Cancelled.

CHAPTER 11

STARTING SWITCHES, ROTAX, U1900 SERIES

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Introduction

1. Starting switches in the U1900 series have been designed to control the starting cycle of gas turbine engines, so that high peak currents, which would otherwise occur owing to the heavy load put on the motor attempting to turn the turbine from rest to full speed in less than thirty seconds, are avoided.

DESCRIPTION

2. A typical starting switch in the U1900 series is illustrated in fig. 1. The unit comprises a time delay switch of the D8400 series, three Type D6106/1 relays and a Type F1718 overspeed relay, mounted on a light alloy base plate, together with two resistors and three terminal blocks. These components are enclosed by a metal cover having cut-outs to allow access to the terminal blocks and to the relay connections. Slots in the front of the cover ensure the full circulation of cooling air.

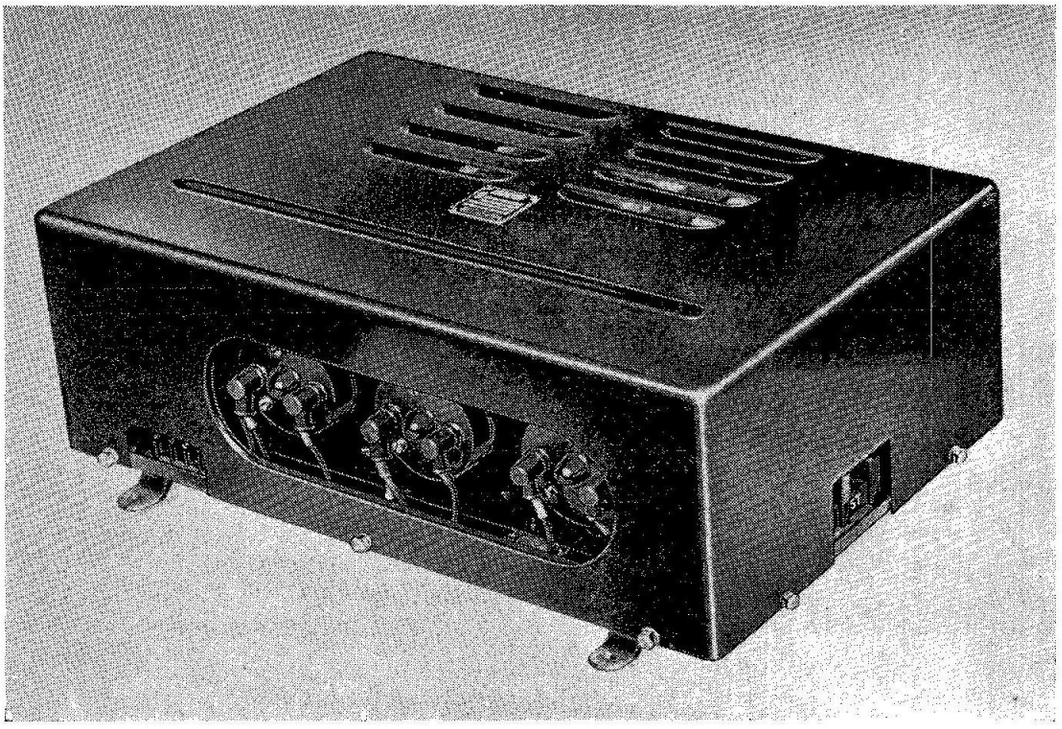

Fig. 1. Typical U1900 series starting switch

Operation

3. Starting is effected in three stages. To initiate the starting cycle, an external hold-on push button is depressed, thereby connecting a 28-volt d.c. supply (via terminal P1) to one contact of the overspeed relay and, through the first pair of contacts in the time delay switch, to the energizing coil of the first stage relay.

4. The first stage relay operates, connecting a heavy current supply to the motor via the engaging resistor, the coils of the overspeed relay and the limiting resistor. The overspeed relay is thus energized, closing the contacts and connecting the 28-volt d.c. supply (via terminal P2) to the coil of the push switch, holding the latter in the closed position. At the same time, a positive supply is fed to the winding relay of the time delay switch and to the second and third pairs of contacts in the same unit. During this stage the starter engages with the turbine.

6. After an interval, the mechanism of the time delay switch closes the second pair of contacts, thus energizing the second stage relay. The contacts of this relay close, thereby by-passing the first stage relay, the engaging resistor and the light duty series winding of the overspeed relay. The latter relay remains closed, however, owing to the current flowing through the two heavy duty series turns of the relay. The motor now runs at an increased speed.

