NM 692
AUTOMATIC PILOT

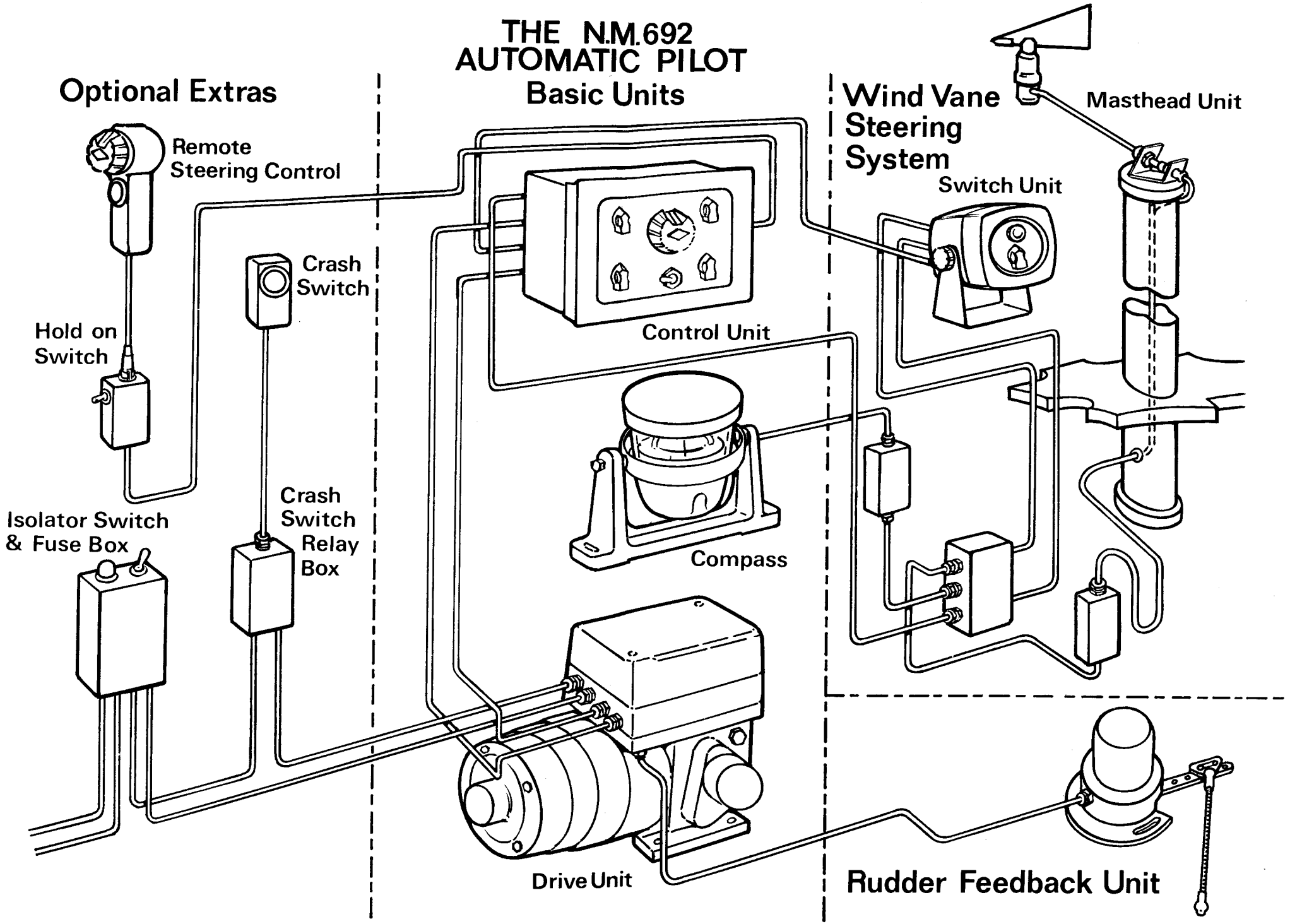
INSTALLATION & OPERATING INSTRUCTIONS

NECO MARINE LIMITED
Walton Road, Eastern Road, Cosham, Portsmouth, Hants.
Tel.: Cosham (07018) 70988. Telex 86149

The Normand Electrical Group of Companies

NM/AP-I0/1

THE N.M.692 AUTOMATIC PILOT



THE NECO NM 69/2 AUTOMATIC PILOT - INSTALLATION INSTRUCTIONS

SECTION 1 LIST OF UNITS

1.1 **THE CONTROL UNIT.** The unit is supplied with brackets (for shelf mounting) and clamping plates (for panel mounting), together with a removeable neoprene bezel trim. Two long plated bolts are supplied for shelf mounting and two short bolts for panel mounting. Cables required for inter connecting with other units are supplied fitted to a plug-in connector, screwed to the rear of the control unit casing. It is normally supplied with three cables factory fitted, and two socket connections. One socket is used when a Remote Steering Control is fitted and the other when the Wind Vane Steering System is fitted. The blanking plugs should **not** be removed unless a Remote Steering Control and/or a Wind Vane Steering System are fitted. Care should be taken that the connectors in the plug-in unit are not damaged, and that it is always plugged in so that the cables emerge towards the centre of the control unit. Apart from panel illumination lamps, which run at battery voltage (and are accessible from the control unit panel), the unit is identical for both 12 and 24 volt D.C., supplies and may be used with a Drive Unit of either voltage. Should the unit be sited in an exposed position some arrangements should be made for covering when not in use.

	ins.	mms.
A	9⅝	244
B	12¾	324
C	5 3/16	132
D	6⅝	168
E	4	102
F	1⅜	35
G	2	51
H	¼	6.3
J	½	12.7
K	7/16	11
L	1	25.4
M	1¾	44.4

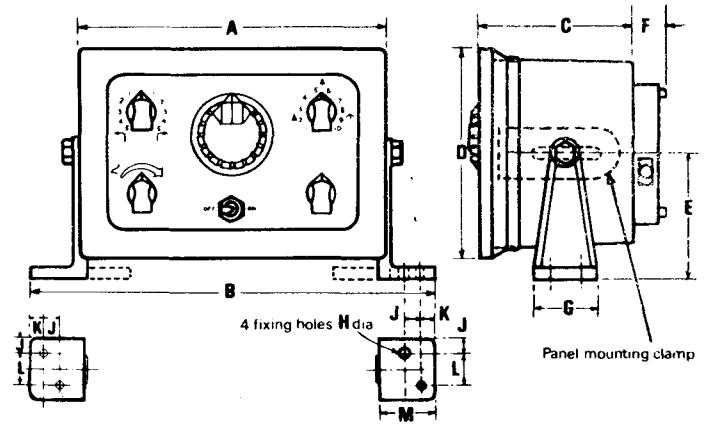
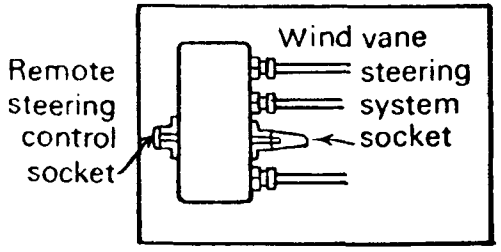
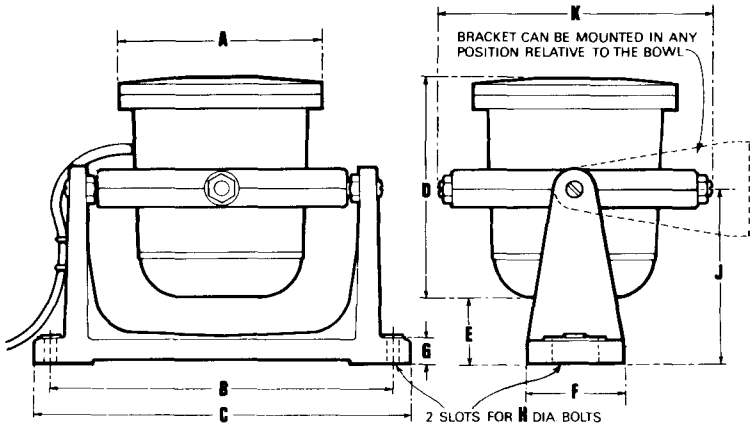


FIG.1 CONTROL UNIT DIMENSIONS



NOTE
A rubber plug is fitted to the R.S.C. socket. The specially wired plug in the wind vane socket should NOT be removed unless the wind vane system is fitted.

1.2 **COMPASS UNIT.** The Compass Unit is based on the well proven NM 3 Neco Magnetic Transmitting Compass. It can be mounted in an exposed position since the unit is watertight and tested to withstand temperatures of +60° to -20° centigrade and thus should be possible to find a suitable site where magnetic deviation will be small. The gimbal bracket has slotted holes to allow the compass to be slewed in order to compensate for coefficient 'A' deviation. 1 metre of tinsel cable is fitted to the compass, with the lead ends terminated in crimped connectors for direct insertion into a connector box. This length of cable should not be shortened.

