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ANALYZED

AN EMERGENCY BUILDING CLEARANCE SYSTEM FOR THE
RADIO AND ELECTRICAL ENGINEERING DIVISION

J. T. MACKEY

OTTAWA

JANUARY 1973

ANALYZED

ABSTRACT

This paper describes a simple inexpensive emergency signalling system for use in building emergency clearance and general practice procedures. The system comprises three boxes, each of which can show the status of 40 areas. Switches and indicator lights are used and are enhanced by verbal communication through speakers.

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Plates

1. Front Panel Display
2. Interior Display

AN EMERGENCY BUILDING CLEARANCE SYSTEM FOR THE RADIO AND ELECTRICAL ENGINEERING DIVISION

-J. T. Mackey-

INTRODUCTION

The system to be described was developed as a result of employees' concern for safety and the need to provide a simple and unambiguous signalling system between widely separated areas of the building for emergencies. Previously, the system consisted of sound-powered telephones with toggle switches in series with lights between the locations being used. Background noise and uncertainties in regard to switch and light operation made the system unsatisfactory. Various attempts to improve the light-switch series arrangement did not prove satisfactory.

The present system evolved out of the inadequacies of the previous systems. A logical approach seemed to be to provide identical panel displays in the control areas (in this instance three), with indicator lights connected in parallel between the panels. Each panel light corresponds to a specific area of the building and is to be switched on as soon as that area is cleared of people. Thus the status of up to 40 areas is shown on all panels simultaneously, and voice communication between control areas is provided as well.

GENERAL DESCRIPTION

1. Front Panel Display (Plate 1)

The system consists of one control box which can be connected to any number of subsidiary boxes; for present requirements two subsidiary boxes have been installed.

Each front panel is composed of area status lights with associated toggle switches, communication speaker with controls and indicator lights, safe to re-enter indicator switch and power on-off switches. The hinged front panel is identical for all the boxes.

2. Interior Wiring Display (Plate 2)

This photograph shows the wiring of the control box which includes 2 fuses, power relay, voltmeter(push switch)for monitoring the two +24-V power supplies, modular audio compressor and audio amplifier, a test speaker, with push switch, barrier strips, and the panel wiring common to all boxes.

3. Area Status Display (Fig. 1)

The function of this circuit is to relay information to all areas simultaneously using toggle switches and indicator lights.

This diagram indicates the manner in which individual area status lights are wired in parallel to all the panels through interconnecting cables. Switching any switch on one

panel will turn on identical area lights on all panels at the same time.

Independent "press-to-test" sockets have been employed, which facilitate the checking of suspected faults in bulbs and switches.

A safe to re-enter indicator switch has been wired in parallel to all the boxes, but a more suitable arrangement is being devised.

