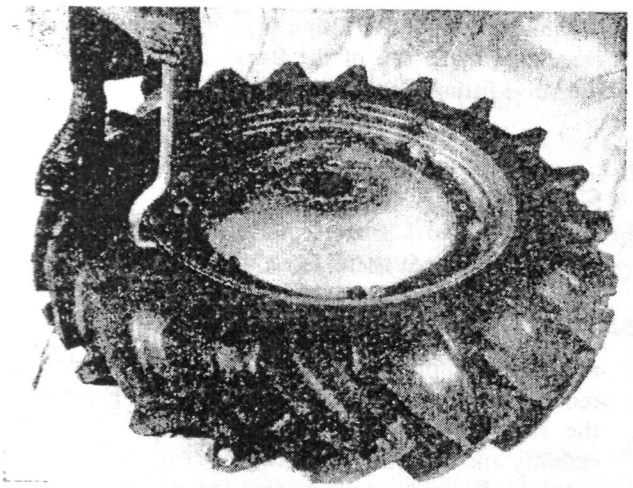


Fig. L.9

Press each bead off its seat with a cranked lever

Replacing a tyre

Inflate the tube until it is just rounded out, i.e. filled with air without stretching it. Too much air will make the fitting operation difficult.

Fit the tube into the cover, ensuring that it is placed with the valve on the correct side relative to the direction of rotation of the wheel and the tyre tread.

Lay the wheel flat on the floor with the valve hole upwards (Fig. L.13). Place the cover and tube, valve pointing upwards, eccentrically over the rim and pass the valve through the hole in the rim. Screw the rim nut lightly onto the valve.

Press the lower bead by hand as much as possible into the well of the rim.

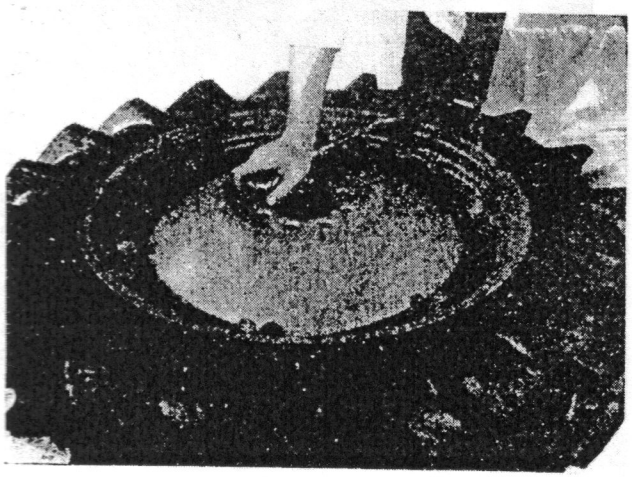


Fig. L.10

Start at the valve position with two spoon levers and remove the bead over the flange

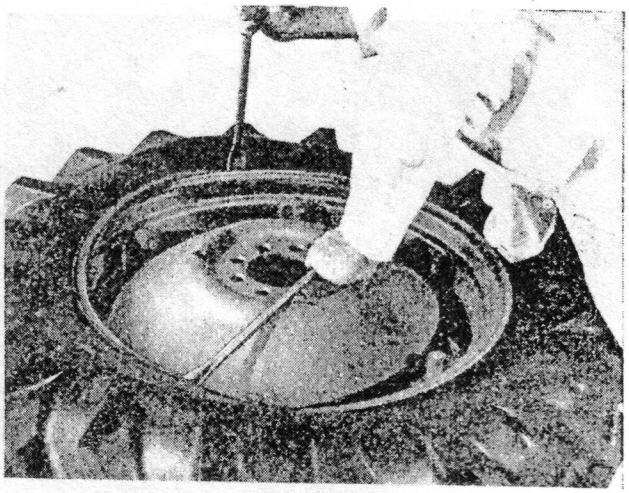


Fig. L.11

Keep the unremoved portion of the bead in the well of the rim

Insert a 20-in. spoon lever (TL20) as close as possible to the point where the bead passes over the flange and lever the bead over (Fig. L.14). Repeat until the bead is completely in position.

Press the upper bead into the well of the rim diametrically opposite the valve. Insert a spoon lever as close as possible to the point where the bead passes over the flange, and lever the bead over the flange (Fig. L.15). Repeat until the bead is completely over the flange, finishing at the valve position.

Push the valve inwards to make sure that the tube adjacent to the valve is not trapped under the bead. Pull the valve firmly back into position and, during inflation,

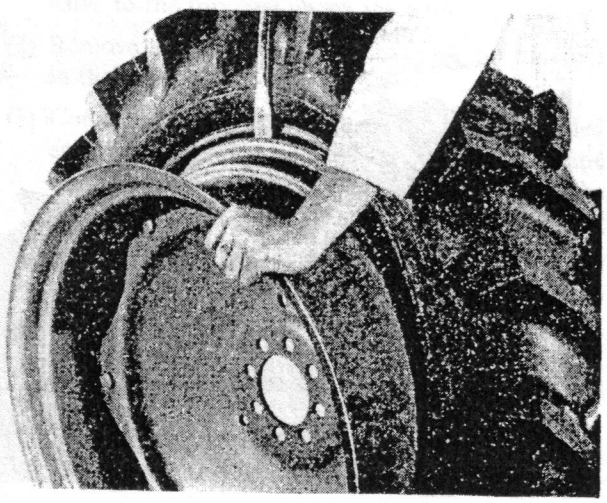


Fig. L.12

Pull the remaining bead back over the flange with one lever

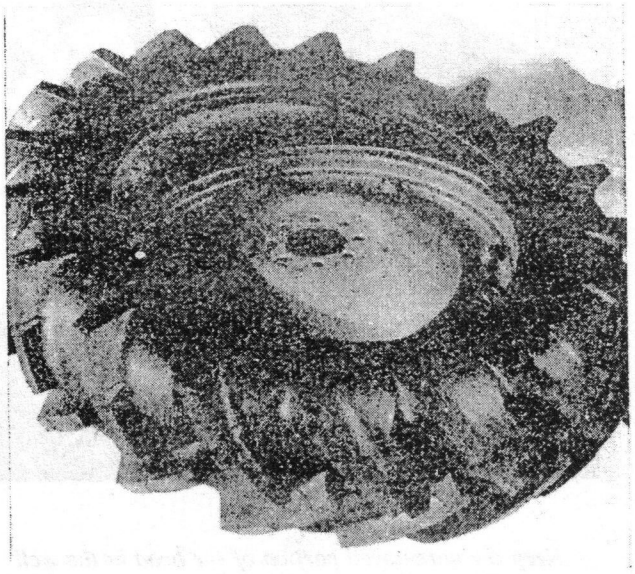


Fig. L.13

The cover, with the tube partially inflated, placed eccentrically over the rim and with the valve lightly secured by the rim nut

see that the valve protrudes squarely from the rim. If it does not do so, deflate the tyre and adjust the position of the cover and tube on the rim.

Tighten the rim nut.

Inflate to 30 to 35 lb./sq. in. (2·1 to 2·4 kg./cm.^{2}) and then reduce to the recommended pressure. The object of this operation is to ensure that the beads are pressed fully home on their seats, so preventing any tendency towards tyre creep.

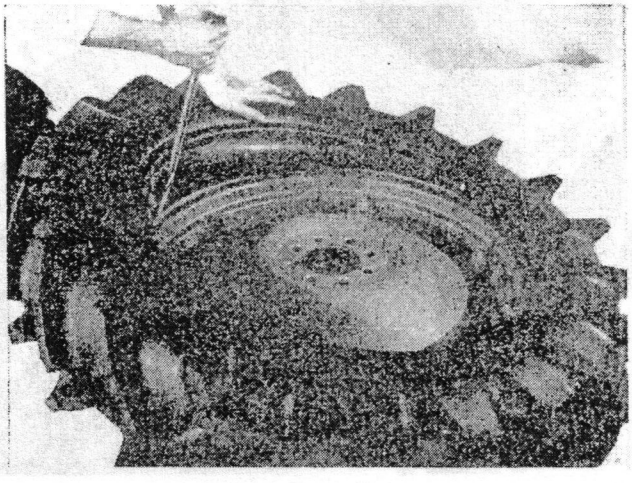


Fig. L.14

A lever inserted as close as possible to the point at which the bead passes over the flange

Make sure that the fitting lines on the cover are concentric with the top of the flange all round and check the valve fittings for tightness.

Section L.5

WHEEL WEIGHTS AND FRONT-END WEIGHTS

When working on steep gradients or with heavy rear-mounted equipment the load on the front wheels is reduced and it is sometimes advisable to fit a weight to the front extension of the main frame to maintain stability and control of the steering (Fig. L.16).

It is undesirable to use a front end weight when front-mounted equipment is fitted, and always before fitting a weight make sure that the drawbar hitch point is not higher than it should be. (See **'GENERAL INFORMATION'**, page 4.)

When working under extreme conditions additional weight may be obtained by water ballasting the front tyres. (See Section L.6.)

Front-end weights are approximately 270 lb. (122·5 kg.) each.

Rear wheel weights

To increase rear wheel adhesion without the use of water ballast weights may be fitted to the rear wheels and secured by three bolts in the holes provided. In extreme cases more than one weight may be fitted to each wheel. The weights are approximately 117 lb. (53 kg.) each.

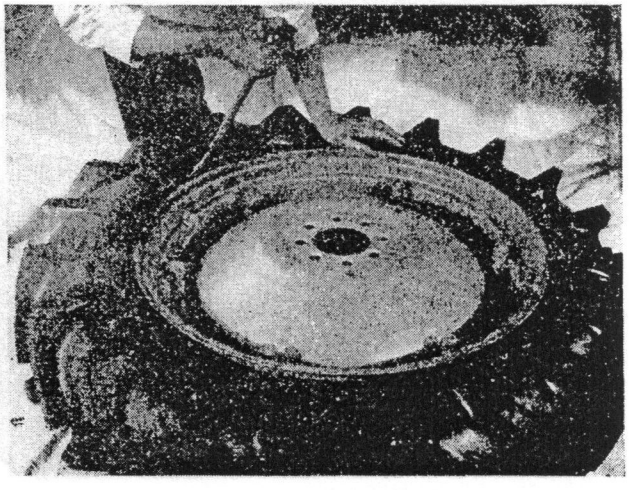


Fig. L.15

Lever the bead over the flange, finishing at the valve position

Section L.6

WATER BALLAST IN TYRES

To increase the adhesion of the rear wheels or the weight on the front wheels extra weight may be provided by filling the inner tubes with water.

To provide protection against frost a solution of calcium chloride is the most convenient and satisfactory form of anti-freeze mixture to use.

WARNING.—Radiator anti-freeze must not be used in tyres nor calcium chloride in the radiator.

Preparation of anti-freeze solution

To prepare the solution the necessary quantity of flaked calcium chloride is first dissolved in a small quantity of water (adding the calcium chloride to the water and **not vice versa**) and more water is then added to make up the total quantity required. The mixture will become warm as a result of the chemical action and must be allowed to cool off before it is pumped into the tube. To avoid acidity of the solution add 1 lb. (·45 kg.) of lime to every 100 lb. (45·3 kg.) of calcium chloride.

The quantities required for filling tyres of various sizes are given on page L.8.

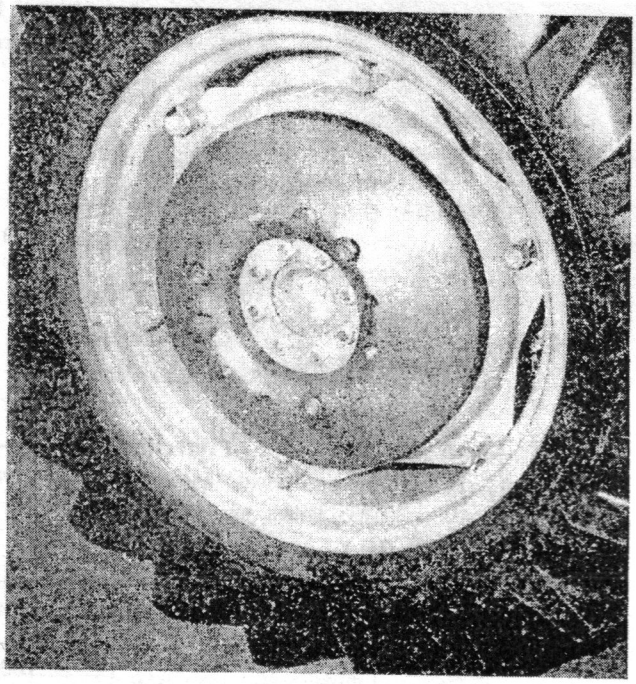


Fig. L.17

A rear wheel weight in position. More than one weight may be fitted if required

Section L.7

PROCEDURE FOR FILLING TYRES

The solution (see Section L.6) may be put into the tyre either by gravity flow from a tank about 6 feet (2 metres) above the tyre, or by a hand pump for 75 per cent. (valve level) filling. Special equipment is required for ballasting over 75 per cent.

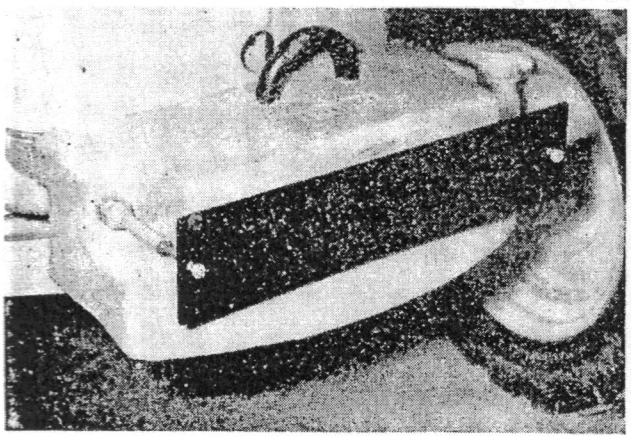


Fig. L.16

A weight fitted to the front end extension of the main frame

The tube by which the solution is supplied is connected to the valve of the tyre by a suitable adaptor (e.g. Schrader Adaptor 8954 and Schrader Hose Connector 4107). The procedure is as follows:

(1) Jack up the tractor, turn the wheel to bring the valve to the top, and chock the wheel in position.

(2) Remove the valve core to release all the pressure in the tube.

(3) Connect the adaptor to the valve with the knurled end towards the rim. Screw on the rest of the adaptor and connect the solution line from the pump or the tank.

(4) Pump in the solution or allow it to drain from the gravitational tank if this method is used.

While the tyre is being filled the solution should be shut off at intervals and the deflator button, located on the adaptor, pressed to release the air trapped in the inner tube. The tube is filled to its correct level when solution squirts from the deflator button when it is depressed.

(5) Remove the adaptor, replace the valve core, and inflate the tyre to 30 lb./sq. in. (2·1 kg./cm.^{2}) to seat the cover beads. Then reduce to atmospheric pressure and reinflate to normal operating pressure.

Protection down to 20° F. (12° of frost)—English measures

75 per cent. filling (valve level)

Size of tyre	10·00—28	11·00—28	5·50—16	6·00—16
Calcium chloride (lb.)	16·5	21·5	3·75	3·75
Dissolve in water (gal.)	2·5	3	1	1
Add more water (gal.)	18·25	24·25	3·5	3·5
Weight of solution (lb.)	224	294	48·75	48·75
100 per cent. filling				
Calcium chloride (lb.)	21	28	—	—
Dissolve in water (gal.)	3	3·5	—	—
Add more water (gal.)	23·75	31·75	—	—
Weight of solution (lb.)	288	380·5	—	—

Protection down to —7° C. (20° F.)—Metric measures

75 per cent. filling (valve level)

Size of tyre	10·00—28	11·00—28	5·50—16	6·00—16
Calcium chloride (kg.)	7·5	9·7	1·7	1·7
Dissolve in water (litres)	11·4	13·6	4·5	4·5
Add more water (litres)	83	110	16	16
Weight of solution (kg.)	101·5	133	22·1	22·1
100 per cent. filling				
Calcium chloride (kg.)	9·6	12·7	—	—
Dissolve in water (litres)	13·6	1·6	—	—
Add more water (litres)	108·5	144	—	—
Weight of solution (kg.)	132	173	—	—

Protection down to 0° F. (32° of frost)—English measures

75 per cent. filling (valve level)

Size of tyre	10·00—28	11·00—28	5·50—16	6·00—16
Calcium chloride (lb.)	37	48·5	8	8
Dissolve in water (gal.)	5	6·5	1	1
Add more water (gal.)	14·5	19	3·25	3·25
Weight of solution (lb.)	232	303·5	50·5	50·5
100 per cent. filling				
Calcium chloride (lb.)	47·5	63	—	—
Dissolve in water (gal.)	6	8·5	—	—
Add more water (gal.)	19	24·5	—	—
Weight of solution (lb.)	297·5	393	—	—

Protection down to —18° C. (0° F.)—Metric measures

75 per cent. filling (valve level)

Size of tyre	10·00—28	11·00—28	5·50—16	6·00—16
Calcium chloride (kg.)	16·7	22	3·6	3·6
Dissolve in water (litres)	22·7	29·5	4·5	4·5
Add more water (litres)	67	86·4	15·1	15·1
Weight of solution (kg.)	105	137	23	23
100 per cent. filling				
Calcium chloride (kg.)	21·5	28·5	—	—
Dissolve in water (litres)	27·3	38·5	—	—
Add more water (litres)	86·4	111·4	—	—
Weight of solution (kg.)	134·3	178	—	—

Section L.8

SETTING THE FRONT WHEEL TRACK
(Using 5·50—16 Tyres)

There are nine positions for each extending axle beam. With the wheel centres in their normal position the front wheel track can be increased from 52¾ to 68¾ in. (1·34 to 1·75 m.) in 2-in. (5-cm.) steps. By reversing the wheel centres on their hubs so that the 'dish' is outwards the tyres are moved outwards by a further 1¼ in. (3·1 cm.) on each side and give a maximum track setting of 71¼ in. (1·81 m.). Towards each end of the axle beam there are four holes drilled in sets of two. The holes are positioned so that for each extension of the axle arm, one of the holes in each set will be in line with the drilling in the axle arm. The arm and the beam are bolted together through these holes.

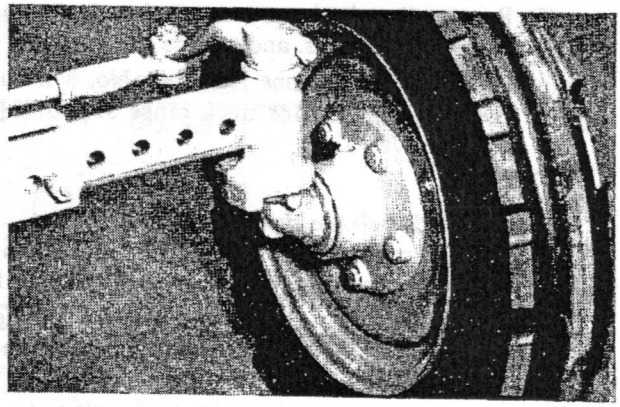


Fig. L.19

The front wheel track can be increased to 71¼ in. (1·81 m.) with the wheel centre reversed as shown

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
52¾	1·34	—	—	1 and 4	A
54¾	1·39	—	—	2 and 5	B
56¾	1·44	—	—	2 and 5	A
58¾	1·49	—	—	3 and 6	B
60¾	1·54	—	—	3 and 6	A
62¾	1·59	—	—	4 and 7	B
64¾	1·64	—	—	4 and 7	A
66¾	1·69	—	—	5 and 8	B
68¾	1·75	71¼	1·81	5 and 8	A

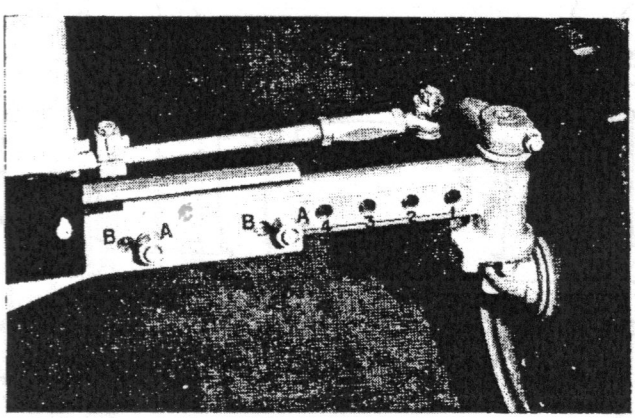


Fig. L.18

There are nine alternative positions for the front axle beam, here shown partly extended

Adjusting track from 52¾ to 68¾ in. (1·34 to 1·75 m.)

