Chapter 3

ACTUATORS, ROTAX, C5200 SERIES

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

Introduction

1. The actuators in this series are similar in design; each unit comprises a reversible d.c. motor, which incorporates an electro-magnetic brake unit and a clutch, to drive an output shaft through a three stage epicyclic gearbox.

2. In this chapter instructions are given for dismantling, inspection and repair, assembling and testing; it should be read in conjunction with A.P.4343D, Vol.1, Book 3, Sect.16, Chap.3, where a full description of the actuators will be found.

3. Various exploded views are included in this chapter, each item being numbered as an aid to dismantling and re-assembling the units.

4. At the end of this chapter will be found appendices; reference made to these will furnish the reader with details of the differences from one actuator to another.

Tools and test equipment

5. The following Rotax tools or their equivalent will be found useful when overhauling the actuators.

Rotax No.	Ref.No.	Description
NT.2723	5W/2514	Extractor for ball bearing from brake drum
NT.2725	5W/2515	Punch and base, assembling ball bearing to output shaft
NT.2726	5W/2516	Punch and base, extracting ball bearing from output shaft
NT.2727	5W/2517	Punch and base for assembling ball bearing to armature
NT.2728	-	Extractor, ball bearing from armature
NT.2738	5W/2640	Bench block for assembling pin to armature
NT.2730	5W/2520	Final checking gauge
NT.2734	-	Height gauge *(all types except C5212/2)*
NT.5724	5W/2521	Height gauge *(C5212/2 only)*
NT.4576	-	Punch, assembling ball bearing to bearing housing
NT.5726	-	Base assembling ball bearing and plate
NT.5727	-	Extractor, ball bearing from plate
NT.387/1	-	Torque test rig
NT.2120	5W/2523	Dynamometer for motor test
NT.5720	5W/2524	Bracket for use with NT.2120
NT.5721	5W/2525	Ring for use with NT.2120
NT.3198/1	-	Panel for NT.2120 and NT.387/1
NT.7714	-	Adapter ring for NT.387/1
NT.7715	-	Driving adapter for NT.387/1

DISMANTLING

6. It is essential that absolute cleanliness of workbench and tools is observed whilst overhauling these actuators. A suitable rack press should be used with all punch and base tools listed in para.5.

Front housing, output shaft and gearbox *(fig.2 unless otherwise stated)*

7. To remove the release mechanism from the release housing, refer to the appendix dealing with the particular unit which is being overhauled.

8. Release the four tabwashers *(fig.4 item 6)*, remove the four screws *(fig.4 item 7)*, and carefully separate the motor housing *(fig.4 item 3)* and the intermediate housing (33).

9. Lift out the first stage planet gear assembly (28) and the second stage planet gear assembly (29) from the intermediate housing. Collect the plunger assembly (30) and the spring (31). Carefully separate the intermediate housing and the front housing (23).

10. Withdraw the floating annulus (34) from the front housing. Back out the four

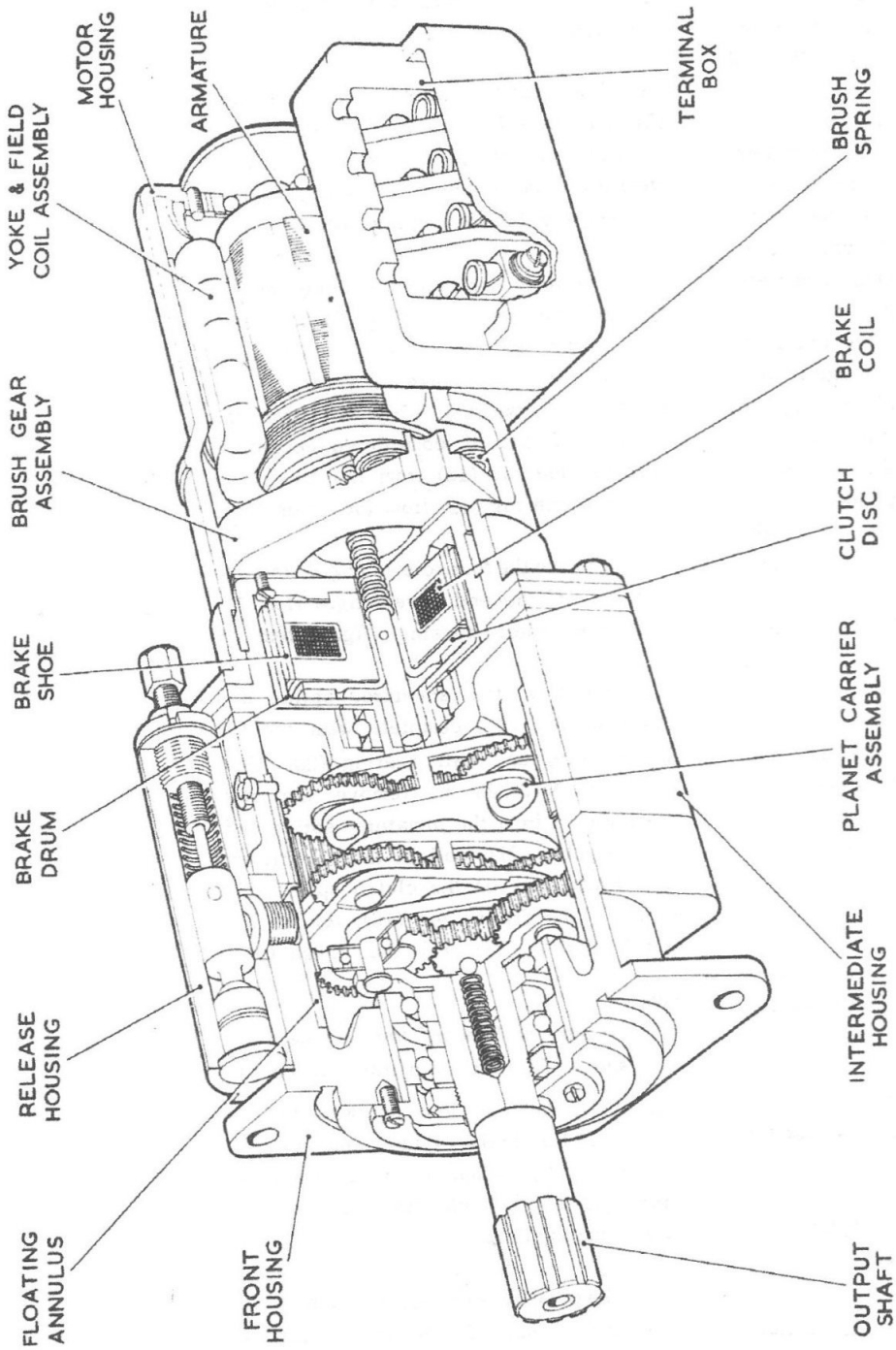


Fig.1 Sectional view of typical actuator

screws (1), collect the four spring washers (2), and remove the bearing cover (3). Release the tabwasher (5), secure the output shaft (32), then remove the nut (4) and the tabwasher.

