after their containers have been opened. If you buy a material by the gallon, at a low unit cost, and then throw a large part of it away, you may not have saved any money. Whether you buy a kit already made up or you assemble one yourself, it is a good idea to carry small quantities of repair and refinishing materials in your service kit so that you can do simple repairs right in the customer's home. Once you have purchased a basic kit (or have assembled one yourself), you may find it economical to buy certain supplies in bulk and refill your kit containers as they empty from use.

Above all, do not go overboard in stocking up on cabinet repair and refinishing equipment. In the beginning, buy as little as you can get along with, and only as you need it.

Order of Operations. The order in which repairs are made in cabinet work is very important. For example, touching up scratches should be done before polishing; and if there is any gluing to be done, it should come before either of the other two operations. There are so many different kinds of cabinet defects that it is practically impossible to give you an order of operations that exactly fits any case that you may come across. In general, however, work on cabinets might follow this order:

1. Gluing, including the gluing together of broken parts and the gluing together of parts that have become loosened.

2. Filling of holes, deep scratches, dents, or cigarette burns

3. Sanding

4. Touching up light scratches and minor defects

5. Removing stains

6. Coloring repair (if necessary) to match cabinet

7. Applying and rubbing in finish

8. Polishing

Working Conditions. Only minor repairs should be attempted in the customer's home. Most major repairs require either the regluing of certain parts or the refinishing of one or more cabinet surfaces. That means that the cabinet will be in repair for at least twenty-four hours, and it is important that you control the conditions in which the cabinet is placed during the period of the repair.

Particularly when refinishing, try to work in a room that is dust-free and where there is no important change in temperature while the cabinet is in work. For example, if parts of a cabinet have been reglued or if surfaces have been refinished, the temperature of the room should remain the same until the glue or the finish is completely dry. If there is any great change in temperature, the glue is likely to crack or loosen, and the new finish is liable to check (crack).

Remember – it is worthwhile to be careful when you do refinishing work. By working carefully, you will accomplish repairs that you can be proud of.

6-2. TOUCHING UP AND POLISHING THE NEW SET BEFORE DELIVERY

Minor scratches and other defects usually should be removed in the customer's home. The only exception to this rule is made in

Fig. 6-3

the case of a new set, which should have touching up and polishing done before delivery. There is a good reason for this. Any dealer or experienced serviceman knows that when the cabinets of radio and TV sets, even from the leading manufacturers, are received, they sometimes show signs of handling or may need to be dusted. The dust may be from the packing material, or the cabinet may have collected dust in the factory as it awaited packing and shipping. Handling marks or dust may make a careful housekeeper very unhappy. It may also make her think that the receiver is not new and so make her dissatisfied with her purchase. For this reason, it is better to unpack the receiver at the shop, touch up any defects in finish, polish it, and repair it before making delivery. What the customer hasn't seen cannot worry her, and what she does see – a well-polished cabinet – makes her very happy.

6-3. WOODEN CABINETS

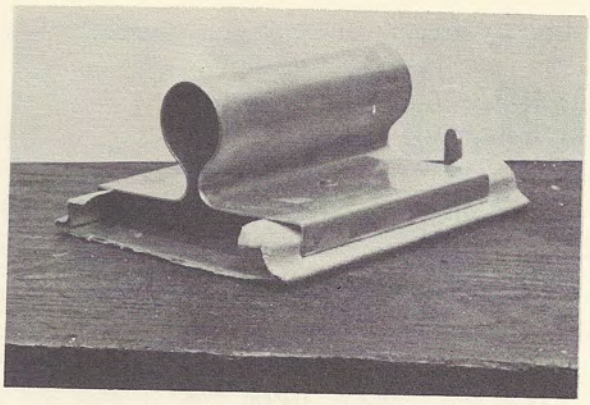
Repairing Minor Scratches. There are two entirely different methods used by servicemen in removing light scratches in cabinets. The first method makes use of the materials included in most cabinet repair kits. The second method is used in cabinet repair shops maintained by larger service organizations. We will discuss the kit method first.

If there are only one or two light scratches, use a scratch-stick, as shown in

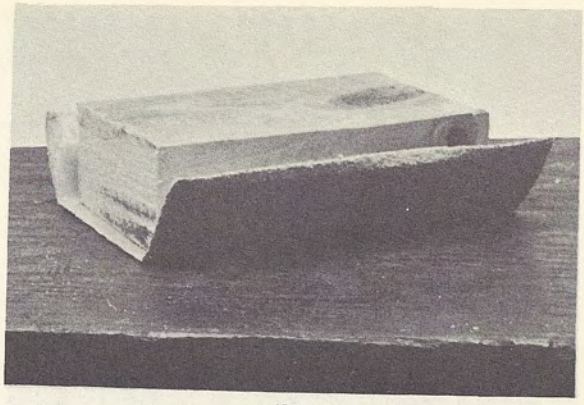
Fig. 6-4

Fig. 6-4. A scratch stick is a handy scratch remover that slips easily into your tool kit or pocket. It consists of a solid stain at one end and a moist felt brush at the other end. The solid stain is rubbed over the scratch and then rubbed in with the moist felt brush. However, when there are many fine scratches, it is better to use scratch-remover polish. This polish comes in two shades: one shade for light woods and another shade for dark woods. Just rub the surface of the cabinet with a piece of cheesecloth moistened with scratch-remover polish. Use another cloth to rub the cabinet dry, and then polish it. Polishing instructions appear later in this booklet. In many cases, this method will remove light scratches in a few minutes.