(1) Apply the hand brake.
(2) Jack up one wheel.
(3) Remove the bolts clamping the axle arm to the axle beam.
(4) Remove the two clamps on each track-rod.
(5) Draw out the wheel to the desired position (see table above).
(6) Refit and tighten the bolts.
(7) Refit the clamps on the track-rod, keeping the bolts as far apart as possible.
(8) Repeat for the other wheel.

Adjusting track from 68¾ to 71¼ in. (1·75 to 1·81 m.)

(1) Apply the hand brake.
(2) Jack up one wheel.

(3) Remove the wheel nuts, reverse the wheel to bring the 'dish' outwards, and replace the nuts.

(4) Carry out instructions No. 3 to No. 8 inclusive given on page L.9 for track range 52¾ to 68¾ in. (1·34 to 1·75 m.).

Selection of axle bolt position

Each axle arm is provided with eight holes. Four of these holes, numbered 1 to 4, are shown in Fig. L.18.

At each end of the axle beam are two pairs of holes—'A' and 'B'. Fig. L 18 shows the bolts inserted in holes 'A'.

The table on page L.9 gives the holes in which the axle bolts are to be inserted for various track settings.

Section L.9

SETTING THE REAR WHEEL TRACK
(Using 10·00—28 Tyres)

The track of the rear wheels may be varied from a minimum of 52 in. (1·32 m.) to a maximum of 80 in. (2·03 m.). Each adjustment will alter the track by 4 in. (101·6 mm.), or 2 in. (50·8 mm.) on each wheel. There are therefore eight different track settings which may be obtained.

Attention is drawn to the two following points:

(1) When reversing a wheel rim on a wheel disc it is important that the correct direction of rotation of the tyres is retained. This may be achieved by exchanging the right-hand rim for the left-hand rim

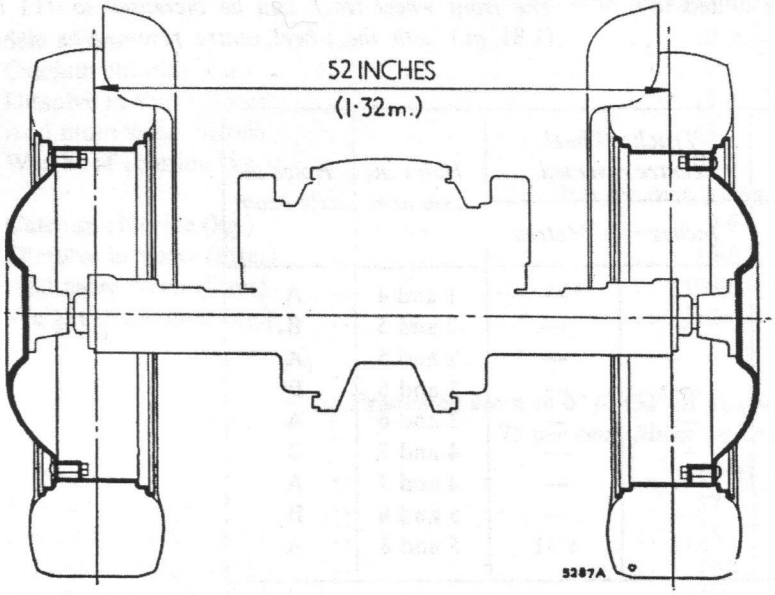


Fig. L.20

52 in. (1·32 m.). Wheel discs with 'dished' ide inwards. Wheel rims with lugs outermost and fitted to the inside *of the wheel discs*

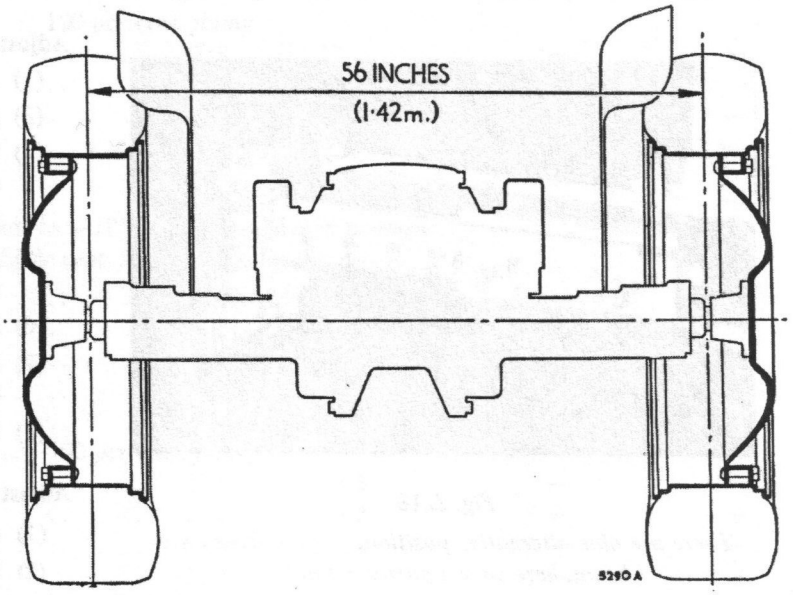


Fig. L.21

56 in. (1·42 m.). Wheel discs with 'dished' side inwards. Wheel rims with lugs outermost and fitted to the outside *of the wheel discs*

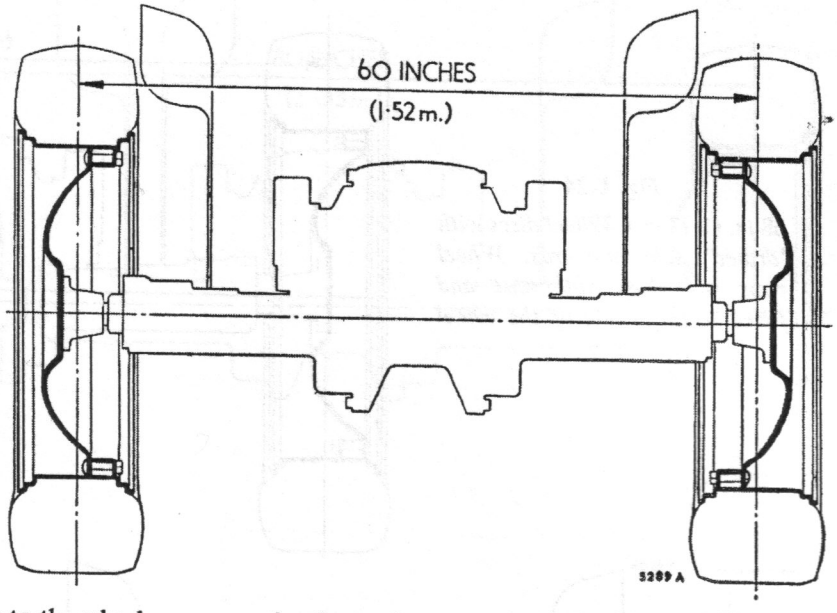


Fig. L.22

60 in. (1·52 m.). Wheel discs with 'dished' side inwards. Wheel rims with lugs innermost and fitted to the inside *of the wheel discs*

(2) The bolts which retain the wheel rims to the wheel discs may only be fitted one way, i.e. the small lug beneath the bolt head must engage the slot in the wheel disc.

To alter the position of the tyre rims on the wheel discs

(1) Jack up the wheel to be adjusted.
(2) Slacken and remove the six nuts, bolts, and washers holding the tyre rim to the wheel disc.
(3) Turn the tyre rim in a clockwise direction to bring the rim lugs in line with the cut-away portion of the wheel disc and withdraw the rim outwards; refit the rim in the desired position.
(4) Insert each of the six bolts through the wheel disc holes and into the rim lugs, ensuring that the small lug beneath the bolt head engages the slot in the wheel disc. Refit the washers and nuts and secure tightly.

To reverse a wheel disc

(1) Jack up the wheel to be adjusted.
(2) Slacken and remove the six nuts, bolts, and washers holding the tyre rim to the wheel disc.
(3) Turn the tyre rim a clockwise direction to bring the rim lugs in line with the cut-away portion of the wheel disc and withdraw the rim.

Unscrew the eight nuts securing the wheel disc to the axle, withdraw the wheel disc, and refit in the reversed position.

(4) Refit the wheel rim in the desired position.

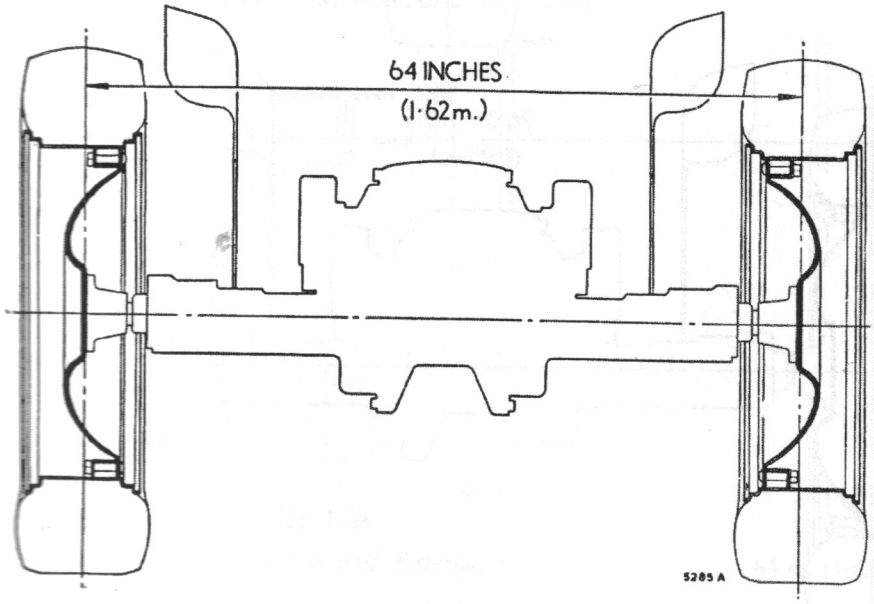


Fig. L.23

64 in. (1·62 m.). Wheel discs with 'dished' side inwards. Wheel rims with lugs innermost and fitted to the outside *of the wheel discs*

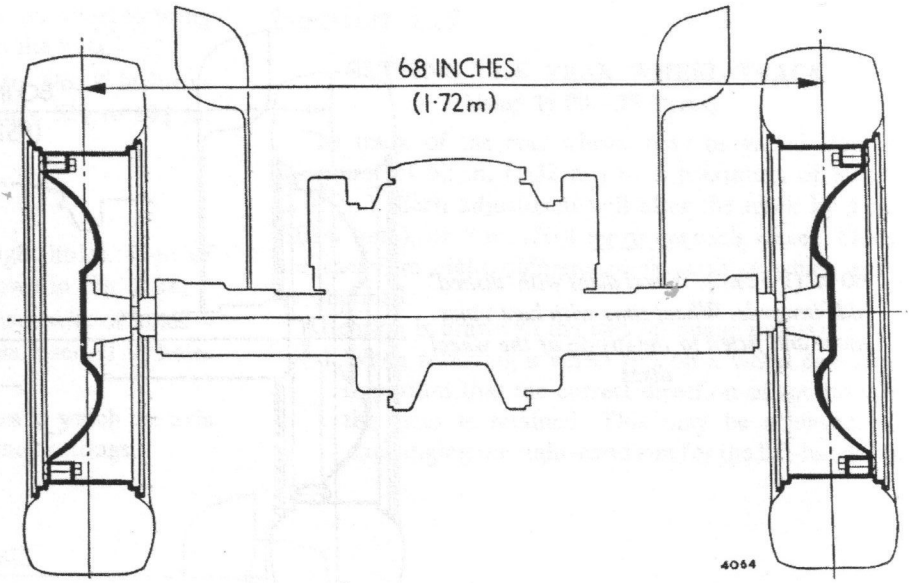


Fig. L.24

68 in. (1·72 m.). Wheel discs with 'dished' side outwards. Wheel rims with lugs outermost and fitted to the inside *of the wheel discs*

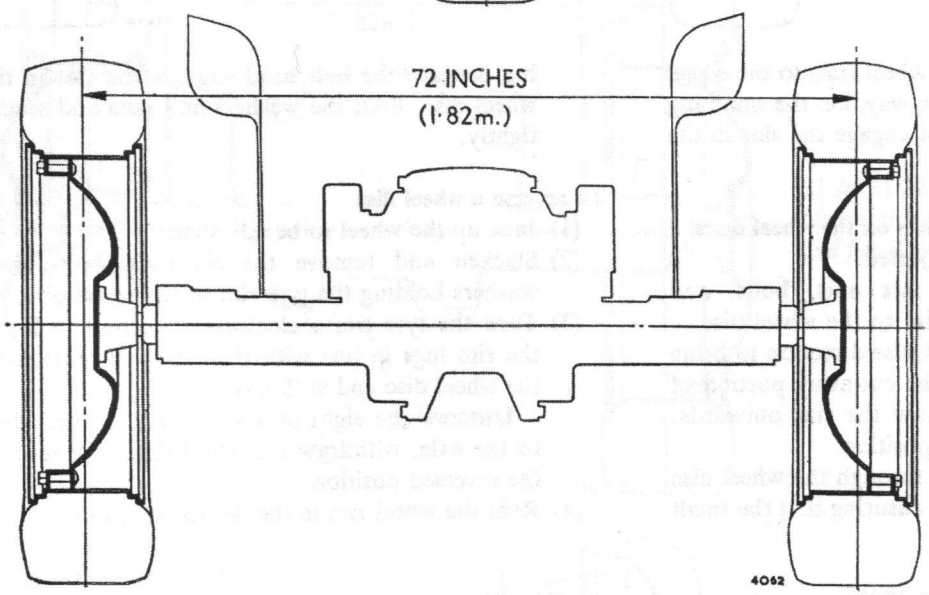


Fig. L.25

72 in. (1·82 m.). Wheel discs with 'dished' side outwards. Wheel rims with lugs outermost and fitted to the outside *of the wheel discs*

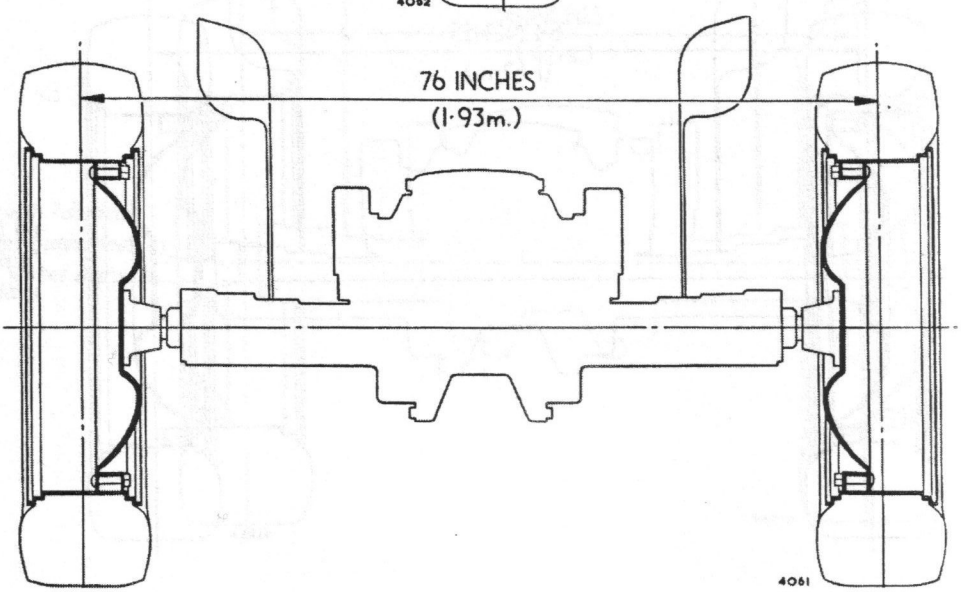


Fig. L.26

76 in. (1·93 m.). Wheel discs with 'dished' side outwards. Wheel rims with lugs innermost and fitted to the inside *of the wheel discs*

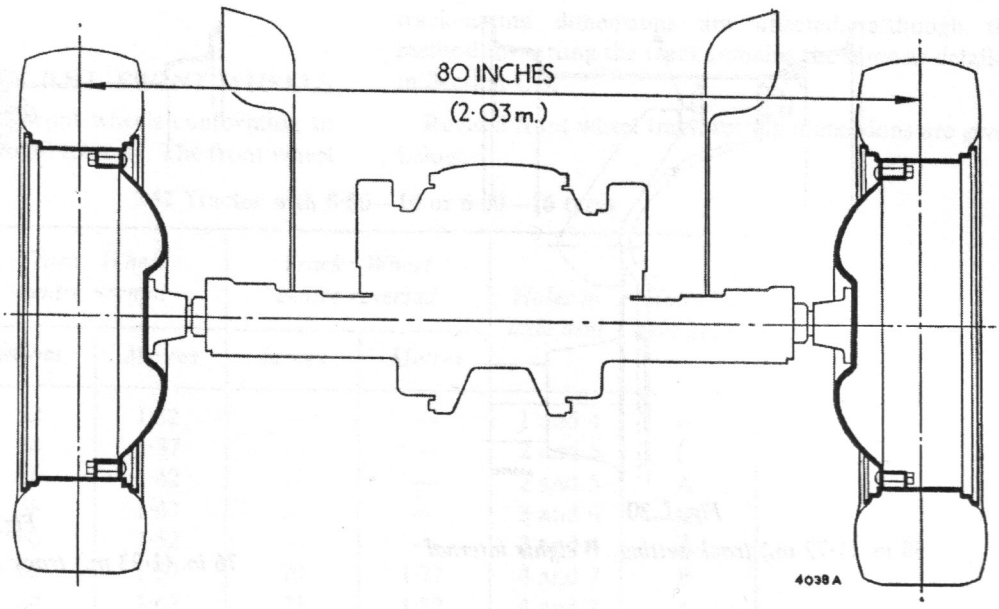


Fig. L.27

80 in. (2·03 m.). Wheel discs with the 'dished' side outwards. Wheel rims with lugs innermost and fitted to the outside of the wheel discs

Section L.10

MODIFICATION TO WHEEL WEIGHTS FOR FITTING TO W12×24 REAR WHEELS

Wheel weights can only be fitted to W12×24 rear wheels when a track setting of 60 in. (1·52 m.) or more is used and then, in some cases, a modification to the wheel weight is necessary.

The following notes detail the requirements for fitting weights to the rear wheels when any track setting between 60 in. and 80 in. (1·52 m. and 2·03 m.) is used.

A. 60 in. (1·52 m.) track setting

Wheel weights require no modification and are attached to the outside of the wheel disc (Fig. L.28).

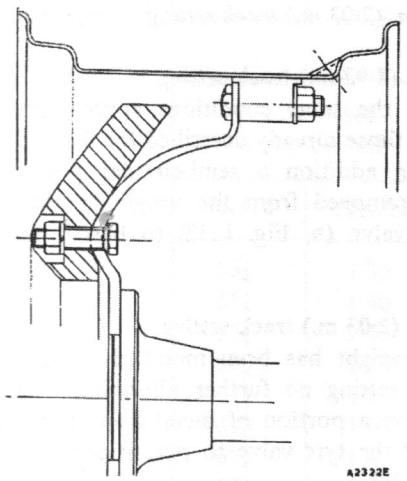


Fig. L.28

60 in. (1·52 m.) track setting. External weights

B. 64 in. (1·62 m.) track setting

When this track setting is used the six bolts securing the tyre rim to the wheel disc must be fitted with the bolt heads facing outwards. The weight must be attached to the outside of the wheel disc. Fit the weight temporarily to the wheel and mark the positions on the weight where each of the six rim securing bolts touch (Fig. L.29). Detach the weight and remove from the inside edge at each of the positions marked a semi-circular portion measuring approximately $\frac{1}{2}$ in. (12·7 mm.) deep by $\frac{3}{4}$ in. (19 mm.). Bolt the weight to the outside of the wheel disc and ensure that there is a clearance around each of the six rim bolts.