11. Mount the front housing (23) complete with the output shaft (32) on the base of punch and base tool NT.2726, fit the punch over the splined end of the output shaft and press out the output shaft complete with the first ball bearing (9) and the distance piece (8). Collect the distance piece and remove the front housing from the base. Fit the split plate supplied with tool NT.2726 between the ball bearing and the planet carrier end of the output shaft and locate assembly in base of NT.2726. Use the punch to press the output shaft out of the ball bearing.

12. Remove the circlip (7) and the ball bearing (6) from the front housing (23).

13. If the planet gears (27) fitted to the output shaft (32) require renewal, drill out and remove the three planet pins (24) remove three planet gear assemblies (27) collect the six washers (26) and the shims (25).

Motor and brake unit

14. To remove the window strap assembly refer to the appendix for dismantling instructions.

15.

Plug or terminal block assembly

Refer to the appropriate appendix for dismantling instructions.

16. The following ten paragraphs refer to fig.3 unless otherwise stated.

17. Back out the four screws (15) collect the four spring washers (16) and the four plain washers (14). Remove the brushes (11) and identify them with their respective brush boxes.

18. Back out the two countersunk screws (2) and carefully separate the ball bearing housing (1) from the motor housing *(fig.4 item 3)*. Remove the ball bearing (3) from the bearing housing using tool NT.5727.

19. Carefully separate the brake housing (29) and the motor housing *(fig.4 item 3)* and withdraw the brake housing (29) complete with the brake drum (4) and the brushgear assembly (26). Remove the green lead and if considered necessary unsolder the tag (13) from the brake coil lead and one tag (12) from the green lead.

20. Remove the four screws *(fig.4 item 16)* and lift off the end cover *(fig.4 item 15)* from the motor housing *(fig.4 item 3)*.

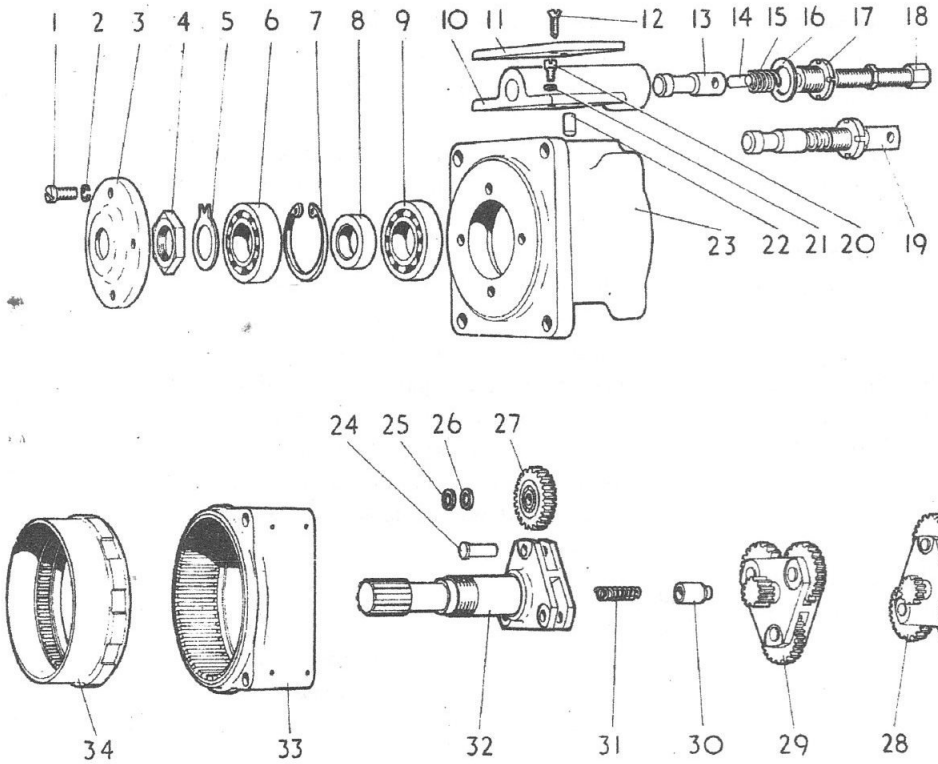
21. Withdraw the armature, spring and pin assembly (21) complete with the oil thrower (19) and ball bearing (20). Use extractor NT.2728 to remove the ball bearing (20) from the armature, spring and pin assembly (21), collect the oil thrower (19). Push back on the clutch spring (23) withdraw the driving pin (18), remove the clutch spring (23) and the shims (22).

Note . . .

Measure and record the thickness of the shims (22) to facilitate assembly.

22. Back out the four screws (28) and withdraw the brake spider and the coil assembly (9) complete with the brake drum (4) and clutch disc (6) from the brake housing (29).