The second method is better used in a dust-free room in your shop. Put a few drops of crude oil on the scratched surface and sand lightly with 6/0 or 7/0 flint or garnet paper, held in a sandpaper holder or used with a wooden block, as shown in Fig. 6-5*a* and *b*. Next, sprinkle a small amount of fine-powdered pumice on the surface and rub the surface with a cloth dipped in crude oil. Rub with the grain, using medium long strokes, so that you don't wear spots in the cabinet finish. This method is shown in Fig. 6-5*c*. If scratches are too deep for this method, use 5/0 steel wool, dipped in rubbing compound, made from 3 parts of crude oil to 1 part of benzine. Rub lightly with a steel-wool pad, using medium long strokes, and be careful not to press. If one or two scratches still remain, try brushing them out with clear brushing lacquer or liquid shellac. Use shellac on varnished surfaces; use lacquer on lacquered surfaces. Use a very fine brush, such as the one shown in



(a)



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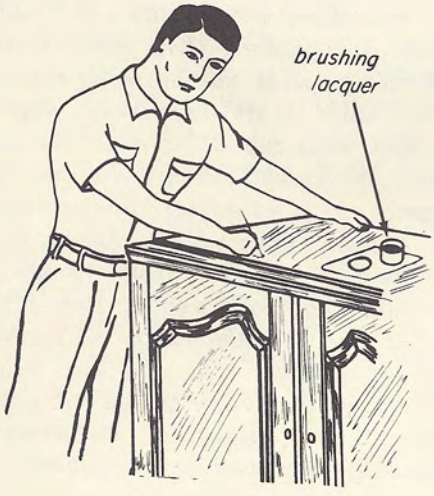
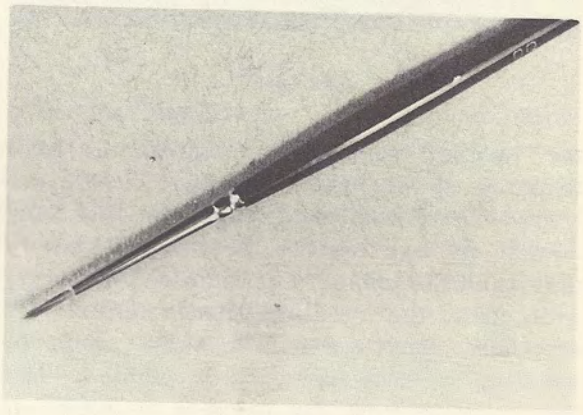
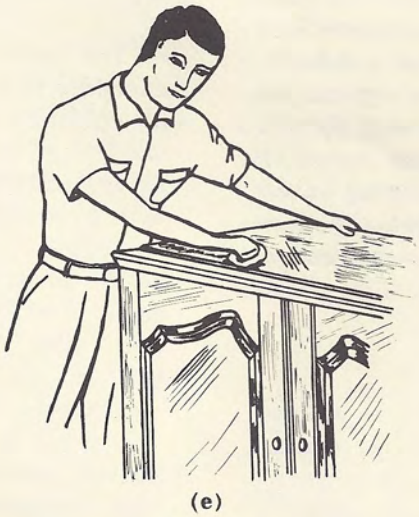


(c)



(d)



(e)

Fig. 6-5

6-5*d*, and permit it to touch only the scratch, as shown in Fig. 6-5*c*. When the lacquer or shellac is thoroughly dry, rub with flint or garnet paper, as before, and then polish.

Polishing. A good grade of furniture polish, preferably one with a wax base, should be in your shop and in your kit at all times. Before polish is applied to a cabinet, the surface of the cabinet itself should be completely free from dust and dirt. Dust and dirt, if rubbed into the finish

Fig. 6-6

of the cabinet, are liable to scratch it. One of the best ways to remove dust from the cabinet is with a dry brush. Take particular care to remove dust from corners and from any ornamental carving on the cabinet. Then apply a small quantity of polish with a clean piece of cheesecloth. To get polish into the corners and into ornamental carving, use a brush (kept just for this purpose), such as the one shown in Fig. 6-6. Then, with a clean pad of cheesecloth, rub the polish into the surface and work up a polish. A good polishing job requires plenty of "elbow grease". So don't look for any short cut, because there isn't any. When polishing, don't forget the corners and the ornamental carving (if any).

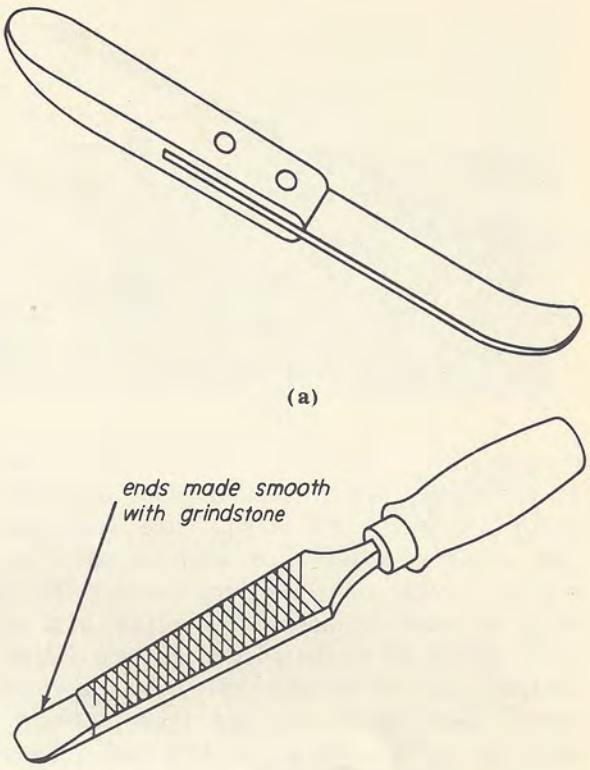
Removing Paint, Glass Rings, and Stains. Sometimes the removal of paint spots, glass rings, and stains is a simple matter, to be classed with other minor jobs on cabinets. If the stain has not gone too deeply into the finish and if the finish is not too thin, the job may take only a few minutes and can be done in the customer's home. Rub down the surface with 6/0 steel-wool dipped in rubbing compound. Use a light touch, with medium long strokes, and work with the grain. When the stain disappears, smooth the surface with a pad of cheesecloth which has a coating of a few drops of linseed oil and some powdered pumice. When the surface is smooth and dry, polish it with a wax-base polish.