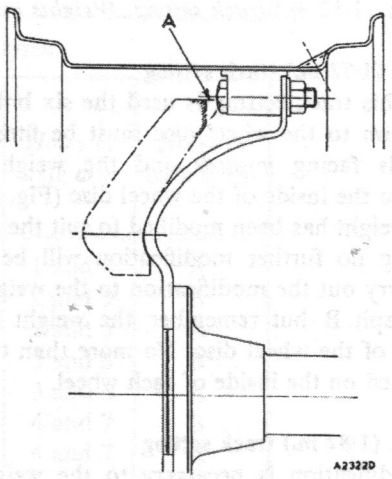


Fig. L.29

64 in. (1·62 m.) track setting. External weights

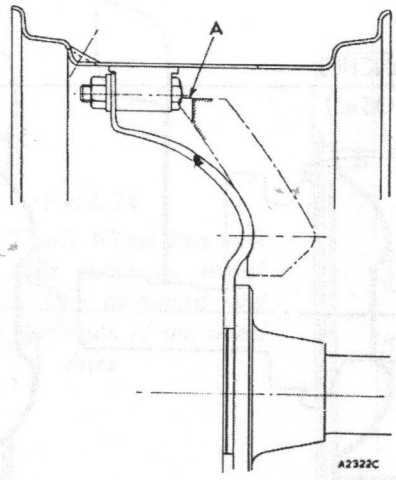


Fig. L.30

58 in. (1·72 m.) track setting. Weights internal

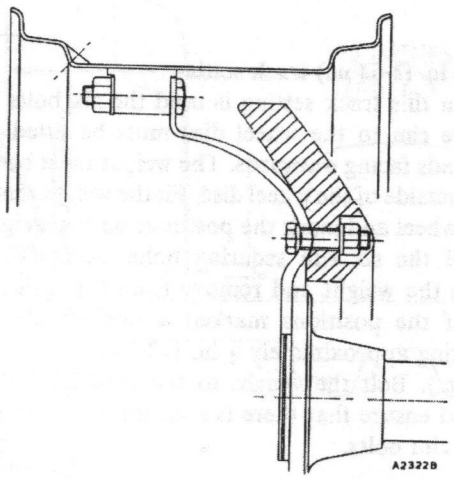


Fig. L.31

72 in. (1·82 m.) track setting. Weights internal

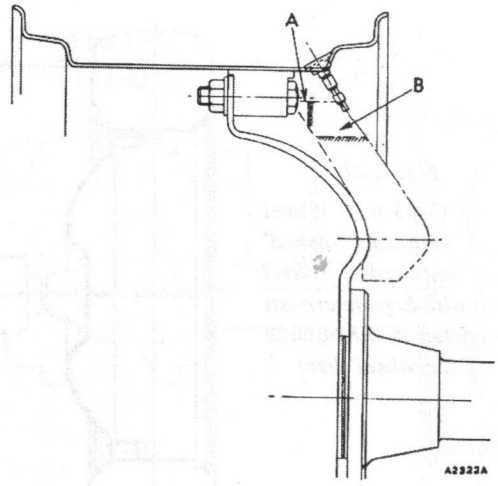


Fig. L.32

76 in. (1·93 m.) track setting. Weights internal

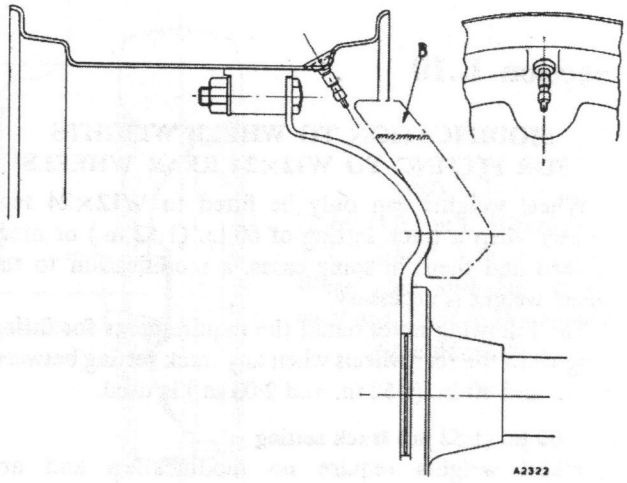


Fig. L.33

80 in. (2·03 m.) track setting. Weights internal

C. 68 in. (1·72 m.) track setting

When this track setting is used the six bolts securing the tyre rim to the wheel disc must be fitted with the bolt heads facing *inwards* and the weight must be attached to the inside of the wheel disc (Fig. L.30).

If the weight has been modified to suit the 64 in. (1·62 m.) setting no further modification will be necessary. If not, carry out the modification to the weight detailed in paragraph B but remember the weight is fitted to the inside of the wheel disc. No more than two weights can be fitted on the inside of each wheel.

D. 72 in. (1·82 m.) track setting

No modification is necessary to the weight but no more than two weights can be fitted on the inside of each wheel (Fig. L.31).

E. 76 in. (1·93 m.) track setting

Exactly the same conditions apply with this track setting as those already described for the 68 in. (1·72 m.) setting. In addition a semi-circular portion of metal must be removed from the weight in the vicinity of the tyre valve (B, Fig. L.32) to permit access to the valve.

F. 80 in. (2·03 m.) track setting

If the weight has been modified to suit the 76 in. (1·93 m.) setting no further alteration is necessary. If not, remove a portion of metal from the weight in the vicinity of the tyre valve to permit access to the valve (B, Fig. L.33).

No more than two weights can be fitted on the inside of each wheel.

Section L.11

TRACK SETTINGS WITH B.S.I. FRONT WHEELS

From Tractor No. 30127 front wheels conforming to B.S.I. standards are fitted to all tractors. The front wheel track-setting dimensions are affected, although the method for setting the track remains the same as detailed in Section L.8.

Revised front wheel track-setting dimensions are given below.

342 Tractor with 5·50—16 or 6·00—16 tyres

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
52	1·32	—	—	1 and 4	A
54	1·37	—	—	2 and 5	B
56	1·42	—	—	2 and 5	A
58	1·47	—	—	3 and 6	B
60	1·52	—	—	3 and 6	A
62	1·57	70	1·77	4 and 7	B
64	1·62	72	1·82	4 and 7	A
66	1·67	74	1·87	5 and 8	B
68	1·72	76	1·92	5 and 8	A

342 Tractor with 6·00—19 tyres

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
54	1·37	69¾	1·77	3 and 6	B
56	1·42	71¾	1·82	3 and 6	A
58	1·47	73¾	1·87	4 and 7	B
60	1·52	75¾	1·92	4 and 7	A
62	1·57	77¾	1·97	5 and 8	B
64	1·62	79¾	2·02	5 and 8	A

342 Tractor with 7·50—16 tyres

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
53¼	1·35	—	—	1 and 4	A
55¼	1·40	—	—	2 and 5	B
57¼	1·45	—	—	2 and 5	A
59¼	1·50	—	—	3 and 6	B
61¼	1·55	—	—	3 and 6	A
63¼	1·60	—	—	4 and 7	B
65¼	1·65	70½	1·79	4 and 7	A
67¼	1·70	72½	1·84	5 and 8	B
69¼	1·75	74½	1·89	5 and 8	A

SECTION LL

THE WHEELS AND TYRES

Section LL applies only to the Nuffield Four Tractor. Information and instructions not included in this Section are the same as those given in Section L for the Nuffield Three Tractor

Section LL.1

WHEEL WEIGHTS AND FRONT-END WEIGHTS

When working on steep gradients or with heavy rear-mounted equipment the load on the front wheels is reduced, and it is sometimes advisable to fit a weight to the front extension of the main frame to maintain stability and control of the steering.

It is undesirable to use a front-end weight when front-mounted equipment is fitted, and always before fitting a weight make sure that the drawbar hitch point is not higher than it should be. (See page 5, **'GENERAL INFORMATION'.**)

When working under extreme conditions additional weight may be obtained by water-ballasting the front tyres. (See Section LL.2.)

Front-end weights are approximately 270 lb. (122·5 kg.) each.

Rear wheel weights

To increase rear wheel adhesion without the use of water ballast weights may be fitted to the rear wheels and secured by three bolts in the holes provided. In extreme cases more than one weight may be fitted to each wheel. The weights are approximately 122 lb. (55·5 kg.) each.

Section LL.2

WATER BALLAST IN TYRES

To increase the adhesion of the rear wheels or the weight on the front wheels extra weight may be provided by filling the inner tubes with water.

To provide protection against frost a solution of calcium chloride is the most convenient and satisfactory form of anti-freeze mixture to use.

WARNING.—Radiator anti-freeze must not be used in tyres nor calcium chloride solution in the radiator.

Preparation of anti-freeze solution

To prepare the solution the necessary quantity of flaked calcium chloride is first dissolved in a small quantity of water (adding the calcium chloride to the water and **not vice versa**), and more water is then added to make up the total quantity required. The mixture will become warm as a result of the chemical action and must be allowed to cool off before it is pumped into the tube. To avoid acidity of the solution add 1 lb. (·45 kg.) of lime to every 100 lb. (45·3 kg.) of calcium chloride.

The quantities required for filling tyres of various sizes are given on page LL.3.

The procedure for filling tyres is the same as that detailed in Section L.7 for the Nuffield Three tractor.

Section LL.3

TRACK-SETTING (FLANGED AXLE)
(Using 10·00—28 Tyres)

The track of the rear wheels may be varied from a minimum of 53 in. (1·34 m.) to a maximum of 77 in. (1·95 m.). Each adjustment will alter the track by 4 in. (101·6 mm.), or 2 in. (50·8 mm.) on each wheel. There are therefore seven different track settings which may be obtained.

Attention is drawn to the two following points:

(1) When reversing a wheel rim on a wheel disc it is important that the correct direction of rotation of the tyres is retained. This may be achieved by exchanging the right-hand rim for the left-hand rim.

(2) The bolts which retain the wheel rims to the wheel discs may only be fitted one way, i.e. the square section under the bolt head must engage the square hole in the rim lug.

To alter the position of the tyre rims on the wheel discs

(1) Jack up the wheel to be adjusted.

(2) Slacken and remove the eight nuts, bolts, and washers holding the tyre rim to the wheel disc.

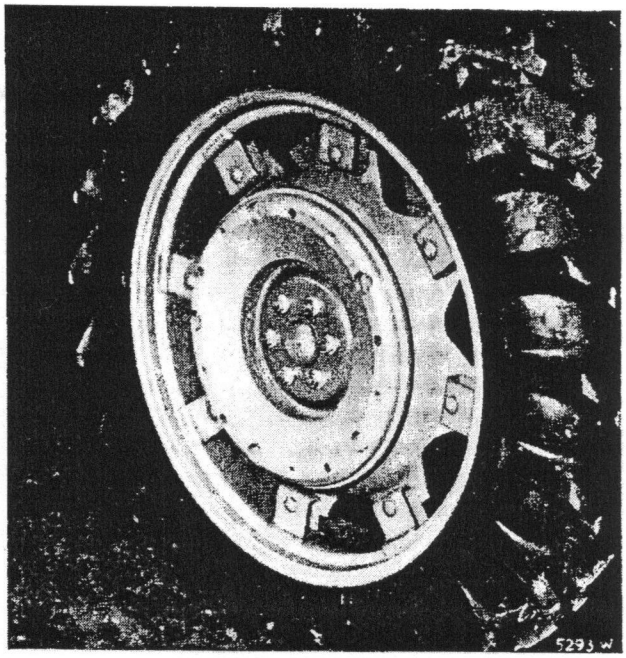


Fig. LL.1

A rear wheel weight in position. More than one weight may be fitted if required

Protection down to 20° F. (12° of frost)—English measures

75 per cent. filling (valve level)

Size of tyre	6·00—16	11·00—36	13·00—30	14·00—30
Calcium chloride (lb.)	3·75	26	33	38
Dissolve in water (gal.)	1	3·5	4·5	5
Add more water (gal.)	3·5	29·5	37·5	43·5
Weight of solution (lb.)	48·75	356	453	523
100 per cent. filling				
Calcium chloride (lb.)	—	32	45·5	53
Dissolve in water (gal.)	—	6	6	7
Add more water (gal.)	—	34	52	60·5
Weight of solution (lb.)	—	432	625·5	728

Protection down to −7° C. (20° F.)—Metric measures

75 per cent. filling (valve level)

Size of tyre	6·00—16	11·00—36	13·00—30	14·00—30
Calcium chloride (kg.)	1·7	11·8	15	17·2
Dissolve in water (litres)	4·5	15·9	20·4	22·7
Add more water (litres)	16	134	170	198
Weight of solution (kg.)	22·1	161·5	205·5	237
100 per cent. filling				
Calcium chloride (kg.)	—	14·5	20·6	24
Dissolve in water (litres)	—	27·2	27·2	31·8
Add more water (litres)	—	154·5	236	275
Weight of solution (kg.)	—	195·5	248·1	330·7

Protection down to 0° F. (32° of frost)—English measures

75 per cent. filling (valve level)

Size of tyre	6·00—16	11·00—36	13·00—30	14·00—30
Calcium chloride (lb.)	8	58	75	87
Dissolve in water (gal.)	1	8	9·5	11·5
Add more water (gal.)	3·25	23	30·25	34·5
Weight of solution (lb.)	50·5	368	472·5	547
100 per cent. filling				
Calcium chloride (lb.)	—	75·5	103	121
Dissolve in water (gal.)	—	9·5	13·5	15·5
Add more water (gal.)	—	30·5	41·5	48·5
Weight of solution (lb.)	—	475	653	761

Protection down to −18° C. (0° F.)—Metric measures

75 per cent. filling (valve level)

Size of tyre	6·00—16	11·00—36	13·00—30	14·00—30
Calcium chloride (kg.)	3·6	26·3	34	39·5
Dissolve in water (litres)	4·5	36·4	43	52·3
Add more water (litres)	14·75	104·5	137	156·8
Weight of solution (kg.)	23	167	214	248
100 per cent. filling				
Calcium chloride (kg.)	—	34·2	46·7	55
Dissolve in water (litres)	—	43	61·3	70·5
Add more water (litres)	—	138·8	188	220·5
Weight of solution (kg.)	—	215	296	345

(3) Turn the tyre rim in a clockwise direction to bring the rim lugs in line with the cut-away portion of the wheel disc and withdraw the rim outwards; refit the rim in the desired position.

(4) Insert each of the eight bolts through the tyre rim lugs and into the wheel discs, ensuring that the square section beneath the bolt head engages in the square hole in the rim lug. Refit the washers and nuts and tighten securely.

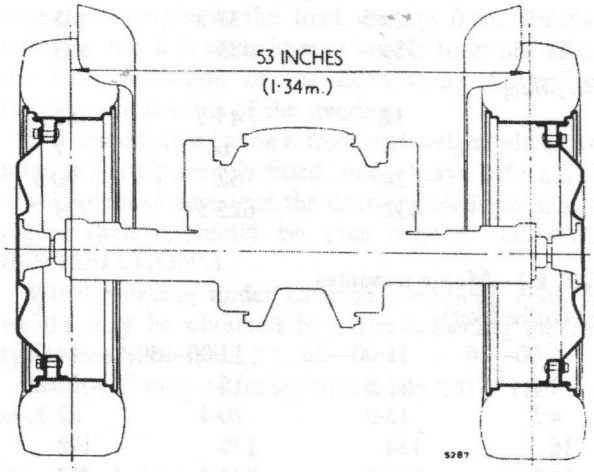


Fig. LL.2

53 *in.* (1·34 *m.*). *Wheel discs with 'dished' side inwards. Wheel rims with lugs outermost and fitted to the* inside *of the wheel discs*

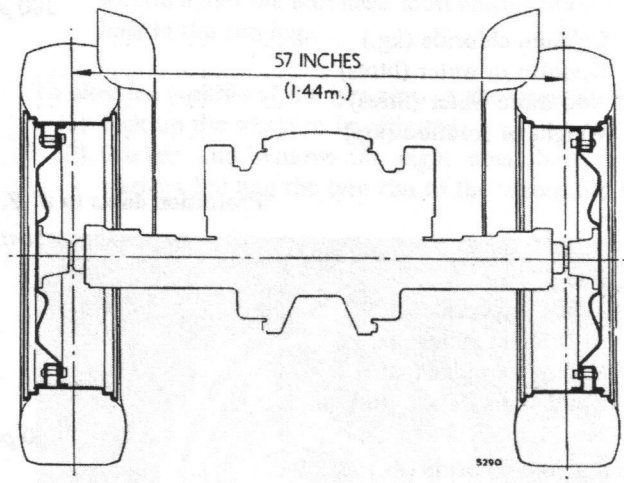


Fig. LL.3

57 *in.* (1·44 *m.*). *Wheel discs with 'dished' side inwards. Wheel rims with lugs outermost and fitted to the* outside *of the wheel discs*

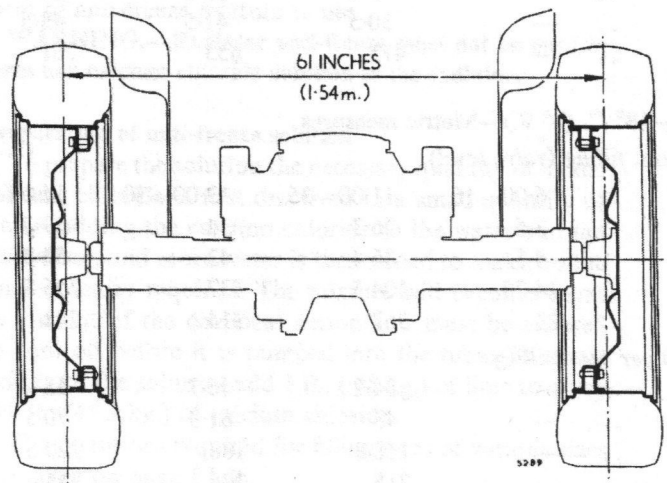


Fig. LL.4

61 *in.* (1·54 *m.*). *Wheel discs with 'dished' side inwards. Wheel rims with lugs innermost and fitted to the* inside *of the wheel discs*

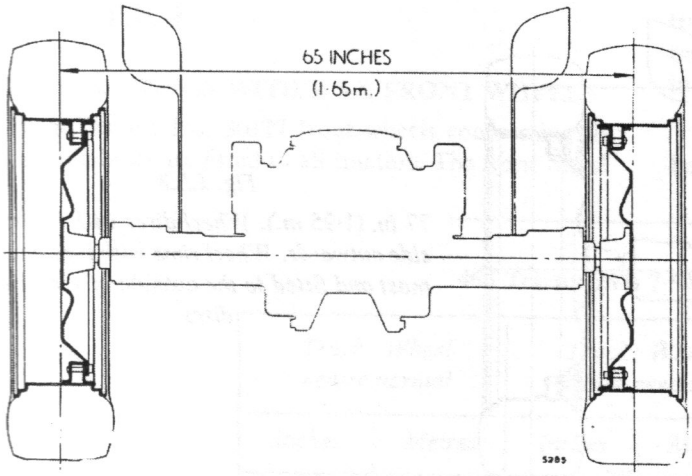


Fig. LL.5

65 *in.* (1·65 *m.*). *Wheel discs with 'dished' side inwards. Wheel rims with lugs innermost and fitted to the* outside *of the wheel discs*

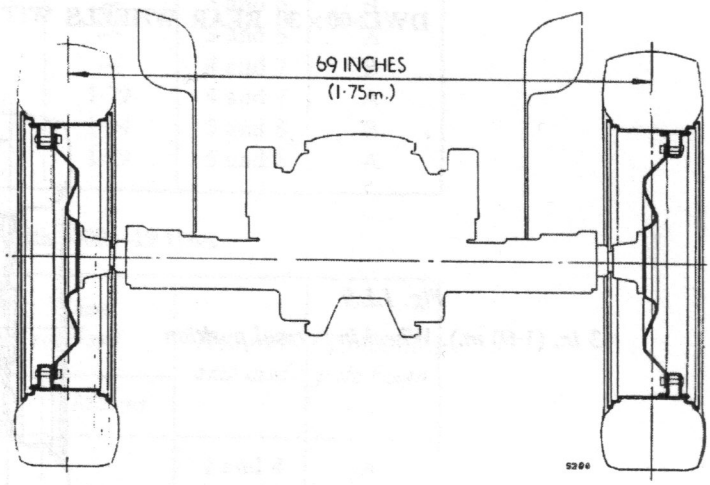


Fig. LL.6

69 *in.* (1·75 *m.*). *Wheel discs with 'dished' side outwards. Wheel rims with lugs outermost and fitted to the* outside *of the wheel discs*

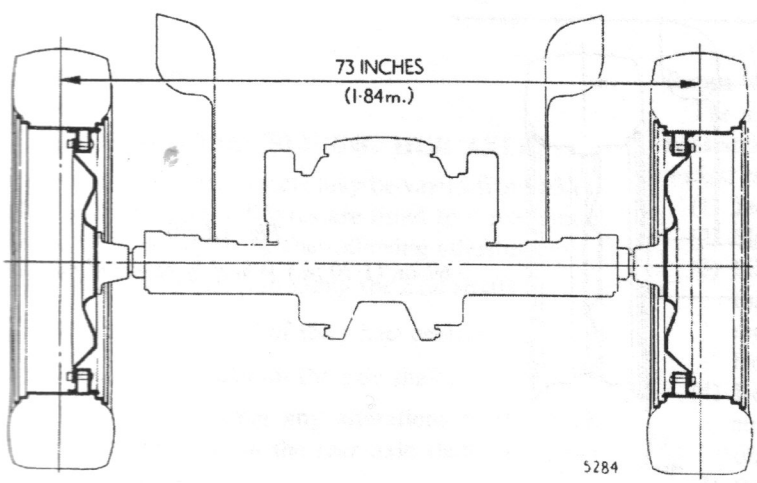


Fig. LL.7

73 *in.* (1·84 *m.*). *Wheel discs with 'dished' side outwards. Wheel rims with lugs innermost and fitted to the* inside *of the wheel discs*