23. Temporarily connect the brake coil and spider assembly (9) to a controlled 24 V d.c. supply and reduce the voltage



ITEM NO.	NOMENCLATURE	ITEM NO.	NOMENCLATURE
1	SCREW	19	RELEASE PLUNGER AND BOLT ASSEMBLY
2	SPRING WASHER	20	SCREW
3	BEARING COVER	21	SPRING WASHER
4	NUT	22	RELEASE PIN
5	TABWASHER	23	FRONT HOUSING ASSEMBLY
6	BALL BEARING	24	PLANET PIN
7	CIRCLIP	25	SHIMS 0.002 in., 0.004 in., 0.012 in.
8	DISTANCE PIECE	26	WASHER
9	BALL BEARING	27	PLANET GEAR ASSEMBLY
10	RELEASE HOUSING ASSEMBLY	28	1ST PLANET CARRIER ASSEMBLY
11	CLAMP PLATE	29	2ND PLANET CARRIER ASSEMBLY
12	SCREW	30	PLUNGER ASSEMBLY
13	RELEASE PLUNGER	31	SPRING
14	NIPPLE	32	OUTPUT SHAFT AND THIRD PLANET CARRIER ASSEMBLY
15	RELEASE SPRING	33	INTERMEDIATE HOUSING ASSEMBLY
16	TABWASHER	34	FLOATING ANNULUS
17	GLAND NUT		
18	STOP (ADJUSTABLE)		

Fig.2 Front housing, output shaft and gearbox

to a level just sufficient to pull the brake shoe assemblies (7) on to the spider. Remove the brake drum (4) and collect the clutch disc assembly (6). Temporarily clamp the four brake shoe assemblies, disconnect the 24 V d.c. supply from the brake coil and release the brake shoe assemblies allowing them to expand gradually. Remove the four brake shoe assemblies and collect the sixteen brake shoe springs (8). If it is considered necessary, remove the oilite bush (5) from the brake drum (4).

24. Remove the four split pins (24) from the brush spring pillars, collect the four plain washers (25) and the four brush springs (17).

25. Back out the two screws (10), lift off the brush block moulding (26) from the brake housing (29) and collect the insulator (27).

26. Back out the screws *(fig.4 item 5)* and withdraw the yoke and field coil assembly *(fig.4 item 2)* from the motor housing.

INSPECTION AND REPAIR

27. All components must be inspected for electrical and mechanical defects in conjunction with A.P.4343, Vol.6, Sect.17, Chap.1. All parts that are badly worn or damaged must be renewed reference being made to the appropriate spare parts list for the actuator under repair.

28. A schedule of fits, clearances and repair tolerances *(Table 1)* is included in this chapter, and reference must be made to this when checking the various dimensions for wear and for bearing fits on assembling the unit.

29.

(1) *Armature*

Minimum commutator diameter is 0.965 in. After skimming of the commutator, under-cut the micas 0.020 in. deep and 0.025 in. wide.

(2) Winding resistance value when new is between 0.140 and 0.170 ohms at 20 deg. C.

(3) Check the insulation resistance value of the armature winding from the shaft. This must be compared with the other items against a final figure of the complete unit. As a guide the insulation resistance when tested with a 250 V insulation resistance tester must not be less than 500,000 ohms.

30.

(1) *Brushes*

The brush length when new is 0.390 in., the recommended minimum length is 0.325 in.

(2) The brush flex must be 1.250 in. approx. in length and must be soldered to the retaining clip with approved resin cored solder.

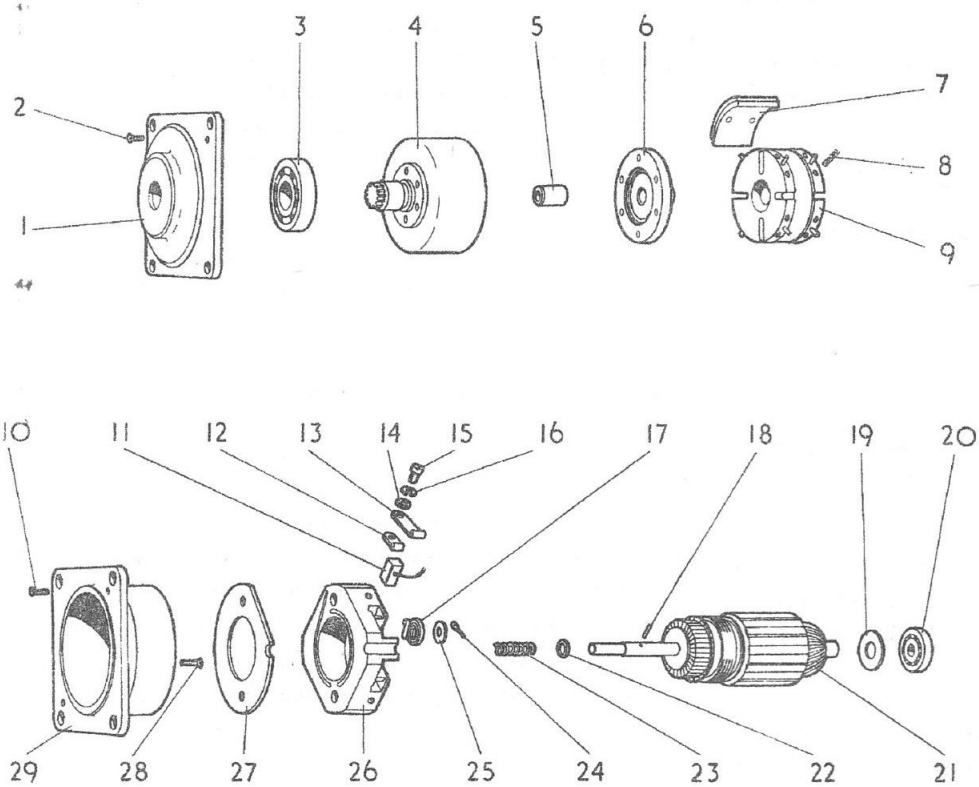
(3) The brush spring pressure must be 5 - 7 oz. when the contact point of the spring is level with the top of the brush box.

31.

(1) *Field coils*

Resistance of winding when new is between 26.0 and 28.0 ohms at 20 deg. C.

(2) Check the insulation resistance value of the field coils from the yoke; this must be as stated in para.29 (3).