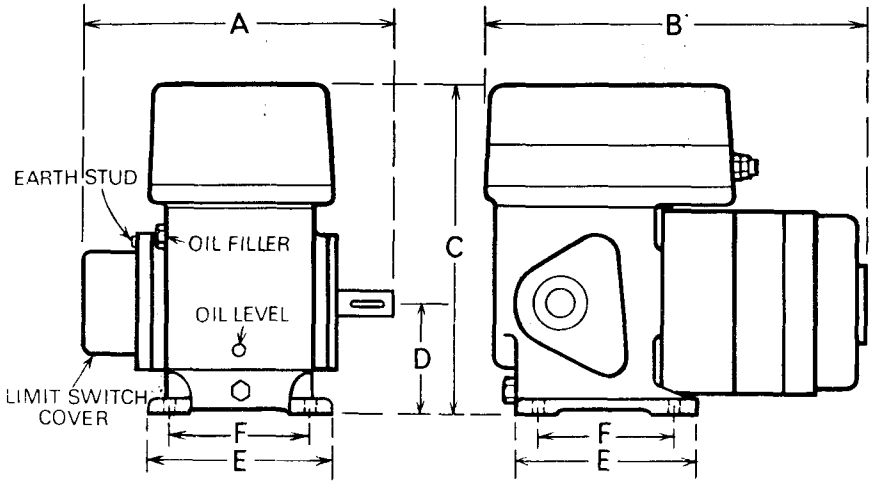


	ins	mm
A	5 1/8	130
B	8.66	220
C	9 7/16	240
D	5 1/21	140
E	1 5/8	41

	ins	mm
F	2 3/8	60
G	5/8	16
H	1/4	6
J	4 3/8	111
K	7	178

FIG.2 COMPASS DIMENSIONS

1.3 **NECO Electric DRIVE UNIT** consisting of a Neco 12 (or 24) volt DC 1/8 h.p., ventilated motor, driving a 5/8" diameter shaft at 17½ or 35 r.p.m. through a type S.W. gearbox. The shaft is milled for a 3/16" x 3/16" x 1" key. For safety in transit the gearbox is supplied drained of oil. Incorporated in the gearbox is an electro magnetic multi-tooth clutch, the feedback transmitter and limit switches. Under the top cover of the unit are located two armature relays, their suppression circuitry, all fuses and a sixteen way connection terminal block. In the 24 volt unit the motor windings are appropriate to the voltage, but a dropping diode is incorporated in the supply to the electronic units, which are common to both voltages. Motor Units are interchangeable. Battery leads are factory fitted.



	A	B	C	D	E	F
ins.	9¼	12	10¼	3¼	5½	4½
mms.	235	305	261	82·6	140	114

Approximate weight: 40 lbs (18kgs)

FIG.3 DRIVE UNIT DIMENSIONS

1.4 **CONNECTOR BOXES.** One is supplied for connecting No. 1 Cable from the control unit to compass.

1.5 **REMOTE STEERING CONTROL** (optional extra). This unit is supplied fitted with 5 metres of trailing cable, the end of which terminates in a plug type R.P.C. 12P-6 for fitting into the Remote Steering Control Socket on the Control Unit, Plug-in connector. When an extra length of cable is required for the R.S.C. a special connector box fitted with "hold-on" switch facility is supplied with the extra cable.

1.6 **HOLD-ON SWITCH** (optional extra) Is supplied for use with the Remote Steering Control. The Hold-on Switch is fitted to a special connector box. The switch in the 'ON' position allows the operator to use the Remote Steering Control irrespective of the press-on switch fitted to the Remote Steering Control.

1.7 **RUDDER FEEDBACK UNIT** (optional extra) The Rudder Feedback Unit with mechanical linkage to the rudder arm, is available for 'sloppy' steering mechanisms and for hydraulic systems subject to slip. Electrical leads from this unit replace those from the normal feedback transmitter at the drive unit. For details of installation see separate instructions, Section 6.

1.8 **'CRASH' SWITCH** (optional extra) The 'Crash' Switch is an emergency device by which means the Automatic Pilot may be switched off at a remote station, for example - a flying bridge. The 'Crash' switch comprises two units, the push button unit for mounting at the remote station, and the relay unit for mounting near to the drive unit of the automatic pilot. A single operation of the push button switch will cause the relay unit to switch the pilot out of operation, a condition which will remain until the system is reset by switching 'Off' at the Control Unit. Switching 'On' at the Control Unit will restore normal pilot operation.

1.9 **COMPASS ADJUSTMENT AID.** This device, normally required for Compass Adjusters and Installation Contractors, is temporarily connected to the Automatic Pilot. It visually indicates when the Pilot is in its 'neutral' position. It provides a rapid method of obtaining compass headings for precise compass adjustment.

1.10 **ISOLATOR SWITCH BOX** (optional extra). A fused switch box, with 'On' indicator lamp for connecting the automatic pilot power supply leads to the battery supply.

1.11 **WIND VANE STEERING UNIT** (optional extra). This unit can be fitted to all NM 692 Systems

1.2 **SPROCKET AND CHAIN DRIVE** The Neco NM692 Automatic Pilot applies rudder by turning some rotary part of the steering mechanism by sprocket and chain driven by the Drive Unit. For normal steering installations, where the rudder movement is restricted to approximately 40^{o} either side of amidships the ratio of sprocket teeth to pinion teeth should be such that the output shaft of the drive unit is rotated through 4½ turns (9 turns when 35 r.p.m. motor is used) or slightly more, when the rudder is moved from hard-over one way to hard-over the other way.

As the Drive Unit also contains the Feedback Transmitter and Limit Switches, it is important that when selecting the sprocket ratio the operation of the Limit Switches is taken into consideration. They are factory set to operate at 2 turns either side of the neutral position of the 17½ r.p.m., Drive Unit shaft, and 4 turns either side of the neutral position of the 35 r.p.m., Drive Unit shaft.

Thus when deciding on the sprocket ratio it is important that the chain drive arrangement is such that the drive unit shaft rotates through at least 2¼ turns between the amidships position and the point at which the rudder comes against each of its stops, or 4½ turns when the 35 r.p.m. drive unit is used. Whilst the limit switches must cut off power to the drive unit before the rudder reaches its stops, it is nevertheless desirable that the switches should not be constantly overridden when steering manually.

VARIATIONS FROM NORMAL - Although 4½ turns (9 turns when a 35 r.p.m. drive unit is used) of drive motor shaft are standard there are cases where more turns may be desirable. By increasing the sprocket ratio the torque available at the rudder will increase although this will reduce the rate of application of the rudder. There is, however, a certain class of steering mechanism, designed for constant torque at the steering wheel regardless of rudder position, with which it is very desirable that the sprocket ratio should be increased. Mathway steering, for instance, is based on this principle. These systems are non-linear in operation and result in rather coarse i.e., sensitive steering in the range near amidships. It is in this range that the automatic pilot normally functions and increasing the sprocket ratio so as to give up to 6(12) drive unit turns may be beneficial. ½" Pitch Chain is recommended, particularly if the automatic pilot is called upon to work near the limit of its power. Nevertheless where space is limited, and the steering gear light 3/8" Pitch Chain has proved acceptable. See Tables A & B.

TABLE A (17½ r.p.m.)

Number of teeth on Steering Gear Sprocket	Steering Gear Turns (Hard over to Hard over)															
	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	4¼	4½	4¾	5
21																25
23															25	
25							13	15	17	17	19	21	23	25		
38			13	15	17	19	21	23	25					38		
57	13	15	19	21	25											
76	17	21	25													
	Number of teeth on Drive Unit sprocket															

TABLE B (35 r.p.m.)

Number of teeth on Steering Gear Sprocket	Steering Gear Turns (Hard over to Hard over)											
	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	5	6
25											13	15
38							13	13	15	17	21	25
57				13	15	17	19	19	21	25		
76	13	15	17	19	21	23	25					
	Number of teeth on Drive Unit sprocket											

N.B. 1 The above tables are derived from the formula:—

No. of teeth on Drive Unit Sprocket =

$$\frac{\text{No. of teeth on Steering Gear Sprocket X Steering Gear Turns (H.O. to H.O)}}{9 \text{ (or } 4\tfrac{1}{2} \text{)}}$$

N.B. 2 A greater sprocket ratio (i.e. fewer teeth on drive sprocket and/or more teeth on the steering gear sprocket) may be required in craft with "lively" steering characteristics or with Mathway steering gear. (See page 5.)

SECTION 2 SITING THE UNITS

2.1 RADIO FREQUENCY INTERFERENCE

It is important when deciding on the position of the automatic pilot units, and planning the run of inter unit and power supply cables that consideration should be given to the proximity of the radio transmitter and its associated cables to them.

Although the NM692 is fully suppressed against any reasonable internal or external radio frequency it is possible for R. F. to be induced if pilot cables are run in the same loom as the radio power carrying or aerial cables, or those containing general ships wiring, as even these can act as a Radio Receiver Aerial and cross coupling will be inevitable.

Therefore as a general rule all pilot inter unit and power supply cables should be run in separate looms and as far away as possible from other cables.

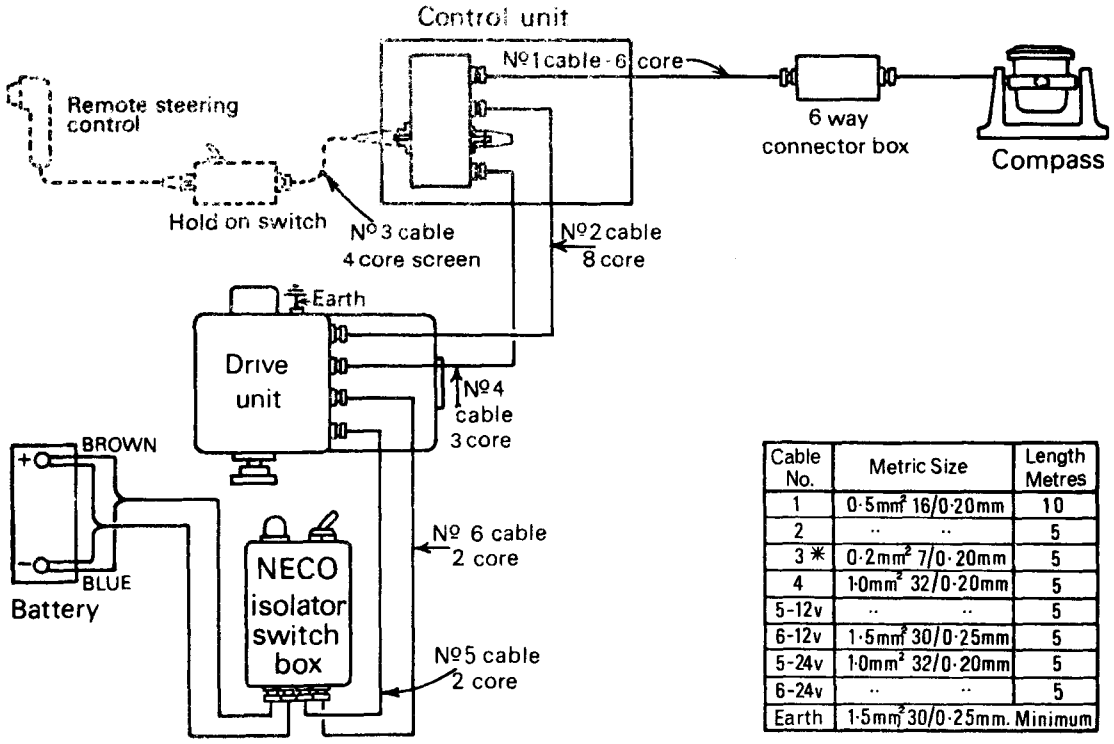
2.2 **CONTROL UNIT.** This may be either bracket mounted or panel/bulkhead mounted. In the former case the clamping plates are not required and the two longer bolts should be used. For panel/bulkhead mounting the neoprene bezel trim is stripped off, and the clamping plates and shorter bolts are used.