If the stain still remains after rubbing with steel-wool and pumice, it may be necessary for you to refinish the surface. Refinishing instructions are given later in this booklet.

Checking. Sometimes very fine lines or cracks appear in the finish of a cabinet or other piece of furniture. This lining and cracking is called *checking*, and the fine lines are called *checks*. If, in finishing or refinishing, the second or third coat of varnish is applied before the preceding coat is thoroughly dry, checking may occur in the undercoat or undercoats and not immediately affect the top coat of the finish. The only cure for this kind of checking is refinishing the checked surface. Sometimes, however, when furniture is exposed to sun or the drying effects of heat, the surface of the finish may check without affecting the undercoats. This kind of checking may be treated by rubbing the surface with steel wool dipped in rubbing compound, followed by rubbing with pumice and linseed oil, as described above for the removal of stains. When the check marks have disappeared and the surface is thoroughly smooth and dry, pad with French varnish. (Padding is discussed later in this booklet.) After padding, apply polish.

Dents, Nicks, Deep Cuts, and Cigarette Burns. Surprising as it may seem, sometimes the repair of dents, deep scratches, cuts, nicks, and cigarette burns can be handled simply and quickly. In other cases, it will be necessary for you to take the cabinet to your shop for repair. Only experience can help you in deciding whether a particular job is a minor or major repair. The first step in repairing any of these defects is to fill in the surface with stick shellac. Stick shellac, illustrated in Fig. 6-7, comes in many shades to match different types of finishes. Cabinet-repair kits contain from 8 to 12 colors to match the more common cabinet finishes. In addition to a supply of stick shellac, you will need a small alcohol lamp and a spatula, or *burning-in* knife, shown in Fig. 6-8*a*. The alcohol lamp is used in preference to any other kind because it burns cleaner and leaves less carbon on the burning-in knife. Most cabinet repair kits include a spatula. However, you can make one as good, if not better, from an ordinary lightweight ½-inch steel file. Just round off the end of the file with a grindstone, as shown in Fig. 6-8*b*. Such a burning-in knife, because it is made of heavier stock, will retain its heat longer

Fig. 6-7



(a)

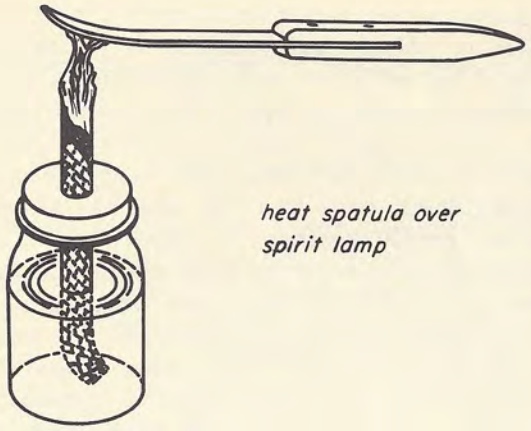
(b)

Fig. 6-8

than the usual spatula. The method of filling in a crack, dent, or other imperfection with stick shellac is called *burning-in.* It is a lot easier to tell about than to do. However, once you have mastered this method, you will be well on your way to being a good cabinet man, and, what's more, you'll find that it pays off. However, before trying the burning-in process on a customer's radio cabinet, get in a lot of practice on an old cabinet at home.

Burning-in. The whole idea behind burning in is to fill the deep scratch, cut, dent, hole, or other similar imperfection with stick shellac of a shade that matches the cabinet finish. So, the first step in burning-in is to select the proper shade for the particular cabinet. It is best to use a shade that is a little lighter than the cabinet finish, because the shellac tends to darken slightly in the burning-in process. Never use a darker shade. The next step is to heat the spatula or burning-in knife over the alcohol flame, as shown in Fig. 6-9*a*. Hold the blade in the blue part of the flame so that little carbon will be deposited on the blade. Wipe the hot blade quickly with a clean cloth to remove carbon and touch the end of the stick shellac with it. The stick shellac will be very slow to melt if the blade is not hot enough. On the other hand, if the shellac melts rapidly and bubbles on the blade, the knife is too hot. When heated properly, the blade should melt the shellac easily without bubbling.

When the blade is at the proper heat, touch it to the stick shellac, as shown in Fig. 6-9*b*, and apply it carefully to the cut. Make sure to touch only the cut with the melted shellac, as shown in Fig. 6-9*c*, and do not allow the blade to touch the surrounding surface, because it may cause blisters to form in the undamaged finish. Do a little at a time and, as you work the shellac into the cut, smooth it with the hot blade. If the blade cools, reheat it. In a deep cut, you may have to reheat the blade several times before you have completed the burning-in process. Continue filling in until the shellac level is even with or slight-



(a)

(b)

(c)

Fig. 6-9

ly higher than the cabinet surface.

If you have a cabinet repair kit, it may include a felt pad and some shellac-stick rubbing compound. If so, moisten the felt pad with the compound and rub the repaired spot until it is smooth and level with the rest of the finish. You may use a piece of fine steel-wool dipped in your rubbing compound, followed by a rubdown with pumice stone and crude oil, to accomplish the same purpose. If the color of the repair is a little light, it is sometimes possible to get the correct shade by brushing it with wood stain. If the repair was made in a section where the grain shows distinctly, it is sometimes possible to match the grain with a wood stain, which should be applied with a fine brush. However, matching grain takes a great deal of skill and should not be attempted unless you have first practiced the method on some old piece of furniture. If the cut is across the grain, there is very little you can do about it; the repair is bound to show.