ITEM NO.	NOMENCLATURE	ITEM NO.	NOMENCLATURE
1	BALL BEARING HOUSING	16	SPRING WASHER
2	SCREW	17	BRUSH SPRING
3	BALL BEARING	18	DRIVING PIN
4	BRAKE DRUM ASSEMBLY	19	OIL THROWER
5	OILITE BUSH	20	BALL BEARING
6	CLUTCH DISC ASSEMBLY	21	ARMATURE SPRING AND PIN ASSEMBLY
7	BRAKE SHOE ASSEMBLY	22	SHIMS 0.005 in., 0.010 in., AND 0.030 in.
8	BRAKE SHOE SPRING	23	CLUTCH SPRING
9	BRAKE SPIDER AND COIL ASSEMBLY	24	SPLIT PIN
10	SCREW	25	PLAIN WASHER
11	BRUSH AND PIGTAIL	26	BRUSH BLOCK MOULDING
12	BRUSH TAG	27	INSULATION
13	TAG (BRAKE COIL)	28	SCREW
14	PLAIN WASHER	29	BRAKE HOUSING
15	SCREW		

Fig.3 Brake drum, brake spider, brushgear and armature

32.

(1) *Brake coil*

Resistance when new is between 0.08 and 0.09 ohms at 20 deg. C.

(2) Check the insulation resistance value; this must be as in para.29 (3).

(3) The brake spring pressure is to be 20 $^{+2}_{-0}$ oz. when compressed to 0.350 in. from its free length of approx. 0.465 in.

Clutch spring

33. The clutch spring pressure is to be 8 ± 0.5 lb. when compressed to 0.593 in. from its free length of 0.880 in. approx.

Plunger spring

34. The plunger spring pressure is to be 3.5 ± 0.25 lb. when compressed to 0.937 in. from its free length of 1.280 in. approx.

Release spring

35. The release spring pressure is to be 2.75 lb. when compressed to 0.625 ± 0.010 in. from its free length of 1.070 in. approx.

ASSEMBLY

36. All components must be thoroughly cleaned by washing in lead free gasoline before assembly is commenced.

37. Select new ball bearings to give the correct light press-fit or sliding fit as stated in Table 1. Ball bearings must not be more than one-third full with grease XG-276 *(Ref.No.34B/9425139)*. Also apply a small amount of this grease to the commutator end of the armature shaft.

38. All armature, field and brake coil leads should be sealed with Bostic C where they pass through the rectangular holes into the terminal block. Where a plug is fitted *(C.5210/1)* refer to the appendix.

39. All screws of 4 B.A. or smaller not provided with locking devices must be assembled with Shellac varnish. All screws provided with locking devices must be assembled with a small amount of grease.

40. It is recommended that all tabwashers, spring washers, gaskets, and split pins are renewed on assembly.

Motor and brake unit *(fig.3 unless otherwise stated)*.

41. Fit the yoke and field coil assembly *(fig.4 item 2)* into the motor housing *(fig.4 item 3)*. Ensure that the yoke butts on to the locating shoulder in the motor housing and that the locating screw holes line up with the screw holes in the motor housing. Secure the yoke and field coil assembly with the two locating screws *(fig.4 item 5)*.

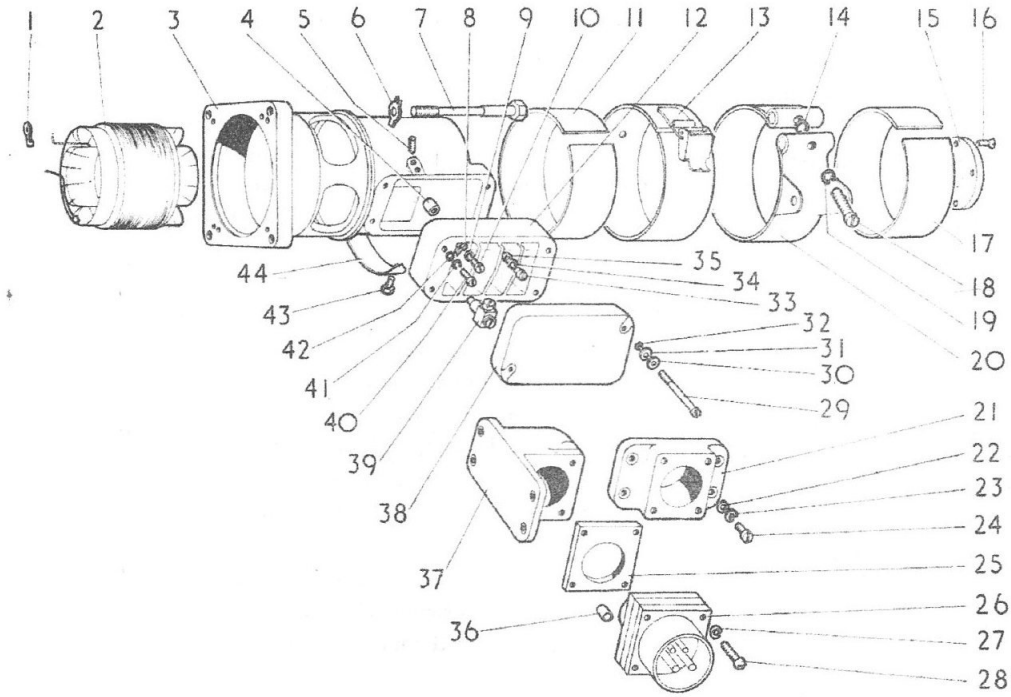
Note . . .

When a new yoke and field coil assembly has been fitted it must be finally secured in position after the neutral setting has been completed as detailed in the testing section (para.60 (2).

42. Assemble the insulator (27) and the brush block moulding (26) on to the brake housing (29) and secure with the two screws (10).

Note . . .

The brush moulding must be so assembled on to the brake housing that the position of brush No.4 is nearest to the white field-coil lead when the brake housing is assembled to the motor housing



ITEM NO.	NOMENCLATURE	ITEM NO.	NOMENCLATURE	ITEM NO.	NOMENCLATURE
1	TAG	15	END COVER	30	PLAIN WASHER
2	YOKE AND FIELD COIL ASSEMBLY	16	SCREW	31	SPRING WASHER
		17	LINING	32	CIRCLIP
3	MOTOR HOUSING	18	SCREW	33	SCREW
4	HELSYN SLEEVE	19	SPRING WASHER	34	SPRING WASHER
5	POLE LOCATING SCREWS	20	STRAP ASSEMBLY	35	PLAIN WASHER
6	TABWASHER	21	PLUG ADAPTER	36	SLEEVE
7	SCREW	22	PLAIN WASHER	37	ADAPTER ELBOW
8	TAG	23	SPRING WASHER	38	TERMINAL BLOCK COVER
9	SPRING WASHER	24	SCREW	39	SOCKET ASSEMBLY
10	SCREW	25	GASKET	40	SCREW
11	LINING	26	PLUG ASSEMBLY	41	SPRING WASHER
12	TERMINAL BLOCK	27	SPRING WASHER	42	PLAIN WASHER
13	STRAP ASSEMBLY	28	SCREW	43	SCREW
14	RETAINING CIRCLIP	29	SCREW	44	MODIFICATION PLATE

Fig.4 Motor housing assembly

43. Assemble the four brush springs (17) on the brush block moulding (26) and secure with plain washers (25) and split pins (24).