The Control Unit must be reasonably accessible to the helmsman and preferably within his range of vision whilst looking out ahead. In many cases it need not actually be within reach of the steering wheel and the helmsman should not have to lean across the wheel in order to reach the unit, particularly if the wheel is of the spoked variety. There is no restriction regarding the proximity of the unit to the steering compass.

2.3 **COMPASS UNIT.** A site should be chosen, either above deck or below where:

a. Minimal deviation will be experienced.
b. There is little risk of magnetic or ferrous material being lodged in the proximity of the compass.
c. Movement of the craft is minimal. Subject to (a) this will normally be low down and near the centre line of the craft.
d. There is no restriction to the movement of the compass within its gimbals.
e. The unit is unobtrusive and unlikely to be touched by members of the crew.

2.4 **CONNECTOR BOXES.** These should preferably be sited under cover. Securing holes are accessible when the cover plate is removed. One connector box is normally supplied and is used to connect No. 1 cable to the Compass.



Cable No.	Metric Size	Length Metres
1	0·5mm² 16/0·20mm	10
2	.. ..	5
3 *	0·2mm² 7/0·20mm	5
4	1·0mm² 32/0·20mm	5
5-12v	.. ..	5
6-12v	1·5mm² 30/0·25mm	5
5-24v	1·0mm² 32/0·20mm	5
6-24v	.. ..	5
Earth	1·5mm² 30/0·25mm. Minimum	

FIG. 4
CABLE INTERCONNECTIONS N.M. 69/2

2.5 **DRIVE UNIT.** This must be sited so that connection by roller chain to some rotary part of the steering gear is possible, with sufficient clearance around the steering gear shaft for the sprocket to be fitted. It can be orientated so that its output shaft is facing either forward or aft. Before placing the unit in position the gearbox should be filled with the lubricating oil (Castrol 'MAGNA') provided, by unscrewing the small plug on the end of the gearbox, and removing the filling plug fitted to the gearbox. Fill the gearbox until oil flows from the oil level plug, replace plugs. As supplied from the factory, the output shaft, viewed from its exposed end, rotates anticlockwise when applying starboard rudder. If reverse rotation of the output shaft is required the wiring connections should be as shown in Fig. 9. It should be noted that some parts of the steering gear shafting may rotate in a direction contrary to that of the ships wheel.
The Drive Unit should be mounted on a horizontal platform which is sheltered from rain and spray and which is reasonably accessible. There should be clearance over the top cover to permit its removal for the servicing of relays and replacement of the fuses and it is desirable that the limit switch cover should be accessible. The robustness of the platform should be commensurate with the weight and power of the drive unit. Slotted holes, or shims, to permit adjustment of chain tension, must be provided. The unit should not be finally bolted down at this stage, NOR SHOULD THE CHAIN DRIVE BE CONNECTED.

2.6 **'CRASH' SWITCH.** The push switch unit should be mounted in an accessible position at the remote station. If the chosen position is open to the weather, it is recommended that the lid of the unit be sealed after wiring and testing with a non-hardening, easy break sealant. The relay unit is connected into the 1mm^2 32/0.20mm control power cable linking the battery with the terminals 1 and 2 on the drive unit connector block, and should be mounted in a position convenient to this cable. The unit may be mounted at any aspect, making use of the feet on the outside of the box.

SECTION 3 CONNECTING UP THE AUTOMATIC PILOT

3.1 **WARNING.** The Control Unit should not be 'opened up' by other than authorised servicing personnel.
Attention is drawn to Section 2.1 Radio Frequency Interference.
Starting from the Control Unit all cables should be routed as described hereafter and securely cleated. Care should be taken to ensure that no undue strain is placed on the cable glands. Lengths of the cables are not critical but power-carrying leads should be no longer than necessary.
CAUTION. To avoid rotation of the cables and possible strain it is recommended that all cable glands be tightened BEFORE connecting up the lead-outs. Referring to the Cable Interconnections diagram Figure 4.

3.2 **No. 1 CABLE** (6 core 0.5mm^2 16/0.20mm unscreened)
The BLACK lead of this cable is not used and may be cut short. The cable is 10 metres long and should be led to the 6 way connector box sited close to the Compass The cable is cut at this position and connected through the connector box as shown in Figure 5. The trailing lead from the Compass is 1 metre long and should *not* be shortened. The lead ends of this cable are terminated in crimped connectors for direct insertion into the 6 way connector box. The trailing lead from the Compass should *not* be connected at this stage.

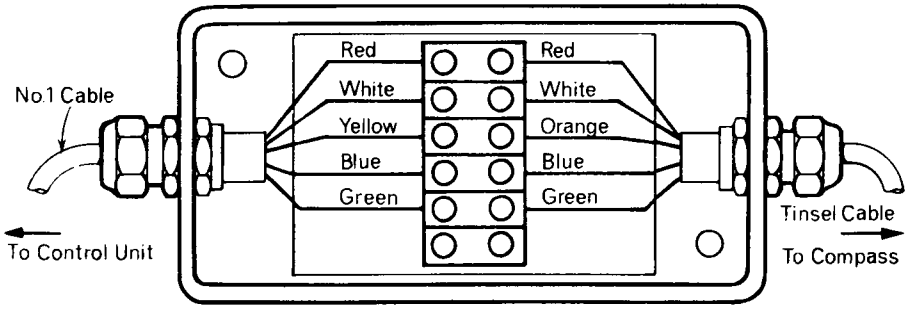
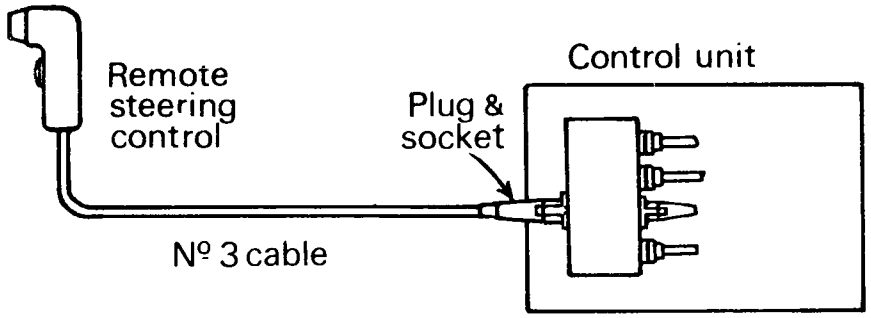


FIG.5 COMPASS CONNECTOR BOX

3.3 **No. 3 CABLE** (4 core 020mm). Only supplied when a Remote Steering Control is fitted. 5 metres of cable is supplied as standard fitted to the Remote Steering Control with the necessary plug for direct connection into the plug box on the rear of the Control Unit as shown in Figure 6.



Note: care should be taken that the R S C. plug is not inserted into the wind vane socket.

FIG. 6

3.4 If a 'hold on switch' or extra cable are provided for the Remote Steering Control a special box fitted with 'hold on switch' is supplied and is connected as shown in Figure 7.

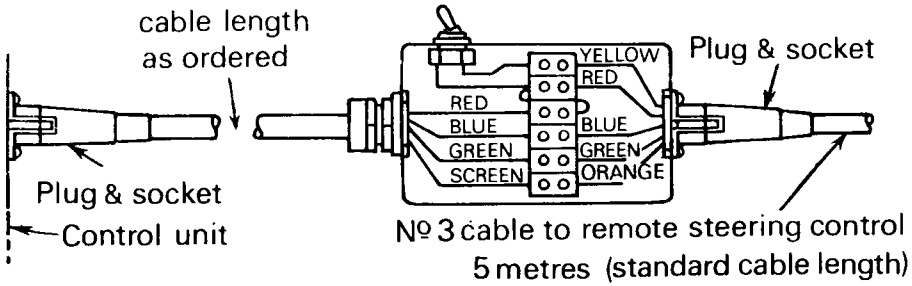


FIG.7

3.5 **No. 2 CABLE** (8 core 0.5mm^2 16/0.20mm) and **No. 4 Cable** (3 core 1mm^2 32/0.20mm are run to the drive unit; No. 4 cable is a power carrying cable.

Remove the top cover of the Drive Unit and cut No. 2 Cable and No. 4 Cable to the required length, leaving sufficient slack to allow the Drive Unit to be moved by small amounts when the roller chain is eventually connected. It is recommended that the lead-outs be tinned.

Decide whether standard rotation or Reverse rotation is required. ("Standard' Rotation is such that, to apply starboard rudder, the output shaft must rotate anticlockwise when viewed from its exposed end).

