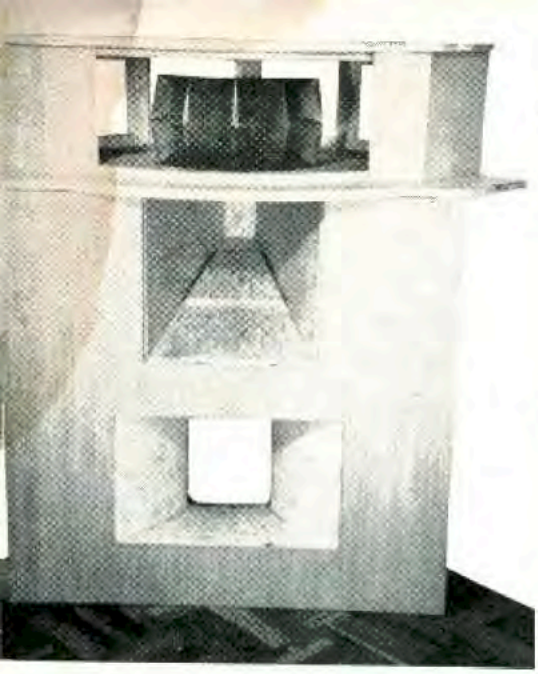

Fig. 3. Front view of the new speaker during construction, showing the speaker well and the TV tube enclosure.

A New Corner Speaker Design

C. G. McPROUD*

A new speaker cabinet designed to accommodate television in addition to providing high-quality sound reproduction.

"Trifles make perfection; but perfection is no trifle."

WITH THIS TRITE SAYING as the guiding maxim in the construction or assembly of a high-quality reproducing system, the experimenter strives constantly to achieve perfection in the whole by working toward perfection in each separate component. In the past few months, the writer has endeavored to delineate the steps taken to arrive at the best possible reproduction from the electrical circuits of a residence radio system. Not that the equipment described is the only solution to the overall problem—far from it—but it is one solution designed to provide the maximum of convenience in operation together with a reproduction quality which leaves little to be desired.

Now that television is firmly established as a home entertainment medium, a *complete* installation must necessarily contain TV facilities, without sacrificing the superb quality desired for radio and phonograph reproduction. And, of course, no mention was made in the previous series of the loudspeaker to be used with the residence system. Therefore, solving two problems at once, the TV installation has been combined with the loudspeaker in a form which results in high-quality reproduction, a reasonable compactness, and a piece of furniture which is an eye-appealing addition to a modern living room.

Basic Design

It has been fairly well established that the most efficient location for a loudspeaker is in the corner of a room. The most outstanding example of this arrangement is represented by the Klipschorn, which consists of a two-way speaker system with both high- and low-frequency units being horn loaded. The cabinet work for the Klipschorn is extremely complicated, and certainly not one which the amateur woodworker should attempt. Some constructors have mounted a multiplicity of medium-quality cone speakers on the two sides of an obtuse enclosure, such as that shown in *Fig.* 1, and used this arrangement in a corner with excellent results. The corner location is optimum from the standpoint of loading on the speaker, since the radiation is over only half the angle of that from a speaker mounted on a flat wall. With a number of ordinary cones, the result is a means for moving rather a large volume of air without the necessity of having a large cone excursion of a single unit. Thus, better low-frequency response is obtained with speakers which individually would not perform so satisfactorily.

The writer has long used a standard two-way speaker of conventional design, and while the reproduction quality has been considered excellent, the low-frequency output did not compare with that of a good theatre system. Thinking from this point, the next step appeared to be in the direction of a corner speaker, yet utilizing the reflex action of a vented cabinet. Basically, therefore, the new design occupies the corner of a room, and is arranged so that the vents are loaded by a horn comprised of the walls and the sides of the cabinet enclosure. The plan view of the cabinet is shown in *Fig.* 2, with the vent openings *A-A'* along the sides. Thus the vents are loaded by the straight-sided horn between the wall and the cabinet.

Fig. 1. Mounting a number of ordinary cones on two sides of an obtuse structure for corner use is one solution to the necessity for moving more air.

Experience has shown that loading of the vents should be accompanied by a similar loading on the direct radiating side of the low-frequency speaker, so the front of the cone is provided with another horn section, *B*, thus equalizing front and back loading and increasing the radiation efficiency. A top for the cabinet provides an air seal by means of gaskets between it and the wall, and the floor provides the other horn wall for the vented ports. The entire cabinet is open to the back, and utilizes the room corner, although if desirable for use in other locations, a false corner could be constructed to provide the necessary back.