7. After a further interval the mechanism closes the third pair of contacts in the time delay switch, thus energizing the third stage relay. The limiting resistor is then by-passed and full current is applied, via the second stage relay, the heavy duty series turns of the overspeed relay and the third stage relay, to the starter motor. The motor will now run at full speed.

8. When the turbine reaches self-sustaining speed the starter armature current decreases considerably and when it has fallen to approximately 55 amperes, the overspeed relay cuts out and thereby switches out the whole circuit. The time switch mechanism comes to rest with the first pair of contacts closed, and the circuit is then ready to commence a further cycle.

9. If the engine fails to start, the time switch mechanism will complete its run of approximately 36 seconds and the second pair of contacts will open, thus de-energizing the second stage relay and breaking the supply to the starter motor.

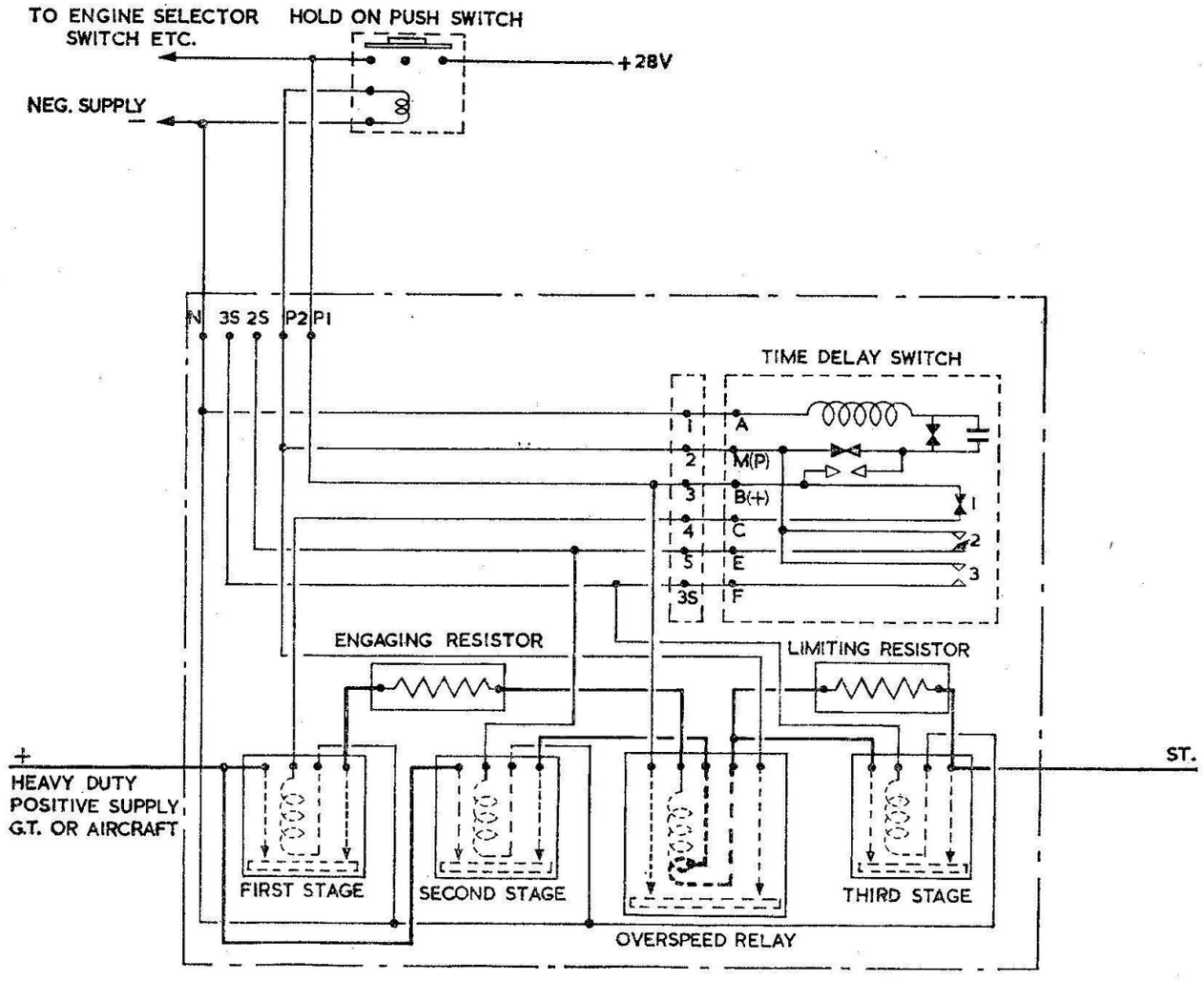

Fig. 2. Diagram of internal connections

INSTALLATION

10. Four mounting feet, riveted to the base of the unit and each drilled with a 0·256 in. dia. hole, are provided for the purpose of installation. The centres of the fixing holes form a rectangle 12·50 ins. by 11·625 ins. The unit must be mounted on a vertical surface with the resistance assembly uppermost.