Figure 8 shows the order in which the lead-outs should be entered into the 16-way terminal block for standard rotation, Figure 9 for reverse rotation. If, however, a Rudder Feedback unit is to be fitted, connections should be as in Figure 8 for both Standard and Reverse rotation.

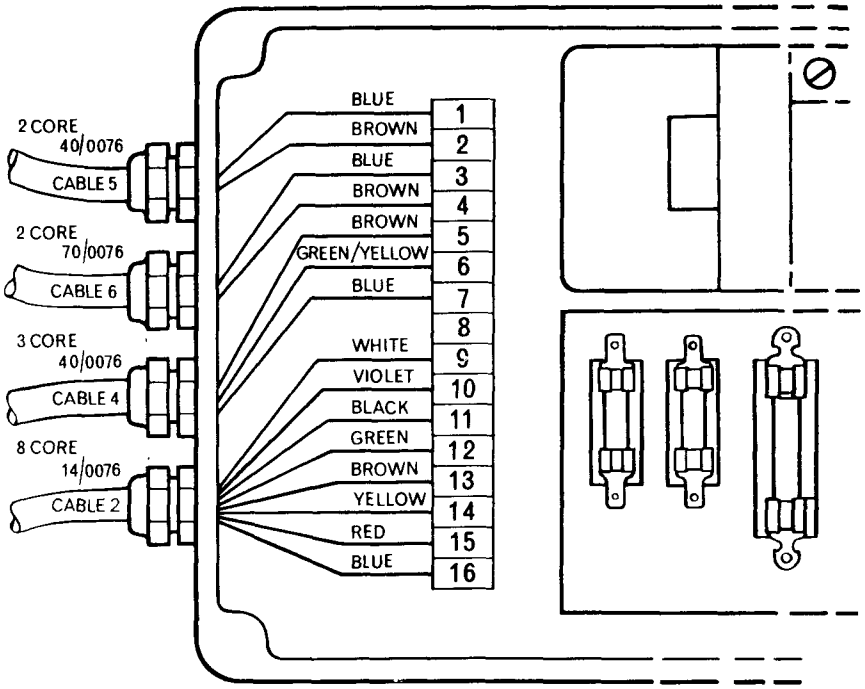


FIG.8

Standard Rotation

3.6 **REVERSE ROTATION OF DRIVE UNIT.** In some installations it may be necessary for the Drive Unit output shaft to rotate in the reverse direction. No. 2 Cable from the Control Unit to the Drive Unit is then connected in accordance with Figure 9. This alteration may necessitate the resetting of the limit switches. These are located under the cylindrical cover adjacent to the earth stud of the Drive Unit.

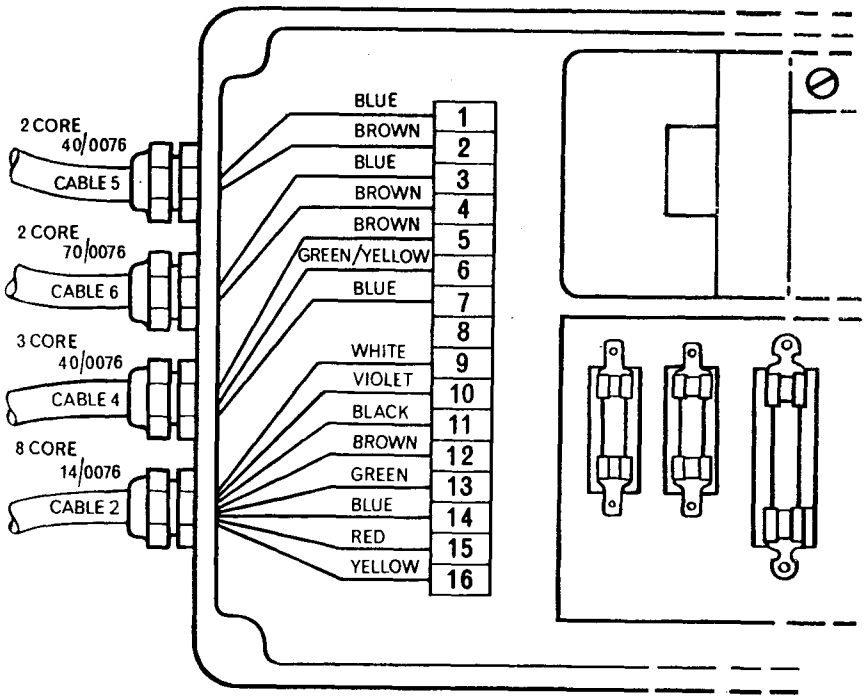


FIG.9

Reverse Rotation

3.7 **POWER SUPPLIES.** The Drive Unit is supplied with two pairs of power leads factory fitted, as shown in Figure 4. No. 5 cable – The Control Power Cable and No. 6 – The Drive Unit Power Cable. Nos. 5 and 6 cable must **not** be connected to independent batteries, unless either the negative or positive terminals of the two batteries are common. It is recommended that both these cables should be capable of being isolated, each with its own Isolator Switch (10 amp) An Isolator Switch Box can be supplied as an optional extra and is wired up in accordance with Figure 10.

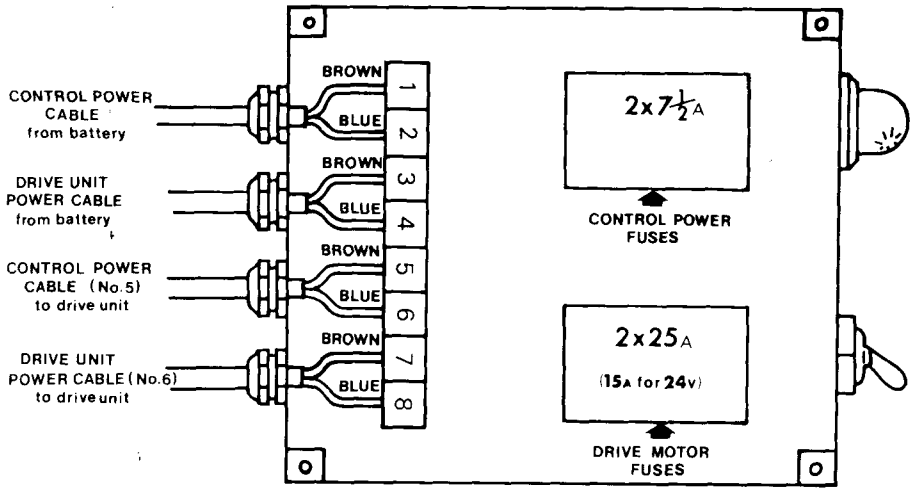


FIG.10 ISOLATOR SWITCH BOX

3.8 **No. 5 CABLE, CONTROL POWER CABLE** (2-core 1mm^2 32/0.20mm) must invariably be routed direct to the battery terminals and never via a cable which is supplying power to the drive unit or other circuits, as shown in Figure 4. Failure to do this will result in poor pilot performance, as the pulse of current taken by the pilot motor by switching (together with the resistance, and possibly more important, the inductance of the cable) can produce a voltage drop of several volts for a few milli-seconds over only a short length of cable, and will cause relay flutter. The Control Unit Illumination is not controlled by the Off/On switch; this can be switched off by turning the brilliance control hard anti clockwise.

3.9 **No. 6 CABLE, DRIVE UNIT POWER CABLE** (2-core 1.5mm^2 30/0.25mm for 12 volt installations) or (2-core 1.0mm^2 32/0.20mm for 24 volt installations) may be run to the battery direct or through a distribution board capable of handling 30 amps (12 volts installations) or 15 amps (24 volt installations). In either case it is recommended that this be isolated by a separate switch. In the event of a relay sticking in the On position it is possible for the Drive Unit to run even with the Control Unit switched Off. By fitting the Isolator Switch in the Drive Unit Power Cable, possible damage to the Drive Unit can be prevented.

3.10 **THE EARTH STUD.** (located on the side of the Drive Unit) must now be connected to the Ship's Earth or to the terminal of the battery which is connected to the Ship's Earth.

3.11 **'CRASH' SWITCH** (if fitted) Disconnect the battery, cut the 2-core 1.0mm^2 32/0.20mm cable No. 5 cable at the chosen position and connect the section of cable from the Control Unit Isolator into terminals 1 and 2 of the Relay Unit, connect the section of cable from the Drive Unit into terminals 5 and 6, and using a length of 0.5mm^2 16/0.20mm link terminals 3 and 4 on the Relay Unit to terminals 3 and 4 on the Push Button Unit. Figure 11.

Terminal 7 is used only with Solenoid Valve-operated Hydraulic Systems. (See section 7)

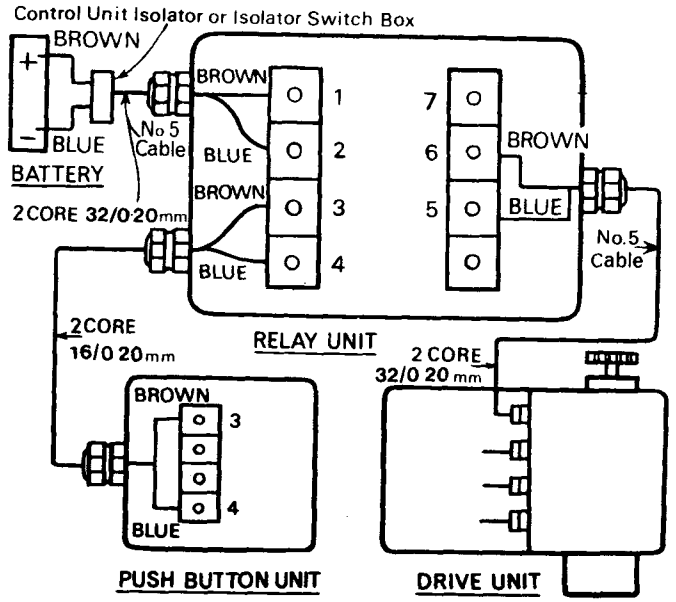


FIG.11 CONNECTIONS FOR CRASH SWITCH MK.2.