44. Temporarily connect the brake spider and coil assembly (9) to a controlled 24 V d.c. supply and using a suitably reduced voltage, assemble the sixteen brake shoe springs (8) and four brake shoe assemblies (7) on the brake spider. Assemble the clutch disc (6), brake drum (4) and brake spider and coil assembly (9). Disconnect the 24 V d.c. supply, allowing the brake shoes to expand and retain the brake drum in position.

45. Enter the brake spider and coil assembly (9) complete with the brake drum (4) into the brake housing (29), ensuring that the blue coil-lead is passed through the channel provided for connection to the terminal block or plug, and the remaining coil lead is adjacent to brush No.3. Secure the brake spider to the brake housing with four screws (28).

46. Use bench block NT.2738 to assemble the shims (22), clutch spring (23), and driving pin (18) to the armature assembly (21); remove the assembly from the bench block. Assemble the oil thrower (19) on the armature shaft and use punch and base tool NT.2727 to assemble the ball bearing (20) to the armature shaft. Enter the complete assembly in the motor housing *(fig.4 item 3)* and slide the ball bearing (20) into the liner at the end of the housing.

Note . . .

Thickness of shims (22) should be as recorded during disassembly.

47. Position the end cover *(fig.4 item 15)* on the motor housing *(fig.4 item 3)* and secure with four screws *(fig.4 item 16);* lock the screws by caulking metal into the screw slots.

48. Solder tag (13) to the brake coil lead and one tag (12) to the green lead connecting brush No.4 to the terminal block or plug. Enter the brake housing (29), complete with the brake drum and brushgear, into the motor housing *(fig.4 item 3)* and align the holes for the long screws, ensuring that brush No.4 is nearest to the white field-coil lead.

49. Use punch NT.4576 and base NT.5726 to assemble ball bearing (3) to ball bearing housing (1). Slide the ball bearing (3) over the brake drum boss, align the holes in the ball bearing housing with the holes in the motor housing *(fig.4 item 3)* and secure the ball bearing housing with two countersunk-head screws (2) to the motor housing. Ensure that the boss of the brake drum is pressed right home in the ball bearing otherwise the back of the clutch assembly will foul the brake spider.

50. If necessary solder the tags (12) to the four brushes, lift the brush spring (17) and fit the brushes into the brush block moulding (26). Connect the leads to the brush boxes as shown in fig.5 together with the brush lead, secure each with the screws (15), the spring washer (16), and the plain washer (14).

Plug or terminal block assembly

51. Refer to the appropriate appendix for assembly instructions.

Window strap assembly

52. Refer to the appendix for assembly instructions.

53. After fitting the terminal block or plug assembly, test the motor and brake unit as instructed in para.61 before pro-

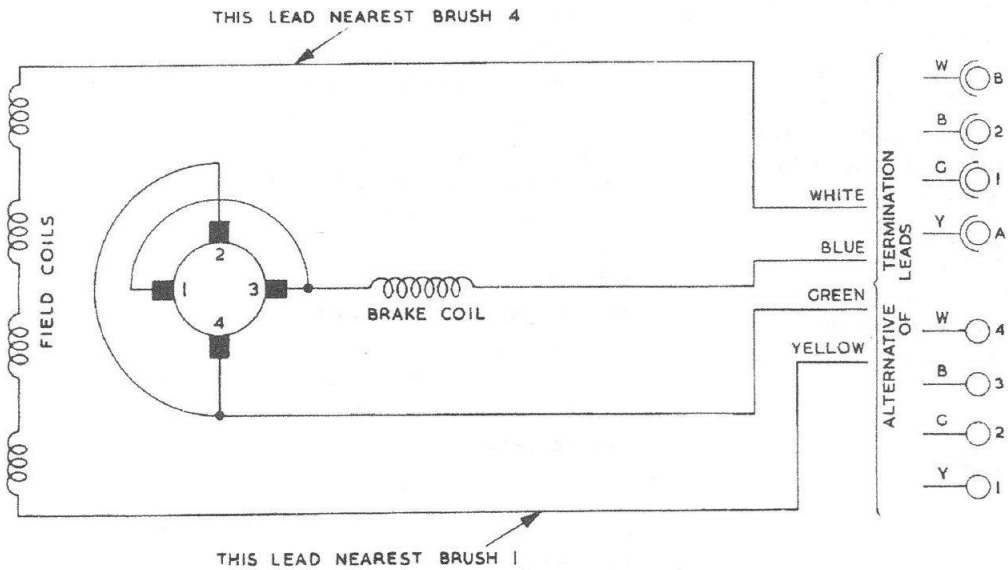


Fig.5 Diagram of connections

ceeding with the assembly.

Front housing, output shaft, and gearbox
(fig.2 unless otherwise stated)

54. If necessary assemble the three planet gears (27) on the output shaft (32), position the washers (26) on either side of the planet gears, fit shims (25) on either side of the planet gear and enter the planet pins (24), from the splined end of output shaft, into the carrier and planet gear bores. Rivet the planet pins flush with the carrier face.

Note . . .

Adjust the thickness of shims (25) to allow the planet gears 0.000 - 0.003 in. end play before riveting.

55. Mount the output shaft assembly (32) and the front housing (23) on the base of punch and base tool NT.2725. Position ball bearing (9) on the output shaft and using the punch and base tool, press the ball bearing home. Enter distance piece (8) and fit the circlip (7) in the front housing (23). Position the ball bearing (6) on the output shaft and press it home. Assemble the tabwasher (5) and secure the output shaft with nut (4). Check the output shaft with height gauge NT.2734 *(NT.5724 for C.5212/2)* and lock the tabwasher (5).