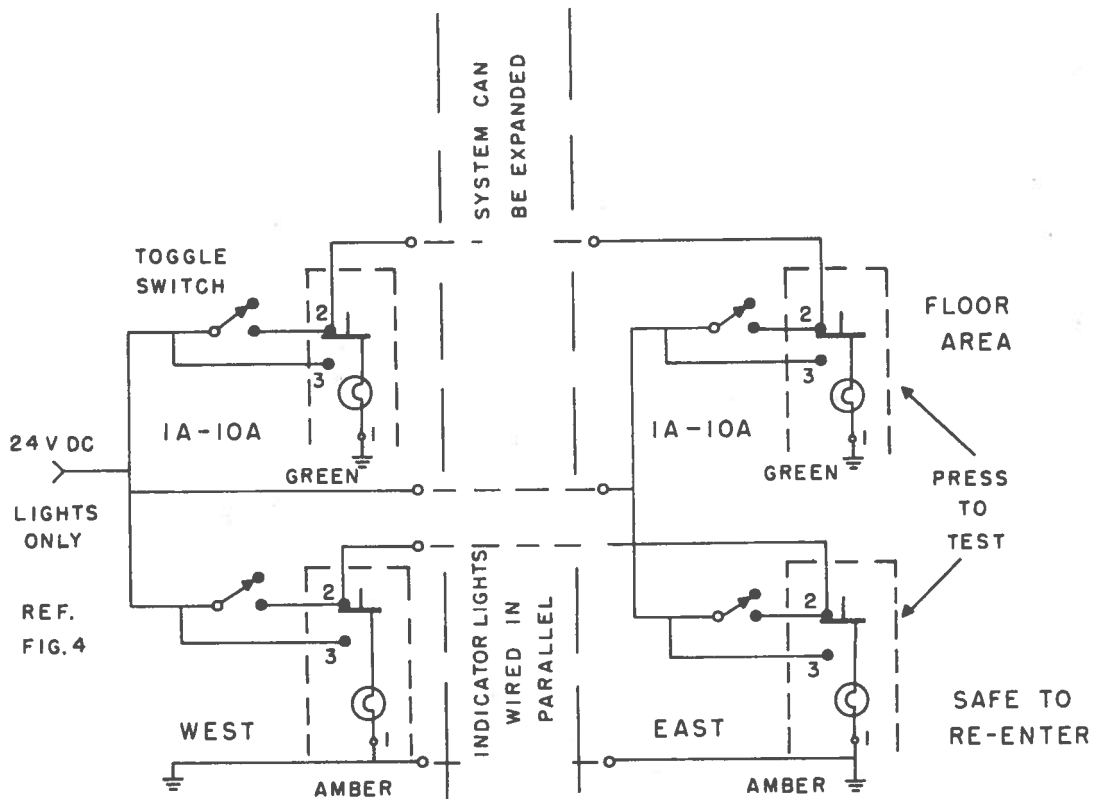


Figure 1 - Area Status Display

Power Control System (Fig. 2)

The Power Control System supplies voltage to the power relay, all the indicator lights and a modular audio compressor and audio amplifier.

This diagram shows a 24-V supply (two 12-V dry batteries in series) for the audio compressor and audio amplifier; a 60-cycle trickle charger (see Appendix II) feeding a 24-V supply (two 12-V storage batteries in series) for the lights only. The batteries and charger are external to the control box.

Power for the audio compressor and audio amplifier is fed into the control box through an 1/8-ampere fuse to contact 7 of the power relay.

Power for the lights is fed into the control box through a 5-ampere fuse to contact 9 on the power relay. From contact "9" power is supplied to the same side of paralleled "press-on" switches on the panels and then from the same side of the last switch a wire is connected to a series "press-off" switch. This in turn is run to the remaining series switches back to contact "3" on the power relay.

The power can be switched "on or off" from any panel, that is, when any one of the "press-on" switches is pushed, a "dc" voltage is picked up and relayed back to contacts 1, 2 and 4 on the power relay, energizing the relay coil. The relay is kept latched through the closed loop of the series "press-off" switches back to contact 3 on the relay. If any one of the press-off switches is pushed, the closed loop is broken and the relay coil is de-energized, switching the power off.

Power for indicator lights to all boxes is taken off contact 11 on the relay. Audio compressor and audio amplifier power is taken off contact 6 on the relay.

The intercom system provides verbal communication between boxes, and consists of an audio compressor and audio amplifier, three intercom speakers, a test speaker, "press-to-talk" switches, and "listen" and "talk" indicator lights.