SECTION 4 LINING UP THE SYSTEM

4.1 **LINING UP ON INSTALLATION** with Feedback unit installed in the Drive Unit – see separate instructions for Rudder Feedback Units.

1. Ensure that the chain drive is disconnected from the Drive Unit.

2. Check that (a) No. 1 cable from the Control Unit is connected into the appropriate connector boxes as shown in Figure 5.

   (b) That the railing cable from the Compass has NOT been connected into the connector box.

3. Position the Controls as follows –

   Sensitivity – Maximum (fully clockwise) } See
   Rudder Control – 10 } Figure
   Trim Control – 0 } 12

4. Ensure that the Drive Unit output shaft is free to rotate. Switch 'ON' the Drive Unit and Control Unit Isolator switches. Switch 'ON' the Automatic Pilot at the Control Unit.

5. The Drive Unit output shaft should now run to its 'neutral' position. Using the Trim Control, check the direction of rotation, return to 0. Mark the output shaft so that it can be returned to this position if inadvertently rotated. It is vital that the controls be set exactly as stated in 2 above.

6. Switch 'OFF' the pilot at the Control Unit and switch 'OFF' both Isolator Switches. Lock the rudder exactly at amidships. Connect up the roller chain to the Drive Unit pinion, with shaft in its 'neutral' position, and the steering gear sprocket drive.

   Bolt the Drive Unit hard down so that the chain tension is similar to that in a new bicycle chain. **Manually check operation of the limit switches. See Section 4.3**

7. Free the steering gear and then close the Isolator switches and Control Unit switch. The electro-magnetic clutch should then engage and lock the pilot and steering gear in the amidships position. Move the Trim Control and Check that the rudder moves accordingly.

8. Switch 'OFF' the pilot at the Control Unit.

9. Now connect the trailing cable from the Compass into the 6 way terminal block as shown in Figure 5. It should be noted that these leads are terminated in crimped connectors for direct insertion into the 6 pin connector box. It is NOT recommended that this length of cable be shortened.

10. Check that the craft is in a berth not subject to magnetic interference, e.g., is not alongside a steel hulled vessel, steel pontoon, etc., and set the Course Setter on the Control Unit to ship's head magnetic. Set the Rudder Control to 10 and Trim Control to 0. If the drive unit moves the rudder, slew the Compass Unit until the drive unit returns the rudder to its amidship position. Bolt the Compass Unit hard down.

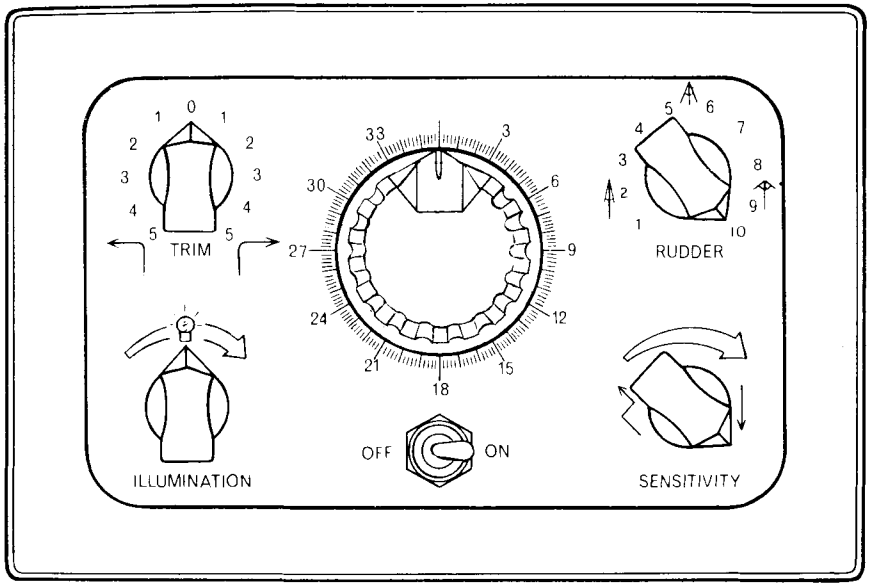


FIG.12 CONTROL PANEL SETTINGS FOR INSTALLATION ALIGNMENT

4.2 **TO CHECK INSTALLATION OF 'CRASH' SWITCH**

1. Reconnect the Battery.

2. Switch 'ON' both Isolator Switches.

3. Put the OFF/ON switch on Control Unit to 'ON' and check the Automatic Pilot for normal operation, this may be done by operating the Trim Control alternately Port and Starboard.

4. Operate the 'Crash' Switch push button.

5. Check that the Automatic Pilot is inoperative by moving the Trim Control to Port and Starboard.

6. Put OFF/ON switch on the Control Unit to OFF, by now switching 'ON' at the Control Unit, normal pilot operation will be restored.

4.3 **RESETTING THE LIMIT SWITCHES** (Systems NOT fitted with Rudder Feedback Unit).
In some installations and where reverse rotation of the Drive Unit output shaft is required the Limit Switches may have to be reset.

This should be carried out as follows:

1. Put the Control Unit and Isolator Switches to 'OFF'.

2. Remove the Limit Switch cover plate from the side of the Drive Unit. This will expose the two limit switches and their respective operating cams.

3. Manually operate the steering gear until the rudder comes onto its physical stop, it will be noticed that as the steering gear is operated one of the cams moves towards its respective limit switch.

4. Manually turn the steering gear in the opposite direction until the rudder is clear of its physical stop (the position in which the Limit Switch is required to operate) reset the cam determined in 3, so that it operates the Limit Switch. The cams are secured in place by a 6 BA socket set screw.

5. Repeat 3 and 4 with the rudder on its opposite physical stop.

6. Manually operating the steering gear, check by observation, that when the rudder is applied the Limit Switches operate before the rudder stops are reached in either direction.

4.4 **ADJUSTING THE COMPASS.** Provided the compass has been installed in a position free from disturbance to the earth's magnetic field and trim correctly adjusted, the course set and that actually steered will be in close agreement.

If there are differences of more than very few degrees it is likely that the compass unit is subject to deviation errors and it will require correcting by a qualified compass adjuster. The following methods enable compass headings to be obtained so that these corrections may be effected. Both take advantage of the fact that, when the pilot Drive Unit is in its "neutral" position, the course setter is effectively a compass repeater.

4.5 **METHOD A using the COMPASS ADJUSTING AID (CAA)**

1. Remove the top cover of the Motor Unit.

2. Remove both 25 amp. (15 amp) fuses. This will render Drive Unit and clutch inoperative when the control unit is switched on, and thus permit manual steering.

3. Remove the Violet, green, brown, yellow, red and blue leads colour for colour, into the terminals 10, 12, 13, 14, 15, and 16 on the gland side of the terminal block (see Fig. 8) but do not disturb the glands.

4. Connect the exposed green, brown, yellow, red and blue leads, colour for colour, into the terminal block of the CAA. The flying orange lead on the CAA should be connected into terminal 10 on the Drive Unit terminal block. It is recommended that the bare end of the disconnected orange lead (see 3 above) be covered with adhesive tape until the pilot wiring is reconnected normally.

5. Set the Switch on CAA to pilot voltage. Set Sensitivity and Rudder Control fully clockwise. Set Trim to "zero".

6. Bring the craft to the desired heading and adjust the Course Setter to this heading.

7. Switch on at the Control Unit and allow a few seconds for the system to settle. Re-adjust the Course Setter as indicated by the CAA lights — increase reading with the green light and vice versa. When both lights go out the system is balanced and the Course Setter then reads within + ½°, of Compass Unit heading.

4.6 **METHOD B.** This is somewhat less accurate and calm water and steady wind conditions are necessary. Nevertheless it is adequate and useful when no CAA is available. No disturbance to any wiring is required. Compass adjustment is carried out underway with the pilot switched on.

The craft is brought on to the required headings with the course Setter and for each heading Trim is re-adjusted (see "Operation" section). If this adjustment is made with care and conditions are steady the Course Setter reading will provide a close indication of compass heading.

Using normal compass adjustment techniques compensating magnets should be placed and, if necessary, the Compass Unit slewed to minimise differences between course set and magnetic course steered. Residual differences should be tabulated in the form of a Deviation Table.

SECTION 5. FUSE AND RELAY REPLACEMENT.

5.1 **FUSES.** situated under the top cover of the Drive Unit and from (see Fig. 13.) the 16 way terminal block are:

1 – 5 amp BS 646
1 – 2 amp BS 646
2 – 25 amp (12 volt installation)
or
2 – 15 amp (24 volt installation)

Situated in Isolator Switchbox

2 – 7½ amp
2 – 25 amp (12 volt installation)
or
2 – 15 amp (24 volt installation)

Before replacing fuses – Switch Drive Unit and Control Unit Isolator Switches to OFF.

5.2 **PANEL ILLUMINATION.** These midget lamps push fit into the slotted caps which screw into the Control Unit Panel. They are: Thorn Bendix 'Atlas' type L.1004 (28 Volt rating for 24 volt installations,14 Volt rating for 12 volt installations) When replacing panel lamps care should be taken to avoid distorting or otherwise damaging the rubber seals.

5.3 **REPLACEMENT OF RELAYS.** (Potter and Brumfield Type PR5DY). It is important that the Drive Unit and Control Unit Isolators are switched OFF, or alternatively the battery connections are disconnected. Access to the Relays may be gained by removing the top cover from the Drive Unit. See Figure 13. The relays are each secured to the base plate by means of 2 – 4 BA screws and washers. The relay connections are made to a terminal block located beneath the fuse and suppression panel. The latter held by 2 – 2 BA nuts and washers and 1 – 6 BA screw and washer in the positions shown in Figure 13, and removal will allow the fuse board to be hinged aside on its wiring in a direction towards the 16 way connector block. Note the position of the wiring where it emerges from beneath the relay base. Disconnect the relays and remove, taking care not to strain the small leaf springs in the connector block when disconnecting.