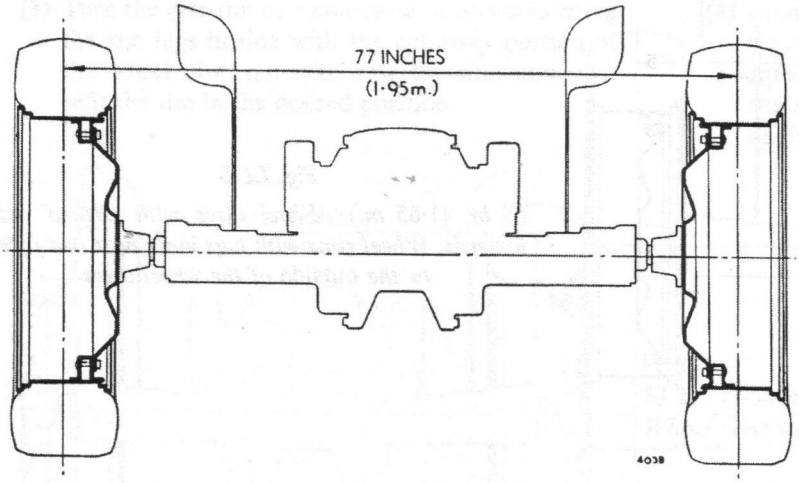


Fig. LL.8

77 in. (1·95 m.). Wheel discs with 'dished' side outwards. Wheel rims with lugs innermost and fitted to the outside of the wheel discs

DW12·00×30 REAR WHEELS WITH 13·00–30 OR 14·00–30 TYRES

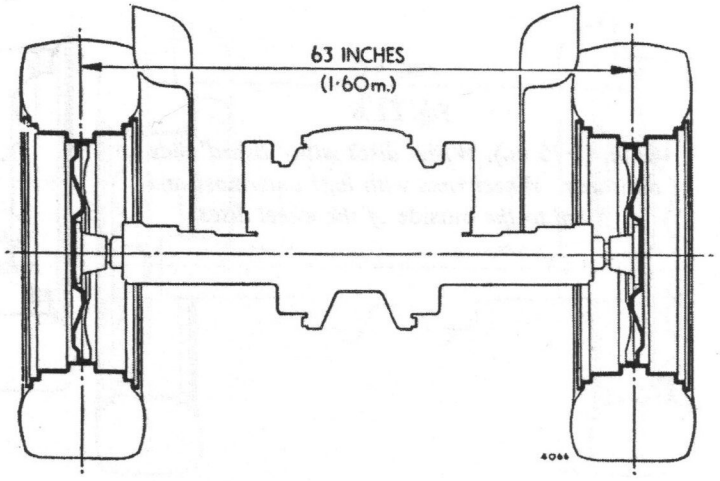


Fig. LL.9

63 in. (1·60 m.). Wheel in normal position

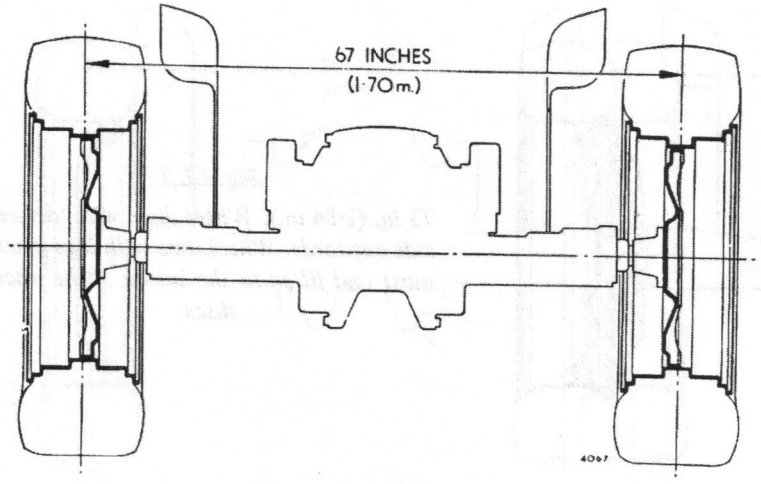


Fig. LL.10

67 in. (1·70 m.) Wheel in reversed position

Section LL.4

TRACK SETTINGS WITH B.S.I. FRONT WHEELS

From Tractor No. 30127 front wheels conforming to B.S.I. standards are fitted to all tractors. The front wheel track-setting dimensions are affected, although the method for setting the track remains the same as detailed in Section L.8.

Revised front wheel track-setting dimensions are given below.

460 Tractor with 7·50—16 tyres

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
53¼	1·35	—	—	1 and 4	A
55¼	1·40	—	—	2 and 5	B
57¼	1·45	—	—	2 and 5	A
59¼	1·50	—	—	3 and 6	B
61¼	1·55	—	—	3 and 6	A
63¼	1·60	—	—	4 and 7	B
65¼	1·65	70½	1·79	4 and 7	A
67¼	1·70	72½	1·84	5 and 8	B
69¼	1·75	74½	1·89	5 and 8	A

460 Tractor with 6·00—19 tyres

Track: Wheel centre normal		*Track: Wheel centre reversed*		*Holes in axle arm*	*Holes in axle beam*
Inches	*Metres*	*Inches*	*Metres*		
48	1·22	—	—	1 and 4	A
50	1·27	65¾	1·67	2 and 5	B
52	1·32	67¾	1·72	2 and 5	A

Section LL.5

TRACK-SETTING (SLIDING HUB AXLE)

The track of the rear wheels may be varied from 53 in. (1·34 m.) when 11·00—36 tyres are fitted to a maximum of 88 in. (2·24 m.) by using the following adjustments:

(1) Sliding the wheel hub along the axle shafts.

(2) Reversing the 'dish' of the wheel centres.

(3) Reversing the hubs on the axle shafts.

NOTE.—Before making any alterations to the track make sure the keyways in the rear axle shafts are clean and free from burrs.

Range 'A' (53 to 65 in. [1·34 to 1·65 m.])

The arrangement of the wheel hubs and wheel centres is as shown in Fig. LL.11. In order to make adjustments within range:

(1) Jack up the wheel to be adjusted.
(2) Slacken the four hub clamp bolts.
(3) Slide the wheel hub into the desired position along the axle shaft. (To obtain the correct setting measure the amount which the shaft prutrudes from the hub, as given in the table on page LL.8).
(4) Retighten the clamping bolts very securely, making sure that the gaps between the clamp and the hub on either side of the shaft are equal.
(5) Remove the jack and repeat for the other wheel.

Range 'B' (65 to 76 in. [1·65 to 1·93 m.])

The arrangement of the wheel centres and wheel hubs is as illustrated in Fig. LL.12. To change from range 'A' to range 'B' remove both wheel assemblies from their respective hubs and refit ('dish' outwards) on the opposite hubs. Adjust the hubs along their shafts to obtain the desired track. See paras. (3) and (4), Range 'A'.

Range 'C' (76 to 88 in. [1·93 to 2·24 m.])

The arrangement of the wheel centres and hubs is as illustrated in Fig. LL.13.

To change from range 'A' to range 'C' remove both wheel and hub assemblies complete and refit ('dish outwards) on the opposite axle shafts. Adjust for track width as in paras. (3) and (4), Range 'A'.

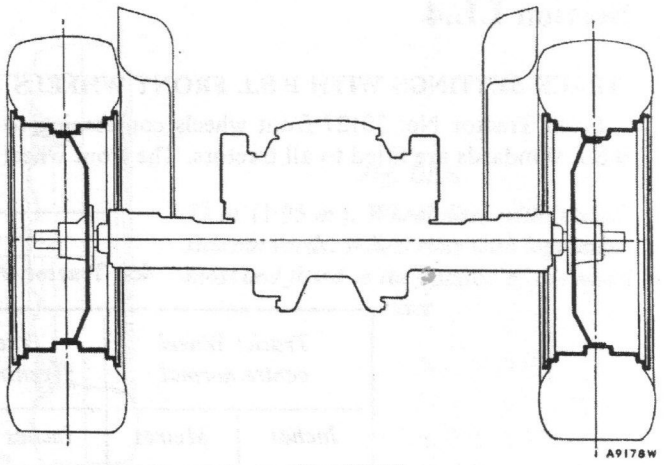


Fig. LL.12

The rear wheel and hub with the wheel disc reversed to give range 'B'

Track in inches			*Track in metres*			*Distance from end of axle shaft to face of hub*	
'A'	*'B'*	*'C'*	*'A'*	*'B'*	*'C'*	*Inches*	*Cm.*
53	65	76	1·34	1·65	1·93	5½	13·9
54	66	78	1·37	1·68	1·98	5	12·7
56	68	80	1·42	1·73	2·03	4	10·2
58	70	82	1·47	1·78	2·08	3	7·6
60	72	84	1·52	1·83	2·14	2	5·1
62	74	86	1·57	1·88	2·18	1	2·5
65	76	88	1·65	1·93	2·24	0	0

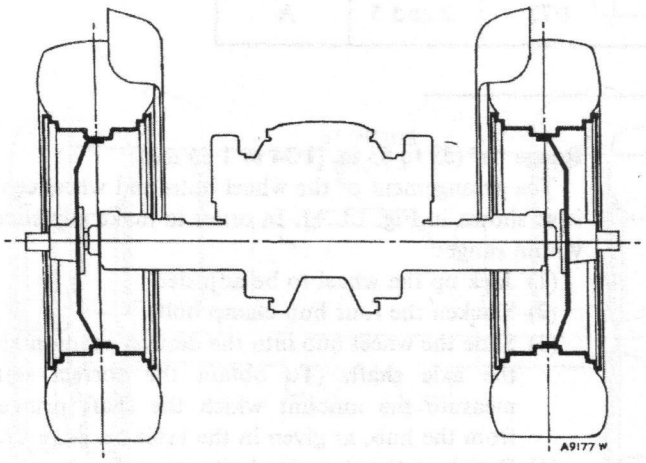


Fig. LL.11

The rear wheel and hub in the normal position for range 'A'

NOTE.—It is desirable to rotate the axle shaft until the keyway is underneath before changing the wheel setting.

Direction of tyre treads

When fitting tyres to wheels and when interchanging tyres and wheel assemblies to give the desired track setting, care must be taken to ensure the correct direction of rotation. An arrow is embossed on the wall of the tyre to indicate the correct rotation.

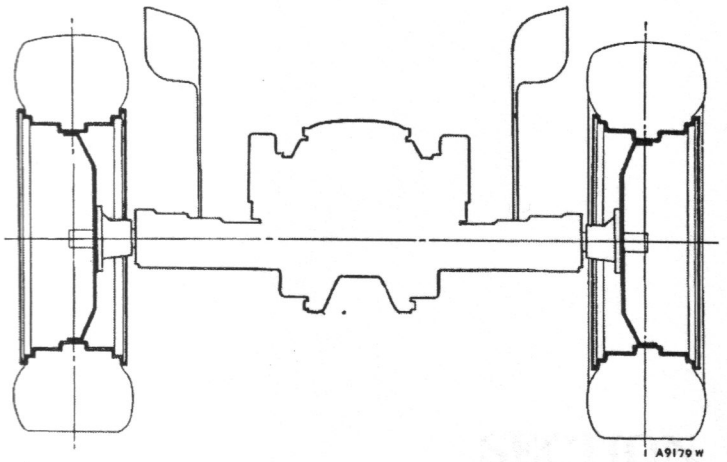
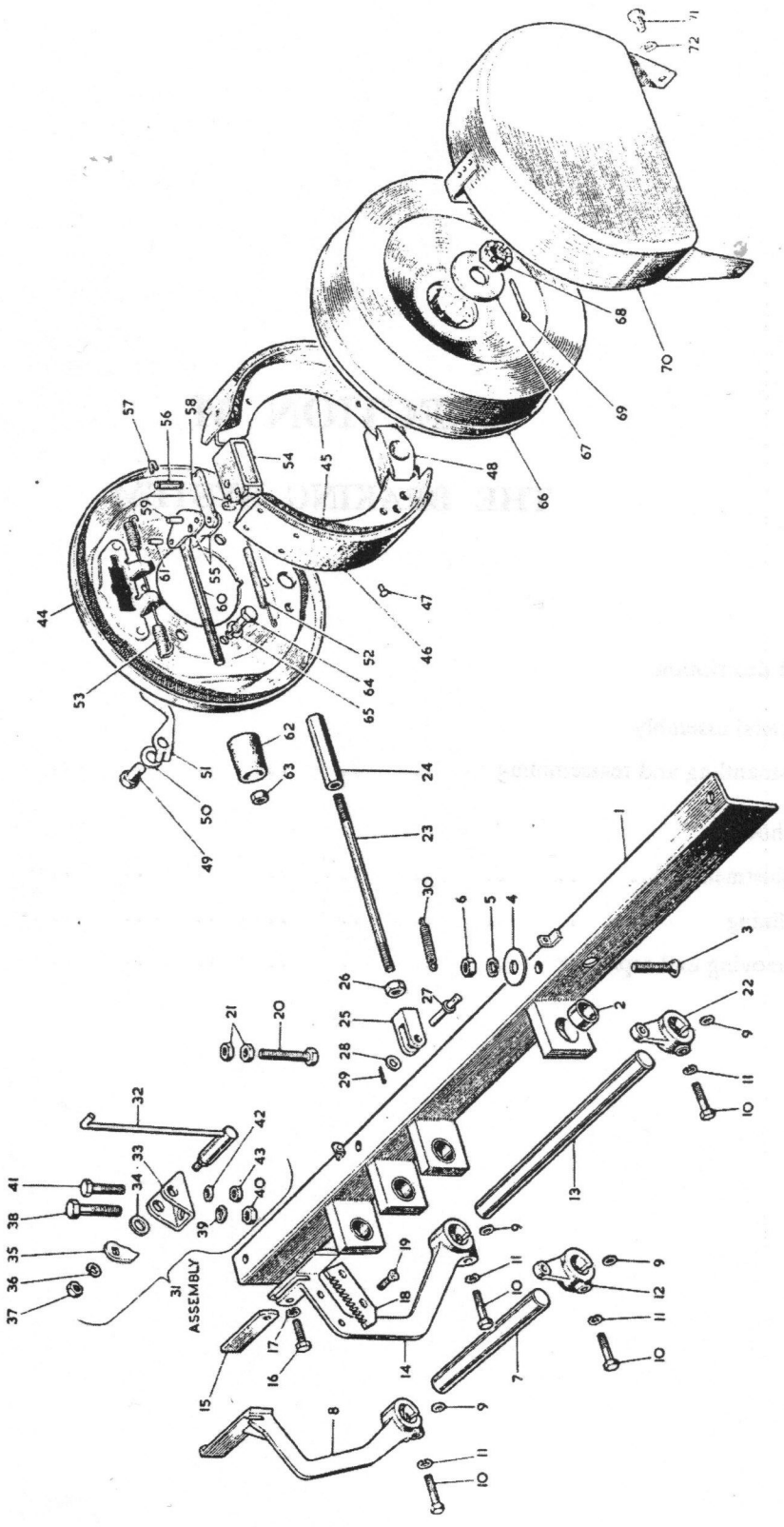


Fig. LL.13
The wheel disc and hub reversed to provide track range 'C'

SECTION M

THE BRAKING SYSTEM

THE BRAKING SYSTEM COMPONENTS



KEY TO THE BRAKING SYSTEM COMPONENTS

No.	Description
1.	Pedal support bracket.
2.	Bush.
3.	Bolt.
4.	Washer.
5.	Spring washer.
6.	Nut.
7.	Pedal shaft—short—R/H.
8.	Brake pedal—R/H.
9.	Key.
10.	Bolt.
11.	Spring washer.
12.	Brake lever—R/H.
13.	Pedal shaft—long—L/H.
14.	Brake pedal—L/H.
15.	Latch.
16.	Bolt.
17.	Spring washer.
18.	Pedal ratchet.
19.	Screw—ratchet to pedal.
20.	Screw—pedal stop.
21.	Nut for screw.
22.	Brake lever—L/H.
23.	Brake-rod.
24.	Brake adjuster.
25.	Jaw—rod to brake lever.
26.	Locknut.
27.	Pin for jaw.
28.	Plain washer.
29.	Split pin.
30.	Brake pull-off spring.
31.	Parking brake lever assembly.
32.	Pawl operating lever.
33.	Bracket for lever.
34.	Spacing washer.
35.	Pawl.
36.	Spring washer.
37.	Nut.
38.	Bolt—long.
39.	Spring washer.
40.	Nut.
41.	Bolt—short.
42.	Spring washer.
43.	Nut.
44.	Backplate and dust cover.
45.	Brake-shoe—lined.
46.	Lining.
47.	Rivet.
48.	Abutment.
49.	Bolt.
50.	Plain washer.
51.	Locking plate.
52.	Tension spring.
53.	Pull-off spring.
54.	Expander body and abutment cover.
55.	Outer lever.
56.	Pin—outer lever pivot.
57.	Circlip.
58.	Inner lever.
59.	Pin—short—inner to outer lever.
60.	Operating rod.
61.	Pin—rod to outer lever.
62.	Rubber boot.
63.	Nut—operating rod to adjuster.
64.	Bolt.
65.	Spring washer.
66.	Brake-drum.
67.	Washer.
68.	Slotted nut.
69.	Split pin.
70.	Cover—brake-drum.
71.	Bolt.
72.	Spring washer.

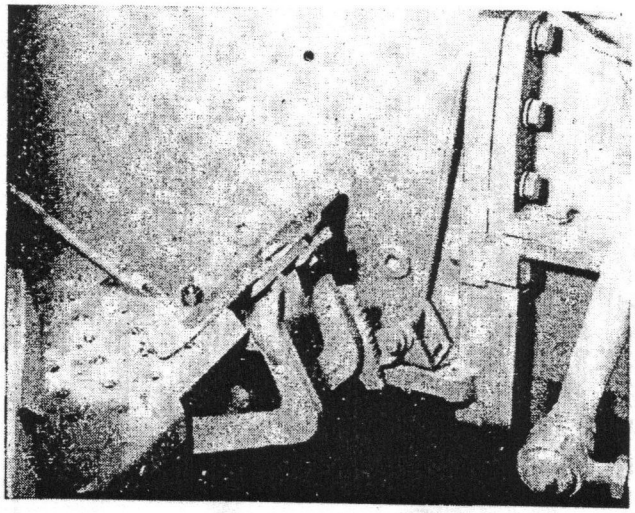


Fig. M.1

The brake pedal parking lever is here shown in the 'on' position with the pedal latch in engagement

GENERAL DESCRIPTION

Two brake pedals are fitted, each operating mechanically a Lockheed brake fitted outside the transmission casing.

To assist operation of both brakes at the same time a latch is provided on one pedal which may be swung across to latch the two pedals together.

A parking latch is fitted to the right-hand side of the tractor adjacent to the brake pedals. It consists of a short lever fitted with a pawl at the lower end and which, when pushed forward while the brakes are applied, engages a ratchet on the left-hand pedal, thus locking the brake on the left-hand wheel or, if the pedal latch is in engagement, both wheels.

A normal type of hand brake may be fitted and is available as an optional extra if desired.

Section M.1

ADJUSTMENT

If the travel of the brake pedals exceed 3 in. (7·6 cm.) before the brakes operate adjustment is necessary.

If one brake has been used repeatedly to assist steering it will require adjustment in order to equalize the brakes when they are latched together for road work.

Chock the rear wheels, check that the brakes are off and the pedals are not latched together, then adjust the brakes as follows:

Right-hand brake

Using a $\frac{9}{16}$ in. AF spanner, slacken the locknut for the turnbuckle on the connecting rod.

The turnbuckle must now be screwed in a clockwise direction until the brake pedal is against the footplate and no free movement of the pedal is present. Unscrew the turnbuckle two and a half turns (anti-clockwise) to give the brake pedal approximately 1 in. (25·4 mm.) free movement measured at the pad end.

Tighten the locknut when the necessary free movement has been obtained.

Left-hand brake

Slacken the turnbuckle locknut (Fig. M.2) for the left-hand-side pedal connecting rod, then depress the right-hand pedal to the full extent of the free movement and maintain it in this position. Adjust the turnbuckle for the left-hand brake (Fig. M.2) until the left-hand pedal pad lines up with that of the right-hand pedal. Tighten the locknut.

