By GEORGE W. SCHULTZE

HOME INTERCOMMUNICATOR

An Efficient Set for Residential Use

THE business or industrial intercommunication system is often extensive and expensive.

To justify a home installation, certain limitations and requirements must be recognized. The system described was developed to satisfy the following criteria:

1. Cost of the installation must be kept to a minimum. In most instances a home "intercom" or "squawk-box" falls in the luxury category, and the economics of the situation must be treated in that light.

2. The amplifier must be able to respond instantly with almost no warming-up wait, but at the same time must be economical on tubes and power.

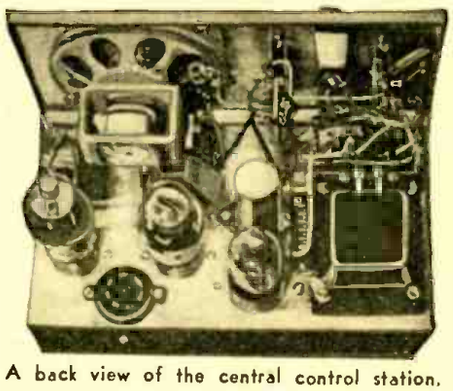
3. The substations must be able to call the master station by voice rather than by signal to allow announcements to be made without waiting for a reply. Any substation operator may talk to the master station on his own initiative, but need not be able to contact other substations. The master station may hold a conversation with any one of the substations.

4. Amplifier and speakers must be capable of transmitting speech to and from a point somewhat removed from the speaker. That is, the system must be able to transmit intelligence even though the user is several feet from the station.

5. Interstation wiring must be as simple as possible, to avoid excessive material and installation costs. This means that high voltages and the need for shielded conductors must be eliminated.

A PRACTICAL SYSTEM

The original installation consists of a master station and three substations. Any number of substations can be installed, and additional ones can be placed in the system at any time. The master station is located in the "boss'" bedroom, while the substations are installed in "Granddad's" room, the kitchen, and the basement shop. The wire length from the master set to the most remote station is about 100 feet.



A back view of the central control station.

The circuit diagram, Fig. 1, shows a conventional two-stage audio amplifier with a 6C6 tube resistance-coupled to a type 41. Many other tube combinations will suggest themselves, but the one given is quite satisfactory. The input transformer T2 can be a conventional output transformer. The author used a compact surplus unit about which nothing is known except that it

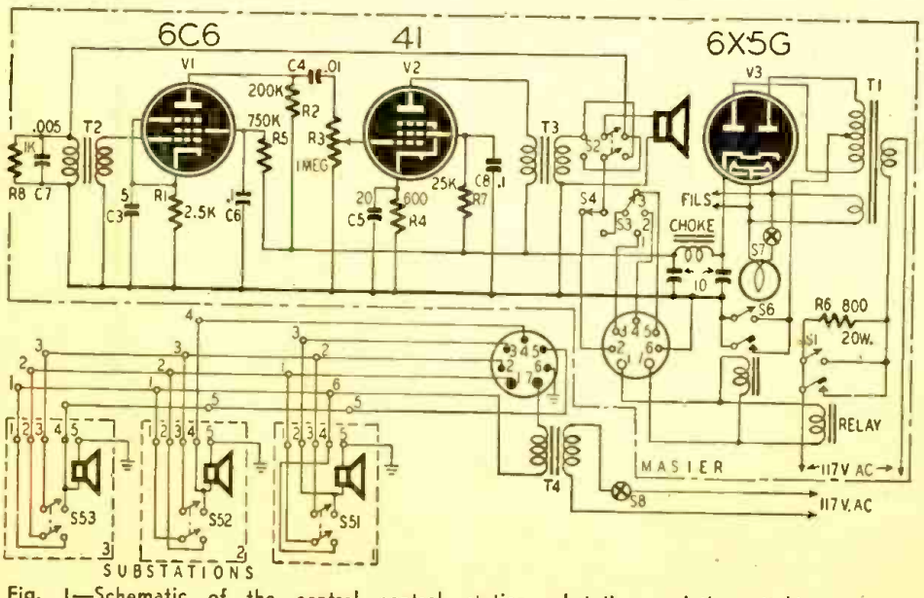
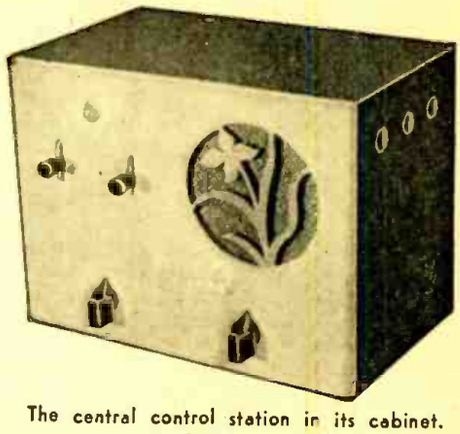


Fig. 1—Schematic of the central control station, substations and the switching system.



The central control station in its cabinet.

works well. The condenser C7 bypasses strong radio broadcast signals picked up by the interstation wiring. The capacity value of this condenser is not critical, but without it, the author's amplifier reproduced a twenty mile distant fifty-kilowatt program very nicely (but undesirably) with S2 in the "listen" position.