The new relays should be screwed into position with the wiring in the position noted for the originals, and care should be taken that all wires are free to move and not trapped. Ensure that the loop of insulated wire connected to the armature of the relay is clear of obstruction and free to move. Connect the relays to the terminal block as shown in Figure 13 coiling excess wire neatly, and refit the fuse board. During the latter operation it is especially important to ensure that the wiring connections beneath the fuse board are not trapped between it and the terminal block, to avoid possible puncture of the insulations by the terminal pins in the board.

5.4. ROUTINE MAINTENANCE

1. Regularly lubricate the roller chain drive between the Drive Unit and steering gear.
2. Once a season check the oil level in the Drive Unit gearbox by slacking back on the oil level screw plug, situated on the end of the gearbox. Oil should seep from the gearbox. If not, top up with Castrol 'Magna' through the filling plug, which is adjacent to the earth connection on the side of the Drive Unit gearbox.
3. The Rudder Feedback Unit (if fitted) should be inspected at regular intervals to ensure that loose gear is not likely to foul the linkage system. The ball and socket joints should be greased occasionally and linkage fastenings checked.
4. To clean the Control Unit panel wash with detergent and rinse with fresh water. Dry off with a soft cloth.
5. Relay contacts. These should not be touched unless symptoms indicating dirty contacts occur. A typical symptom would be the cessation of operation of the pilot, with the rudder at a fixed angle. This may temporarily be remedied by switching the autopilot OFF and then ON again, but the relays should be cleaned at the first subsequent opportunity.
To clean the Relays:
It is important that before any service operations are carried out, that the Drive Unit be isolated from the battery by opening both Isolator Switches, or alternately disconnecting the battery connections. Access to the Relays may be gained by removing the top cover from the drive unit.
The contacts should be cleaned using preferably a solvent cleaner fluid such as Arklone, Inhibisol or Sprayclene, but in the absence of any of these, any good domestic dry cleaning fluid should suffice. The cleaner should be worked between the contacts using a piece of smooth surfaced card such as postcard, until all traces of blacking are removed. The relays may be manually operated to facilitate this and the subsequent greasing operations. Repeat the operation for both pairs of contacts and allow time for the excess solvent to evaporate. On no account should any abrasive or file ever be used on the contacts.
The contacts should then be treated with a protective coat of Electrolube 2G grease. This may be applied by lightly coating the end of a feeler gauge or similar tool with the grease and wiping between each pair of contacts in turn, recoating the feeler gauge as necessary.

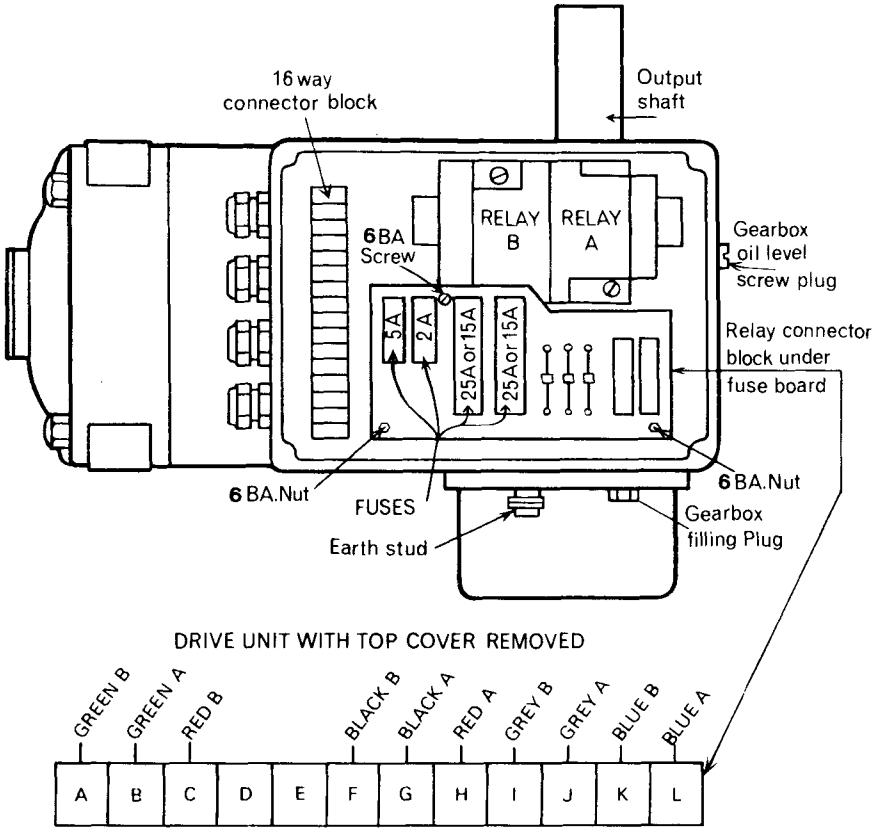


FIG. 13 RELAY CONNECTOR BLOCK

SECTION 9

9.1 OPERATING INSTRUCTIONS

Switch ON the Isolator Switch (or Switches).
The autopilot is now available for immediate use.

9.2 TO STEER BY AUTOMATIC PILOT

Set: The Course Setter to the Course to be steered.
Trim Control to 0.
Rudder Control to 5.
Sensitivity Control to its Mid position (12 o'clock).
Ensure that the steering gear is free.

Put the ON/OFF switch on the Control Unit to ON. The drive unit magnetic clutch will now engage and the craft will be steered by the automatic pilot to the course set.

9.3 ADJUSTING THE CONTROLS FOR OPTIMUM PERFORMANCE

1. **RUDDER CONTROL**
   Adjust the Rudder Control at the lowest setting which gives the most satisfactory steering. If the control is set too high, excessive rudder is applied the craft will oversteer and weave about the set course. With too low a setting, rudder applied may be insufficient to bring the craft onto the set course.

2. **TRIM CONTROL**
   This applies rudder irrespective of the position of the Course Setter and Rudder Control.
   To set the Trim Control:
   Check that the Trim Control is at 0.
   Set the Rudder Control to 10 or highest setting which gives a reasonably steady course, note the mean course actually steered. Then set the Rudder Control to 1. If the mean course steered alters — adjust Trim Control to regain course. Reset the Rudder Control to 5. The amount of Trim setting required is likely to vary with alterations in speed and/or relative wind speed and direction.

3. **SENSITIVITY**
   Adjust the Sensitivity Setting to reduce yawing. With a low setting the craft may yaw to some degree but battery consumption will be reduced.

9.4 TO ALTER COURSE.

Reset the Course Setter to new course to be steered. It is not necessary to switch off the pilot when altering course. (It should be noted that for a course alteration of more than 180°, the autopilot will apply rudder to turn in the most direct direction towards the new course).
Reassess Trim Setting.

9.5 TO STEER BY REMOTE STEERING CONTROL (IF FITTED).

Depress the switch on the Remote Steering Control Handle and maintaining the pressure, turn the Control Knob for the required amount of rudder. All controls except Trim on the Control Unit are inoperative while the Remote Steering Control Switch is depressed.

When the R.S.C. switch is released, the craft will regain the course set on the control unit. If a 'Hold On' switch is fitted the R.S.C., is operative whenever this switch is in the ON position.

9.6 OPERATING THE CRASH SWITCH (IF FITTED).

Push the Crash Switch Push Button. This will switch OFF the Autopilot and disengage the drive unit from the steering gear. To reset and steer by autopilot, switch OFF at the Control Unit. Then switch ON at the Control Unit and the craft will then regain the course set.

9.7 OPERATING THE WIND VANE STEERING UNIT (IF FITTED).

1. Switching from Compass to Wind.
   Note the angle on the bow of Relative Wind that the craft is required to steer. Put the Trim Control to 0. Set the Switch Unit to Wind and immediately set the course setter to the angle on the bow of the Relative Wind. (See Figure 26).
   The Sensitivity Setting should be left set to the setting determined for the prevailing conditions as in 9.3.4.
   The Delay setting should be adjusted to damp fluctuations of the Wind Vane due to small changes in wind direction, bearing in mind that the higher the delay setting (clockwise) the more battery consumption is reduced. No change in Rudder setting should be necessary.

2. Switching from Wind to Compass.
   Note the Compass course required to steer. Set the Switch Unit to Compass and immediately set the Course Setter for the course required.
   Readjust the Control Settings as in 9.3.

