Practical Electronics

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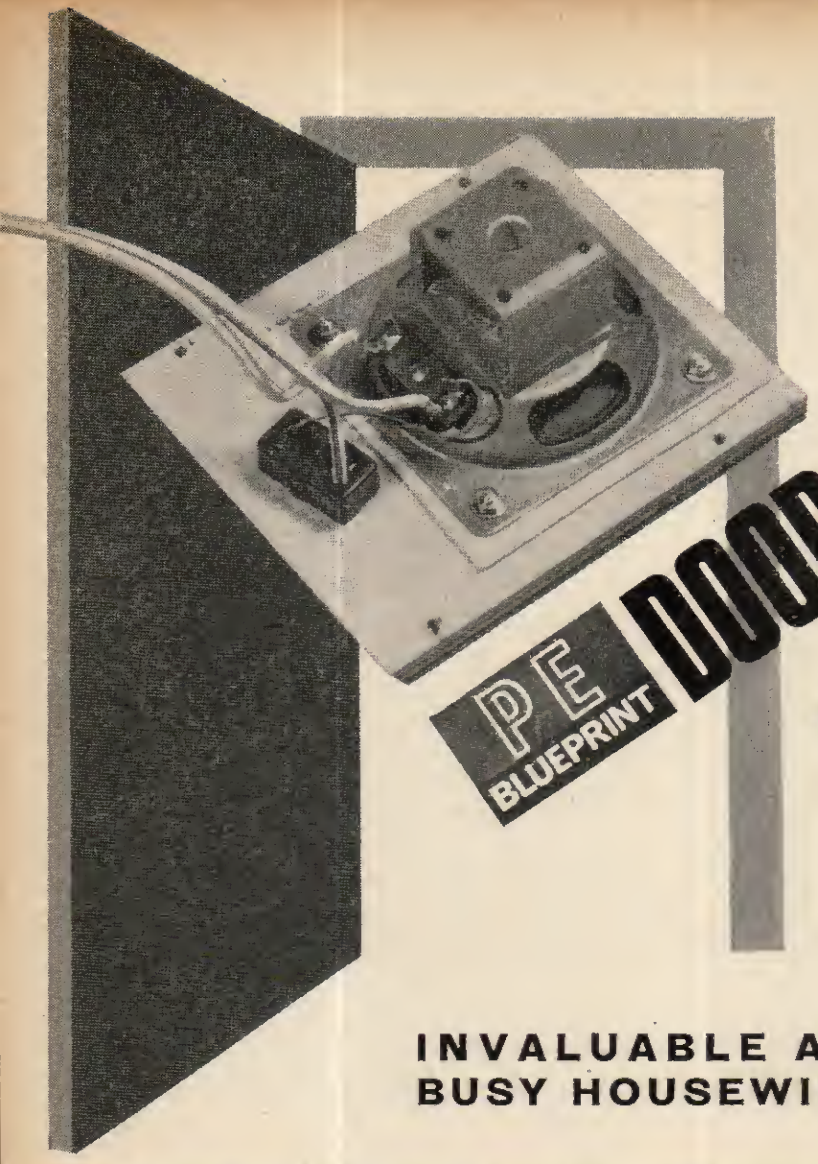
PRICE 2/6

BUILD THE P.E. DOORPHONE

FREE INSIDE

2 FULL SIZE BLUEPRINTS AND DATA CHARTS



PE BLUEPRINT

DOOR PHONE

two-way loudspeaking intercom with an audible calling signal

By R. E. F. Street

INVALUABLE ASSET FOR THE BUSY HOUSEWIFE AND INVALID

ONE OF this month's blueprints shows the details for making an intercom system designed for use between the front door of a house and the kitchen. A busy housewife is thus able to convey messages to tradesmen without the need to leave a particular chore or child unattended. It has been found to be a considerable asset to an invalid or handicapped person who is left alone in the house.

No doubt readers will be able to find a host of applications for the system, since it is entirely self-contained in two units and does not rely on an external source of supply.

A "calling" system is also incorporated so that the caller at the front door can attract the attention of the occupant, so dispensing with conventional bell and knocker systems. Alternatively, the calling system may be omitted if the conventional systems are preferred. Even with the calling system, the number of interconnecting wires is kept to a minimum; there are only three wires used here.

CIRCUIT DESIGN

The circuit of the unit is shown in Fig. 1 on the blueprint. Basically, it consists of a four-transistor amplifier having a maximum output of about 500mW. The amplifier is conventional in circuitry, apart from R5, the function of which will be explained later.