There should now be approximately 1 in. (25·4 mm.) of free movement in both pedals and the latch on the left-hand pedal should drop easily into the slot in the right-hand pedal. The tractor should also draw up evenly when the brakes are applied with the pedals latched together. Should the tractor pull to one side,

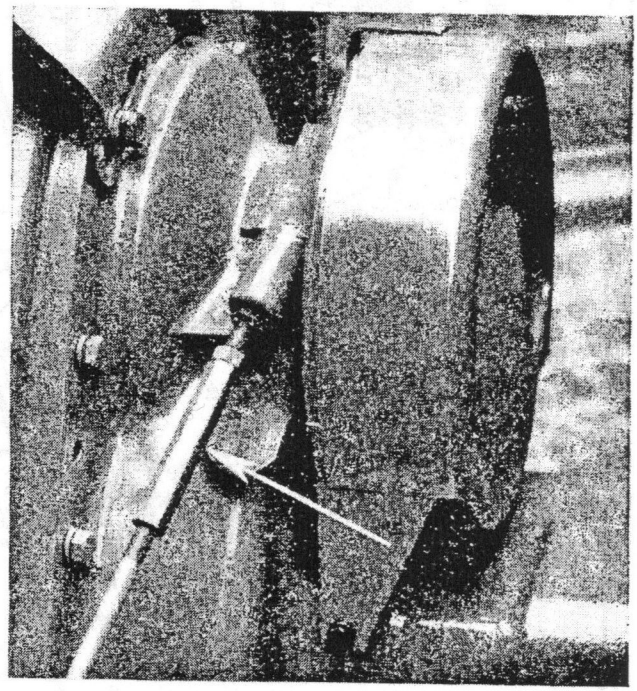


Fig. M.2

The brake adjusting turnbuckle and locknut on the left-hand brake

slightly increase the free movement of the pedal operating that particular side. It is important to tighten the locknuts securing the turnbuckles after the final adjustments have been completed.

Section M.2

REMOVING AND REPLACING THE BRAKE-SHOES

Take out the three bolts securing the brake-drum cover and remove the cover.

Using a $\frac{9}{16}$ in. (14·3 mm.) AF spanner, slacken the locknut from the turnbuckle on the connecting rod.

Screw the turnbuckle in a clockwise direction, viewed from the top, until it is free of the operating rod.

Unlock and remove the brake-drum retaining nut and flat washer and withdraw the brake-drum from the pinion shaft.

Lever the large upper spring with the twin coils from beneath the clips on the backplate.

Mark the holes in the brake-shoes in which the upper and lower springs are hooked to ensure correct replacement. (See Fig. M.3.)

Withdraw the lower ends of the shoes outwards to disengage them from the abutment. Disengage the upper ends from the expander body and abutment cover.

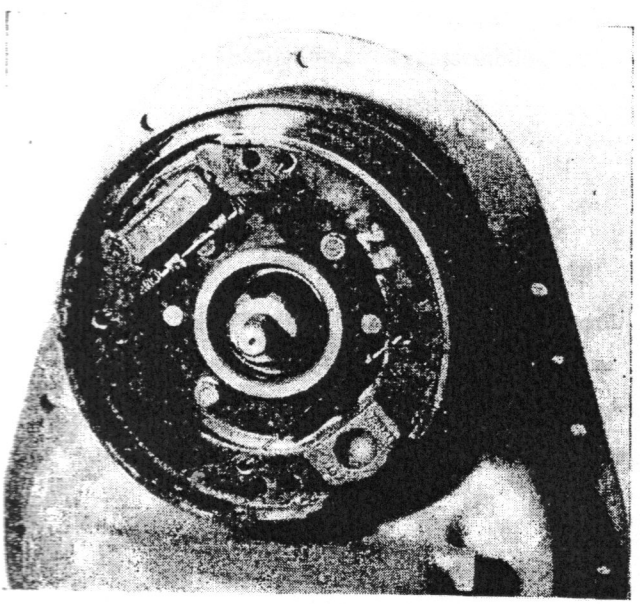


Fig. M.3

The left-hand-side brake assembly. Note the holes in the brake-shoes into which the return springs are fitted and also the position of the leading edge of each shoe. The right-hand brake assembly is symmetrically opposite to the left-hand side

Reassembly is a reversal of the dismantling procedure. The leading edge of the shoes is that which carries the bare portion with no lining. This leading edge must face the general direction of rotation, which is opposite to that of the road wheel. The upper shoe, therefore, is fitted with the leading edge next to the upper expander body and the lower shoe with the leading edge next to the abutment block. (See Fig. M.3, which clarifies the procedure.)

The return springs **must** be fitted between the shoes and the brake backplate.

Adjust the brakes as detailed in Section M.1.

Section M.3

RELINING THE BRAKE-SHOES

Remove the brake-shoes as detailed in Section M.2.

Hold the web of the shoe in a vice and remove the old lining by cutting the rivets with a sharp cold chisel.

Check that the brake-shoe is in good condition and rivet the new linings to it, ensuring that the rivet heads are properly seated below the surface of the linings.

Obtain the correct lining material as specified in the **'GENERAL DATA'.**

Refit the shoes and adjust to the drums as detailed in Sections M.1 and M.2.

Section M.4

DISMANTLING THE BRAKE PEDAL ASSEMBLY

Remove the floor plates and disconnect the brake operating rods from the pedal cross-shaft levers.

Release the pedal support bracket from the transmission casing and secure in a vice.

Bushes are fitted in the lugs of the brake pedal support bracket and circular keys with locking bolts passing through their centres are used to secure the levers to the pedal shafts.

Remove the bolt and key from the left-hand pedal and tap the pedal shaft through the bracket. When the pedal is clear of the shaft withdraw the shaft complete with the left-hand brake lever.

Take out the bolts and keys securing the right-hand pedal and the brake operating lever and drive out the shaft.

Reassembly is a reversal of the dismantling procedure. As a guide to the respective position of the components see the illustration on page M.2.

Remember to reconnect the brake pedal return springs before replacing the floor plates.

SECTION N

THE ELECTRICAL SYSTEM

DESCRIPTION

The electrical equipment fitted is of the 12-volt type incorporating constant voltage control for the charging circuit. The positive earth system of wiring is employed.

The battery is mounted under the bonnet and is readily accessible for examination and maintenance attention.

The dynamo is driven by an endless belt from the engine crankshaft and a hinged mounting enables the belt tension to be adjusted.

The control box is sealed and should not normally need attention.

The starter motor, which is mounted on the flywheel housing on the right-hand side of the engine unit, operates on the flywheel through the usual sliding pinion device.

Electric lighting equipment is available and can be fitted to all Nuffield Tractors not originally supplied with it. The equipment consists of a front floodlight, rear floodlight assembly, sidelamps, and horn. The rear floodlight illuminates the plough or other appliance and the beam of light is readily adjustable for height by hand. Also incorporated is a change-over switch, which is conveniently placed near to the number-plate so that the driver can readily switch over from tail lamp to rear floodlight. The number-plate is designed so that it can be swung out of position when the rear floodlight is being used.

Section N.1

BATTERY

Routine maintenance

In order to keep the battery in good condition a periodical inspection should be made and the following carried out.

(1) *Topping up*

Every two weeks (or more often in warm climates) remove the vent plugs from the top of each of the cells and examine the level of the electrolyte. If necessary, add distilled water **until the top edges of the separators are only just covered.** Do not fill above this level, otherwise the excess electrolyte will be thrown out from the cell. A hydrometer will be found useful for topping up, as it prevents the distilled water from being spilled on the top of the battery.

NOTE.—In very cold weather it is essential that the tractor be used immediately after topping up the battery to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing, with consequent damage to the battery.

When examining the cells do not hold naked lights near the vent holes, as there is a danger of igniting the gas coming from the plates.

(2) *Testing the condition of the battery*

Occasionally examine the condition of the battery by taking hydrometer readings. There is no better way of ascertaining the state of charge of the battery. The hydrometer contains a graduated float on which is indicated the specific gravity of the acid in the cell from which the sample is taken.

The specific gravity readings and their indications for both models are as follows:

	Specific gravity	
State of charge	342 *Model*	460 *Model*
Cell fully charged ..	1·270–1·290	1·250–1·270
Cell half-discharged	1·190–1·210	1·170–1·190
Cell fully discharged	1·110–1·130	1·090–1·110

These figures are given assuming an electrolyte temperature of 16° C. (60° F.). If the temperature of the electrolyte exceeds this, ·002 must be added to hydrometer readings for each 2·8° C. (5° F.) rise to give the true specific gravity. Similarly ·002 must be subtracted from hydrometer readings for every 2·8° C. (5° F.) below 16° C. (60° F.).

The reading for each of the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked from one of the cells or there may be an internal fault. In this case it is advisable to have the battery examined by a battery specialist. Should the battery be in a low state of charge, it should be recharged from an external source of D.C. supply. Recharge at the appropriate rate (see below) until all the cells are gassing freely and voltage and specific gravity show no increase over three successive hourly readings. Approximately four hours' charging should be sufficient for a refresher charge.

Specific gravity	*Baumé degrees*
1·090	11·08
1·110	13·19
1·130	16·69
1·170	21·07
1·190	21·56
1·210	25·18
1·250	29·00
1·270	30·83
1·290	32·60

Fig. N.1

The table gives converted figures in Baumé degrees for the various specific gravity figures quoted in Section N.1

The recharge rate can be determined by dividing the amp-hour capacity at the 10-hour rate by 10.

Tractor model	*Battery type*	*Capacity*
342	MV.15A	74 A.H.
460	TR.19E	115 A.H.

For example, the recharge rate for the TR.19E is

$$\frac{115}{10} = 11{\cdot}5 \text{ amperes.}$$

Warning.—Never allow smoking or the use of a naked flame near batteries while they are on charge.

After examining the battery check the vent plugs, making sure that the air passages are clear, and screw the plugs into position. Wipe the top of the battery to remove all dirt and moisture.

Storage

If a battery is to be out of use for any length of time, it should first be fully charged and then given a freshening charge at least once every four weeks.

A battery must never be allowed to remain in a discharged condition, as this will cause the plates to become sulphated.

(1) *Preparing new batteries for service*

Batteries supplied for the home market are normally supplied filled and charged and can be put into service without further attention. For overseas requirements batteries are supplied in a charged condition but without electrolyte and with the vent holes sealed to prevent deterioration of the battery in storage. To put these 'dry-charged' batteries into service they must be filled with acid of the correct specific gravity as given below.

Batteries for use in:

Climates normally below 32° C. (90° F.)	1·275
Climates frequently above 32° C. (90° F.)	1·215

(2) *Preparation of electrolyte for filling 'dry-charge' batteries*

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid of 1·835 S.G. The mixing must be carried out in a lead-lined tank or a suitable glass or earthenware vessel. Steel or iron containers must **not** be used. The acid must be added slowly to the water while the mixture is stirred with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction may have dangerous consequences.

Electrolyte of specific gravity 1·275 can be prepared by adding one part (by volume) of 1·835 S.G. sulphuric acid to 2·8 parts of distilled water. 1·215 electrolyte requires one part of acid to four parts of distilled water.

Heat is produced by the mixture of acid and water, and the electrolyte should therefore be allowed to cool before pouring it into the battery, otherwise the plates, separators, and moulded container may become damaged.

(3) *Filling the cells*

Carefully break the seals in the cell filling holes and fill each cell with electrolyte to the top of the separators **in one operation.** The temperature of the filling room, battery, and electrolyte should be maintained between 16 and 27° C. (60 and 80° F.). If the battery has been stored in a cool place it should be allowed to warm up to room temperature before it is filled.

(4) *Charging*

Batteries filled in accordance with the instructions given above are 90 per cent. charged and may be fitted to the vehicle immediately. When time permits, however, a short refreshing charge is beneficial; such a charge should last for no more than four hours at the normal recharge rate of the battery.

During the charge the electrolyte must be kept level with the top edge of the separators by the addition of distilled water.

Check the specific gravity of the electrolyte at the end of the charge. If 1·275 acid was used to fill the battery, the specific gravity should now lie between 1·280 and 1·300. If 1·215 acid was used the gravity should be between 1·200 and 1·240.

Section N.2

DYNAMO

The dynamo is a shunt-wound two-pole two-brush machine arranged to work in conjunction with a compensated voltage control regulator unit.

The output of the dynamo is controlled by the regulator and is dependent on the demands made on the electrical equipment and the state of charge of the battery. When the battery is in a low state the dynamo gives a high output, whereas if the battery is fully charged the dynamo gives only sufficient output to keep the battery in good condition without overcharging.

A high boosting charge is given for a few minutes immediately after starting up to restore to the battery the energy taken from it by the starter motor.

The dynamo is a Lucas model C39P–2 non-ventilated type. The identification numbers are stamped on the yoke and should always be quoted when ordering replacements.

To test on vehicle to locate fault in charging circuit

(1) Make sure that belt slip is not the cause of the trouble. The belt should be capable of being deflected approximately 1 in. (25 mm.) at the centre of its longest run between two pulleys with moderate hand pressure. If the belt is too slack tightening is effected by slackening the two bolts on which the dynamo pivots and the bolt attaching it to the slotted adjustment link and gently pulling the

dynamo outwards by hand until the correct tension is obtained. The slotted link bolt must then be tightened, followed by the two pivot bolts.

(2) Check that the dynamo and control box are connected correctly. The dynamo terminal 'D' should be connected to the control box terminal 'D' and the dynamo terminal 'F' connected to the control box terminal 'F'.

(3) After switching off all lights, disconnect the cables from the terminals of the dynamo marked 'D' and 'F' respectively.

(4) Bridge the two dynamo terminals with a short length of copper wire.

(5) Start the engine and set it to run at normal idling speed.

(6) Clip the negative lead of a moving coil type voltmeter, calibrated 0–20 volts, to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

(7) Gradually increase the engine speed, when the voltmeter reading should rise slowly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If the reading is low (approximately 1 volt) the field winding may be faulty (see Section N.5).

If the reading is approximately 5 volts the armature winding may be faulty (see Section N.5).

If there is no reading check the brush gear.

Re-test the dynamo; if there is still no reading on the voltmeter there is an internal fault and the complete unit should be changed or dismantled for examination.

If the dynamo is in good order remove the temporary link from between the terminals and restore the original connections, taking care to connect the dynamo terminal 'D' to the control box terminal 'D', and the dynamo terminal 'F' to the control box terminal 'F'. Remove the lead from the 'D' terminal on the control box and connect the voltmeter between this cable and a good earthing point on the tractor. Run the engine as before. The reading should be the same as that measured directly at the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. If the reading is correct test the control box (see Section N.10).

Section N.3

REMOVING AND REPLACING THE DYNAMO

Disconnect the leads from the dynamo terminals.

Supporting the dynamo, slacken and completely remove its three attachment bolts.

Carefully free the belt from the pulley and lift the dynamo from the engine.

Replacement of the dynamo is an exact reversal of this procedure.

Readjust the drive belt tension as described in Section C.1.

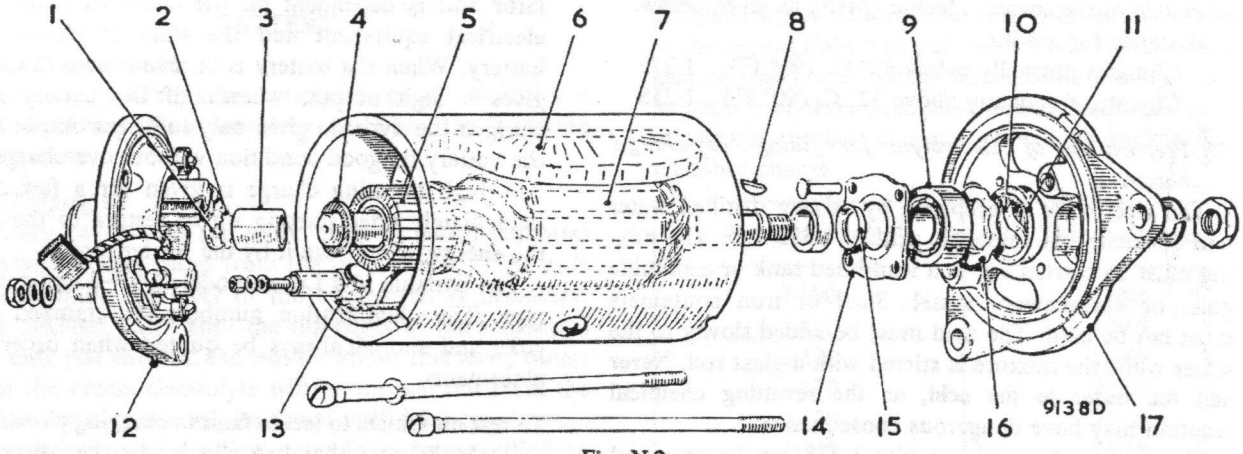


Fig. N.2

The C39P–2 non-ventilated-type dynamo

1. Felt pad
2. Aluminium disc.
3. Porous bronze bush.
4. Fibre washer.
5. Commutator.
6. Field coils.
7. Armature.
8. Shaft key.
9. Bearing.
10. Felt washer.
11. Oil retaining washer.
12. Commutator end bracket.
13. Field terminal post.
14. Bearing retaining plate.
15. Cup washer.
16. Corrugated washer.
17. Driving end bracket.

Section N.4

DISMANTLING AND REASSEMBLING THE DYNAMO

Remove the securing nut and spring washer and take off the drive pulley.

Remove the Woodruff key and distance collar from the commutator shaft.

Release the field terminal nut and washer and then unscrew and remove the two through-bolts and take off the commutator end bracket. The driving end bracket, together with the armature and its ball bearing, can now be lifted out of the yoke. Unless the ball bearing is damaged or requires attention it need not be removed from the armature. Should it be necessary to remove the bearing, the armature must be separated from the end bracket by means of a hand press.

Reassembly of the dynamo is a reversal of the dismantling procedure except that when assembling the commutator end bracket the bushes must first be held clear of the commutator by partially withdrawing them from their boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released onto the commutator by a small screwdriver or similar tool when the end bracket is assembled to within about half an inch (12·7 mm.) of the yoke. Before closing the gap between the end bracket and the yoke see that the springs are in correct contact with the brushes.

Section N.5

SERVICING THE DYNAMO

Dismantle the dynamo as instructed in Section N.4.

Brushes

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension with a spring scale if available. The correct tension is 15 to 25 oz. (425 to 709 gm.). Fit a new spring if the tension is low.

If the brushes are worn so that the flexible lead is exposed on the running face new brushes **must** be fitted. Brushes are preformed, so that bedding to the commutator is unnecessary.

Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator mount the armature (with or without the drive end bracket) in a lathe, rotate at high speed, and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the mica insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hacksaw blade ground down to the thickness of the mica (see Fig. N.3).

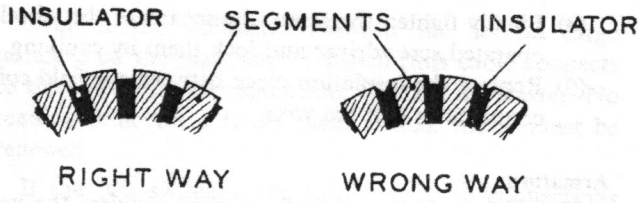


Fig. N.3

The correct method of undercutting the dynamo commutator segments

Field coils

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be between 6·0 and 6·3 ohms. If this is not available, connect a 12-volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be renewed. To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the dynamo yoke and, with a low-wattage carbon-filament test lamp connected from supply mains, test across the field terminal and earth. If the lamp lights the field coils are earthed and must be renewed.

When fitting field coils, carry out the procedure outlined below, using an expander and wheel-operated screwdriver:

(1) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting the yoke.
(2) Mark the yoke and pole-shoes in order that they can be refitted in their original positions.
(3) Unscrew the two pole-shoe retaining screws by means of the wheel-operated screwdriver.
(4) Draw the pole-shoes and coils out of the dynamo yoke and lift off the coils.
(5) Fit the new field coils over the pole-shoes and place them in position inside the yoke. Take care to ensure that the tapping of the field coils is not trapped between the pole-shoes and the yoke.
(6) Locate the pole-shoes and field coils by lightly tightening the fixing screw.
(7) Insert the pole-shoe expander, open it to the fullest extent, and tighten the screws.

(8) Finally tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.
(9) Replace the insulation piece between the field coil connections and the yoke.

Armature

The testing of the armature winding requires the use of a volt-drop test and growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side movement of the armature shaft must be replaced by new ones.

To fit a new bearing bush at the commutator end of the dynamo proceed as follows:

(1) Press the bearing bush out of the commutator end bracket.
(2) Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing.

Before fitting the new bearing bush allow it to stand completely immersed in thin engine oil for 24 hours to fill the pores of the bush with lubricant.

