B.R.33003/247
April 1968

DIESEL MULTIPLE UNIT TRAINS WITH 'BLUE SQUARE' COUPLING CODES AND MECHANICAL TRANSMISSION

PART 1
GENERAL DATA AND EQUIPMENT

THIS INSTRUCTION IS ISSUED IN THREE PARTS
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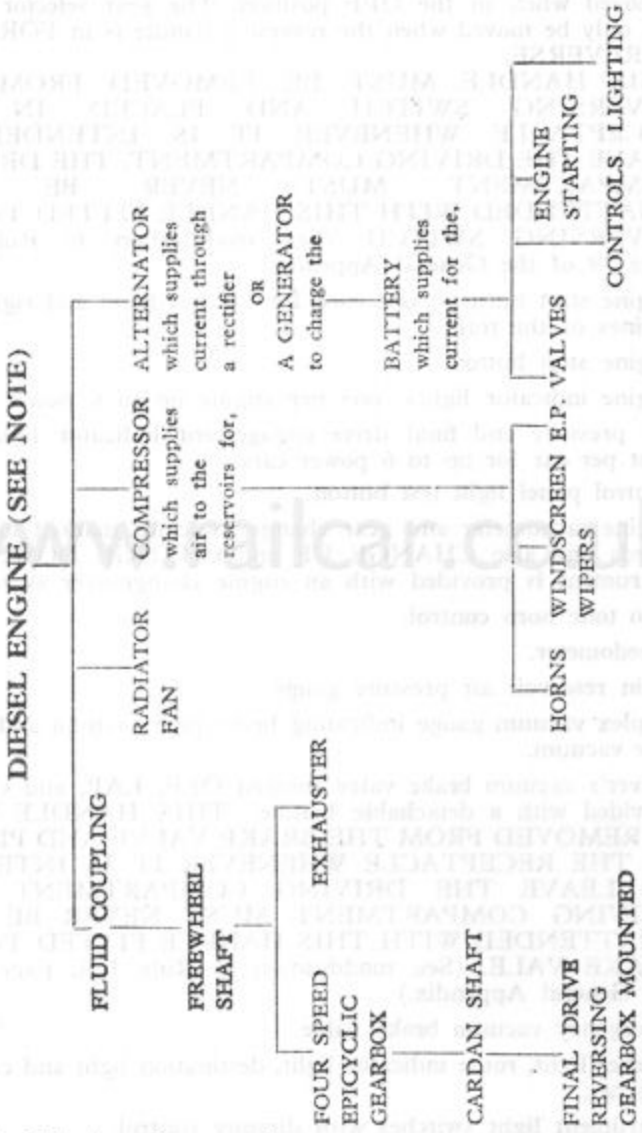
EQUIPMENT FITTED TO 'BLUE SQUARE' DIESEL MULTIPLE UNIT TRAINS WITH MECHANICAL TRANSMISSION

POWER AND TRANSMISSION SYSTEM

The majority of Diesel multiple unit trains are provided with two horizontal Diesel engines, each of which is arranged to drive through a transmission to the axle. A typical arrangement of one set of equipment is as follows:-



NOTE : Diesel engines used are:-
B.U.T. 6-cylinder 150 h.p.
B.U.T. 6-cylinder 230 h.p.
Rolls-Royce 6-cylinder 180 h.p.
Rolls-Royce 8-cylinder 238 h.p.

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DRIVING COMPARTMENT EQUIPMENT

(1) Control circuit switch, operated by a Yale type removable key.

(2) Power controller handle incorporating a Driver's Safety Device (D.S.D.).

(3) Gear selector handle marked N (neutral) 1, 2, 3 and 4.

(4) Reversing switch with detachable handle. This device selects FORWARD and REVERSE, but the handle can only be removed when in the OFF position. The gear selector handle can only be moved when the reversing handle is in FORWARD or REVERSE.
THIS HANDLE MUST BE REMOVED FROM THE REVERSING SWITCH AND PLACED IN THE RECEPTACLE WHENEVER IT IS INTENDED TO LEAVE THE DRIVING COMPARTMENT. THE DRIVING COMPARTMENT MUST NEVER BE LEFT UNATTENDED WITH THIS HANDLE FITTED TO THE REVERSING SWITCH. (See modification to Rule 126, page 39 of the General Appendix).