When designing the unit, the aim was to employ readily available components, and this meant that 3Ω loudspeakers were called for. It was decided to use a single loudspeaker at each end of the two-way intercom system and use them alternately as microphones and loudspeakers. The switching necessary to accomplish this procedure is carried out by a four-pole, three-way switch, S1. The three positions of the switch, which is situated at the same end of the system as the amplifier, correspond to " off ", "speak", and "listen".

When either loudspeaker is used as a microphone, it is matched into the first transistor TR1 by means of a transformer T1. The transformer suggested is a miniature type having a ratio of 50 : 1 and originally intended for use in the output stage of a valve radio receiver. It is connected to provide a step-up ratio of 1 : 50 to the base circuit of TR1. A conventional microphone transformer of ratio 35 : 1 was tried but was much larger, more expensive, and did not give such good results as the type specified.

SWITCHING

The input and output circuits of the amplifier, and the loudspeakers, are switched by S1a and S1b respectively. The "off" position of S1 connects the loudspeakers in the same manner as the "listen" position as will be seen from the circuit diagram.

The remaining sections of S1 (S1c and S1d) are used for switching the battery supply. The negative side of the battery is permanently connected to the negative line of the amplifier while the positive side of the battery is wired to the wiper of S1d. In the "speak" and "listen" positions of S1, the positive side of the battery is connected to the positive line of the amplifier, but in the "off" position, it is connected to the third wire of the three-core cable connecting the door unit to the amplifier unit.

The door unit is fitted with a push-button switch S2 and when this is pressed, even if the main unit is in the "off" position, power is applied to the amplifier. Switch S1c is used to render the push-button S2 inoperative when the main unit has been switched to "speak" or "listen".

COMMON IMPEDANCES

It will be seen that on the circuit diagram wire B from T1 and wire G from T3, and one side of each loudspeaker, have been joined together at a single point, which is then connected to the positive line of the amplifier. This procedure is most important; if the wiring is not carried out in the fashion indicated in Figs. 1 and 3, there is likely to be a small impedance common to both the input and output circuits of the amplifier. Since the amplifier has a very high gain, if only a few inches of wire are common to both input and output circuits, severe feedback will result and the symptoms can be most bewildering if they are not expected.

It was thought when designing the unit that it would be useful if there could be some means of "calling" the amplifier unit from the door unit. When S2 is operated, power is supplied to the amplifier when the amplifier unit is in the "off" position. Since the "off" position of S1 places the loudspeakers in the same configuration as in the "listen" position, it might be thought that pressing S2 would enable the person using the door unit to speak and be heard from the loudspeaker in the amplifier unit. However, this is not so if the previously mentioned "common impedance" remarks are observed and "earthing" connections are adhered to.

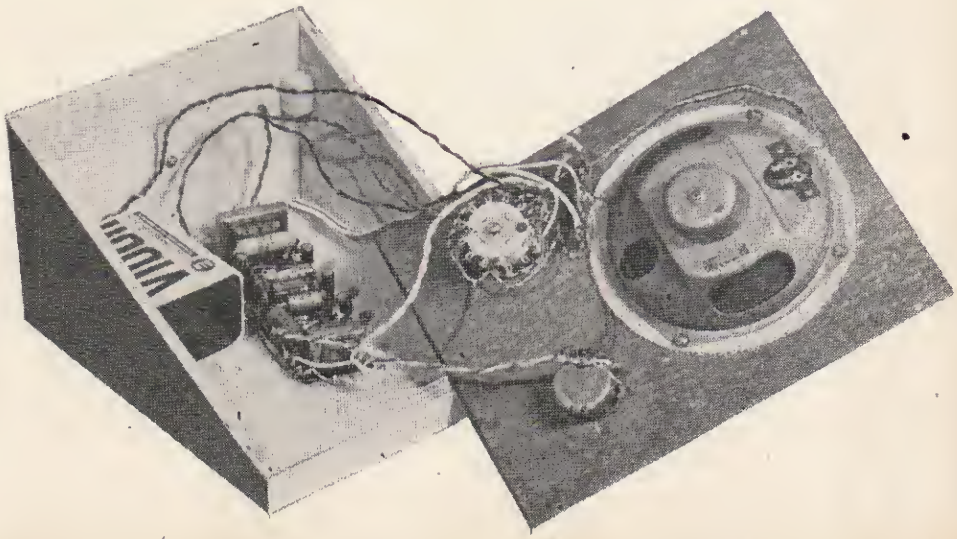
The supply from the positive terminal of the battery passes via one of the leads of LS2, and the lead is thus common to the input circuit of the amplifier and the battery supply. The resulting "howl" of feedback is sufficient to attract the attention of anyone near the amplifier unit. Of course, the person at the amplifier unit then uses S1 in the normal way to speak to the person at the door unit.

This simple system using feedback to produce an audible signal is quite adequate. Its main disadvantage is that the note produced is not particularly harmonious, but this will not normally be disturbing since it is only heard momentarily.

