Chapter 15

AUDIO WARNING UNIT, S.T.C., TYPE A1205

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LIST OF ILLUSTRATIONS

Introduction

1. The audio warning unit (*Stores Ref.* 5CZ/5651) may also be known as Electronic Fire Bell 107–LRU.61A or B the letter A or B merely denoting the type of transistors employed in the circuit. It is a component of the centralised warning system which has been introduced in Service aircraft to provide aural and visual warning of fire, serious defects in vital services, or other emergencies necessitating immediate action by the aircrew to avert disaster. The visual warning is given by the illumination of the warning light for the service affected and by the intermittent flashing of two red lights, positioned to ensure that the pilot's attention is drawn to them whenever they operate.

2. The aural warning is provided by the audio warning unit which generates a sound, similar to the clanging of a fire bell, when the unit is switched on by a connection from the centralised warning circuit. This sound is fed into the pilot's headphones through a high speed relay which breaks the normal telephone circuit and substitutes the fire bell.

Description

3. The unit consists of a circuit arrangement of six transistors. Four of these transistors are connected such as to form two multivibrator type oscillator circuits, one to represent the ringing pitch of the bell (transistors X1 and X2) the other to produce the "clapper" action (transistors X5 and X6). The remaining transistors, X3 and X4, are used in the output circuit, X3 being the output transistor, while X4, under the action of the clapper multivibrator circuit, modulates the output to produce the characteristic sound of a bell in the pilot's headphones.

4. The first multivibrator operates in the region of 1Kc/s and is fed into the output transistor, in the collector of which there is a transformer tuned to approximately 3 Kc/s.

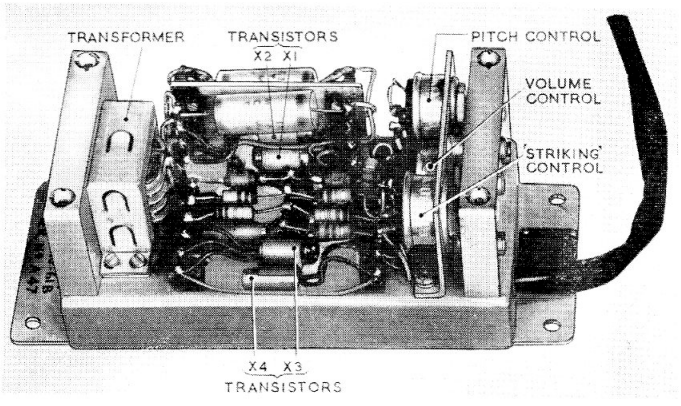

Fig. 1. View of unit from above (cover removed)

This suitably accentuates the harmonic content of the waveform and, in conjunction with the damping and resonance characteristics of the pilot's headphones, produces a sound which corresponds to the ringing of a bell. The frequency of this multivibrator is adjustable by a potentiometer which is called the PITCH control.

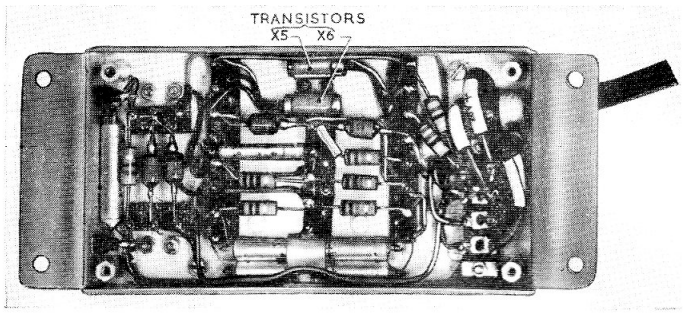

Fig. 2. Unit viewed from below

5. The "striking" component of the required bell sound is provided by the second multivibrator which operates at about 6 c/s. This oscillator is arranged to modulate the pitch oscillator output in a sawtooth fashion designed to represent the sharp strike of a mechanical clapper followed by the slow die away, or decay, before the next strike. The amount of decay between each strike is adjustable by a control referred to as the STRIKING control; this control is provided partly to take up tolerances and partly to give an adjustment of quality to suit individual requirements.

6. A third control, known as the VOLUME control limits and adjusts the maximum audio output of the unit. All the controls are accessible after removal of the cover.

OPERATION

General

7. With the circuit arrangement shown in fig. 3, a small current flow in the emitter-base circuit of each transistor causes an amplified current to flow in the emitter-collector circuit. When no current flows in the emitter-base circuit, the emitter-collector circuit does not conduct.

Pitch multivibrator circuit

8. When 20–30 V d.c. is applied to the unit via terminals A and B, the current flow in the emitter-base circuit is approximately 1 mA. Since the current gain is 50 to 100, the current in the emitter-collector circuits tries to rise to 50 to 100 mA. Obviously this cannot happen since the voltage which would exist across the collector resistors, if this current was flowing, would exceed the input voltage. What actually happens is that transistor X1 bottoms, i.e. the collector voltage rises to equal that of the emitter and settles at that value. Transistor X2 is prevented from bottoming by the action of the "starting" circuit.

9. The condition of the pitch multivibrator circuit shortly after voltage is applied is therefore, that transistor X1 is conducting maximum current and bottomed, whilst X2 is conducting less current and prevented from bottoming by the low potential existing at the lower end of resistor R18. Resistor R18 and capacitor C7 form the starting circuit, the charging circuit current for C7 causing an initial large voltage drop across R18 which holds the collector of X2 negative.

10. Since transistor X1 is bottomed, a positive potential is applied to capacitor C2 which initially carries the base of X2 positive. With its base at a positive potential, no current flows in the emitter-base circuit of X2 and, therefore, no current flows in the emitter-collector circuit; in this condition the transistor is said to be cut-off. As C2 charges, the base of X2 becomes increasingly negative until finally the emitter-collector circuit again starts to conduct. Since C7 is also nearing its fully charged condition, the lower end of R18 is at a higher potential than previously and allows the collector voltage of X2 to rise as more current flows through the collector resistor R2.