The ball bearing at the driving end is renewed as follows:

(1) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.
(2) Press the bearing out of the end bracket and remove the corrugated washer, felt washer, and oil-retaining washer.
(3) Before fitting the replacement bearing see that it is clean and pack it with a high-melting-point grease.
(4) Place the oil-retaining washer, felt washer, and corrugated washer in the bearing housing in the end bracket.
(5) Locate the bearing in the housing and press it home by means of a hand press.
(6) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembly

The reassembly of the dynamo is described in Section N.4.

If the end bracket has been removed from the armature in dismantling press the bearing end bracket onto the armature shaft, taking care to avoid damaging the end plate and armature winding.

Add a few drops of oil through the hole in the armature end cover.

Section N.6

STARTER

The starter motor is a series-wound, four-pole electric motor incorporating a lever-operated pre-engaging driving pinion.

The yoke (cylindrical frame) carries four field coils. The commutator end bracket (with brush gear) and intermediate support bracket are mounted at the yoke ends and carry the armature bearings. The armature shaft is extended and splined to carry the drive pinion and clutch assembly. The drive end bracket supports the extended armature shaft and provides a mounting for the operating lever and pilot switch. Through-bolts secure the assembly of yoke and brackets together.

When operating the starter control the forked lever slides the pinion and clutch assembly along the armature shaft extension to engage with the flywheel starter ring. When the teeth are correctly engaged the forked lever operates the pilot switch, which energizes the solenoid in the main starter switch and so applies power to the motor to crank the engine.

The torque from the motor is transmitted through a multi-plate clutch which protects the motor from overload and is shim-set to slip at two or three times normal full load starting torque.

In the event of a tooth-to-tooth contact the pre-engagement feature is over-ruled by compression of the tension spring so that the pilot switch will still make contact. When the motor turns, the pinion is forced into mesh by the tension spring.

When the starter control is released the operating lever returns the pinion and clutch assembly to its out-of-mesh position against a Ferodo brake ring, which immediately brings the motor to rest.

No external adjustments can be made to the starter motor. The commutator and brushes can, however, be cleaned, but first clean the outside of the starter before removing the metal cover band which gives access to the brush gear.

If the starter motor does not operate or is sluggish, the following points should be checked prior to removal of the starter. If, however, the motor is heard to operate but does not attempt to crank the engine, indicating a damaged drive, remove the starter for inspection (Section N.7).

Connect a voltmeter (0–20 volts) across the battery terminals and operate the starter control.

(1) If the voltmeter reading drops to about 6 volts but the starter motor is not heard to operate, this

indicates that current is flowing through the motor windings but that the armature is not rotating. Remove the starter from the engine for examination.

(2) If the voltmeter remains steady at about 12 volts check the circuit for continuity as described below and examine the connections throughout the circuit.

Connect the voltmeter between the large supply terminal on the main starter switch and earth. No reading indicates a completely discharged battery, faulty cable, or loose connection.

Connect the voltmeter between the supply terminal of the pilot switch (which is mounted on the drive end bracket of the starter) and earth. No reading indicates a faulty cable or loose connection between the supply terminal of the solenoid switch and the pilot switch.

Connect the voltmeter between the second terminal on the pilot switch and earth. Operate the starter. No reading indicates a faulty pilot switch. To renew the pilot switch disconnect one of the battery leads from the battery and the two cables from the switch, release the rubber cover from the recess in the switch locknut, release the locknut, and remove the switch. When the new switch has been fitted reconnect the battery lead; the switch adjustment must be carried out as detailed on page N.9.

Connect the voltmeter between the small terminal on the main starter switch and earth. Operate the starter. No reading indicates a faulty cable or loose connection between pilot switch and solenoid switch.

Connect the voltmeter between the second large terminal on the main starter switch (this cable connects to the starter motor) and earth. Operate the starter. No reading indicates a faulty main switch, which must be renewed.

If the two switches, the cables, and the connections are in order check with the voltmeter between the starter motor terminal and earth. Operate the starter, when a reading of 6 to 7 volts should be obtained if the starter is operating normally. A lower or zero reading indicates a faulty internal connection, and the starter must be removed for servicing.

Section N.7

REMOVING AND REPLACING THE STARTER MOTOR

Disconnect the cables from the battery to prevent possible short circuits, the heavy cable from the starter motor terminal, and the two light cables from the pilot switch.

Remove the pin coupling the operating linkage to the motor operating lever. Release the starter motor supporting strap. Remove the three bolts securing the motor to the flywheel housing and withdraw the starter motor forward and away from the engine.

To replace the starter motor reverse the foregoing instruction.

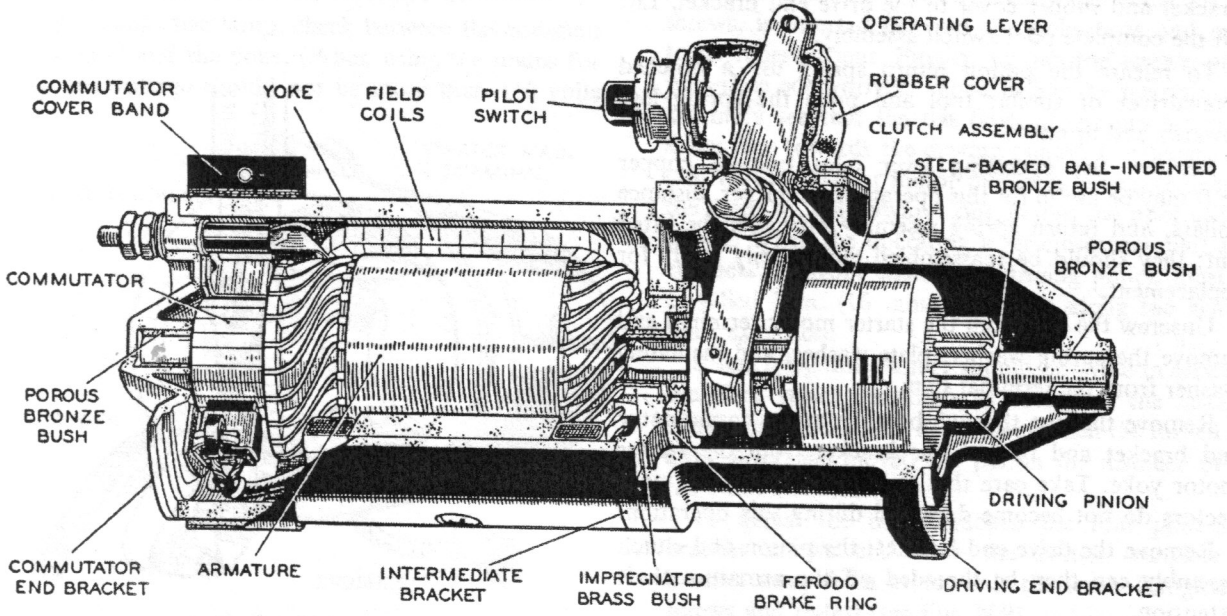


Fig. N.4

The starter motor components

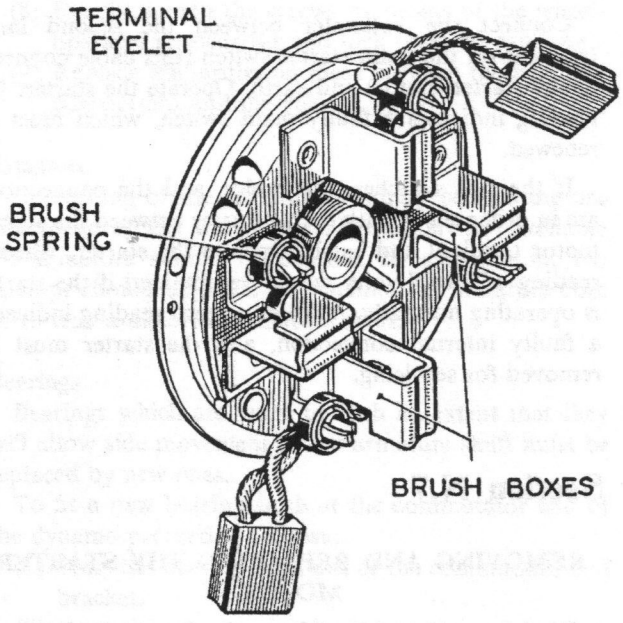


Fig. N.5
Starter motor end bracket brush connections

Section N.8

DISMANTLING AND REASSEMBLING THE STARTER MOTOR

Remove the cover band, hold back the brush springs, and lift the brushes from their holders.

Remove the four screws securing the pilot switch bracket and rubber cover to the drive end bracket. Lift off the complete pilot switch assembly.

To release the pinion return spring use a notched screwdriver or similar tool and press the spring legs inwards and upwards.

Remove the operating lever pilot bolt—a copper drift may be useful for this operation. The lever, distance collars, and return spring assembly may then be lifted out; they should be reassembled temporarily ready for replacement.

Unscrew the nut from the starter motor terminal and remove the spring washer, plate washer, and insulating washer from the terminal stem.

Remove the two through-bolts from the commutator end bracket and remove the bracket from the starter motor yoke. Take care that the brushes and their connectors do not become damaged during this operation.

Remove the drive end bracket; the pinion and clutch assembly can then be threaded off the armature shaft extension.

Remove the intermediate bracket from the yoke and carefully withdraw the armature.

For maintenance to the drive assembly refer to Section N.9.

Brushes

Check for sticking of the brushes in their holders. To free sticking brushes clean all carbon and copper deposits away, using a petrol-moistened cloth; if necessary, ease the brushes by lightly polishing the sides with a smooth file.

If the brushes are worn so that they do not bear on the commutator, or if the flexible connector is exposed on the running face, the brushes must be renewed. The brushes are removed by unsoldering the flexible connectors from the eyelets. Two are connected to brush boxes on the commutator end bracket and two are connected to the free ends of the series field coils. The brushes are preformed, so that bedding to the commutator is unnecessary.

Commutator end bracket

Check the brush holders for security on the commutator end bracket. Also test the insulated pair of brush boxes for continuity between box and bracket. If the test lamp lights this indicates faulty insulation and the end bracket must be renewed.

Brush springs

Check the tension of the brush springs with a spring scale. The correct tension is 30 to 40 oz. (850 to 1134 gm.) (see Fig. N.6); new springs should be fitted if the tension is below these limits.

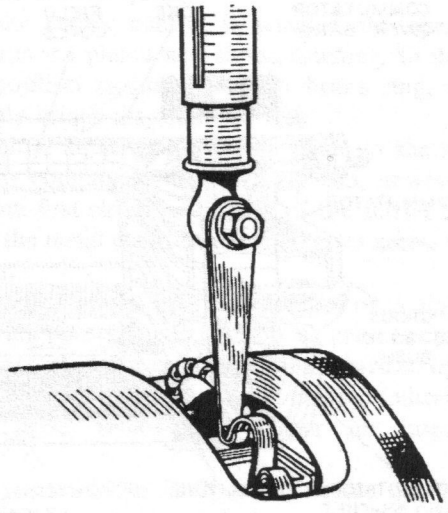


Fig. N.6
A method of checking the brush spring tension

Commutator

Clean the commutator with a petrol-moistened cloth; if in good condition it will be burnished and free from pits or burned spots. If not in good condition spin the armature and polish the commutator with fine glass-paper, **not emery**; remove all abrasive dust with a dry air blast. If the commutator is badly worn mount the armature in a lathe and take a fine cut, using a sharp cutting tool at high speed. Do not remove more metal than necessary. Finally, polish with very fine glass-paper. **The insulators between the commutator segments must not be undercut.**

Armature

To make a thorough check on the condition of the armature the use of a volt-drop test and growler is essential. If these are not available the armature should be checked by substitution. A visual examination can be made for conductors which have lifted from the end of the armature core, probably caused by overheating or overspeeding. In either case the clutch should be suspected. Also examine for fouling of the armature core against the pole faces; this indicates a worn bearing or distorted shaft.

No attempt should be made to machine the armature core or to true a distorted shaft.

Field coils

With the armature removed, test the field coils for continuity, using a 12-volt test lamp and battery between the starter terminal and each field brush in turn. Make sure that both brushes are clear of the yoke.

Using a mains test lamp, check between the common field terminal and the yoke. (When using the mains for testing, the voltage should not be more than 110 volts supplied through a suitable transformer.) Should the lamp light, faulty insulation of one or more coils is indicated, and they must be renewed.

The yoke and pole-shoes should be marked to ensure correct reassembly and a pole-shoe expander and pole-shoe screwdriver used for removing and replacing the coils and shoes.

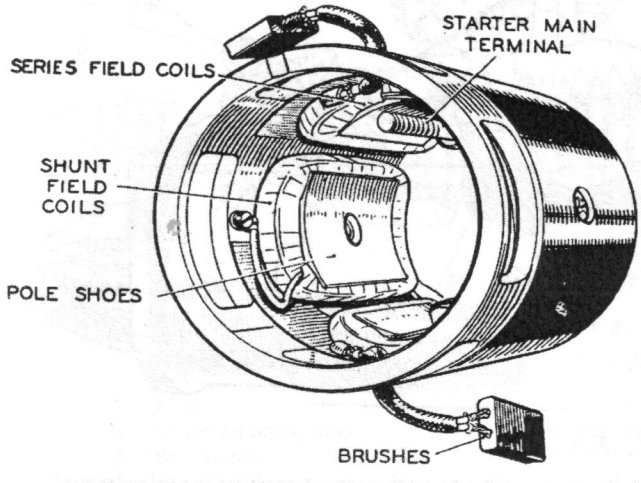


Fig. N.7

The starter motor field coil connections

Bearings

Examine the bearings in the three brackets for wear; if they allow excessive play of the armature shaft they must be renewed. The commutator and drive end brackets each carry a porous bronze bush, while the intermediate bracket carries a graphite-impregnated brass bush.

In the case of the commutator end bracket bush, a thin-tongued extractor will be required to withdraw it from the bracket; alternatively a $\frac{5}{8}$ in. (15·87 mm.) tap can be screwed in and withdrawn complete with the bush.

The bushes in the intermediate and drive end brackets may be pressed out.

Before fitting the new porous bronze bushes they should be completely immersed in thin engine oil for 24 hours. In a case of extreme urgency this period may be reduced to two hours by heating the oil to 212° F. (100° C.).

Reassembly

Reassembly is a reversal of the dismantling procedure but note that the fitting of the field coils requires the use of a pole-shoe expander which, after locating the field coils and pole-shoes by lightly tightening the fixing screws, is inserted between the pole-shoes and opened to its fullest extent. Finally, tighten the screws, using a pole-shoe screwdriver. When fitting the operating lever assembly see that the flat faces of the pivot operating shoes face towards the driving pinion. It is most important that the starter motor pinion is in engagement with the teeth on the flywheel ring before the pilot switch is closed. When the operating lever closes the pilot switch contacts the front end of the driving pinion must have travelled $\frac{5}{8}$ in. (16 mm.) outwards along the armature shaft extension.

A test lamp and battery should be wired in series with the pilot switch terminals to determine the instant of contact closure, which must occur when the forked operating lever has moved the pinion the distance of $\frac{5}{8}$ in. (16 mm.) outwards.

To adjust the travel slacken the four pilot switch bracket screws and slide the switch complete with bracket away from or towards the lever. Retighten the screws and re-test (see Fig. N.9).

NOTE.—This adjustment is most important, for if the pilot switch is closed before the starter pinion is in

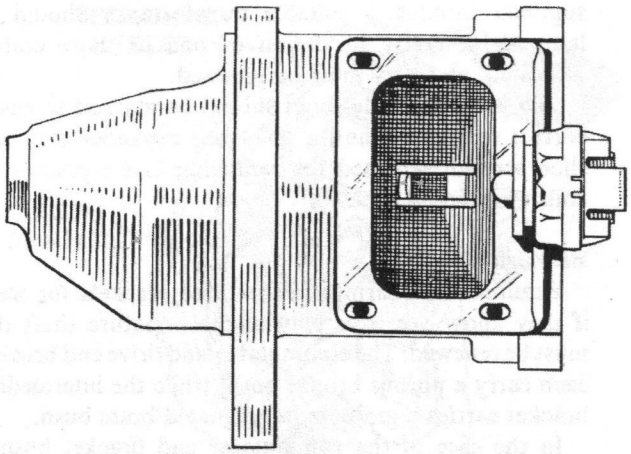


Fig. N.8

The elongated starter switch adjustment holes

engagement with the teeth of the starter ring damage to the teeth will result.

After reassembly the starter motor should be checked for operation before installation as follows:

Hold the starter motor yoke in a vice and connect it to a 12-volt battery, using heavy-gauge cables. One cable must be connected to the starter motor terminal and the other held against the yoke or end bracket.

Before connecting the circuit pull back the operating lever to disengage the drive from the Ferodo brake ring.

Under these light load conditions the motor should run freely at approximately 4,500 r.p.m.

Section N.9

DISMANTLING AND REASSEMBLING THE PRE-ENGAGED STARTER DRIVE MECHANISM

Remove the lock ring from the central core. To facilitate this place the drive upright with the pinion resting on a soft-metal block and compress the tension spring by using a hand press and distance piece to contact on the brake plate.

Prise up the edge of the lock ring retaining cup so that this can be pushed down the central core to release the lock ring. After the lock ring has been removed gradually release the spring pressure, when the brake plate, operating bush, and tension spring can be removed from the centre core.

Remove the circlip and withdraw the central core complete with clutch unit, followed by the cushion spring and thrust washer, from inside the pinion and barrel unit.

The drive can now be completely dismantled by removing the retaining washer, moving member, clutch plates, shims, and backing ring. The two pressure plates are held in position by the ring nut. This nut should only be removed if absolutely necessary, as it is secured by peening.

Examine the pinion teeth for wear and damage; renew the pinion and barrel unit if necessary.

Examine the clutch plates for wear on the friction faces; ensure that they are free in their engagement splines.

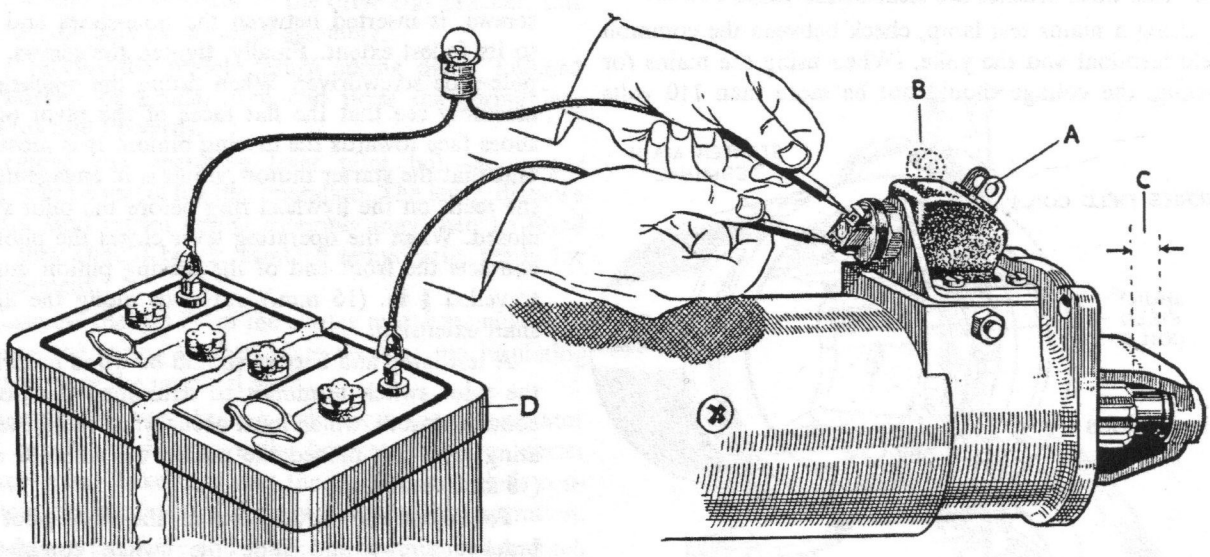


Fig. N.9

Method of checking the instant of starter pilot switch contact closure with respect to starter pinion travel

A. Location of lever with pinion at rest.
B. Position of lever with contacts just closing.
C. $\frac{5}{8}$ in. (16 mm.) with pinion at rest.
D. 12-volt test circuit.

Test the tension spring and cushion spring for weakness; a simple method is to compare the springs against new ones.

To reassemble the mechanism replace the pressure plates, fit the ring nut, and secure by peening.

Place the clutch plates onto the moving member and position these with the shims and locking ring onto the central core.

Ensure to reassemble the components in the correct order as shown in Fig. N.10.

Insert the thrust washer and cushion spring inside the pinion and barrel unit so that they are correctly positioned over the bearing bush. Insert the clutch unit, fit the retaining washer, and secure the assembly by locating the circlip into the groove in the barrel unit.