Also across the primary of T2 is placed R8. This was found necessary to eliminate the loud "beep" from the master station speaker when, on throwing the power switch to OFF, S4 is opened and the filter condensers momentarily supply B-voltage. R8 in the author's set is 1000 ohms. No decrease in signal volume was observed because of its insertion. It was found that a resistor of about 30,000 ohms across the secondary of T2 achieved the same results.

THE SWITCHING SYSTEM

The input circuit within the amplifier was wired with shielded conductor to eliminate objectionable feed-back. T3 is a conventional output transformer. The permanent magnet speakers, which also double as microphones, are preferably all identical. The ones shown in the photos are 4-inch, a compromise between compactness and reasonable response. The talk-listen switch, S2, allows switching the speakers from the speaker function to the microphone function at the will of the master station operator. S2 is a double-pole double-throw lever action switch with spring return. It is arranged so as to be normally in the "listen" position.

The power supply uses about the smallest standard line transformer available. A 6X5-GT rectifier was used in the original outfit, but an 80 or a 5Y3-G would be satisfactory. An a.c.-d.c. type power supply was ruled out because of the positive grounding of the amplifier B-minus. The rectifier circuit is conventional, giving a B-plus voltage of 310 d.c. In one of the primary

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leads of T1, however, is inserted a resistor R6, and the by-passing switch S1 and one pair of relay contacts. S6 and another pair of relay contacts open or close the power supply B-minus connection to ground. When S1 and S6 and both circuits of the d.p.s.t. relay are open, the plate voltage on the tubes is removed and the filament voltage is cut down to approximately half normal value. This is the standby condition, and allows almost instantaneous use of the amplifier, but conserves tube life when idling. Using a 800-ohm resistor for R6, the idling filament voltage will be about 3.4 volts. R6 is a 20-watt wire-wound unit. This results in a warm-up period from idle condition to full gain of approximately five seconds. This waiting time, starting from cold tubes of the type described, is longer than fifteen seconds. Placing R6 in the transformer primary, rather than the proper value in the filament leads, avoids excessive heating of T1 under continuous operation, and eliminates all transformer hum while idling. (Transformer hum,

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although slight in a good unit, can still be objectionably loud in the quiet of a bedroom at night.)

S1 and S6 are ganged with S4 and S7 in the form of a four-pole two-position lever action positive type twitch. S7 makes or breaks the 6.3 volt leads to the pilot light. The function of S4 will be treated in the following paragraph.

In each substation is located a double-pole single-throw switch in the form of a spring-return push button. These switches are normally open. When closed, one side completes the relay coil energizing circuit, thus closing both pairs of relay contacts. This, in turn, applies B voltage to the amplifier and brings the filament voltage up to normal level. The other side of the substation push-button switch connects the substation speaker voice coil to the amplifier input, through S4. This connection by-passes the regular voice coil leads and the master station selector switch S3, thus allowing the substation to call the master station even though the latter's power switch is "off," and the selector switch is set to the wrong position. If the ensuing conversation is of any length, the master station operator may set the station selector switch properly and throw his power switch to "on," thus relieving his fellow conversationalist of the duty of holding in the push button. When the master station power switch is turned "off" upon completion of the conversation, S4 is returned to position.

The other side of the substation

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speaker voice coil is grounded to a water pipe, as is No. 6 pin of the amplifier connecting plug. The water pipe system cannot be used as one of the relay leads as well as a return for the audio signal because of the coupling between the two circuits when the relay circuit is closed. This interaction would cause intolerable distortion.

CONSTRUCTION DETAILS

The 9¼ by 7 by 2-inch chassis was built for the job of 22 gage galvanized sheet. A metal chassis front was provided for mounting the controls and speaker so that the cabinet front could be made an integral part of the box. A standard chassis and panel could have been used. The usual precautions in separating the input circuit from the rest of the amplifier should be followed. The power and interstation leads enter the master set through chassis-mounted connectors so that the amplifier may be easily detached for servicing.

The chassis and panel layouts are clearly shown in the photographs. The power transformer is mounted in the lower right hand corner of the chassis. R6 is mounted on two of the transformer bolts, as is the two-prong plug assembly for the power-line connector. The relay is located between T1 and the panel. Immediately to the left of the power transformer the rectifier tube and the triple-unit electrolytic filter condenser can be seen. Next in line is the power tube, with the 6C6 farthest to the left. Between the two amplifier tube sockets, and near the back edge, is the socket for the seven-prong plug terminating the interstation wiring. The input and output transformers are located under the speaker.

Looking at the panel front, the power and talk-listen switches are located to the left, with the pilot light between. The volume control is positioned below the pilot light. The station selector is mounted directly below the speaker. Both of the latter two controls are positioned below the chassis top. The arrangement described gives a convenient layout with minimum lead lengths.

Ordinary bell wire was used for the interstation leads, the maximum voltage handled being 16 volts in the relay circuit. By shopping around, seven different insulation colors were obtained, providing color-coded leads. Some ingenuity will be required in getting the leads hidden in partitions, closets and the attic, but no special precautions need be observed except to keep the relay wires separated slightly from the others when this can be done easily. The use of bell wire keeps the cost of this part of the installation to a minimum. Connection blocks were inserted at strategic points as indicated in the wiring diagram. Transformer T4, which is a door chime transformer rated at 16 volts output, was installed in a closet, with a line cord switch as S8.