After determining the basic design, any necessary variations can be made to accommodate TV, as has been done in this case. The picture tube is simply enclosed in a wood housing, and doors in the cabinet front cover the screen when it is not being used. The superstructure, shown in *Fig.* 3, houses the multicellular high-frequency horn and unit, and the space behind is large enough to accommodate the TV receiver chassis. With such a construction, the picture tube is between the two speaker sections, and the illusion of sound coming from the picture is considerably better than if the speaker is either

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above or below, or at the side of the screen.

Development of the practical aspects of the construction is controlled by the units selected for both high- and low-frequency speakers. In order to get the best possible low-frequency reproduction, manufacturers' catalogs were studied, and the cone selected on the basis of power handling ability and natural resonant frequency.

Good speaker performance depends on a number of factors. Among these is a high gap flux, which should be as great as possible. A high field strength ensures good damping as well as the maximum of efficiency. Another important factor is the relative weights of the cone itself and the voice-coil structure. It is considered good practice —for good low-frequency reproduction—to have these two weights as nearly equal as possible. It is also important to have as low a resonant frequency as can be obtained readily.

The low-frequency cone selected for this system is a 15-inch model, rated at 20 watts, and with a resonant frequency of 42 cps. This model is the Stephens P52L*x*—the *x* denoting a special model of the more-common P52Y—designed for the woofer of a two-way system, and having straight cone sides and a lower resonant frequency than the standard model. Another important feature is the special treatment of the cone rim to prevent reflections from the frame. Good results may be expected from any of the high-quality 15-inch speakers available, such as the Altec-Lansing 803A or the 515, or the Jensen PLM-15A or P15-NLA models, but the lower resonant frequency of the Stephens model governed the final selection for this particular application.

The selection of suitable high-frequency units is slightly wider. Ready-made are the Stephens P15 unit and the 824 horn, with an 800-cps crossover; the Racon RABAT unit with a two-cell horn designed for a 1200-cps crossover; or the Jensen P8-151 horn with an XP-101 unit. The Atlas HF-1 is also usable, but if this choice is made, the low-frequency cone should have an impedance of 8 ohms to match the dividing network which is supplied. The unit installed in the complete speaker shown is an Altec-Lansing Model 901B, of early vintage, but still quite satisfactory. The horn is a 2x4 multicellular type, built by the writer, and previously described in these pages.[1]

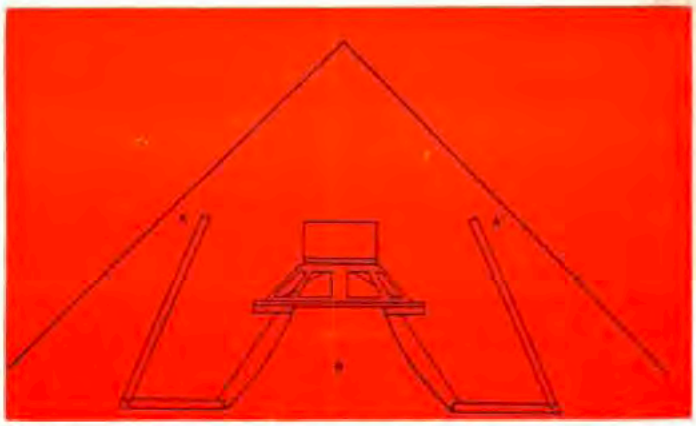


Fig. 2. Plan view of the new corner speaker design, showing vents at either side between the cabinet and the wall, and the horn loading provided by the wall and the cabinet sides.