At this point of reassembly the clutch slipping torque must be checked as follows:

(1) Firmly secure the pinion in a vice, using soft-metal jaws.

(2) Apply an anti-clockwise torque to the central core, using a suitable torque wrench on the flats on the end of the core.

The clutch should not slip until the torque is between the limits of 65 to 80 lb. ft. (9·2 to 10·9 kg. m.).

(3) If the clutch slips at below the minimum torque figure dismantle again and **add** shims until the correct figure is obtained.

(4) If the clutch does not slip, even at the maximum torque figure, dismantle again and **remove** shims until the correct figure is obtained. The shims are available in thicknesses of ·004 in. (·102 mm.), ·005 in. (·127 mm.), and ·006 in. (·152 mm.).

(5) When the clutch slipping torque is correct complete the reassembly by placing the spring, operating bush, and brake plate over the central core and compress the tension spring as for dismantling.

(6) Place a new lock ring retaining cup over the shaft and fit the lock ring.

(7) Release the pressure on the brake plate so that the spring forces the retaining cup over the lock ring.

(8) Press the edge of the retaining cup inwards so that it holds firmly over the lock ring. Finally, replace the drive assembly to the motor.

Section N.10

CONTROL BOX

Regulator adjustment

The regulator is carefully set before leaving the Works to suit the normal requirements of the equipment, and in general it should not be necessary to alter it. If, however, the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the setting and, if necessary, to readjust it.

It is important, before altering the regulator setting, when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

How to check and adjust electrical setting

The regulator setting can be checked without removing the cover on the control box.

Start the engine and disconnect the negative lead from the battery.

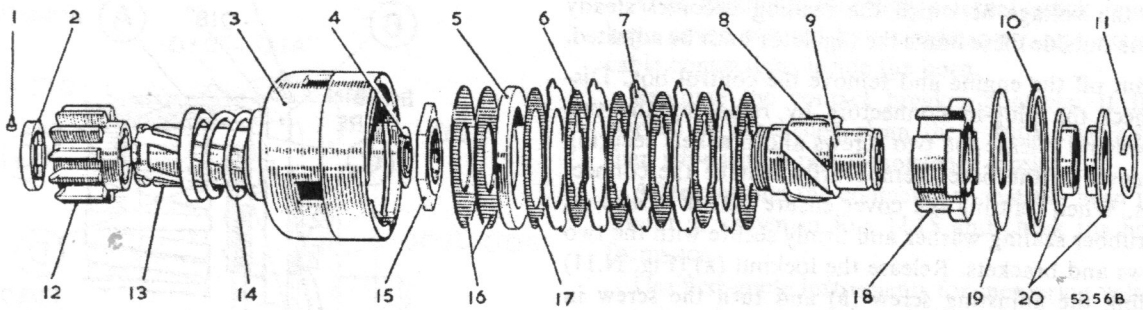


Fig. N.10

Starter motor drive components

1. Rivet.
2. Pinion retaining ring.
3. Barrel unit.
4. Thrust washer.
5. Backing ring.
6. Clutch plates (inner).
7. Clutch plates (outer).
8. Helical splines.
9. Driving sleeve.
10. Cirlip.
11. Lock ring.
12. Pinion.
13. Helical splined sleeve.
14. Cushion spring.
15. Ring nut.
16. Pressure plates.
17. Shim.
18. Moving member.
19. Retaining washer.
20. Engagement bush.

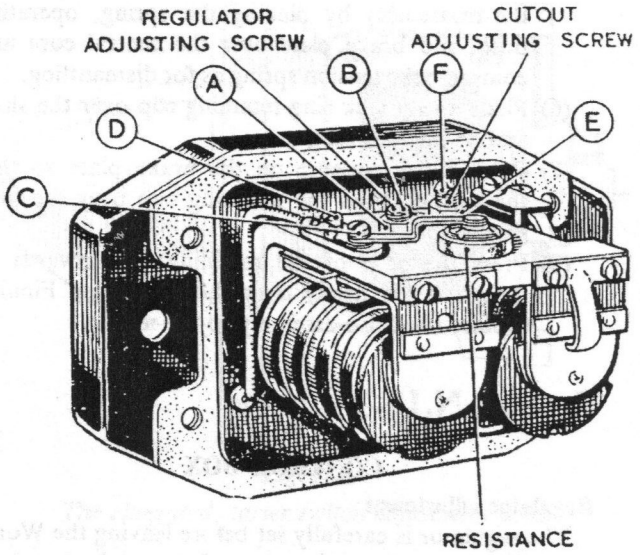


Fig. N.11

The voltage control box with the cover removed

Connect the negative lead of a moving coil voltmeter (0–20 volts full scale reading) to the 'D' terminal in the dynamo (yellow lead) and connect the other lead from the meter to a convenient chassis earth.

Slowly increase the speed of the engine until the voltmeter needle flicks and then steadies; this should occur at a voltmeter reading between the limits given below for the appropriate temperature of the regulator:

Setting at 10° C. (50° F.)	15·3–15·9 volts
„ „ 20° C. (68° F.)	15·0–15·6 „
„ „ 30° C. (86° F.)	14·7–15·3 „
„ „ 40° C. (104° F.)	14·4–15·0 „

If the voltage at which the reading becomes steady occurs outside these limits the regulator must be adjusted.

Shut off the engine and remove the control box. Disconnect the plug-in connectors by removing the two screws and release the two screws and brackets securing the cover to the base. Temporarily remake the connections. When refitting the cover ensure that it locates on the rubber sealing washer and firmly secure with the two screws and brackets. Release the locknut (A) (Fig. N.11) holding the adjusting screw (B) and turn the screw in a clockwise direction to raise the setting or in an anticlockwise direction to lower the setting. Turn the adjusting screw only a fraction of a turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

Remake the original connections.

When the dynamo is run at a high speed on open circuit it builds up a high voltage. When adjusting the regulator do not run the engine up to more than half-throttle or a false voltmeter reading will be obtained.

Mechanical setting

The mechanical setting of the regulator is accurately adjusted before leaving the Works, and, provided that the armature carrying the moving contact is not removed, the regulator will not require mechanical adjustment. If, however, the armature has been removed from the regulator for any reason the contacts will have to be reset. To do this proceed as follows:

(1) Slacken the two armature fixing screws (E) (Fig. N.12). Insert a ·018 in. (·46 mm.) feeler gauge between the back of the armature (A) and the regulator frame.

(2) Press back the armature against the regulator frame and down onto the top of the bobbin core with the gauge in position and lock the armature by tightening the two fixing screws.

(3) Check the gap between the under side of the shim (G) and the top of the bobbin core. This must be ·012 to ·020 in. (·30 to ·51 mm.). If the gap is outside these limits correct by adding or removing shims (F) (Fig. N.12) at the back of the fixed contact (D).

(4) Remove the gauge and press the armature down, when the gap between the contacts should be between ·006 in. (·15 mm.) and ·017 in. (·43 mm.).

Cleaning contacts

To render the regulator contacts accessible for cleaning slacken the screws securing the plate carrying the fixed contact. It will be necessary to slacken the upper

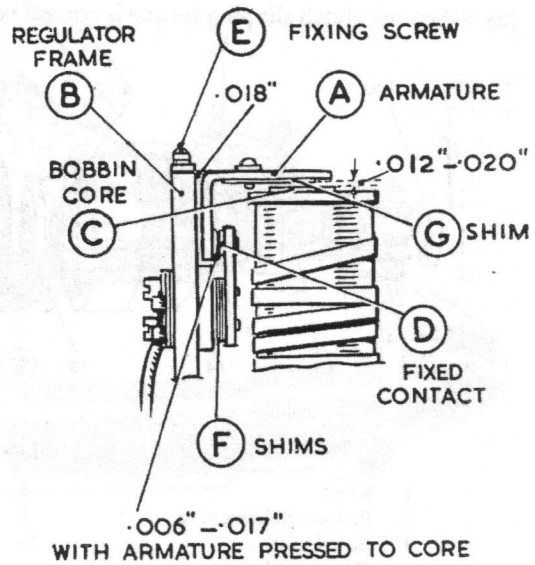


Fig. N.12

The mechanical setting of the voltage regulator

screw (C) (Fig. N.11) a little more than the lower (D), so that the contact plate can be swung outwards. Clean the contacts by means of a fine carborundum stone or fine emery-cloth. Carefully wipe away all traces of dirt or other foreign matter. Finally, tighten the securing screws.

Cut-out adjustment

If it is suspected that the cutting-in speed of the dynamo is too high connect a voltmeter between the terminals marked 'D' and 'E' at the control box and slowly raise the engine speed. When the voltmeter reading rises to between 12·7 and 13·3 the cut-out contact should close.

If the cut-out has become out of adjustment and operates at a voltage outside these limits it must be reset. To make the adjustment slacken the locknut (E) (Fig. N.11) and turn the adjusting screw (F) a fraction of a turn in a clockwise direction to raise the operating voltage or in an anti-clockwise direction to lower the voltage. Tighten the locknut after making the adjustment.

Mechanical setting

Adjustment should not be necessary unless the armature has been removed. The correct setting is shown in Fig. N.13 and is carried out in a similar manner to that detailed for the regulator. Armatures which have a shim fitted to the under side must be set so that the gap between the armature and the core face is ·011 to ·015 in. (·28 to ·38 mm.).

Cleaning

To clean the contacts remove the cover, place a strip of fine glass-paper between the contacts, and then, closing the contacts by hand, draw the paper through. This should be done two or three times, with the rough side towards each contact.

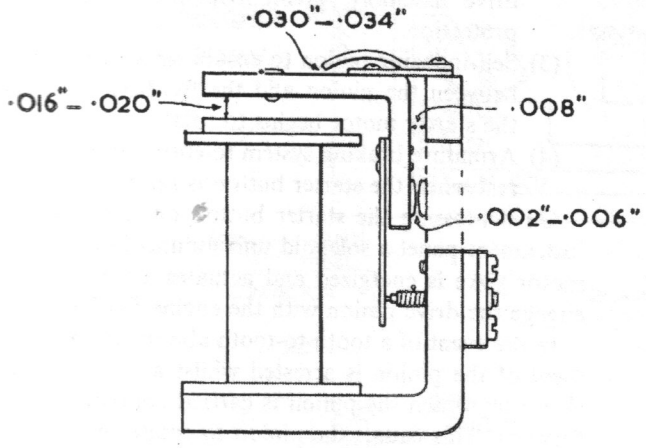


Fig. N.13

The mechanical setting of the cut-out unit in the voltage control box

Section N.11

ELECTRIC HORN

The operation of the horn is based on the simple trembler principle. When the horn-push is pressed current flows through the closed contacts of the contact breaker and energizes the coil. The coil core is thus magnetized and attracts a leafspring-suspended armature towards an adjustable push-rod attached to the diaphragm and tone disc. Movement of the armature opens the contact breaker each time the armature is drawn into the coil, de-energizing the magnet system and causing the cycle to be repeated at a frequency determined by the characteristics of the diaphragm and the spring leaves.

The diaphragm and tone disc are coupled by an adjustable push-rod. The vibrating armature impinging on this push-rod sets the diaphragm and tone disc into vibration, the diaphragm at a relatively low frequency and the tone disc at a higher frequency. These two sets of vibrations combine together with their various harmonics to give the horn its characteristic note.

No internal maintenance is required. Externally all that is required is an occasional inspection of the horn circuit cables and the fixing bolts.

If the horn fails to operate, or operates unsatisfactorily, first carry out the following external checks:

(1) Examine the cables of the horn circuit, renewing any that are badly worn or chafed. Ensure that all connections are clean and tight and that the connecting nipples are firmly soldered to the cables.

(2) Check that the bolts securing the horn bracket are tight and that the body of the horn does not foul any other fixture.

After making a thorough external check remove the horn cover, secured by a single screw, and examine the cable connections inside the horn.

Examine the contact breaker contacts. If they are burned or blackened clean them with a very fine file, then wipe with a petrol-moistened cloth.

After cleaning the contacts connect the horn in a test circuit as shown in Fig. N.15 and check the horn performance.

Use first-grade instruments for measuring voltage and current when checking and, if necessary, adjusting the horn performance. A horn in correct adjustment has a current consumption of 3 to 3½ amps.

Horn adjustment

Remove the cover nut, dished identification washer, locknut, washer, push-rod, tone disc, and spacer.

Energize the horn at 8 volts, using a pure D.C. supply —not rectified A.C. Turn the adjustment nut on the

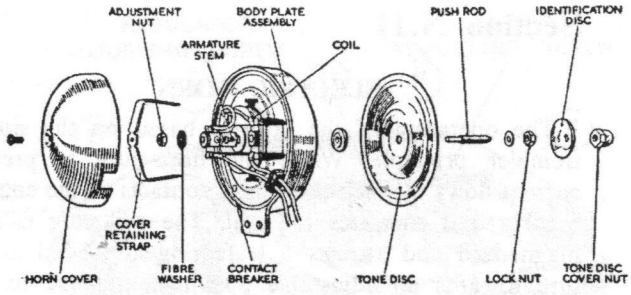


Fig. N.14

The component parts of the electric horn

armature stem until the armature buzzes and a current reading of 1·8 amps. is given.

Loosely refit the push-rod, spacer, tone disc, washer, and locknut (see Fig. N.14). Raise the supply voltage to 12 volts and screw in the push-rod until the horn operates. Tighten the push-rod locknut before testing the horn after each adjustment. Test the horn over a voltage range from 10 to 16 volts, when a clear, steady note should be obtained. Make the final tests for performance with the dished identification washer and tone disc cover nut in position.

If the contacts are so worn that correct adjustment is not possible, then the body plate assembly must be renewed.

Coil testing

If, when the horn is energized with the cover removed, the ammeter (see Fig. N.15) gives an indication of a short or open circuit, check the horn coil. Connect an ohmmeter, or other suitable test instrument, between the two coil supply cables. The resistance of the coil should be approximately ·85 to ·90 ohm.

If the coil is burnt out the windings will show visible signs of overheating.

A fault in the coil necessitates the renewal of the complete body plate assembly. Do not attempt to remove the coil from the assembly.

Section N.12

BULBS

	B.M.C. Pt. No.	*Volts*	*Watts*
Front floodlight ..	2H4441	12	36
Rear floodlight ..	2H4441	12	36
Sidelamps	2H4442	12	6
Tail lamp	2H4442	12	6
Panel lamp	2H4442	12	6

Section N.13

CLEANING LAMPS

Care must be taken when handling lamp reflectors to prevent them from becoming finger-marked. A transparent and colourless protective covering enables any finger-marks to be removed by polishing with a chamois-leather or a very soft dry cloth if they do become marked. **Do not use metal polish on reflectors.**

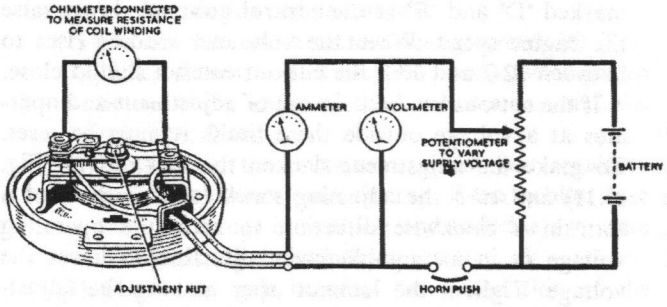


Fig. N.15

Horn-testing circuit

Section N.14

SOLENOID-OPERATED PRE-ENGAGED STARTER MOTOR

The starter motor is a four-pole four-brush earth return machine with series-parallel-connected field coils.

A solenoid-operated pre-engaged drive assembly is carried on an extension of the armature shaft, the main features of this type of drive being:

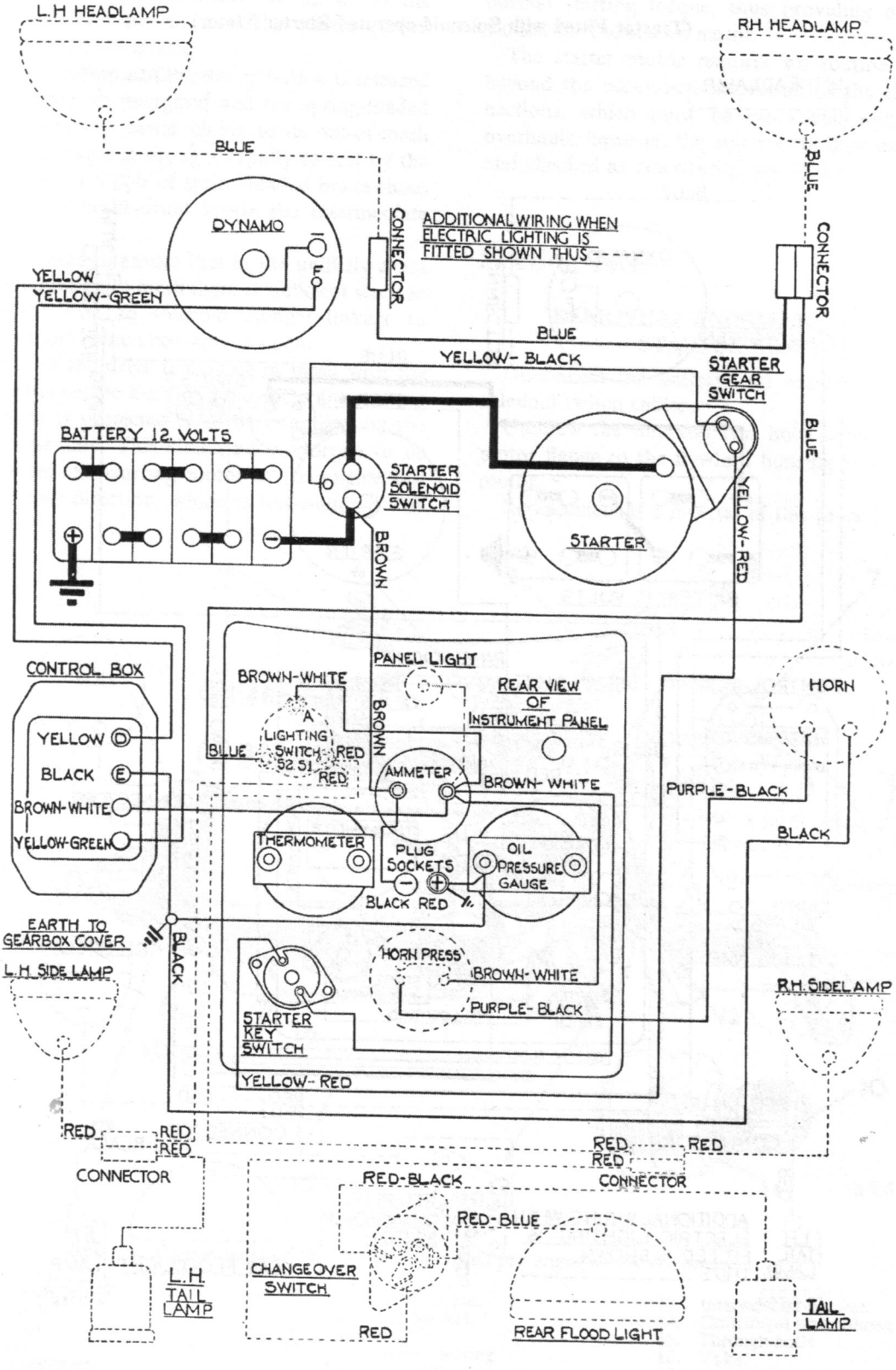
(1) Positive pinion engagement, preventing the pinion from being thrown out of mesh whilst starting.
(2) Dual-purpose plate clutch incorporated in the drive assembly, giving overspeed and overload protection.
(3) Self-indexing pinion to ensure smooth engagement between the pinion and the flywheel teeth before the starter motor begins to rotate.
(4) Armature braking system to ensure rapid return to rest when the starter button is released.

On depressing the starter button on the right of the instrument panel a solenoid unit mounted on the starter motor yoke is energized and actuates a forked lever to engage the drive pinion with the engine flywheel.

In the event of a tooth-to-tooth abutment, axial movement of the pinion is arrested whilst a helically splined sleeve on which the pinion is carried continues to move forward. This causes the pinion to rotate relative to the flywheel. When the teeth become aligned, spring pressure slides the pinion into mesh with the flywheel.