CALLING SIGNAL

For the system to work satisfactorily, the volume control of the amplifier must not be at its minimum setting. R5 is inserted so that, when VR1 is at minimum volume setting an output will still be obtained if a signal is applied to the input of T1. The value of R5 can be varied in the light of experiments; if the howl produced on pressing S2 is too low or too high in volume, R5 can be increased or decreased slightly as appropriate. The value (39 ohms) was found to give adequate volume of howl under normal conditions. There may be a bell-push and bell associated with the front door already in use. If so, then obviously, the "call" system described here will be of little value, and may be omitted. The cable linking the amplifier unit to the door unit can then be of two-core type, wire L being omitted.

If required, a miniature buzzer could be fitted in the cabinet of the main unit and wired to function when S2 is operated. It would be advisable to use a separate battery for the buzzer since the specified battery would have insufficient capacity; S1c could still be used to prevent S2 from having any effect when S1 is in the "speak" or "listen" position. The buzzer would be



Main amplifier unit and control panel

wired between the wiper of S1c and the wire which goes to S2, and the lead joining "O" on S1c to "O" on S1d would be disconnected. The battery for the buzzer would then be connected with the negative lead to "O" on S1c and the positive lead to the positive line of the amplifier.

AMPLIFIER CONSTRUCTION

The amplifier itself is built on an 18-way component groupboard but it should be noted that if parts larger than those shown in Fig. 2 on the blueprint are employed, it may prove difficult to accommodate them on the board. Full details of the wiring are given on the blueprint and it is recommended that the components be fitted to the groupboard first, as indicated in Fig. 2, omitting for the time being the connecting leads A to I. The mounting lugs of T1, T2 and T3 are soldered to tags on the groupboard. This is important in the case of T2 because the transformer clamp provides a link between R13 and the common positive line. The transistors should be wired in last, taking due precautions against damage from the heat of the soldering iron by using a suitable heat shunt.

When the amplifier has been built, it can be tested, after connecting the volume control and the two loudspeakers to the appropriate points. Having established that the amplifier works satisfactorily, it can be wired up to the switch S1 as shown in Fig. 3.

Note that S1 consists of two two-pole, five-way, make-before-break wafers. The switch is a Radiospares "Maka-Switch" type and the movable "stop" should be positioned to convert the wafers into two-pole, three-way types. The diagram (Fig. 3 on the blueprint) makes clear which tags on the wafers are disregarded. It is important that the switch obtained is of the make-before-break variety; if it is not, then damage may result to the two output transistors if at any time the secondary winding of T3 is left open-circuited while there is an input signal to T1. The use of an m.b.b. switch ensures that the secondary winding of T3 is always loaded, a necessary requirement to prevent TR3 and TR4 "running away".

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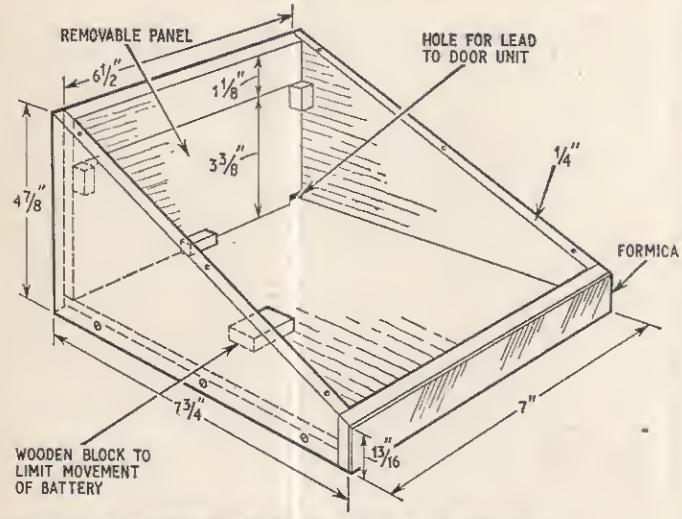


Fig. 6. Constructional details of the main amplifier unit, made from ¼in thick plywood and covered with a plastic laminate. The removable panel provides easy access to the battery. All parts are glued and screwed.