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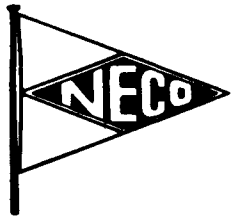

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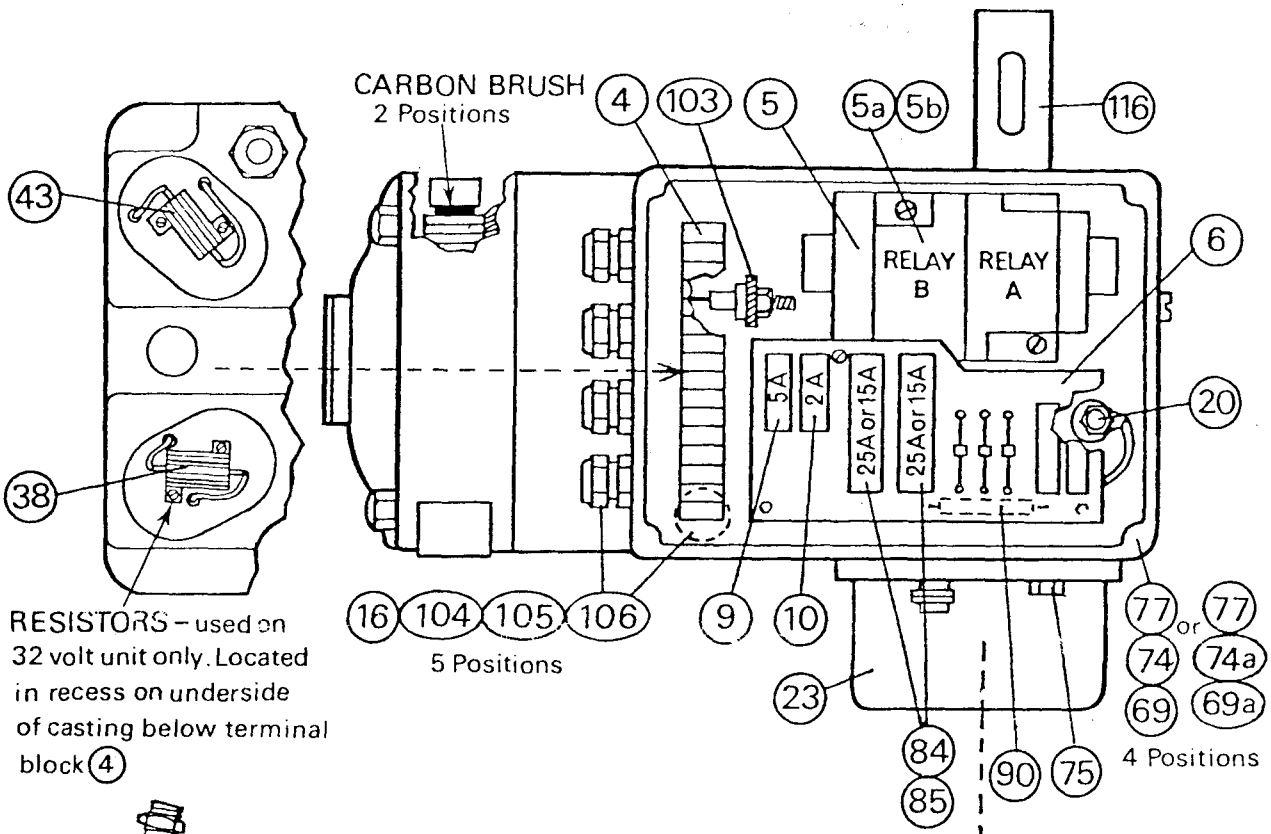
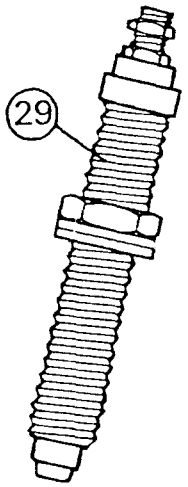
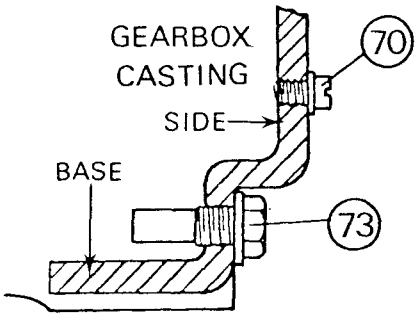
DRIVE UNITS 17DR8 & 35DR8

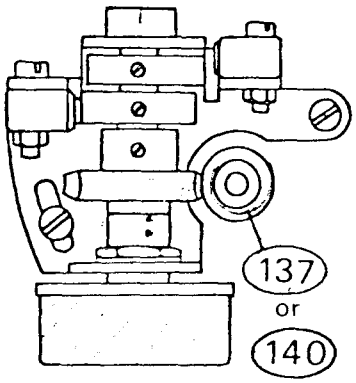
TIS 1035
SHEET 1 OF 2





BRUSH ASSEMBLY –
Electromagnetic clutch

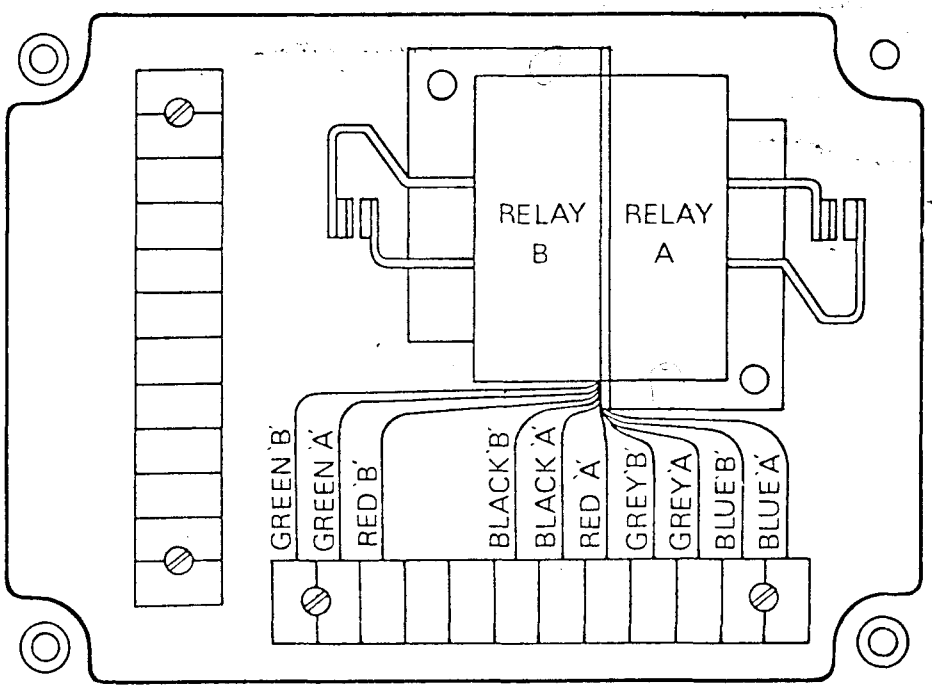


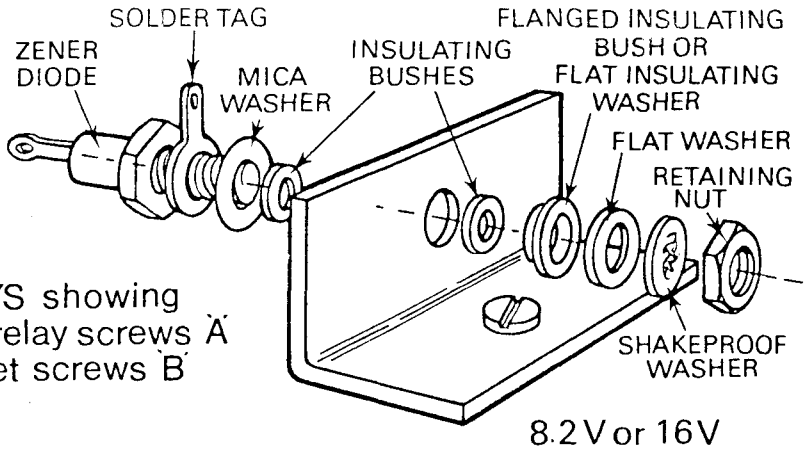


7 or 8 FEEDBACK ASSEMBLY

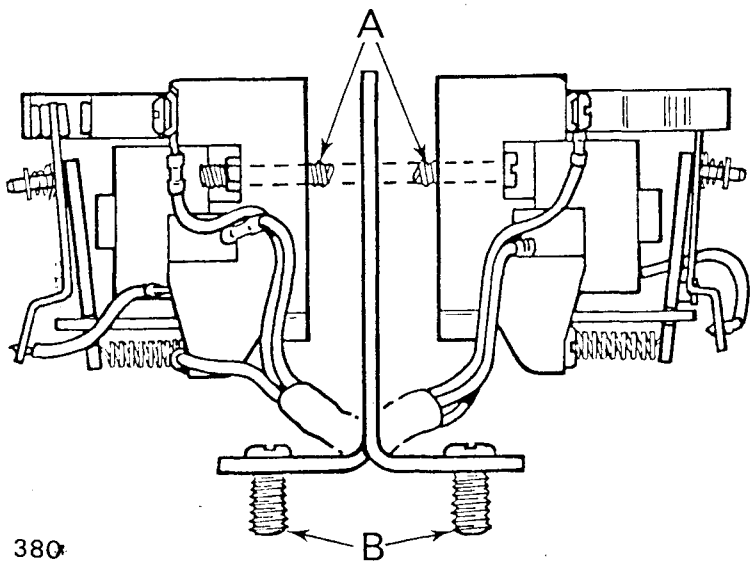
RELAY 'A' AND 'B' CONNECTIONS TO DRIVE UNIT OR RELAY BOX TERMINAL BLOCK

TIS 1040





TYPE PRD 60282 RELAYS showing separation by removal of relay screws 'A' for access to relay bracket screws 'B'