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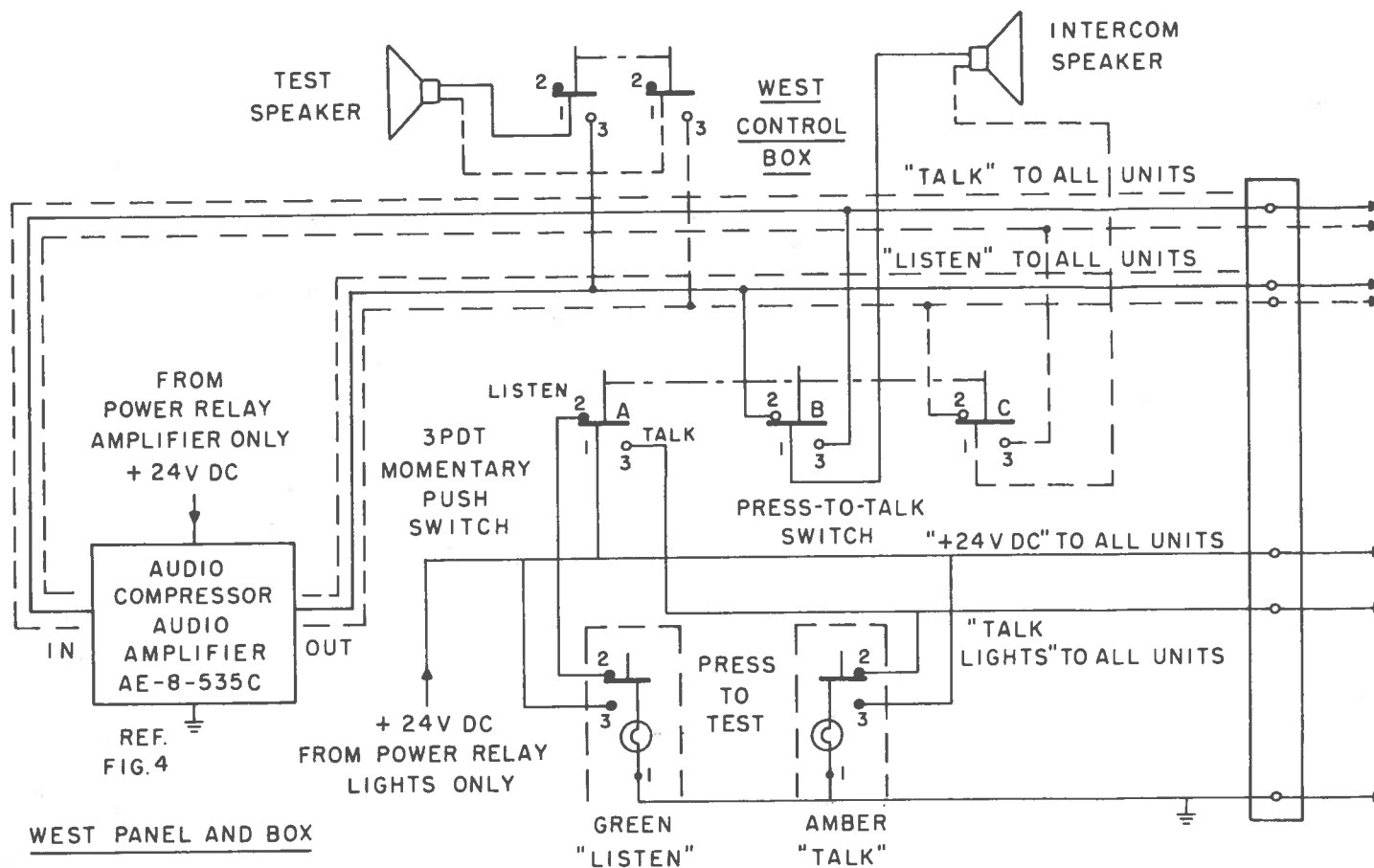


Figure 3 - Intercom System

All intercom speakers are electrically wired through "press-to-talk" switches which are normally in the "listen" position (green "listen" lights on) and connected to the output of the modular audio compressor and audio amplifier. To communicate from panel to panel a "press-to-talk" switch may be pushed which electrically connects a speaker to the input of the modular audio compressor and audio amplifier and changes the status of the "talk" and "listen" lights.

Note the manner in which the "press-to-talk" switches are wired in the diagram, Fig. 3. Each is a 3PDT momentary push switch with indicator lights and speaker connections. Since the green "talk" lights are independent on the individual panels and the amber "listen" lights are parallel on all panels, the green light on the activated panel goes out while all the amber lights come on. With this arrangement, area ambiguity for verbal communication is partially eliminated.