Construction Details

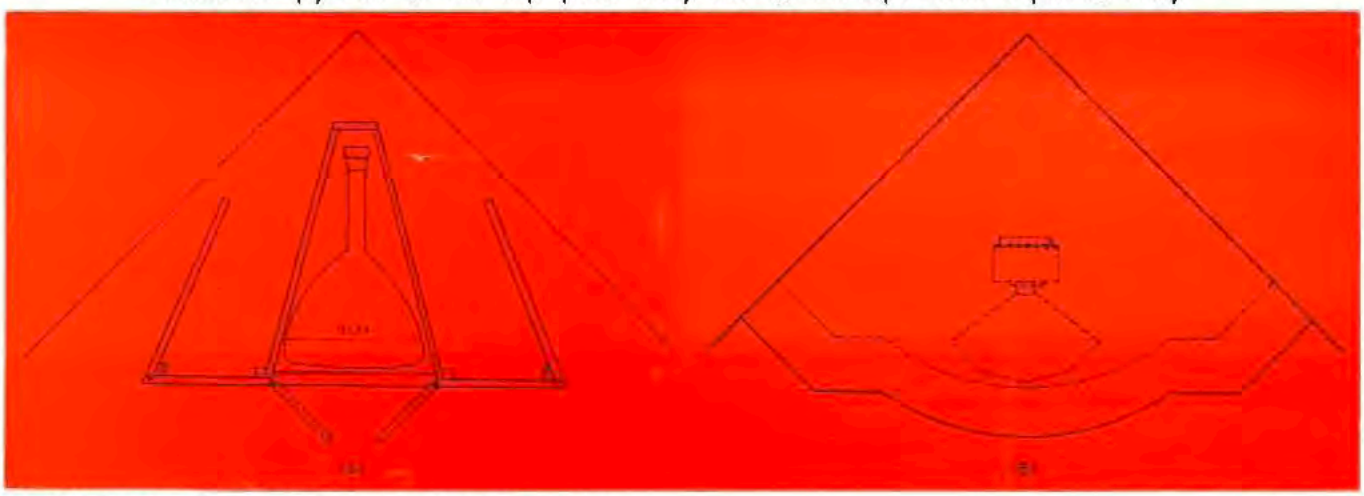
Getting down to a specific design, therefore, the cabinet takes the shape shown in *Fig.* 2 for a cross section at the plane of the low-frequency cone, and at (*A*) of *Fig.* 4 at the plane of the center of the TV picture tube. The top of the low-frequency cabinet has the outline shown in the solid line at (*B*), with the superstructure shown by the dotted lines. The top is 39 inches from the floor, and the corners of the top meet the side wall 36½ inches from the corner. Allowing for the volume of the speaker well and speaker and of the tube enclosure, the net volume of the cabinet is 8.5 cu. ft. This does not include the vent horns, which are usually included in the volume when vent pipes are used on the reflex ports.

Figure 5 shows the major parts used in the assembly of the low-frequency portion of the speaker, together with the housing for the picture tube. It will be noted that there is a hand hole in the bottom of the tube enclosure, with a removable cover which serves two purposes: it mounts the deflection yoke, and thus permits adjustment of the TV receiver with the tube removed from the cabinet; and it also permits anchoring the cabinet to the corner of the room by means of a pair of steel cables and two turnbuckles. The cabinet is placed close to the corner, and with the turnbuckles open to their maximum, the cable is looped over a hook mounted on the floor right in the corner. Then the turnbuckles are tightened up, thus locking the cabinet into the corner with the top tight against the wall. The quarter-inch semicircular groove along the back edges of the top provide space for a gasket to make an airtight seal. When the hand-hole cover is replaced, the structure is airtight except for the vents.

The wood selected for the top and

[1] *Winslow, "Two-Way Speaker System,"* Audio Engineering, *Nov. 1947.*

Fig. 4. (A) Cross section of the cabinet at the plane of the center of the picture tube to show location of tube enclosure. (B) Plan of the top (solid lines) and of the superstructure (dotted lines).