56. Assemble the bearing cover (3) on the front housing (23) and secure with the four screws (1) and the spring washers (2) and enter the floating annulus (34) in the front housing.

57. To fit the release mechanism and release housing refer to the appropriate appendix.

58. Fit the intermediate housing (33) on to the front housing (23), enter the spring (31) and plunger assembly (30) into the bore of the output shaft (32), lubricate and fit the second planet carrier (29) and the first planet carrier (28) assemblies into the intermediate housing (33).

59. Fit the intermediate housing (33) and the motor housing *(fig.4 item 3)* together, ensuring that the holes for the four long screws *(fig.4 item 7)* are aligned. Fit the four long screws to secure the two housings together.

TESTING

Motor only

60.

(1) *Brush bedding*

Brushes should be bedded over a minimum of 95 per cent of their area and over the full brush arc, the bedding time being shared approximately between both directions of rotation. The motor must be kept cool by an air blast.

(2) *Neutral setting*

A preliminary setting can best be obtained by adjusting so that the torque required to turn the armature when it only is excited by 20 to 25 amp. is the same for both directions of rotation. Final setting should be obtained by adjusting the field stack so that the speed at a torque of 22.0 oz. in. is within 2½ per cent of the mean speed in each direction of rotation, the results being obtained with the motor at room temperature.

(3) *Performance*

For both clockwise and anti-clockwise rotation, light speed and load points should be taken and results should lie within the following limits:-

Volts (d.c.)	Amp.	R.P.M.	Torque oz. in.
29.0	4.5 - 5.5	15,000 - 18,000	Nil
29.0	16.2 - 18.8	14,000 - 16,000	22.5

Motor and brake

61.

(1) *Brake operation (static test)*

The brake shoes should pull on to the spider when the latter is excited by a current of 35 amp. and should not fall off until the current has fallen below 2.0 amp.

(2) *Brake operation*

Test with motor only at 20 deg. C running on no load. The brake should pull off, and remain off, when the motor and brake are energized for clockwise or anti-clockwise rotation on voltages ranging from 18 V to 29 V on no load. The motor should be connected direct to a supply of from 18 V to 29 V for this test as opposed to obtaining the voltage by means of a series voltage control resistor. In addition, the brake should prevent the armature from rotating when a torque of not less than 40 oz. in. is applied to the armature shaft via the brake drum pinion.

Complete unit

62.

(1) *Release mechanism*

A torque of 25 lb. ft. should be applied clockwise through the output shaft, and the direct pull on the Bowden plunger required to effect release should be determined, testing each of the eight cam faces in the floating annulus in turn. Repeat the test with the torque applied anti-clockwise; the pull should be less than 20 lb. wt. in each of the readings.

Note . . .

For C5212/2 only the following test must be made:-

Tests are to be made to determine the maximum torque that is necessary to apply to the output shaft (in a stationary condition) to ensure that the shaft is freed when the release mechanism is operated. The test is to be carried out on each of the eight cam face positions of the rotating annulus in turn and with the torque load applied alternatively in clockwise direction. The output shaft must be freed by the operation of the release mechanism when the pre-loading of the output shaft is no greater than 1.50 lb. ft.

(2) *Clutch slip test*

The output shaft torque at which clutch slip occurs shall not be less than 30 lb. ft. and the clutch must slip before the motor stalls. The field should be separately excited or a minimum of 24.0 volts should be applied direct to the motor terminals for this test.

(3) *Static loading*

The brake should prevent the output shaft from turning when a torque of 120 lb. ft. is applied.

(4) *Performance*

Light speed and load points should next be taken for each direction of rotation on 24.0 V and 28.0 V. The results should be substantially the same for either direction of rotation and should lie within the following limits *(gear ratio 275 : 1)*.

Volts (d.c.)	Amp.	R.P.M. (Output shaft)	Torque lb. ft.
24	3.5 - 5.75	48 - 61	-
24	14.5 - 18.0	42 - 51	25.5
29	3.75 - 6.0	50 - 69	-
29	14.0 - 16.5	48 - 58	25.5

The actuator should be kept cool during the above tests.

(5) *Insulation*

The actuator should be run on 29.0 V with a torque of 25.5 lb. ft. for one minute, and while hot the insulation measured with a 250 V insulation resistance tester. The insulation must not be less than 500,000 ohms.