OPERATION

Turn-on Procedure

1. Press "power on" switch from any location.
 - Red power indicator lights and green communication system indicator lights will all come on.
2. Check to see that all other indicator lights are off; if not, switch them off.
 - The system is now ready to be used.

Turn-off Procedure

1. When the system is not in use switch off all indicator lights. (Power light and communication light will remain on).
2. Press "power-off" switch.

Set-up and Test Procedure

- A. 1. Unlatch front panel of control box.
 - a) check + 24-V for lights-on voltmeter.
 - b) check + 24-V for amplifier; press switch, mounted on voltmeter bracket; replace fuses if necessary.
2. Press "power-on" switch.
 - a) Press "press-to-test" all indicator lights.
 - b) Toggle all indicator lights.
 - c) Check operation of "press-to-talk" switch.
 - d) Replace burned bulbs or faulty switches if necessary.
3. Check modular audio compressor and audio amplifier by pushing a "press-to-talk" test switch, mounted at the lower left corner of the test speaker bracket. Turn up gain

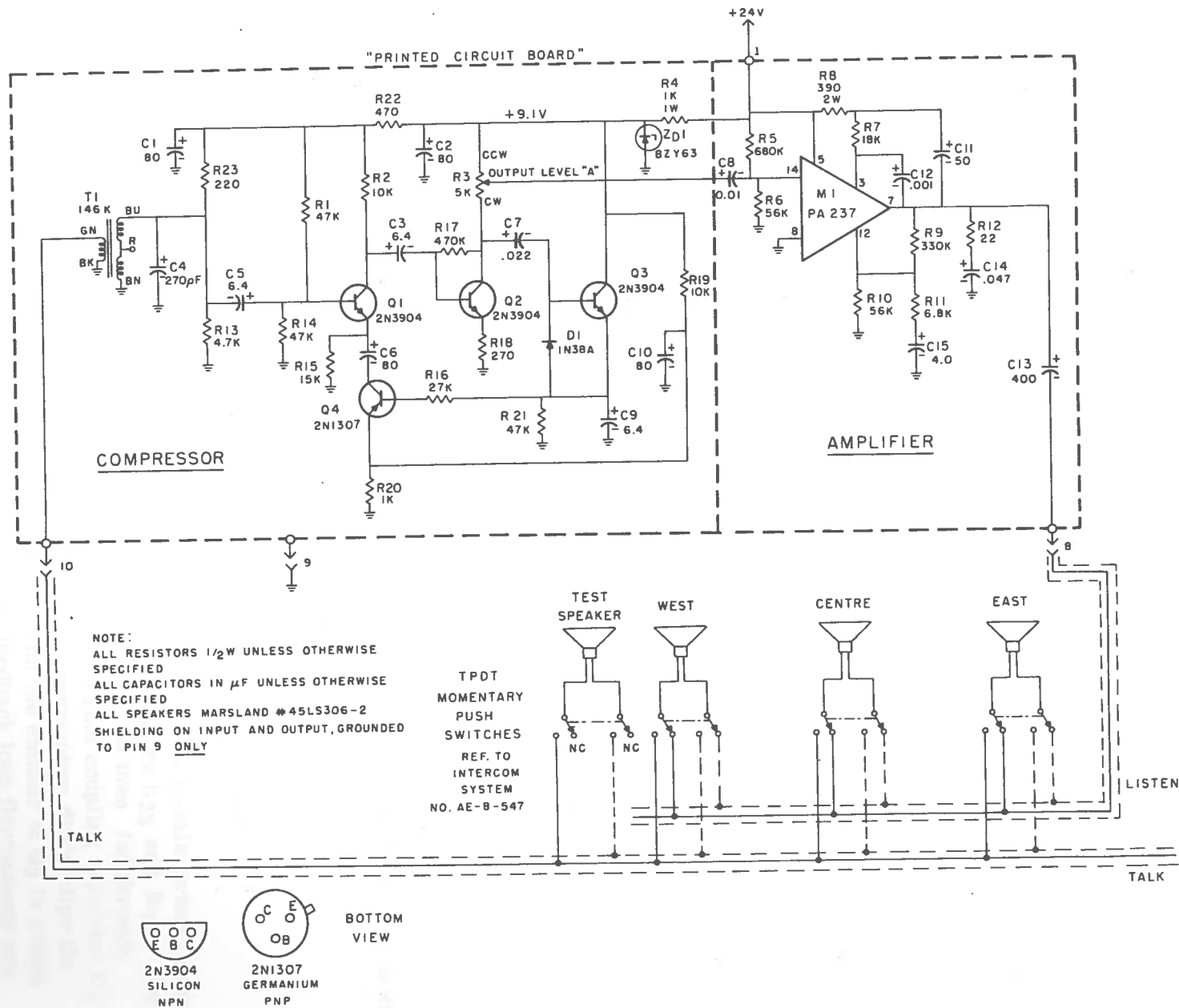


Figure 4 - Audio Compressor and Audio Amplifier Circuit Diagram

control if necessary or if modular unit is faulty, replace it. If modular unit operates satisfactorily, close and latch front panel.

4. Be sure all indicator lights are switched off (exclusive of the "power" light and the "listen" light.
5. Press "power-off" switch.

B. 1. Check subsidiary panels for "power on-off".

2. Follow procedure as above for indicator lights and switches.

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| Mr. B. McEvoy | Model Shops |
| Mr. S. K. Keays | Assistant Chief Building Warden |
| Mr. W. A. G. Kennedy | Chief Building Warden |

APPENDIX I

Audio Compressor and Audio Amplifier (Fig. 4)

Circuit Description

This circuit is composed of two parts, an audio compressor (automatic gain control) and a 2-watt audio power amplifier.

Audio Compressor

The compressor circuit is used to maintain a constant audio level.