Electrical connections (*fig.* 2)

11. High voltage connections, + and ST, are made via a standard three-way terminal block, one terminal not being used. 28-volt connections are made via a standard five-way terminal block.

Note . . .

Terminals 2S and 3S shown in fig. 2 are supply points for the operation of auxiliary equipment at the commencement of the second and third stages.

SERVICING

12. Remove the cover and make a visual examination of the components to ensure that they have not sustained any physical damage and that the electrical connections are secure. Ensure also that the unit is secure on its mounting. Before replacing the cover, apply the following insulation resistance test.

Insulation resistance tests

13. The insulation resistance between the following points should not be less than 0·5 megohm (for R.N.) or 5 megohms (for R.A.F.) when measured with a 250 volt insulation resistance tester:—

(1) Terminal + and terminals ST, N, and frame.

(2) Terminal ST and terminal N and frame.

(3) Terminal N and frame.

Appendix 1

STARTING SWITCH, ROTAX, TYPE U1902A

LEADING PARTICULARS

Starting switch, Type U1902A	*Ref. No. 5CZ/*
Supply voltage	112*V d.c.*
Relay operating voltage	16 *to* 29*V*
Cycle time	36 *seconds*
Overspeed relay trip current	55 *amp.*
Temperature range	—40 *deg. C to* +70 *deg. C*
Dimensions—	
Length	17·125 *in.*
Width (including mounting feet)	12·375 *in.*
Height	6·439 *in.*
Weight	26 *lb.*

1. The starting switch, Type U1902A, is identical to that described and illustrated in the main chapter. It incorporates a time delay switch, Type D8428, the operating sequence of which is as follows:—

Total motor run	36 sec. ±1 sec. from zero
Contacts 1 open	5 sec. ±½ sec. from zero
Contacts 1 close	During last 2sec. of motor run
Contacts 2 close	3 sec. ±½ sec. from zero
Contacts 2 open	30 sec. ±1 sec. from zero
Contacts 3 close	11 sec. ±1 sec. from zero
Contacts 3 open	33 sec. ±1 sec. from zero

Appendix 2

STARTING SWITCH, ROTAX, TYPE U1903

LEADING PARTICULARS

Starting switch, Type U1903	*Ref. No.* 5CZ/5574
Supply voltage	112*V d.c.*
Relay operating voltage	16 *to* 29*V d.c.*
Cycle time	36 *seconds*
Overspeed relay trip current	55 *amp.*
Temperature range	—40 *deg. C to* +70 *deg. C*
Dimensions—	
Length	17·125 *in.*
Width (*including mounting feet*)	12·375 *in.*
Height	6·439 *in.*
Weight	26 *lb.*

1. The starting switch, Type U1903, is mechanically and electrically similar to the Type U1902A, which is described and illustrated in the main chapter. It differs from the Type U1902A in that the Type D8428 time delay switch has been replaced by a Type D8466. The lead F from the connection to the Type D8466 passes directly to terminal 3S on the 5-way terminal block. Thus the terminal block to which the remaining leads from the Type D8466 are connected becomes a 5-way block. It also differs from the U1902A in that a capacitor is connected between the positive and negative energising current terminals of the first stage solenoid relay. The main characteristics of the U1903 are given under Leading Particulars.

2. The operating sequence of the time delay switch, Type D8466, is as follows:—

Total motor run	36 sec. ± 1 sec. from zero
Contacts 1 open	7 sec. $^{+\frac{1}{2}}_{-0}$ sec. from zero
Contacts 1 close	34 sec. ± 1 sec. from zero
Contacts 2 close	6 sec. $\pm \frac{1}{2}$ sec. from zero
Contacts 2 open	30 sec. ± 1 sec. from zero
Contacts 3 close	14 sec. $\pm \frac{1}{2}$ sec. from zero
Contacts 3 open	32 sec. $^{+1}_{-\frac{1}{2}}$ sec. from zero

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