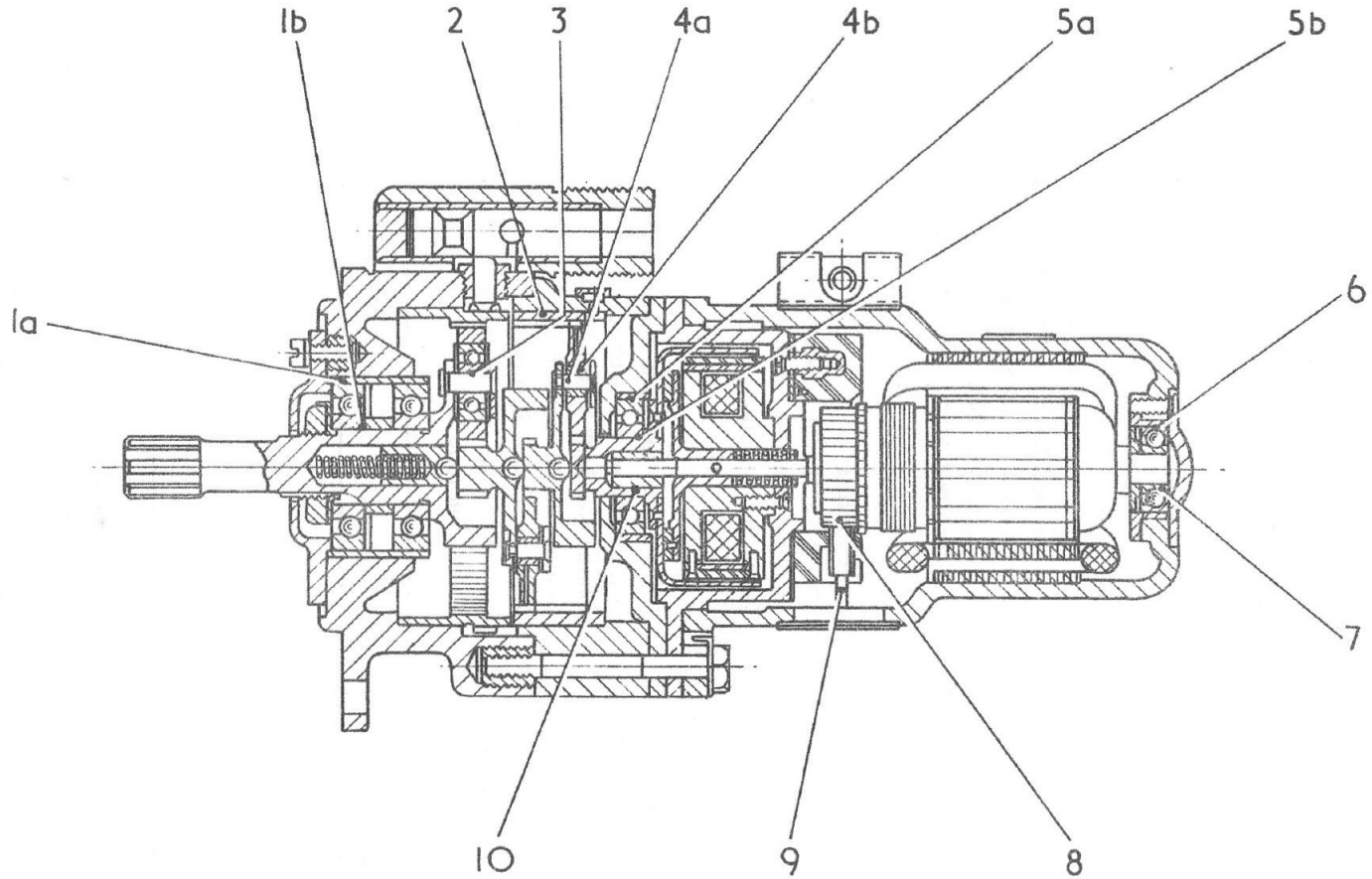


Fig.6 Diagram for schedule of fits and clearances

TABLE 1 SCHEDULE OF FITS, CLEARANCES AND REPAIR TOLERANCES FOR ACTUATORS, ROTAX, C5200 SERIES

(ALL DIMENSIONS IN INCHES)

Ref. No. on Fig.6	Part and description	Dimension, new	Permissible worn dimension	Clearance, new	Permissible worn clearance	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	OUTPUT SHAFT ASSEMBLY					
(a)	Liner Dia.	1.37495 1.37445	1.3755	0.0001CL 0.0005CL	0.0001CL 0.0007CL	By selective assembly
	Ball race O/Dia.	1.37470 1.37420	1.3737			
(b)	Ball race I/Dia.	0.62520 0.62470	0.6257	0.0002INT 0.0006CL	0.0002INT 0.0008CL	
	Shaft Dia.	0.6249 0.6246	0.6239			
2.	FLOATING ANNULUS					
	Housing I/Dia.	2.626 2.625	2.628	0.002 0.004	0.005	
	Annulus O/Dia.	2.623 2.622	2.620			
	Backlash Any two mating gears.			0.003 0.007		Total between sun gear, any pinion and annulus.

TABLE 1 (continued) — **SCHEDULE OF FITS, CLEARANCES AND REPAIR TOLERANCES FOR ACTUATORS, ROTAX, C5200 SERIES**

(ALL DIMENSIONS IN INCHES)

Ref.No. on Fig.6	Part and description	Dimension, new	Permissible worn dimension	Clearance, new	Permissible worn clearance	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	PLANET GEAR ASSEMBLY					
	Ball race I/Dia.	0.1575 0.1570	0.1585	0.001CL	0.0015CL	
	Planet pin Dia	0.1570 0.1565	0.1555			
4.	PLANET CARRIER ASSEMBLIES (1st AND 2nd).					
(a)	Bush Bore	0.12525 0.12475	0.1258	0.00055Cl 0.00025INT	0.0008CL	
	Pin O/Dia.	0.1250 0.1247	0.1240			
(b)	Gear Bore	0.25025 0.24975	0.251	0.0012CL 0.0004CL	0.002CL	
	Bush O/Dia.	0.2493 0.2490	0.2475			

TABLE 1 (continued) — **SCHEDULE OF FITS, CLEARANCE AND REPAIR TOLERANCES FOR ACTUATORS, ROTAX, C5200 SERIES**

(ALL DIMENSIONS IN INCHES)

Ref. No. on Fig.6	Part and description	Dimension, new	Permissible worn clearance	Clearance new	Permissible worn dimension	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	BALL RACE HOUSING					
(a)	Liner Bore	1.12445 1.12395	1.1248	0.0001INT 0.0004INT	0.0001INT 0.0004INT	By selective assembly
	Ball race O/Dia.	1.12470 1.1242	1.1239			
(b)	Ball race I/Dia.	0.50020 0.4997	0.5008	0.0001CL 0.0004CL	0.0001CL 0.0006CL	By selective assembly
	Brake drum assembly shaft	0.49995 0.49945	0.4989			
6.	MOTOR HOUSING ASSEMBLY					
	Liner Bore	0.75015 0.74965	0.7503	0.0001CL 0.0004CL	0.0001Cl 0.0006CL	By selective assembly
	Ball race O/Dia.	0.74970 0.74920	0.7491			

TABLE 1 (continued) **SCHEDULE OF FITS, CLEARANCE AND REPAIR TOLERANCES FOR ACTUATORS, ROTAX, C5200 SERIES**

(ALL DIMENSIONS IN INCHES)

Ref. No. on Fig.6	Part and description	Dimension, new	Permissible worn dimension	Clearance, new	Permissible worn clearance	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
7.	ARMATURE ASSEMBLY					
	Ball race I/Dia.	0.2502 0.2497	0.2508	0.0001INT 0.0004INT	0.0001INT 0.0004INT	By selective assembly
	Shaft O/Dia.	0.25065 0.24995	0.2496			
8.	BRUSH AND COMMUTATOR					
	Brush length	0.380 0.400				The minimum permissible working length of brush is 0.325 when measured on the long edge.
	Commutator dia.	0.985 0.990	0.965			
9.	BRUSH SPRING PRESSURE	5oz. 7oz.				Measured when contact point of spring is level with top of brush box.
10.	BRAKE DRUM ASSEMBLY					
	Bush Bore	0.1882 0.1872	0.1892			
	Shaft (Armature) O/Dia.	0.1862 0.1857	0.1847	0.001 0.0025 CL	0.003	

Appendix 1

ACTUATOR, ROTAX, TYPE C5210/1

1. This actuator is fitted with a plug and adapter housing. The window strap assembly is provided with brackets.

2. The unit can be dismantled, re-assembled, inspected and tested as in the main chapter, with the addition of the following paragraphs.