In the case of cigarette burns, if the damaged area is not too great, it is sometimes possible to smooth the area with stick shellac, as in the filling of cuts and dents. However, if the area is great enough, it is sometimes necessary to refinish the top or panel where the burn is. (See refinishing instructions later in this booklet.)

Splits and Cracks. A split or cracked cabinet is usually a major repair job – one that you might well leave to the skill of a cabinet maker. However, if it is an old cabinet and the customer doesn't want to go to the expense of an expensive repair job, you may find it possible to make a satisfactory repair without too much difficulty. If the crack is not all the way through the wood, you might fill it with wood filler for wide cracks and with stick shellac for fine cracks. If the crack or split is all the way through the wood, it should be reglued. (Complete instructions for gluing are given later in this booklet.

Troubles With Veneer. Many cabinets are made with some inexpensive wood covered with a thin layer or veneer of a more expensive wood. After a while, the layer of veneer may become loosened from the base of the cabinet. In such cases, it is often possible to reglue the veneer and clamp it in place until the glue is set. (Gluing instructions are given in the next section.)

In other cases, the veneer may bulge or bubble away from the base wood. In such cases, there is little you or anybody can do about it. It is possible, of course, to cut away the bubbled surface of the veneer and fill it in with a wood filler. However, such a repair would be a messy job – one not likely to prove satisfactory.

Gluing. The main requirements for good gluing are time, patience, clamps, and a good grade of glue. A good grade of casein, resin, or hide or fish glue will meet all your requirements. If you use casein or powdered glue, it will be necessary for you to mix the glue as you need it. Be careful to follow the manufacturer's instructions exactly. Don't try any short cuts, because they seldom prove short. Do not use any of the lacquer-based household or radio cements as a substitute for glue. Figure 6-10 shows some of the clamps used in cabinet repair shops. Buy them only as you have need for them. You will find that the smaller C clamps come in handy in your radio service work as well as in making cabinet repairs.

The purpose of gluing is to bond two surfaces together so that they hold fast to each other. To accomplish this, glue must penetrate the surface of each of the materials to be glued. Before anything can be glued, it must be cleansed first. In regluing a piece of furniture, first chip away the old glue and remove any dust or dirt so that the glue may come into direct contact with the material. After each surface is clean, it should be roughened and a thin coat of glue should be applied. Wait a few minutes for the glue to get "tacky"; then press the surfaces firmly together and clamp them in place. Make sure that the clamps do not press directly against the wood. Use wide wooden blocks between each clamp and the wooden surface of the piece being glued. Remove any excess glue and put the work aside for the glue to set. Most glues require at least 24 hours in which to harden. It is better to allow a little more than to allow less time. After the glue has hardened, carefully remove any excess glue with a sharp knife or razor blade. Be careful not to dig into the finish of the wood. Then smooth the surface with fine sandpaper. After regluing, touch up the surface as in previous repairs, or, if necessary, refinish the surface. (Refinishing instructions are given later in this booklet.)

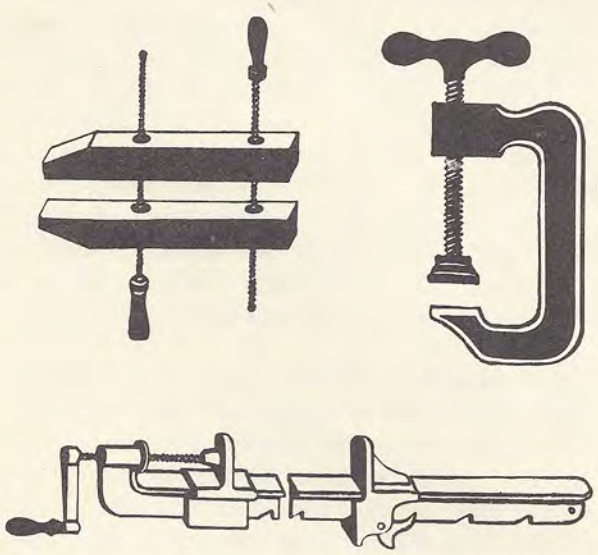


Fig. 6-10

Repairing Breaks. A broken leg, crosspiece, or other member of the cabinet is a major defect and one that only a man who likes to work with wood should attempt to repair. If a cabinet is received from the factory with a broken member, it should be returned for replacement. If you must repair such a break, here is how you might go about it. Let us assume that you wish to repair a broken leg or crosspiece, similar to the break in Fig. 6-11*a*. A successful repair will require that you provide some means of fastening the two pieces, in addition to glue. One way is to coat each of the broken surfaces with a thin layer of glue. Wait five or ten minutes to permit the glue to become tacky, place the pieces so that the broken surfaces exactly match, and clamp them together with a C clamp. Be sure to use thin wooden blocks between the clamps and the surfaces of the broken pieces. While broken pieces are thus clamped, as shown in Fig. 6-11*b*, drill a small-diameter hole through the first piece and part way through the second. Then turn the work around and drill a hole through the second piece and part way through the first, as shown in Fig. 6-11*c*. Fill the screw holes from the head of each screw to the surface of the wood with stick shellac of the proper shade or with wood filter, as shown in Fig. 6-11*d*.