(5) Engine start buttons; one each for the left hand and right hand engines of the train.

(6) Engine stop button.

(7) Engine indicator lights; one per engine up to 6 power cars.

(8) Air pressure and final drive engagement indicator lights; one light per car for up to 6 power cars.

(9) Control panel light test button.

(10) Engine tachometer and gear change indicator marked in engine speeds and also CHANGE UP and CHANGE DOWN. This instrument is provided with an engine change-over switch.

(11) Two tone horn control.

(12) Speedometer.

(13) Main reservoir air pressure gauge.

(14) Duplex vacuum gauge indicating brake pipe vacuum and release pipe vacuum.

(15) Driver's vacuum brake valve marked OFF, LAP, and ON and provided with a detachable handle. THIS HANDLE MUST BE REMOVED FROM THE BRAKE VALVE AND PLACED IN THE RECEPTACLE WHENEVER IT IS INTENDED TO LEAVE THE DRIVING COMPARTMENT. THE DRIVING COMPARTMENT MUST NEVER BE LEFT UNATTENDED WITH THIS HANDLE FITTED TO THE BRAKE VALE. (See modification to Rule 126, page 39 of the General Appendix.)

(16) Emergency vacuum brake valve.

(17) Marker light, route indicator light, destination light and cab light switches.

(18) Instrument light switches with dimmer control.

(19) Windscreen wiper valves.

(20) Driver/Guard communication buzzer and driver's buzzer button.

(21) Handbrake.

(22) D.S.D. isolating valve. These valves are covered with a transparent cover, which must be removed before the valve can be operated. If this cover is removed an entry must be made in the Repair Book.

(23) D.S.D. hold over button on the right hand side of the driving compartment. On some cars this button is mounted on the right hand side of the driving desk facing upwards. GREAT CARE MUST BE TAKEN TO ENSURE THAT NO OBJECTS ARE PLACED ON THIS BUTTON AND THEREBY RENDER THE D.S.D. INOPERATIVE.

(24) Car and train light controller.

(25) Car heater switches.

(26) Fire alarm bell.

(27) Demister switch.

(28) A.W.S. switch.

(29) A.W.S. reset button.

(30) A.W.S. indicator.

(31) Loudaphone (where fitted).

(32) Handbrake indicator light (where fitted).

EXTERNAL CONTROLS AND EQUIPMENT

(1) Fuel injection pump manual control handle. This may take the form of a "T" handle mounted on the solebars or as a lever extension on the fuel pump control linkage.

(2) Panel containing local engine "Start" and "Stop" buttons.

(3) Fire alarm bell test button; one mounted on a fire alarm control box attached to each solebar.

(4) Engine isolating switch; one on each solebar.

(5) Final drive isolating plunger; one on each final drive gearbox.

(6) Unloader valve blanking cap nut.

(7) Battery isolating switch.

(8) Flame switch, under protecting cover.

(9) Graviner fire bottle detector pins for determining if fire bottles are full. One on underside of each bottle.

(10) Fuel line shut off cocks.

EQUIPMENT ON HEADSTOCK

(1) Screw coupling.

(2) Vacuum brake pipe.

(3) Vacuum release pipe.

(4) Main reservoir equalising pipe with self venting shut-off cock and "Star" valve in coupling.

(5) Jumper cables (two) with dummy sockets.

(6) Live jumper sockets (two).

FUNCTIONS OF EQUIPMENT WITH TRAIN IN WORKING ORDER AND FULL AIR PRESSURE

(1) **Control circuit switch with removable Yale type key.**

This switch provides a positive supply of current from the battery of the leading car, via the No. 6 fuse, to the driving compartment controls and the local start and stop buttons on the whole train. A negative return from all train line control equipment is also controlled by this switch simultaneously with the positive supply.

(2) **Reversing switch**

This switch is fitted with a removable handle. The handle can only be fitted and removed when the switch is in the OFF position. When the handle is moved to FORWARD or REVERSE, the gear selector handle is unlocked and gears may be selected. When the switch is moved to a FORWARD or REVERSE posiion, the positive E.M.F. from the battery, which is switched by the control circuit switch, is made available to:-

(a) Energise the appropriate forward or reverse relays on the train.

(b) Supply current for operating the D.S.D. relay.

(c) Supply current, via the D.S.D. switches, for the gear selector switches. (See Gear selector.)