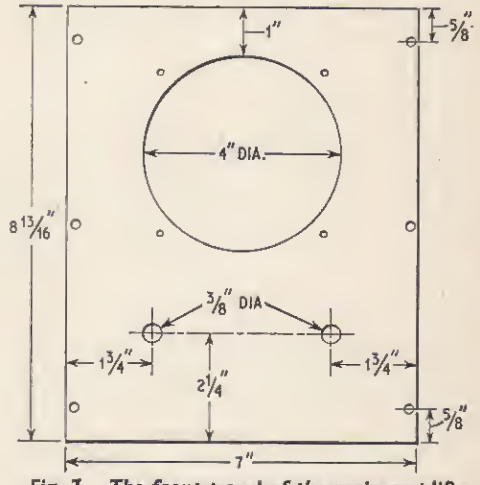


Fig. 7. The front panel of the main amplifier unit. This can be made from plastic laminate sheet. The size of the loudspeaker hole and the position of the fixing screws depends on the loudspeaker used

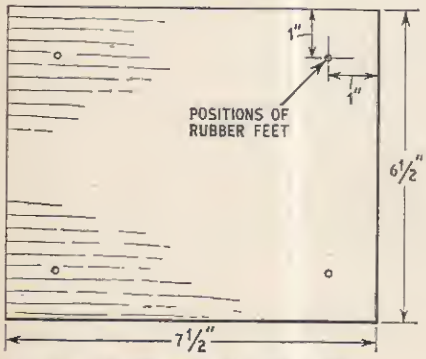
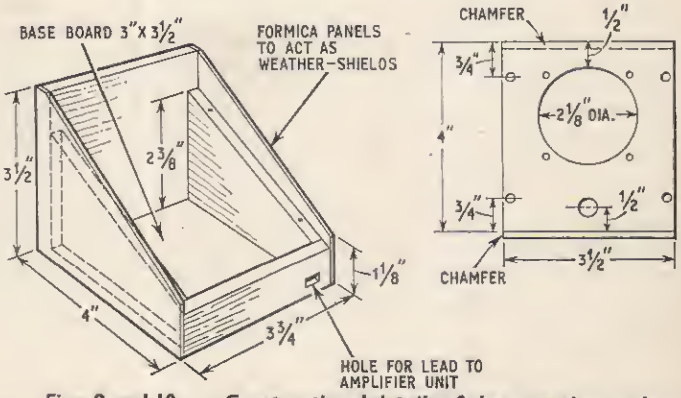


Fig. 8. Baseplate of the main amplifier unit. Four rubber or plastic feet are fitted to prevent damage to paper or paintwork on the wall



Figs. 9 and 10. Constructional details of the extension or door unit made in a similar style to the main unit. Notice that the front panel is chamfered to fit in a recessed position in the case. All parts are glued and screwed

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CABINETS

The cabinet of the amplifier unit is made of plywood and has a laminated plastic (such as "Formica" or "Wareite") front panel. The construction is shown in Fig. 6, and the drilling details of the front panel in Fig. 7. The baseboard is shown in Fig. 8. It will be found that the amplifier has to be positioned inside the cabinet at a slight angle in order to be clear of the loudspeaker, battery and switch S1. The end of the amplifier which carries the largest transformer (T3) should be at the rear of the cabinet. The amplifier may be screwed down to the baseboard of the cabinet if small soldering-tags are soldered to the end terminals of the groupboard. Four rubber or p.v.c. feet should be fitted to the underside of the baseboard.

The door unit is constructed quite simply from plywood and is shown in Figs. 9 and 10. The wiring of the door unit is given in Fig. 5 on the blueprint and is quite straightforward. It should be noted though that the connection from S2 to the loudspeaker LS2 should be made to the wire which is connected to the positive line of the amplifier, and not to the wire connected to S1a. When the unit is completed, and S1 is at the "off" position, the wire from S2 can be connected to each side of LS2 in turn. Connecting it to one side will be found to result in a more pronounced howl when S2 is operated than connecting it to the other side of LS2.

LOCATION

Since the door unit will be positioned in the open, its location should be chosen with care to avoid the direct incidence of rain. Obviously, the more sheltered the position finally chosen, the less chance there will be of damage to the unit by the weather. The door unit should be painted to keep out damp and it would also be a good idea to seal all the joints when the unit is finally assembled. The grill on the front between the loudspeaker and the panel should be of fine mesh; perforated zinc was used in the prototype. However, there is now on the market a plastic substitute for perforated zinc which would be a better type of material to use. To keep out the damp, a thin sheet of polythene can be fixed to the grille behind the panel; the sound level will be reduced somewhat, but the weather-proofing will be better.

If the door concerned has a porch, this is all to the good, and the door unit can be fitted in a sheltered position.

OTHER USES

This intercom system is capable of giving an output of quite good quality and would certainly be adequate for communication between two offices. It would also be found useful for wiring between the bedroom of a sick person or invalid and another room to prevent needless journeys upstairs. Yet another use would be as a baby alarm, in which case the switches S1 and S2 would not be required, their place being taken by a simple on/off switch for the battery.

The prototype was also found handy for use when installing a television aerial in an area of weak signal, giving communication between the aerial rigger and someone watching the receiver, so that the aerial could easily be positioned for optimum results. ★