8.2V or 16V ZENER DIODE MOUNTING ASSEMBLY

Reference TIS 1035

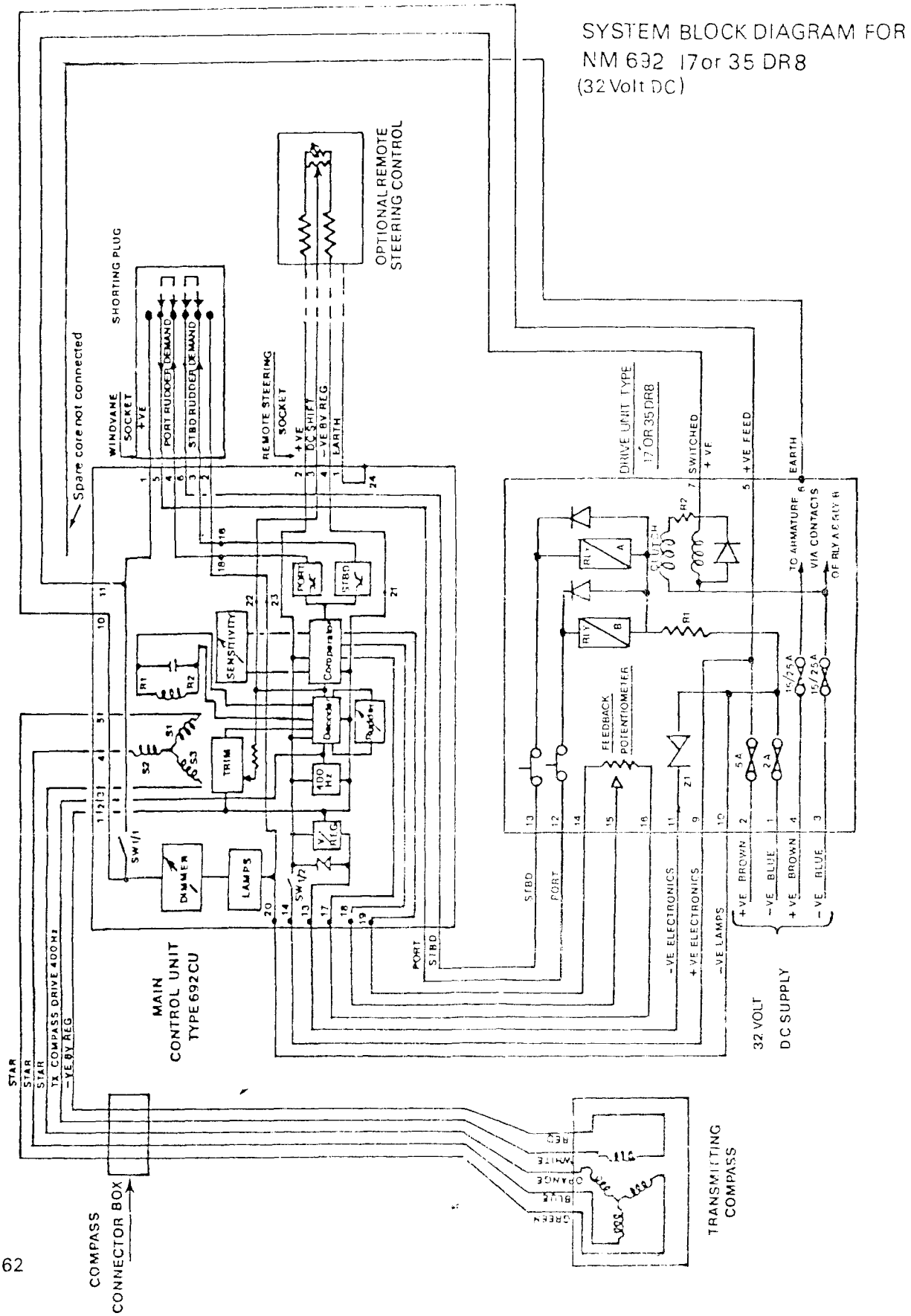
DRIVE UNITS

17DR8 12V	1033087-1
17DR8 24V	1033087-2
17DR8 32V	1033087-3
35DR8 12V	1033087-4
35DR8 24V	1033087-5
35DR8 32V	1033087-6

FIND #	ITEM	P/N
4	Terminal Block 16 Conn	1033087-46
5	Relay Assembly	1033087-9
5B	Diode 10D1	1033087-11
6	Suppression PCB	1033087-17
7	Feedback Assembly 17DR8	1033087-12
8	Feedback Assembly 35DR8	1033087-13
9	Fuse 5A 20 MM	1033087-23
10	Fuse 2A 20 MM	1033087-24
16	Gland Body	1033087-45
23	Feedback Cover	1033087-14
29	Brush Assy (Complete)	1033087-8
38	Resistor 120Ω HSA5	1033087-29
43	Resistor 15Ω	1033087-28
69	Studding 1/4" BSW x 2-5/8"	
69A	Studding M6 x 67 MM	
70	Screw w/Washer (Oil Level)	1033087-33
73	Plug w/Washer (Oil Drain)	1033087-34
74	Nut, Dome 1/4" Chrome	1033087-39
74A	Nut, Dome Metric M6	1033087-64
75	Plug, Oil Fill	1033087-35
77	Washer, Fiber	
84	Fuse 15 Amp	226-7176P50
85	Fuse 25 Amp	226-7176P52
90	Resistor 68Ω 10W	1033087-27
103	Diode 8.2V	1033087-30
103A	Diode 16V	1033087-31
104	Nut, Cable Gland	1033087-42
105	Locking Ring	1033087-43
106	Washer, Rubber	1033087-44
116	Key 3/16"	1033087-32
137	Worm 17.5 RPM FB Unit	1033087-12
140	Worm 35 RPM FB Unit	1033087-13
	Carbon Brush, Motor F4	1033087-7

TIS 1015

SYSTEM BLOCK DIAGRAM FOR NM 692 17or 35 DR8 (32 Volt DC)



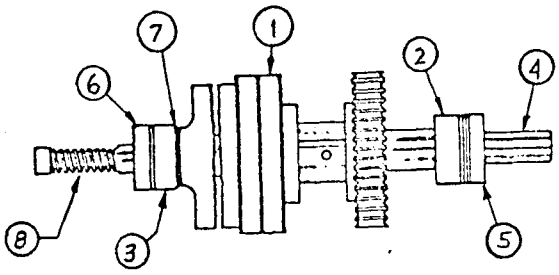


Fig 1 DRIVE SHAFT ASSEMBLY

PARTS LIST

(1)	Clutch Assy 12V	1033087	-226
	Clutch Assy 24V	"	-227
(2)	Bearing RLS 5	"	-228
(3)	Bearing RLS 4A	"	-229
(4)	Final Shaft	"	-230
(5)	Oil Seal 080	"	-231
(6)	Oil Seal 010	"	-232
(7)	Circlip	"	-233
(8)	Gear, Worm Start 17.5 RPM		-234
	Gear, Worm Start 35 RPM		-235

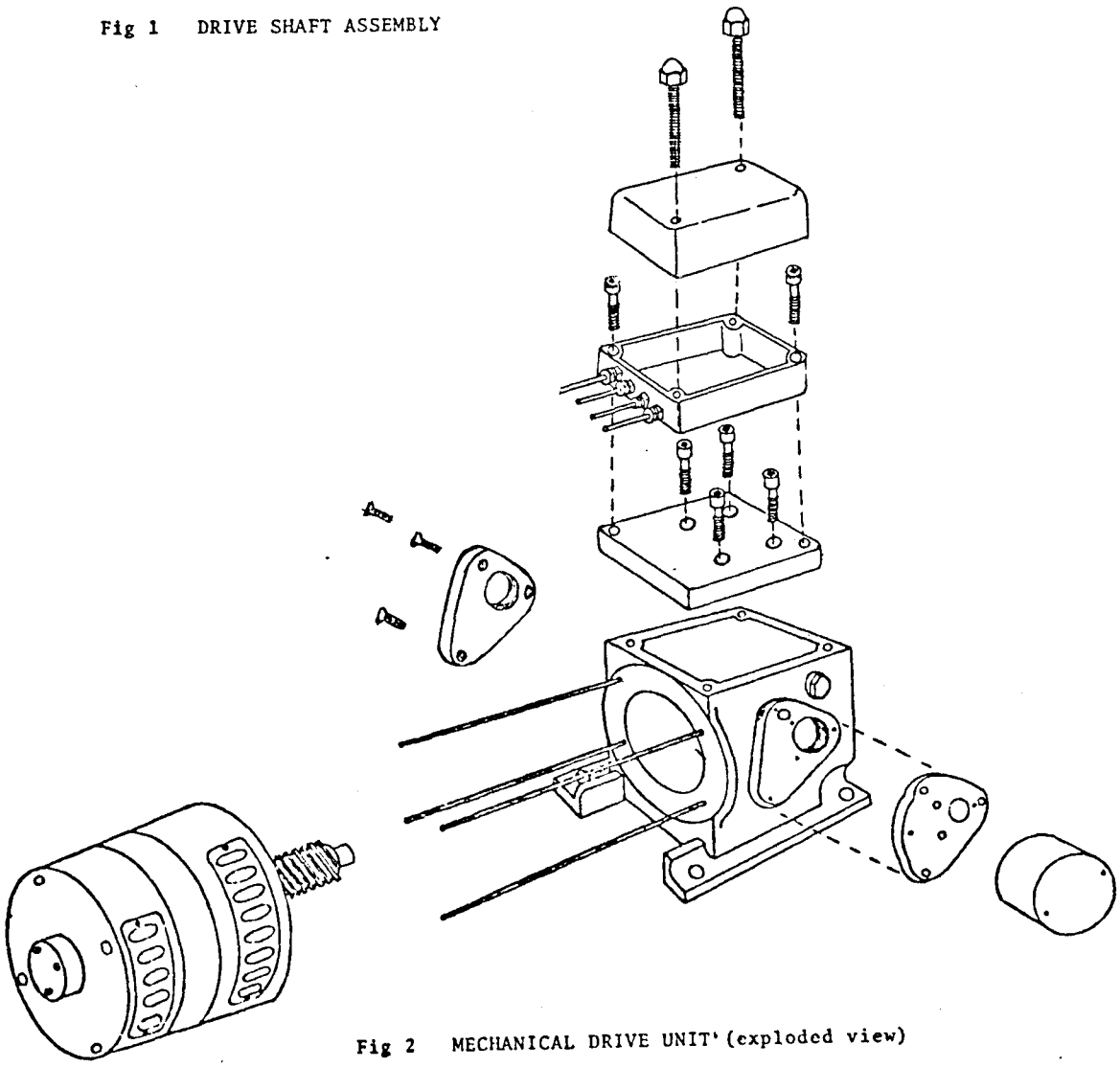


Fig 2 MECHANICAL DRIVE UNIT (exploded view)