(d) Supply current, via the D.S.D. switches, for the power controller switches. (See Power controller and Driver's safety device).

(e) Operate the "Engine" and "Air and Axle" indicator lights.

(3) **Gear selector**

The gear selector is provided with a control handle which is normally locked in the NEUTRAL position and cannot be moved until a direction is selected by the reversing handle.

When a direction is selected the gear selector may be moved into any of the four gear ratio positions. In each of these positions an appropriate switch is closed by cam action and current from the battery is supplied, as described in "Reversing switch" (c) above to the appropriate relay on each power car of the train for gear selection.

(4) **Power controller and Driver's Safety Device**

The power controller is provided with a handle which is hinged at the base and sprung in such a way that its normal position is slightly higher than its operating position, i.e. under the weight of the driver's hand. When the handle is depressed the following actions take place:-

(a) A switch is closed which allows current to flow from the battery, via the control circuit switch and a switch operated by the reversing switch shaft, to the operating coil of each D.S.D. relay on the train.

(b) A switch is closed which allows current to flow from the battery via the control circuit switch and a switch operated by the reversing switch shaft, to the switch contacts in the gear selector and power controller. If the handle is moved from its normal IDLING position without being initially depressed the brakes will remain fully applied, the engines

will continue to run at idling speed and the gearboxes will remain in neutral, irrespective of the gear selector position.

If the power controller handle is depressed and then moved from the IDLING position towards the full power position, four switches will be closed and opened in sequence due to cam action. The contacts of these switches when closed, allow current to pass along the train lines and energise the engine power control relays in each power car.

(5) Relays and E.P. (Electro-pneumatic) valves

As shown above, the movement of the gear selector, power controller and reversing switch allows current to pass along the train lines to energise the operating coils of various relays, situated within the control scheme of each power car. Each relay is equipped with a pair of contacts which are open when the coil is de-energised, but become closed when the coil is energised. When the relay contacts are closed they allow current to pass from the local battery to the coil of an E.P. valve. By using this method, the comparatively heavy current required by the E.P. valves is not taken from the battery of the leading car alone and the difficulties of passing this along the train lines are also avoided. It will therefore be seen that the batteries of the leading car only require to supply sufficient train wire current for relay operation, as an additional load to the local circuits.

An E.P. valve is a device which, when energised, will allow a supply of compressed air to pass into another piece of apparatus. When de-energised it will allow the air which has passed into the apparatus to become vented to atmosphere and shut off the supply of air.

The E.P. valves which become energised by the engine speed relays, gearbox relays and forward and reverse relays are each arranged to pass compressed air into the appropriate engine speeder motor (throttle motor), speed change gearbox cylinders and final drive reversing gearbox cylinders. When, for instance, it is desired to change from one gear ratio to another, the relay coil controlling the gear becomes de-energised, by having its current supply removed by the gear selector. The relay contacts then open and remove from the E.P. valve coil the current supply from the local battery. The E.P. valve then allows air in the gearbox air cylinder to become vented to atmosphere and the gearbox becomes temporarily in neutral. When the next gear is selected a switch in the gear selector closes and allows train line current to energise its relay. When the relay becomes energised its contacts close and allow current from the local battery to energise the E.P. valve for the next gear. Upon becoming energised the E.P. valve allows compressed air to pass to the appropriate gearbox operating cylinder and the new gear ratio comes into effect. The actions are identical on each power car and take place simultaneously along the train.

(6) Driver's brake valve

The driver's brake valve is of a type to be used only with the Gresham and Craven "Quick release" system. It has three positions, i.e. OFF, LAP, and ON.

When it is desired to release the brakes the engines are normally idling and the capacity of the exhausters, which are belt driven from the engines, is consequently low. For this reason the "Quick release system" has been designed.

The functions of the system are as follows:-

(a) OFF position. In this position the brakes are initially released and maintained in the OFF position. When being released, air in the brake pipe passes through the driver's brake valve and feed valve of the leading car, into the brake release pipe and then via the control valves into the high vacuum reservoirs on each car. A release of the brakes will therefore cause a temporary reduction in release reservoir vacuum. If the brake is applied and released several times in rapid succession the vacuum in the release pipe will become progressively reduced, i.e. if no time is allowed for recharging after each release. A release reservoir vacuum of less than 21in. Hg would not contribute very effectively to the release of the brakes, but if allowed to fall to a very low level would considerably increase the time of brake release by the exhausters alone. A control valve is provided on each vehicle which retains at least 19in. of vacuum in the release reservoirs at all times.