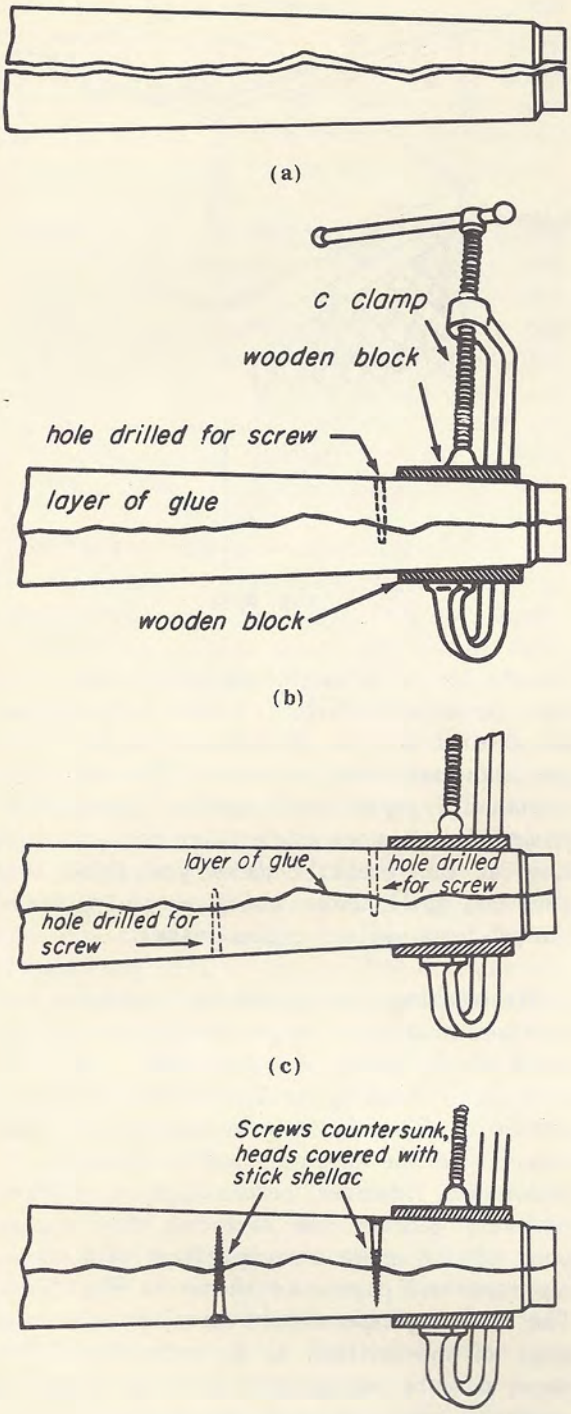


Fig. 6-11

Another method uses wooden *dowels*. A dowel, as you probably remember from your grammar school shop class, is a wooden pin cut from a length of doweling. Most hardware stores sell doweling in several diameters.

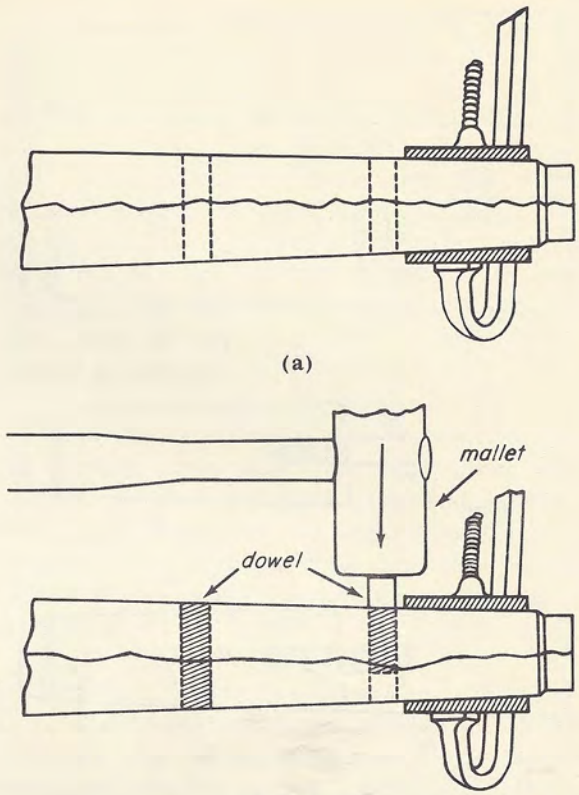


Fig. 6-12

The size you want is ¼-inch doweling. The procedure is very similar to that used for putting in screws. First cut two dowels of the proper length from your length of doweling. Drill two holes as before. However, this time drill them all the way through both pieces, as shown in Fig. 6-12*a*, and use a drill size that is just the same, or slightly smaller, than the diameter of the dowels. Using a wooden or plastic mallet, as shown in Fig. 6-12*b*, tap each dowel into place. Tap lightly in order to prevent the head of the dowel from spreading. Dowels of proper length will meet the surface of the joined pieces at each end of the dowel holes. If the dowels are a little short, it will be necessary to fill in from the end of the dowel to the surface of the wood with either stick shellac or wood filler. Keep the repaired piece clamped together until the wood has had sufficient time to set. When the glue is thoroughly dry, remove the clamp, trim away any excess glue, and rub down all rough or high points with fine steel wool dipped in rubbing compound. If possible, touch up light spots with stain, pad the repaired surfaces

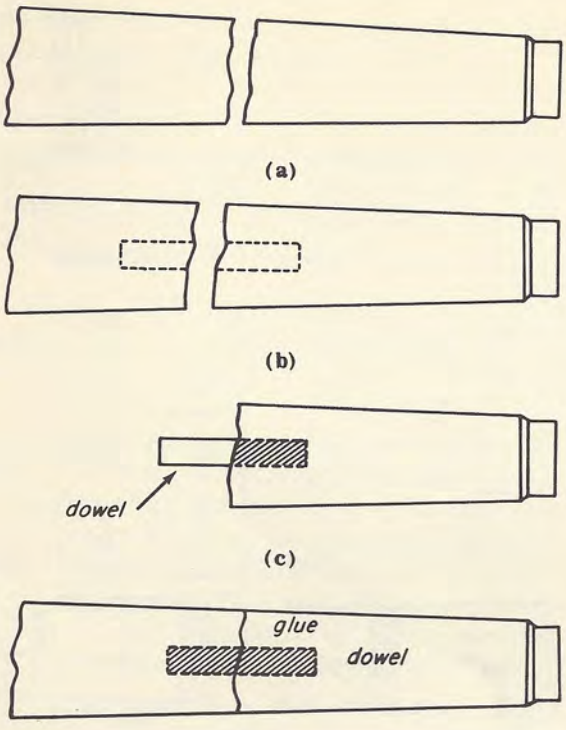


Fig. 6-13

with French varnish, as described later in this booklet, and polish.