DISMANTLING

Release mechanism *(fig.2)*

3. Withdraw the plunger (13), and remove the nipple (14) if it is fitted. Back out the four screws (20), collect four spring washers (21), remove the release housing (10), and invert the front housing (23) to allow release pin (22) to drop out.

Window strap assembly *(fig.4)*

4. Release the screw (18) and remove the window strap assembly (20) complete with the lining (17). If considered necessary, remove the lining from the window strap, remove the retaining clip (14), and collect the spring washer (19) and screw (18).

Plug assembly *(fig.4)*

5. Remove the four screws (28), collect the four spring washers (27), lift off the plug assembly (26), and cut through the crimped end of the four pins to release the leads, exercising care not to cut or damage the leads. Remove the plug assembly, collect the gasket (25) and four Helsyn sleeves (36).

6. Remove the four screws (24), collect the four spring washers (23) and four plain washers (22). Lift off the adapter elbow (37) or plug adapter (21) from the motor housing (3).

ASSEMBLY

Plug assembly *(fig.4)*

7. Mount the adapter elbow (37) or plug adapter (21) on to the motor housing (3) , and secure with the four screws (24) spring washers (23) and plain washer (22).

8. Fit the Helsyn sleeves (36) to the four leads, assemble the plug (26) and gasket (25) and crimp the leads into the four plug pins, pulling the Helsyn sleeves over the leads after crimping.

9. Position the gasket (25) and plug (26) on to the adapter elbow (37) or plug Adapter (21), and secure with the four screws (28) and spring washers (27).

Note . . .

Wellseal C.S.20T/15A must be applied to those parts of the plug pins enclosed by moulding.

Window strap assembly *(fig.4)*

10. Fit a new lining (17) on to the window strap assembly (20) with I.C.I. adhesive 311-9238. Assemble together spring washer (19) and screw (18), enter

the screw into the trunnion and fit the retaining clip (14). Place the strap assembly in position on the motor housing (3) and secure with the screw (18).

Release mechanism *(fig.2)*

11. Enter the release pin (22) in the bush in the top of the front housing (23), ensuring that the cone shaped end of the release pin engages the cam face of the floating annulus (34). Mount the release housing (10) on to the front housing and secure with the four screws (20) and spring washers (21). Assemble the nipple (14) into the plunger (13), and enter the plunger into the release housing (10).

Appendix 5

ACTUATOR, ROTAX, TYPE C5210/1

LEADING PARTICULARS

Actuator, Type C5210/1	*Ref. No. 5W/336*
Normal voltage	*28V d.c.*
Current (at normal operating torque)	*16·5 amp.*
Normal operating torque (at 52 r.p.m.)	*25 lb. ft.*
No load speed	*58 r.p.m.*
Maximum static torque	*125 lb. ft.*
Clutch setting	*30—45 lb. ft.*
Time rating	*1 min.*
Angle of rotation	*Continuous rotation in either direction*
Brush spring pressure	*5—7 oz. (141—199 gm.)*
Minimum brush length	*0·325 in.*
Brush length (new)	*0·4 in.*
Reduction gear ratio	*275: 1*
Release mechanism	*Pull 20 lb. at 25 lb. ft. output torque. Travel 0·218 in.*
Overall dimensions—	
Length	*8·675 in.*
Width (over plug)	*4·5 in.*
Height (over release mechanism)	*4·36 in.*
Weight	*4 lb. 15 oz.*

1. This actuator is generally similar in construction to that described and illustrated in the main chapter. Electrical connection is, however, made to a 4-pole plug (Ref. No. 5X/6031); the type and position of this plug is the only point of difference between this and the C5209 actuator details of which are given in Appendix 4.

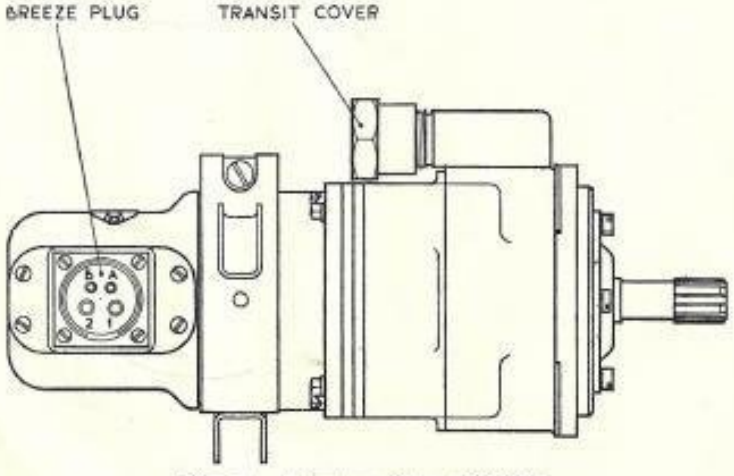


Fig. 1. Actuator, Type C5210/1

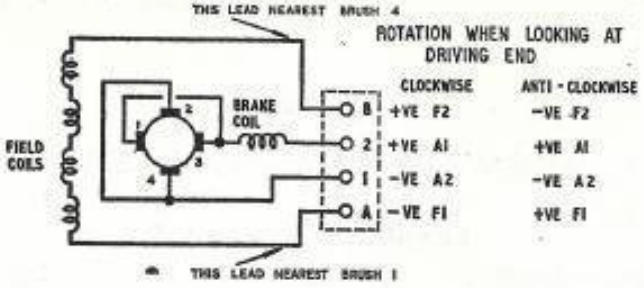


Fig. 2. Diagram of internal connections