An audio signal is fed from any of four speakers via a press-to-talk switch through an impedance matching transformer T_1 to a voltage divider network R_{23} and R_{13} . The signal is fed through C_5 to the base of Q_1 , a voltage amplifier, and then fed through coupling capacitor C_3 to the base of a power amplifier Q_2 . From coupling capacitor C_7 the signal goes to the base of Q_3 an emitter follower. D_1 germanium diode clips the negative swing of the signal. The resulting component from the emitter of Q_3 is a bias voltage which is fed to the base of Q_4 through R_{16} . The feedback loop fluctuations are reflected at the base of Q_1 as a voltage bias change. This action produces an automatic gain control.

PA237 2-W Amplifier

The signal from Q_3 is taken from the gain control potentiometer R_3 through coupling capacitor C_8 to the input of a 2-watt - PA237 - Audio Amplifier. The output may be used to drive one or all of the intercom speakers.

The audio compressor and audio amplifier are built as a modular unit and were tested in the laboratory using two one thousand foot lengths of RG58C/U co-axial cable, two speakers, and the appropriate number of switches. The inner conductor and the shield of both input and output co-axial cables must be switched simultaneously to eliminate oscillations.

A separate power supply is required for the audio compressor and audio amplifier, to improve stability. The results were satisfactory, providing low noise level and ample gain.

APPENDIX II

Battery Charging Regulator (Fig. 5)

This trickle charger utilizes silicon-controlled rectifiers (SCR) for regulation eliminating the problem of sticking or contact burning normally inherent in electro-mechanical relays.

The bridge rectifier, D_1 , delivers a dc voltage to SCR_1 in series with the battery to be charged. When the battery voltage is low, SCR_1 is triggered on through R_6 and CR_3 . In this condition the wiper voltage of R_5 is less than the breakdown voltage of zener diode Z_D and SCR_2 cannot fire. As the battery approaches full charge the voltage at the wiper of R_5 equals the voltage at Z_D and SCR_2 commences firing.

As the battery voltage rises and charging continues SCR_2 starts to fire before the input sine wave has a chance to fire SCR_1 . As voltage divider R_6 and R_7 keeps D_3 back biased and SCR_1 cannot fire, heavy charging ceases. During off periods a trickle charge continues. Heavy charging re-commences when the voltage at the wiper of R_3 is less than the voltage at zener Z_D .