If the break is straight across the member, as shown in Fig. 6-13*a*, drill a hole to the depth of one inch on each side of the break, as shown in Fig. 6-13*b*. The size of the drill used should be the exact size of the dowel to be inserted. Cut a dowel slightly less than two inches in length. Apply a thin coating of glue to each side of the break. Put a very small amount of glue in each of the two holes. Allow five to ten minutes to permit the glue to become tacky. Tap the dowel into one of the two holes with a mallet, as shown in Fig. 6-13*c*, being careful not to spread the head of the dowel. Then slip the other broken piece over the dowel until the broken edges meet. If possible, clamp the joined surfaces in place. If not, turn the cabinet up on its legs and permit the weight of the cabinet to keep pressure on the joined surfaces. Do not move the cabinet until the glue has had time to harden.

When the glue is hardened, remove any excess glue and smooth the surface at the break with steel wool and rubbing compound.

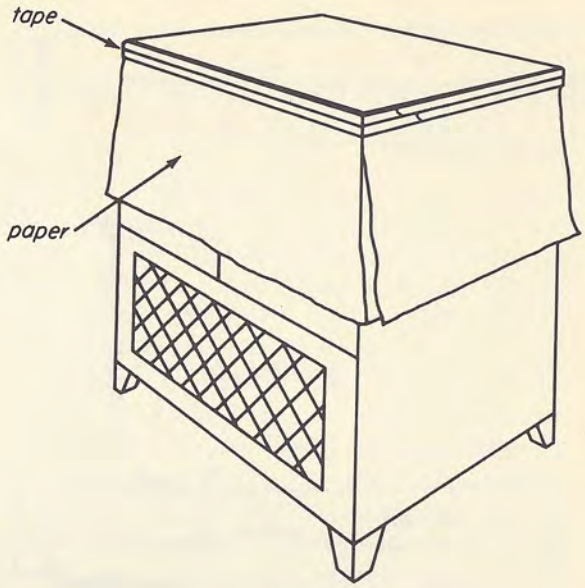


Fig. 6-14

Touch up or refinish, as necessary. This type of repair, while it looks very simple, is one of the most difficult repairs that you can undertake to make. The key to a successful repair is in making the two opposing holes meet each other in a straight line at the break. Unless you think that you can drill these holes properly, leave the job for a skilled cabinetmaker.

Refinishing. Badly checked cabinets and cabinets that have major defects sometimes need whole surfaces refinished. The first step in refinishing is to remove all of the old finish. This is done by applying varnish remover to the surface that is going to be refinished. However, before applying varnish remover, protect the surfaces that are in good condition by covering them with masking tape and paper, as shown in Fig. 6-14. The masking tape should meet exactly each edge of the surface to be refinished. The paper may be newspaper, although wrapping paper is better because the varnish is less likely to go through such paper. If possible, place the cabinet so that the surface that is to be refinished is exactly level and facing up, as shown in the figure. Apply the varnish remover with a paint brush, making sure that none of it is permitted to drip on to any other surface. The varnish remover will cause the finish to curl and blister. When this happens, scrape off the old varnish with a scraper or a putty knife. Make sure

that there are no nicks in the blade of the scraper or putty knife and be careful not to dig into the surface of the wood as you remove the varnish. It may take two or three applications of varnish remover before all the surface is free of varnish.

When all of the varnish is removed, the next step is to remove all traces of the varnish remover. Unless this is done, some of the varnish remover will remain in the wood and will ruin any new finish that you try to apply. So, use a pad dipped in turpentine to clean the surface of the varnish remover. Be careful that none of the turpentine drips down on the good finish.

Remember – no wood finish can be smoother than the surface of the wood to which it is applied. If there are any nicks or scratches in the wood, get rid of them before you apply any finish. Fill in any cracks or nicks with wood filler. When the wood filler is thoroughly dry, smooth down the whole surface with fine sandpaper or steel wool. When you are through, the surface should be thoroughly smooth and ready for staining. Use an alcohol-base (spirit) stain of the desired color. Apply several light coats until you get the desired shade. Permit each coat to dry for 3 to 4 hours before applying the next one. Stain may be applied with either a soft brush or a cheesecloth pad. When the last coat of stain is dry, rub the surface down with powdered pumice and a cloth pad dipped in crude oil. When the surface is smooth, you are ready for the finish. *Remember that this work should be done in a dust-free room.* This is particularly true when you are applying the finishing coats, because any dust that falls on the surface during this period will show up in the finish when you are through. Do not try to apply a finish to a cabinet in rainy or hot, humid weather. If you do, you may find that the finish becomes cloudy or turns white. Before applying any finishing coat, make sure that the surface is thoroughly clean and free of dust.