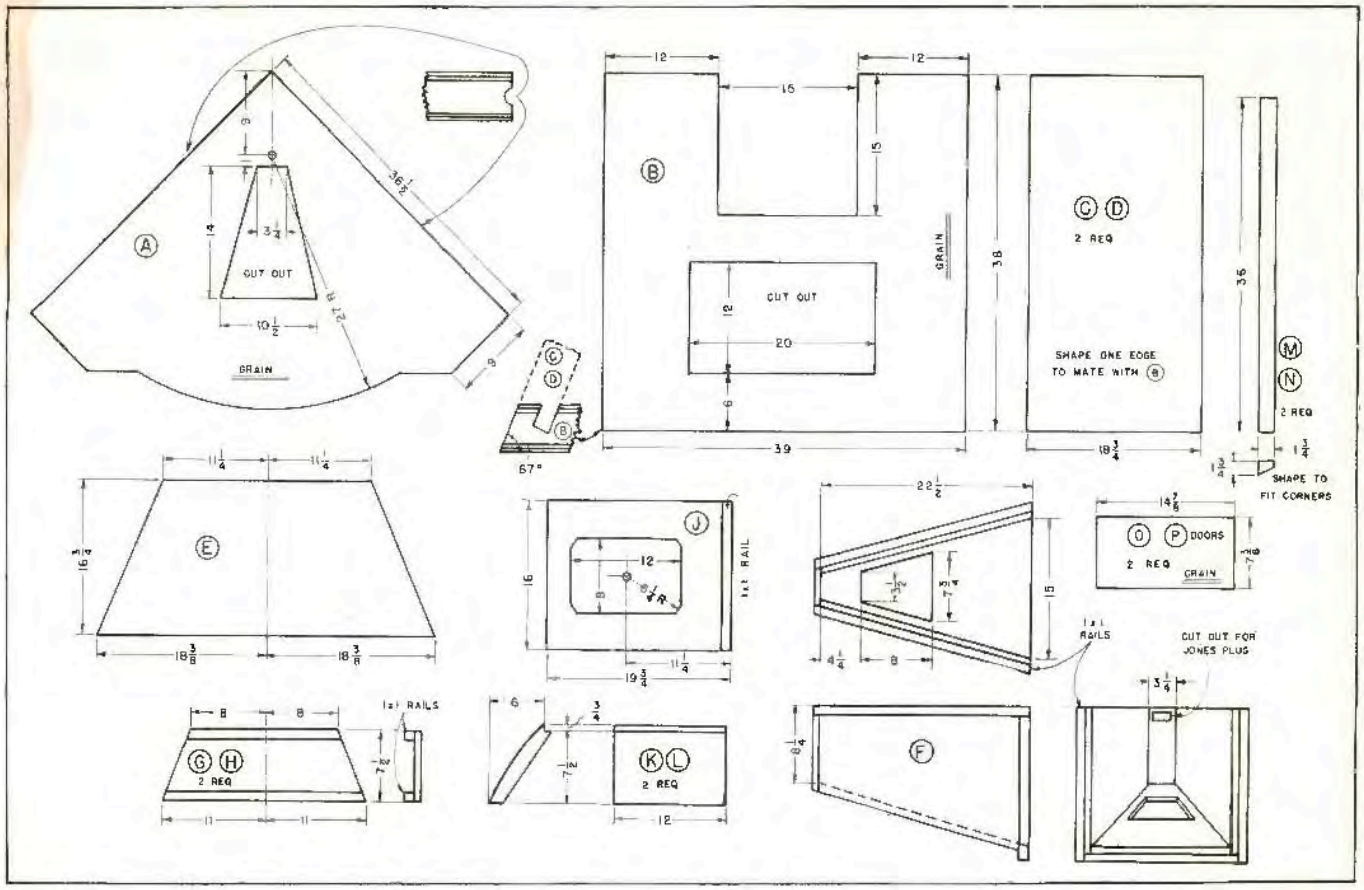


Fig. 5. Details of the pieces which comprise the lower cabinet, speaker well, and tube enclosure.

front of the cabinet should be a suitable match (or contrast) for the furniture used in the room where the speaker is located. For solid construction, ¼-in. material is recommended, with veneered hardwood being used for the top *A* and the front *B*. The doors *O* and *P* should be solid, or else veneered on both sides. The bottom *E*, sides *C* and *D*, speaker baffle *J*, and the tube enclosure *F* can be of less expensive fir plywood, also ¾-in. thick. The tube enclosure is a part of the acoustic chamber, which accounts for its seemingly over-solid construction.

The sides, *K* and *L*, of the speaker well are shaped from two-inch white pine, and should be fitted to the opening in the panel. The speaker baffle is drilled with eight holes, and T-nuts for mounting the speaker are installed on the front before the "horn" is assembled. In addition to the pieces shown, a number of ¾ x ¾ strips will be needed for corner reinforcement. Parts *M* and *N* are for the acute corners at the front of the cabinet.

The details of the superstructure will be described in next month's issue, and the parts are not shown in Fig. 5. However, it might be well to plan on another veneered piece nearly as large as the top *A*, since the grain should run parallel with the front of the cabinet, as shown by the shading lines. The two tops will cut readily from one panel of hardwood veneer.