(b) LAP position. In this position the brake valve isolates the brake cylinders from the exhausters and from the atmosphere. A partial reduction of vacuum in the brake cylinders can therefore be retained without further movement of the brake valve handle.

(c) ON position. In this position the ports of the valve are arranged to admit air from atmosphere into the vacuum brake pipe. The intensity of the brake application is increased as the brake valve handle is moved further towards the ON position.

(7) Starting panel

The engine starting panel consists of one start button to start all of the left hand engines on the train and one start button to start all of the right hand engines. These buttons must not be used unless there is sufficient air pressure to illuminate the final drive indicator lights. When insufficient air pressure is available "local" starts must be made.

When a driving compartment engine start button is pressed, a relay operating coil on each power car becomes energised, via the train lines and control circuit switch, from the battery of the leading power car. Energisation of the engine starting relays causes their contacts to close and allow a current supply from each local battery to operate the starting contacts within each starter motor. The starting contactor within the starter motor directly couples its armature/field system to the local battery. This begins the starting sequence within the motor which enables the engine to be started. This action takes place on all of the right hand or left hand engines simultaneously. Arrangements are made however for a signal from the tachometer drive motor to operate a relay in such a way that the local current supply, which controls the starting contactor within each starter motor, will be open-circuited when the corresponding engine runs at its

idling speed. This ensures that the starter motor action ceases when the engine fires, even if the start button remains depressed. It also prevents damage to a starter motor if the start button is depressed when the engine is already running.

An isolation switch in the circuit, situated on the solebar, can be operated to prevent an engine from being started, when a driving compartment starter button is pressed. This switch is used when an engine or transmission component is defective and thereby prevents the engine from being started.

(8) **Stop button**

One Stop button is provided in each driving compartment. This provides a supply of current from the battery of the leading power car, via the control circuit switch, to the operating coils of the stop relays of each car on the train. When the contacts of these relays close, a supply of current from the local battery on each car energises the stop solenoids, which then operate the stop mechanism of each fuel pump governor.

(9) **A.W.S. switch**

In the driving compartments of cars fitted with B.R.-A.W.S. equipment, a switch is provided which must be ON in the leading car only. The switch consists of two pairs of contacts which open and close simultaneously. One of these switches controls the supply of battery current to the A.W.S. voltage convertor. The other switch is electrically in series with the control circuit switch. Due to the fact that the switches work simultaneously, the driving compartment controls are inoperative until the A.W.S. voltage convertor is brought into operation.

When the A.W.S. apparatus is isolated by moving the red handle into the ISOLATED position, the voltage convertor contacts remain open and a cock is closed in the vacuum brake pipe connection. Operation of the switch is still required if the equipment is isolated, in order to provide a supply of battery current to operate the controls.

It will therefore be seen that references in the text to the positive current supply to the controls being taken from the battery, via the control circuit switch, should include the A.W.S. switch as being in series with this arrangement when A.W.S. equipment is fitted. It is not necessary, however, to close the A.W.S. switch in order to enable local engine starting to be performed.

Driver's safety device *(D.S.D.)*

(10) In section (1) (d) it was shown that the power controller handle when depressed, closes a switch which provides a supply of positive current from the battery to the operating coil of each D.S.D. relay on the train. This current closes the contacts of each relay and provides a local current supply to the solenoid of each D.S.D. valve. When the solenoid is energised the brakes can be released. When the solenoid is de-energised, atmospheric air is admitted into the timing chamber of the apparatus through a small orifice. After a period of 5-7 seconds, the timing chamber and an associated chamber become sufficiently charged with air to act on the diaphragm of the emergency valve and lift it off its

seat. The opening of the emergency valve admits air into the brake pipe through a full orifice.

The driver's safety device valves are normally situated behind a transparent cover. If the valve becomes faulty the transparent cover must be removed and the isolating handle must be placed in the ISOLATE position. It will therefore be seen that the isolation of one D.S.D. valve on the train does not prevent others from working and the D.S.D. is only inoperative if all the D.S.D. valves on the train are isolated.