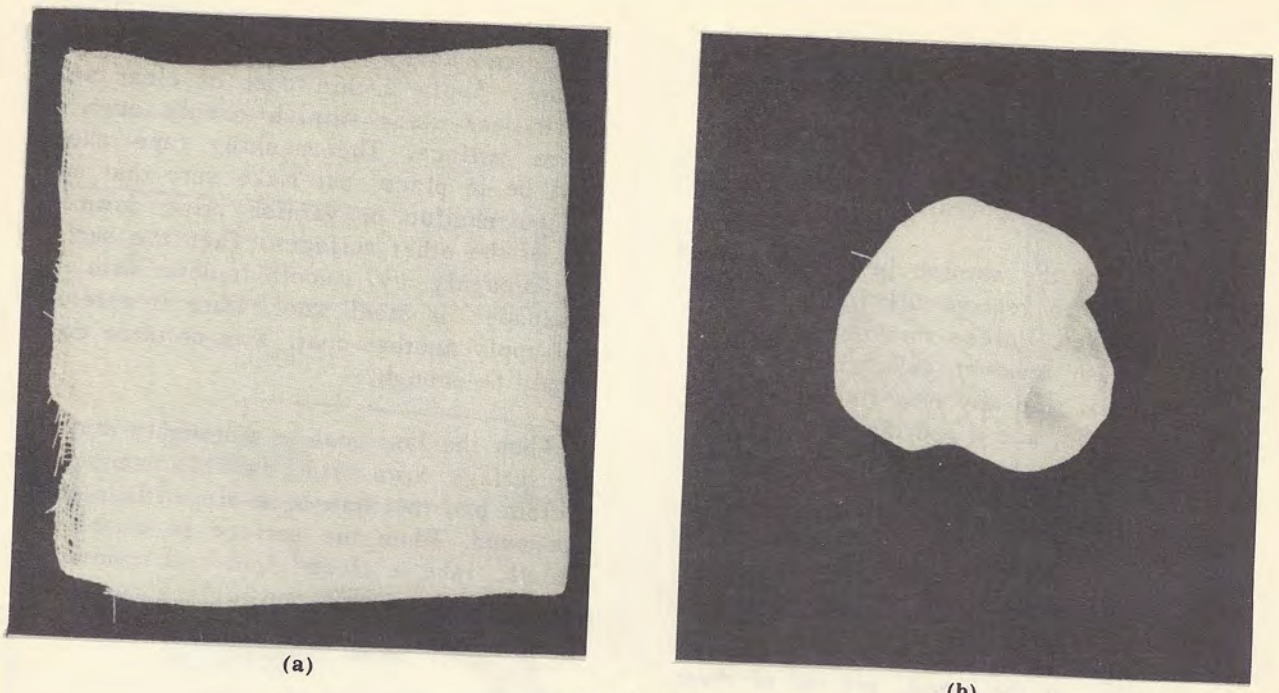
Large cabinet shops use a spray gun to apply finishing coats, but the average dealer or serviceman has little use for a spray gun, so its purchase is not usually advisable. The easiest way to apply a finish by hand is with a fine, soft brush. Your local paint dealer can advise you on the type of brush to use. Apply a thin coat of clear white shellac or clear varnish evenly over the entire surface. The masking tape should still be in place, but make sure that none of the shellac or varnish drips down on any of the other surfaces. When the surface is thoroughly dry, smooth it down with fine sandpaper or steel wool. Dust it carefully and apply another coat. Two or three coats should be enough.

When the last coat is thoroughly dry, rub the surface down with powdered pumice and a cloth pad that has been dipped in rubbing compound. When the surface is completely smooth, take a clean cloth and remove all traces of the pumice and rubbing compound. Apply polish.

Padding. *Padding* or *French polishing*, as it is sometimes called, is another and more difficult way of applying the finish. However, the results are well worth the effort, because you get a finer finish without brush marks. The pad used in padding should be made from cheesecloth or lint-free muslin. Fold the cloth over several times until you have a pad of about 4 inches by 4 inches, as shown in Fig. 6-15*a*. Stuff the center with cotton or some other soft material. Tie the four corners together and you should have a ball of material about the size of a handball, as shown in Fig. 6-15*b*.

Padding is done as follows: Dip the pad into the French varnish. To spread the varnish evenly on the pad, pad it until it starts to get tacky. Then rub it over the entire surface of the wood. Never let the pad run off the edge of the cabinet. If you do, the varnish will run down the sides of the cabinet and produce drip marks on the good surfaces. Use a rapid circular motion. When the first coat is applied, lift the pad from the surface of the cabinet with a sweeping motion. Unless you do this, the final finish will show cloth marks. *Do not go over the surface a second time until the first coat is dry.*

When the first coat is thoroughly dry, sprinkle the surface with a few drops of crude oil and sand it lightly with fine sand-



(a) (b)

Fig. 6-15

paper. Make sure that the surface is completely free of dust and then add another coat of French varnish, as before. Permit each coat of varnish to dry thoroughly before adding a new one. When the finish is as you want it, rub down the surface with pumice and a cheesecloth pad dipped into compound. Clean the pumice and compound from the surface and polish.

6-4. METAL CABINETS

Metal cabinets are seldom used any more in home receivers. Occasionally, however, you may come across one. Very little can happen to a metal cabinet except that it might be dropped and become dented. Small dents usually may be removed by tapping the dented area with a ball pean hammer from inside the cabinet. This seldom makes a cabinet look as it did when new, but, in the case of an old radio, it may satisfy the customer. A badly dented metal cabinet should be replaced with a new one.

It is usually quite difficult to match the enamels or lacquers used on metal cabinets. If there is a small place on such a cabinet that needs touching up, you might try a touch-up enamel such as is sold in automotive supply stores. Apply a little of the bottom of the cabinet to see how closely it matches the enamel on the cabinet before you apply it to some exposed surface. When enamels dry, they are about two shades darker than when wet, so you should allow for this. In most cases, with small metal cabinets, the simplest way is to re-enamel the whole surface. For such refinishing, choose an enamel that does not show brush marks.

6-5. FABRIC-COVERED CABINETS

Many small radios (particularly portables) come in cabinets covered with leatherette or canvas, as shown in Fig. 6-16. Light scratches in high-luster fabrics can sometimes be removed by polishing the surface with a stain-wax polish of the same shade as the fabric. Scratches on canvas can be removed by using a neutral shoe polish.