APPENDIX III

1. Indicator box

dimension

weight

operating controls

- 20 x 6 x 12 inches

- approximately 5 lbs

- power control push button switches

- indicator controls

toggle and push button switches

- lamp holder press-to-test

Dialco Type 327

- speaker, Marsland No. 45LS306

- fuse extractor post 3AG.

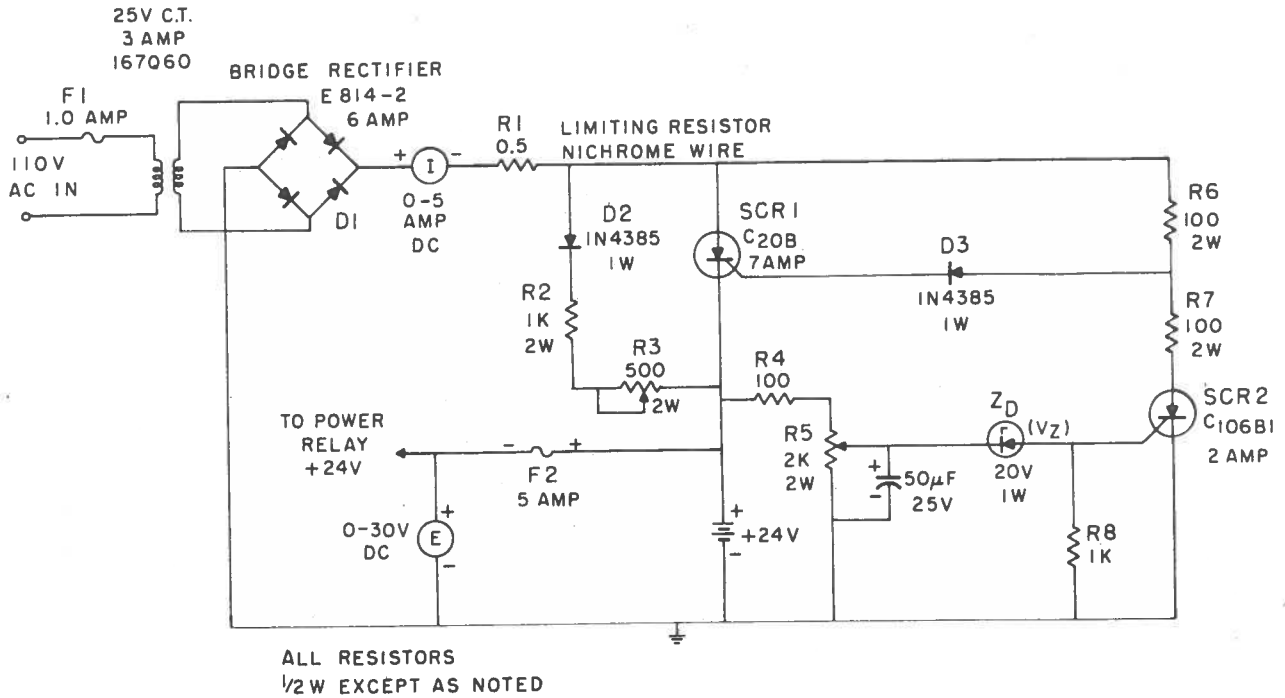


Figure 5 - Battery Charging Regulator Circuit Diagram

2. Electrical

- relay coil 24-V dc - 52 mA
- audio compressor and } 24-V dc - 15 mA
- audio amplifier }
- indicator bulb 24-V @ \approx - 40 mA
Type No. T-1 $\frac{3}{4}$
- fuse 3AG - 5 amperes - lights only
- fuse 3AG - $\frac{1}{8}$ ampere - audio amplifier

Power requirements

- present approx. 5 amperes @ 24-V dc
- future approx. 6 amperes @ 24-V dc

3. Detailed Drawing

Emergency building clearance panel box assembly AE-8-522D.

Available from Editorial Office, National Research Council of Canada, Radio and Electrical Engineering Division, Ottawa, Ontario, K1A 0R8.