Since this speaker is supposedly "functional," no attempt is made to disguise its appearance. The front of the low-frequency cone is visible in the speaker well, or horn, being protected by a screen of expanded metal. The inside of this horn is finished in dark blue lacquer, as are the sides of the cabinet and the edges of the two tops. The front and the top, together with

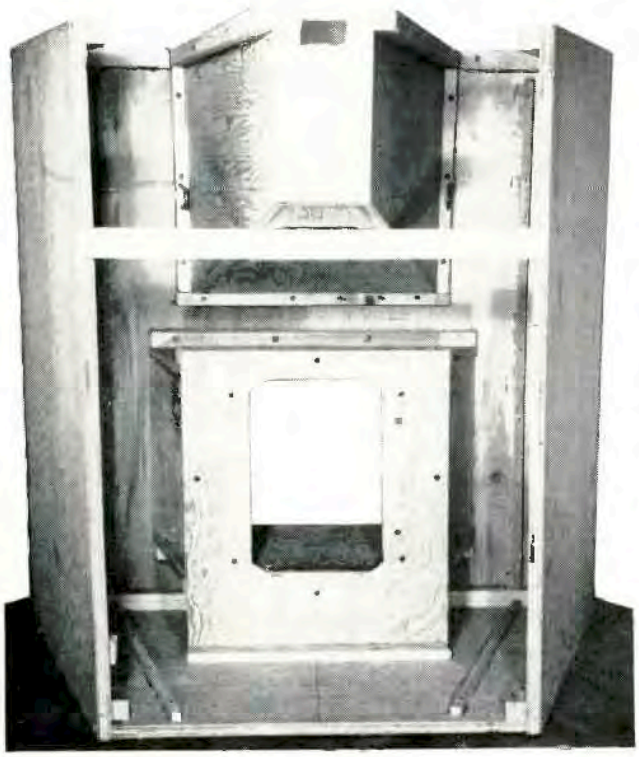


Fig. 6. View of the rear of the lower cabinet showing method of assembling the various sections.

the superstructure, are bleached oak, as is the tube mask. Lacquer covers the jointing of the speaker well to the panel, as well as the non-veneered edge of the top. If a uniform hardwood appearance is desired, the edges should be veneered—a job best done by the cabinet maker who cuts the pieces out. One caution is necessary—make sure that the top will fit the corner tightly. *Not all rooms have 90-deg. corners.*

Assembly

Once all the pieces have been cut out, the next step is that of assembly. Since some of the operations appear to be tricky, it is well to follow a certain procedure to avoid having to put the last few screws in with an offset screwdriver. The first step is to assemble the speaker well, which is a short exponential horn. Parts *G* and *H* are mounted on part *J*, using the shaped sides as spacers. Remember to put the T-nuts in place on the baffle before attaching the other parts. All joints should be glued, preferably with casein glue, and secured with 1¼—12 flathead wood screws, countersunk. This assembly should then be attached to the front panel, also with glue and wood screws. The shaped sides, *K* and *L*, are then fitted into place, also with glue and screws. Every joint in the cabinet is made with both glue and wood screws except that between the top and the lower section. This facilitates moving the entire unit. The top is attached only with screws, so it may be removed to enable the cabinet to pass through a 30-in. door.

After the speaker well is completed, the bottom is attached to the front, using a ¾-in. strip at the joint. The front extends clear to the floor, to eliminate the extra construction necessary for a recessed base. The bottom is thus inset, since the sides also extend to the floor. After the bottom is attached to the front, it is also secured to the speaker baffle. Next the corner braces are attached to the front, and the strips along the lower edges of the sides are screwed in place, ¾-in. up from the edge. The sides are then fitted into the groove in the front panel, and all joints screwed together. The tube enclosure is next mounted to the front, and supported at the back with a cross brace. The entire structure should now resemble that shown in *Fig. 6*, which also shows the ½-in. square furring strips for the sound-deadening lining.

At this point, the doors should be fitted, using ⅜-in. Soss invisible hinges which are mortised into the front and the doors. These hinges are the least obtrusive of any hinge available, and while they are a little difficult to mount, the final appearance warrants the extra effort.