In cases where the fabric is loosened from the cabinet, you may reglue it in place. Do not use any of the standard household or radio cements, as they are liable to destroy the finish of the material.

It seldom pays to completely recover such a cabinet; instead, it should be replaced with a new one.

Fig. 6-16

6-6. PLASTIC CABINETS

As we have already indicated, it very seldom pays to try to repair plastic cabinets. However, if a plastic cabinet is cracked, apply plastic cement (obtainable from your radio distributor) to both sides of the crack, clamp the cabinet together, and permit the cement to harden overnight. Deep scratches, nicks, and chips may be filled with stick shellac. Be careful that the hot knife does not touch the plastic, as most plastics tend to melt at temperatures little higher than the boiling point of water (212° F). After filling in and cementing, you may touch up the cabinet lacquer to match the finish of the cabinet.

6-7. REPLACING GRILLE CLOTHS

The speaker opening of most radio and TV cabinets is covered from the inside with a grille cloth. When you are refinishing a cabinet, or when the grille cloth is obviously in bad condition, the grille cloth should be replaced with a new one. Most distributors supply grille cloths for replacement purposes. Grille cloths are specially made so that they do not interfere with the sounds produced by the loudspeaker. It is not a good idea to use any other type of material just because it is available. It is not likely that you will be able to match the material that was originally installed in the cabinet, but do the best you can; if you have any doubt about your customer's reaction to your choice of material, let him see it before you install it.

To replace the grille cloth, it is necessary

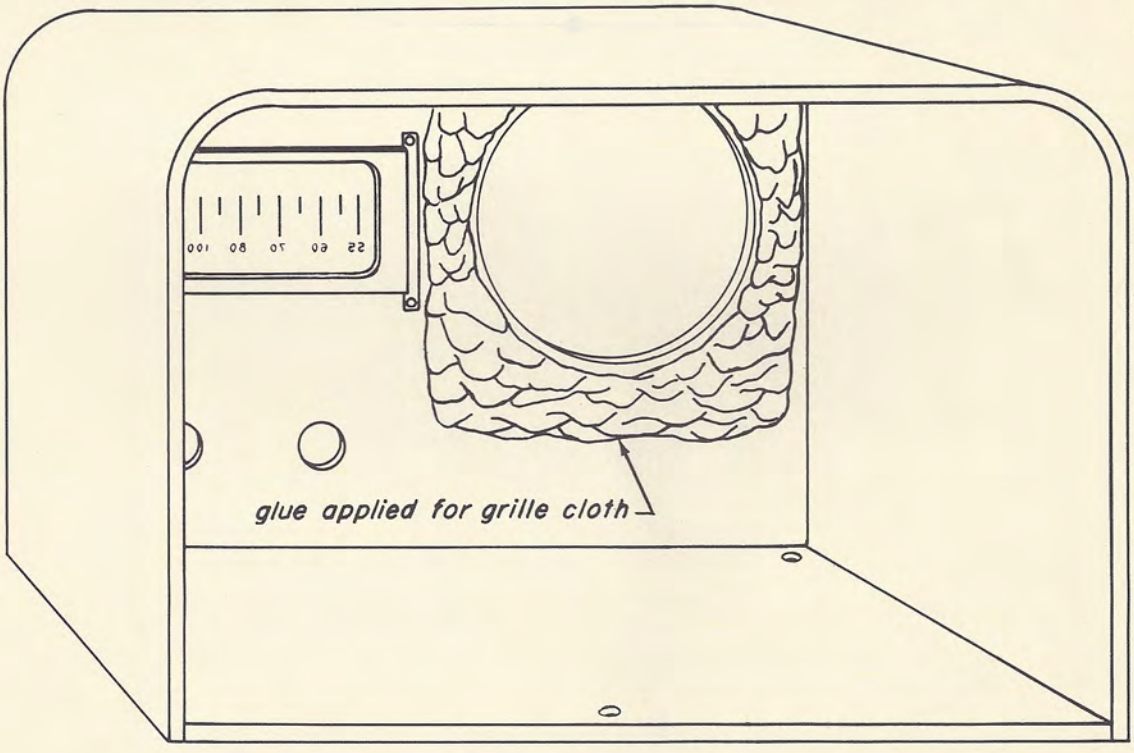


Fig. 6-17

to work from the inside of the cabinet, so the speaker or radio chassis must be removed. Remove the old cloth and carefully clean the surface where the new cloth is to go. Cut the new grille cloth to fit the opening that it has to cover. Apply glue or cement all around the area where the grille cloth is to be attached, as shown in Fig. 6-17. Stretch it across the opening. Place a thumbtack in each of the two top corners of the cloth, gently pull the cloth taut so that there are no wrinkles, and tack the lower top corners. When the glue or cement is dry, remove the tacks. In plastic cabinets, the grille cloth is usually cemented to a cardboard or wooden baffle board, which may be removed from the cabinet. The new cloth can be cut to size, stretched, stapled and tacked to the baffle. Before stapling or tacking, the surface of the baffle may be coated with cement or glue for better fastening of the grill cloth to the baffle. For high-fidelity audio equipment, it is better to use grille cloth that is designed for such equipment. Most radio and television parts dealers carry it.

6-8. TRANSPORTING THE CABINET

In removing the cabinet from the customer's house to your shop, and later in returning it, use the utmost care to prevent damaging the cabinet while it is in transit. Don't add any damages to the finish on either trip. It may seem unnecessary to give this warning, but more than one serviceman has added to his work by careless handling of a customer's cabinet. Large wooden cabinets should be wrapped in a quilt, as discussed in Service Practices 4. A standard quilt, such as those used by movers of fine furniture, is a good investment for any radio and TV dealer. He will save its cost many times over in the cabinet repair jobs that are avoided by its use, and, needless to say, his customers will be better satisfied.