Plate I - Front Panel Display

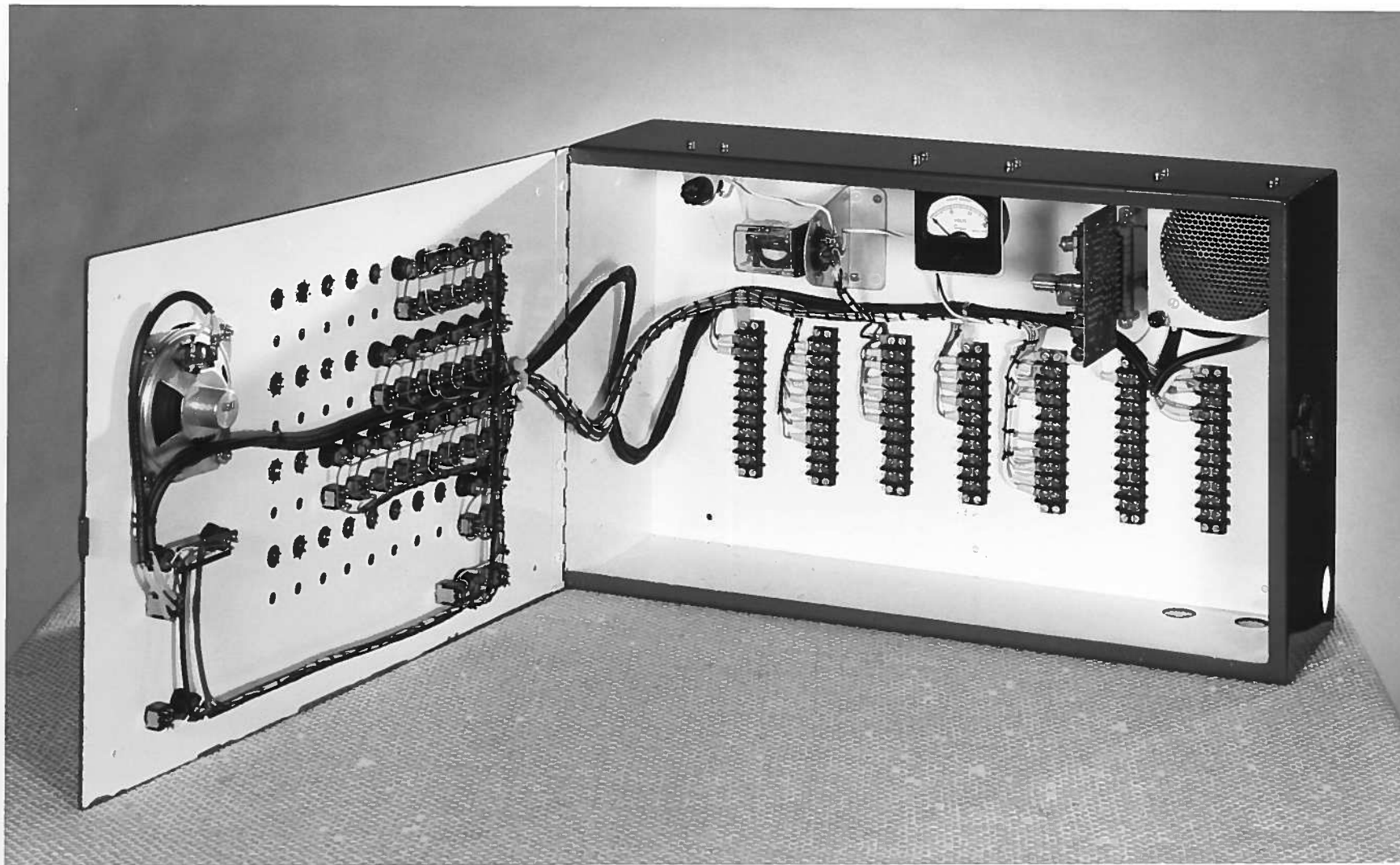


Plate II - Interior Display