11. Capacitor C1 thus receives a positive charge causing a positive surge to be applied to the base of X1. This positive surge causes X1 to cut-off. X1 collector now falls to earth potential because no current is flowing through R3 and capacitor C2 discharges. The discharging action of C2 carries the base of X2 even more negative and the emitter-collector circuit rapidly passes maximum current.

12. The base of X1 travels negative as capacitor C1 charges until eventually X1 conducts once more. Capacitor C2 commences to charge, X2 base is carried positive and X2 cuts-off. This regenerative switching

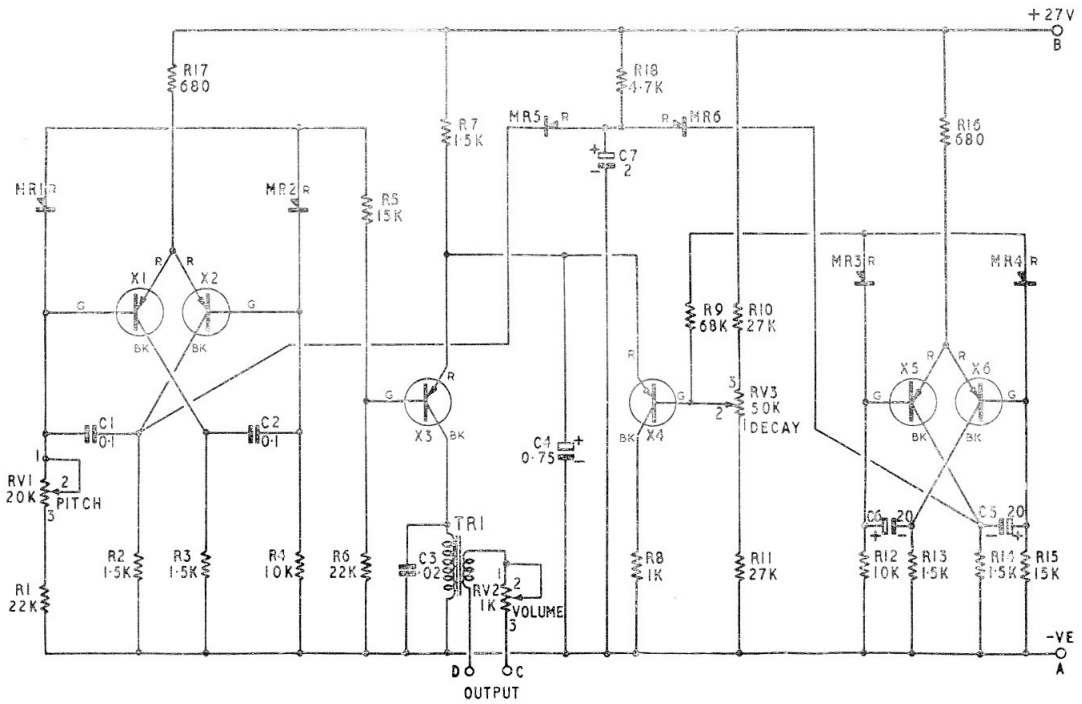

Fig. 3. Circuit diagram

procedure is repeated continuously at a frequency dependent upon the value of C1 and C2 and the base resistors of X1 and X2.

Striking multivibrator circuit

13. This circuit operates in exactly the same manner as the pitch circuit except that the values of capacitance and resistance are such that the frequency of oscillation is approximately 6 c/s.

Output and modulation circuit

14. The outputs from the transistors in each of the multivibrator circuits are passed through rectifiers MR1, MR2, MR3 and MR4. These rectifiers are, in effect, shaping diodes since they cut off the negative half of the output waveform and leave a triangular pulsing output from each transistor. The outputs from the two transistors in each multivibrator circuit are combined and, since they are anti-phase, the resulting waveform is triangular in shape but not intermittent as before.

15. The pitch circuit output is applied to the base of the output transistor X3 and varies its potential, thus varying the current in the emitter-collector circuit. If this output were not modulated by the output of the striking circuit, a steady note in the pilot's headphones would result.

16. The output from the striking multivibrator is applied to the base of a modulating transistor X4, the emitter of which is connected to the emitter of X3. The base of X4 has its potential varied by the output of the striking multivibrator and, consequently the emitter-collector current is varied also. The decay or striking potentiometer RV3, adjusts the base-bias potential of X4 which has the effect of varying the amplitude of the emitter-base current.

17. When X4 is conducting maximum current it, in effect, by-passes current from the output transistor X3, causing the output of X3 to be modulated from maximum to minimum at a frequency of 6 c/s. This modulated output is applied to the primary of the output transformer TR1, which is roughly tuned to the third harmonic (3–4 Kc/s) by capacitor C3. The reason for this tuning is that it produces a note which is more characteristic of the tone of a bell.

18. The overall operation of the unit is, then, that the pitch circuit produces a note of similar frequency to that of a bell, and is modulated to a sharp maximum, dying away to a minimum by the action of the striking circuit. The result is a sound in the pilot's headphones similar to that of a " clapper " striking a bell and the note slowly dying away.

SERVICING

19. With the unit energised, the output into the pilot's headphones should be adjusted by the three potentiometers to most realistically simulate the sound of a fire bell. The striking control (RV3) provides the correct die-away between individual strokes of the " bell." The pitch control (RV1) adjusts the tone of the " bell " while the volume control adjusts the audio output.

20. The unit should be switched on and off several times, ensuring that it operates correctly each time it is energised, i.e. both striking and pitch multivibrators operate.

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