Electrical Connections

To avoid external wires, some provision must be made to introduce the signal and an a-c line to the unit, since it will not be readily accessible once the cabinet is mounted in place. The power circuit is necessary for the TV chassis, as well as for a possible outlet for a lamp or clock as an ornament on top of the speaker. Since the speaker is designed to work from a radio-phono system housed elsewhere, the speaker signal must also be fed in. This is done at a small panel located just inside the lower right corner of the cabinet. One three-way male receptacle is used for speech, and a two-way male twistlock receptacle is used for the a-c line. The speech circuit goes to a switch which selects radio-phono in one position, or TV in another, and with an off position the unused inputs being properly terminated. The output of the switch then goes to the dividing network, mounted on top of the speaker well, and thence to the two speaker units. Access to the high-frequency unit is had through an 8-terminal Jones receptacle, which also receives the input from the TV receiver and carries the a-c line up to the superstructure. This receptacle is mounted at the back of the tube enclosure, and permits removal of the top without disconnecting any wiring. The electrical circuits are shown in *Fig. 7*.

Preliminary Finishing

After the lower section is completely assembled, it should receive its first finishing operation. To protect the surface of the wood, the interior and the bottom should be given a primer coat of lacquer or some other undercoat. All cracks in the exterior should be filled with plastic wood, and the rear corners of the speaker well should be rounded out with fillets of the same material. After thorough sanding, the sides and the speaker well should receive a coat of an undercoat such as Firzite, which is an excellent filler for plywood. Finishing of the hardwood exterior should wait until the superstructure is completed in order that the two sections match as well as possible. Since most of the work on the lower section is now complete, the padding may be tacked in, using large-headed nails to prevent tearing out. Ordinary rug padding, such as Ozite, appears to be satisfactory for this purpose, although rock wool or Fibreglas is recommended by some constructors. The possibility of the fine glass shredding around a speaker cone argues against the use of either of the latter insulating materials, and the Ozite appears to do a satisfactory job of deadening without this risk. It is desirable to use two thicknesses over the larger areas, though the furring strips provide a good absorptive covering since there is an air space behind the padding.

In the next article of this series, the superstructure details will be described. While this cabinet design is intended to include TV, there is no reason why

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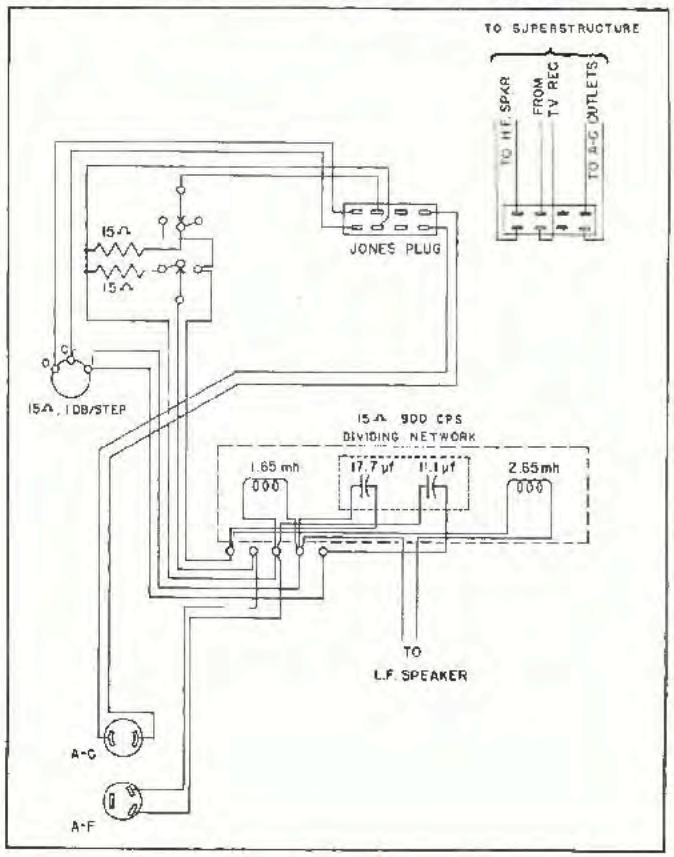

Fig. 7. Wiring diagram of the lower cabinet.

CORNER SPEAKER DESIGN

[from page 17]

it must, and plans are being drawn for a smaller cabinet of similar design, intended for use solely as a speaker. This model will use a good-quality 12-in. speaker for the woofer, and the Atlas HF-1 horn unit for the tweeter, the latter being mounted where the tube enclosure is in the original model. Thus it will be somewhat lower in over-all height, and considerably less costly to build. Exceptional performance is expected from it, however, if the results obtained with the original model are any criterion. Next month's article will give the full set of performance characteristics together with efficiency measurements compared to a conventional 7.5 cu. ft. vellexed cabinet.