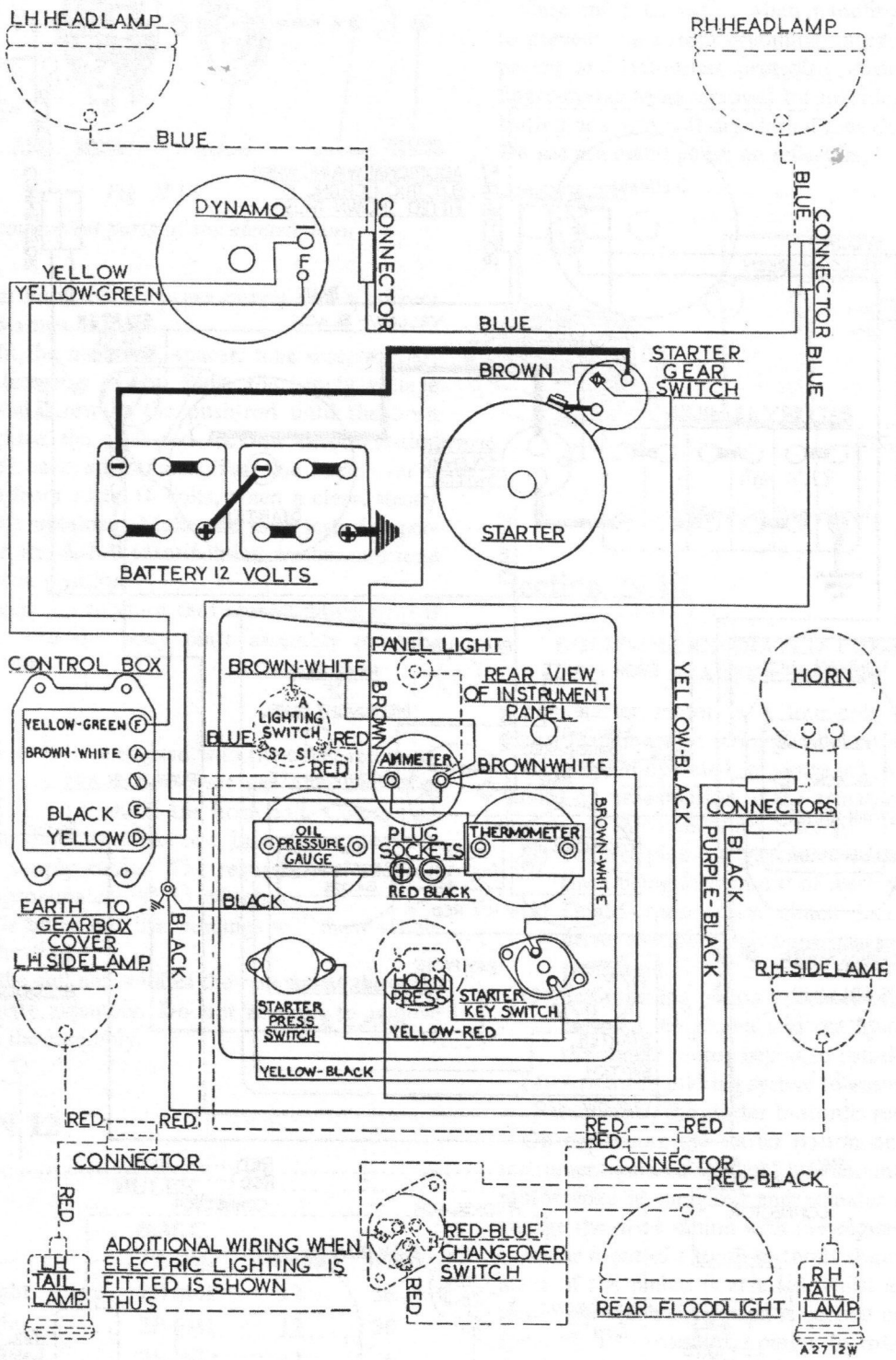
When the pinion is properly engaged with the flywheel

WIRING DIAGRAM



WIRING DIAGRAM

(Tractor Fitted with Solenoid-operated Starter Motor)



teeth a pair of contacts are closed in the rear of the unit. Closure of these contacts connects the motor to the battery, the armature rotates, and the starter pinion commences to crank the engine.

When the engine fires and the starter button is released the solenoid unit is de-energized and the spring-loaded plunger withdraws the starter pinion to its out-of-mesh position. The armature is brought rapidly to rest by the centrifugal action of a pair of spring-loaded brake-shoes bearing against a brake-drum inside the intermediate bracket.

Provision is made to ensure that in the unlikely event of the pinion jamming in mesh there is sufficient slack in the engagement lever to solenoid plunger linkage to permit the solenoid switch contacts to open.

In the event of the drive remaining in mesh with the flywheel after the engine has run up to speed the starting motor armature is protected from overspeeding by the plate clutch assembly. This clutch allows torque to be transmitted from the starting motor to the engine but not in the reverse direction, which is free-running. The clutch is set to slip at between two and three times normal starting torque, thus providing overload protection for the starter motor.

The starter motor requires no routine maintenance beyond the occasional inspection of the electrical connections, which must be clean and tight. At major overhauls, however, the unit may be dismantled, cleaned, and checked as described in the following sections.

Section N.15

REMOVING AND REPLACING THE STARTER MOTOR

Disconnect the battery and remove the starter and solenoid switch cables.

Unscrew the nut and two bolts securing the starter motor flange to the flywheel housing and withdraw the motor.

Replacement is a reversal of this procedure.

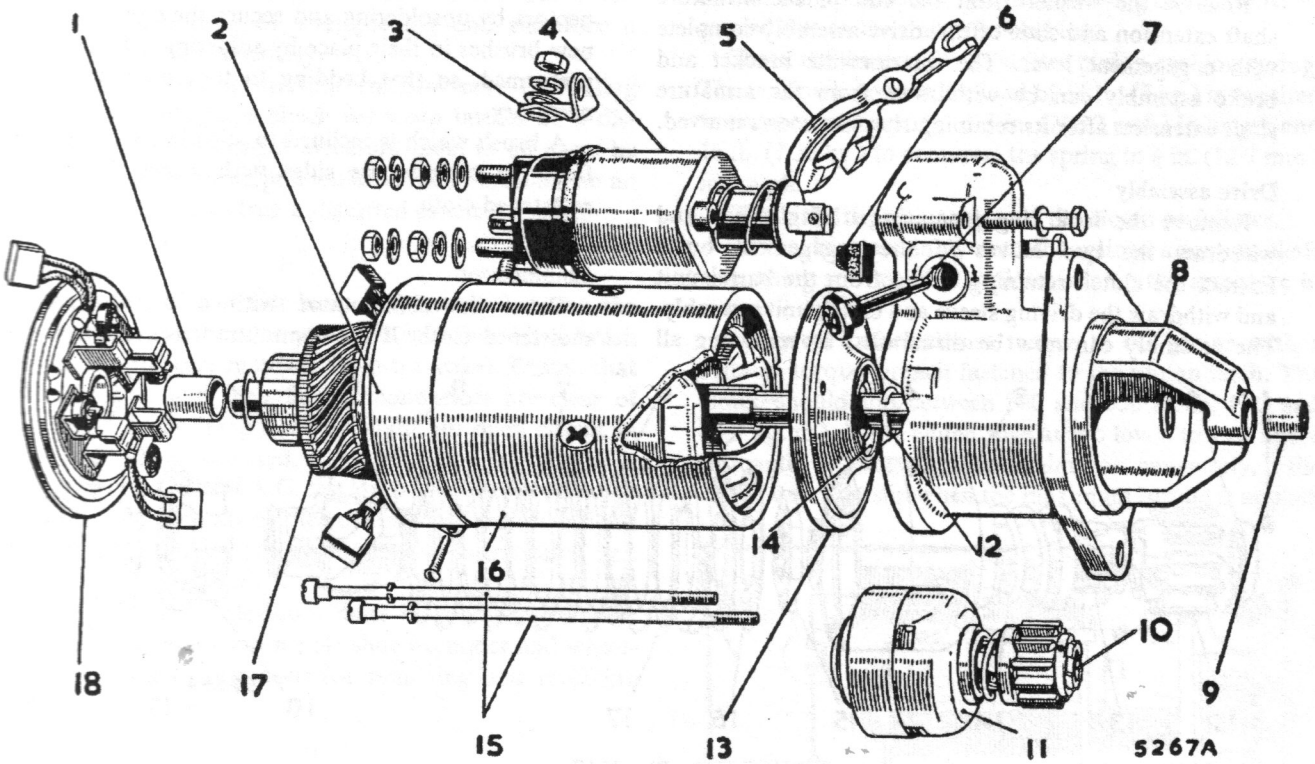


Fig. N.16

Components of the solenoid-operated pre-engaged starter motor

1. Bearing bush.
2. Cover band.
3. Copper link.
4. Solenoid.
5. Engagement lever.
6. Rubber seal.
7. Eccentric pivot pin.
8. Drive end bracket.
9. Bearing bush.
10. Pinion sleeve bearing.
11. Drive assembly.
12. Retaining ring.
13. Intermediate bracket.
14. Centrifugal brake-shoes.
15. Through-bolts.
16. Yoke.
17. Armature.
18. Commutator end bracket.

Section N.16

DISMANTLING AND REASSEMBLING THE STARTER MOTOR

Before dismantling the starter motor test with a spring scale the tension of the brush springs, which must be 30 to 40 oz. (850 to 1134 gm.). If the tension is low new springs must be fitted.

Disconnect the copper link from the lower terminal on the solenoid and the yoke of the starter motor. Unscrew the two bolts with the spring washers securing the solenoid to the starter driving end bracket and withdraw the solenoid, carefully disengaging the solenoid plunger from the starter drive engagement lever.

Remove the cover band, hold back the brush springs, and withdraw the brushes from their holders.

Unscrew the two through-bolts and withdraw the commutator end bracket and the yoke. Extract the rubber seal from the drive end bracket; slacken the locknut on the engagement lever pivot pin and unscrew the pin. The drive end bracket may now be withdrawn.

Remove the washer from the end of the armature shaft extension and slide off the drive assembly complete with engagement lever. The intermediate bracket and brake assembly can be withdrawn from the armature shaft extension after its retaining ring has been removed.

Drive assembly

Remove the lock ring from the driving sleeve and withdraw the two halves of the engagement bush. Extract the clutch retaining circlip from the barrel unit and withdraw the driving sleeve and clutch unit assembly. The assembly can now be dismantled by removing all the remaining parts, with the exception of the two pressure plates, from the driving sleeve.

To remove the two pressure plates, which are secured to the driving sleeve by a ring nut, slide the driving sleeve onto the splined armature shaft and, using soft-metal jaw plates, clamp the armature in a vice. File away the peened rim; unscrew the ring nut and withdraw the pressure plates. When reassembling, fit a new ring nut and peen the ring over the notch in the driving sleeve to lock the nut in position.

Punch out the rivet which secures the pinion retaining ring to the helically splined sleeve and withdraw the retaining ring, pinion, and cushion spring with cup washers.

Brushes

Check the brushes for wear and freedom of movement in their holders. If the brushes are worn to, or approaching, $\frac{5}{16}$ in. (8 mm.) in length they must be renewed. Two of the brushes are connected to the brush boxes on the commutator end bracket and two are connected to tappings on the field coils.

To renew the brushes, disconnect the flexible connectors by unsoldering and secure the connectors of the new brushes in their place by soldering. The brushes are preformed, so that bedding to the commutator is unnecessary.

A brush which is inclined to stick in its holder can be freed by cleaning its sides with a petrol- (gasoline-) moistened cloth.

Commutator

Clean the commutator with a petrol- (gasoline-) moistened cloth. If the commutator is burned or pitted

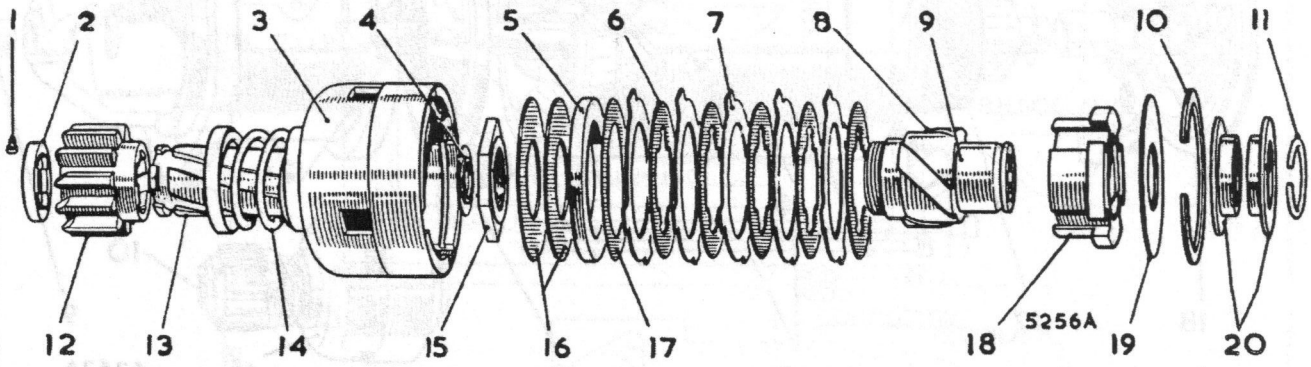


Fig. N.17

The components of the starter drive assembly

1. Rivet.
2. Pinion retaining ring.
3. Barrel unit.
4. Thrust washer.
5. Backing ring.
6. Clutch plates (inner).
7. Clutch plates (outer).
8. Helical splines.
9. Driving sleeve.
10. Circlip.
11. Lock ring.
12. Pinion.
13. Helical splined sleeve.
14. Cushion spring.
15. Ring nut.
16. Pressure plates.
17. Shim.
18. Moving member.
19. Retaining washer.
20. Engagement bush.

spin the armature and polish the commutator with super-fine glass-paper—not emery: remove all abrasive dust with a dry air blast.

If the commutator is badly worn mount the armature in a lathe and take a fine cut at high speed, using a sharp cutting tool. Do not remove more metal than necessary. Finally, polish with super-fine glass-paper.

The insulators between the commutator segments must not be undercut.

Armature

Check the armature insulation, using a 110-volt A.C. test lamp. The test lamp must not light when connected between any one commutator segment and the armature shaft.

If a short circuit is suspected it may be checked if a growler is available. A voltage drop test may also be carried out but is not always reliable. If either of these tests cannot be applied the armature must be checked by substitution.

Check to ensure that the armature conductors have not lifted fromthe end of the commutator core, which would indicate overheating or overspeeding and therefore a fault in the clutch assembly.

If there are signs on the armature core of fouling against the pole faces check for worn bushes or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine an armature core or to true a distorted armature shaft.

Field coils

Connect a 12-volt test lamp and battery between the insulated terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.

Connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. Should the lamp light, faulty insulation of one or more coils is indicated and they must be renewed.

The yoke and pole-shoes must be marked to ensure correct reassembly and a pole-shoe expander and wheel-operated screwdriver used for removing and replacing the coil and shoes.

Bearings

The commutafor and drive end brackets are each fitted with a porous bronze bearing and the intermediate bracket is fitted with an indented bronze bearing.

Bearings worn to such an extent that they allow excessive side-play of the armature shaft must be renewed.

The bearing bushes in the intermediate and drive end brackets may be pressed out, whilst the bearing bush in the commutator end bracket is best removed by screwing an $\frac{11}{16}$ in. (17·46 mm.) tap squarely into the bush and withdrawing it.

Before fitting the new porous bronze bushes they should be completely immersed for 24 hours in clean engine oil (S.A.E. 30–40). In a case of extreme urgency this period may be reduced to two hours by heating the oil to 212° F. (100° C.) and then allowing the oil to cool before removing the bushes.

Fit the new bushes by means of a shouldered and highly polished mandrel approximately ·0005 in. (·012 mm.) greater in diameter than the shaft that is to run in the bearing.

Porous bronze bushes must not be reamered out after fitting as the porosity of the bush will be impaired.

After fitting a new intermediate bearing bush lubricate the surface with Ragosine Molybdenized Non-creep Oil.

Reassembly

Reassembly of the starter motor is a reversal of the dismantling procedure, but the following checks must be carried out as the unit is assembled.

Check the tension of the starter pinion cushion spring. The tension is correct if a load of 11 lb. (5 kg.) is required to compress the spring to $\frac{7}{8}$ in. (22·22 mm.) in length and 16 lb. (7·26 kg.) to compress the spring to $\frac{1}{2}$ in. (12·7 mm.) in length.

Check the slipping torque of the clutch as follows.

Fit the drive assembly onto the splined armature shaft and, using soft-metal jaw plates, clamp the armature in a vice.

Apply an anti-clockwise torque to the pinion with a suitable torque wrench fastened to the pinion teeth. The clutch should slip between 800 and 950 lb. in. (9·2 and 10·9 kg. m.). If the clutch slips at too low a torque figure dismantle the clutch and add shims, or, conversely, if the clutch does not slip when the maximum torque is applied

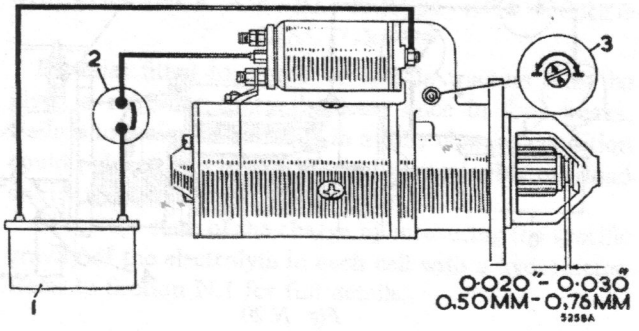


Fig. N.18

Setting the pinion movement

1. 6-volt battery. 2. Switch.
3. Eccentric pivot pin.

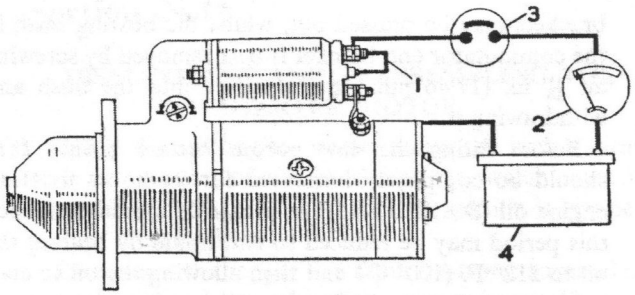


Fig. N.19

Measuring the light running current

1. Connecting link.
2. Ammeter.
3. Switch.
4. 12-volt battery.

remove shims until a figure within the above limits is obtained.

The assembled clutch unit and lever mechanism must be capable of being pushed to the full extent of the set travel, and it must move along the armature shaft extension smoothly and freely but without slackness.

Before fitting the drive assembly lightly smear the armature shaft, and pack the space between the bearings inside the helical splined sleeve, with a bentonite-based grease such as Ragosine Bentone. If at any time the drive assembly becomes sluggish it should be removed and the bearings cleaned and lubricated as above.

The fitting of the solenoid unit to the drive end bracket can be facilitated by easing the drive assembly forward along the armature shaft. It must be fitted so that the copper link between the solenoid and the starter is connected to the solenoid terminal marked 'STA'.

Setting the pinion movement

With the starter motor completely assembled, but with the engagement lever pivot pin locknut slack, set the pinion movement as follows.

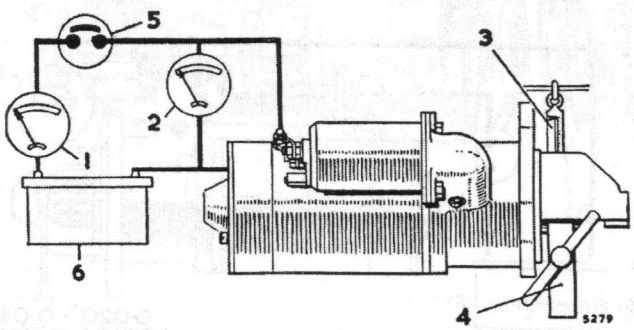


Fig. N.20

Measuring lock torque and lock current

1. Ammeter.
2. Voltmeter.
3. Spring balance.
4. Torque arm pinion clamp.
5. Switch.
6. 12-volt battery.

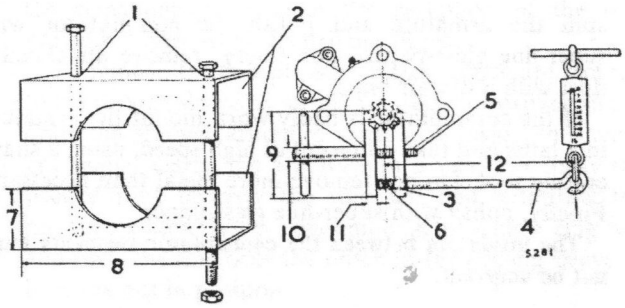


Fig. N.21

Apparatus for measuring lock torque

1. ½ in. (12·7 mm.) diameter holes.
2. 3 in. (76·2 mm.) channel iron machined to suit yoke.
3. ⅜ in. (9·5 mm.) clearance.
4. ⅜ in. (9·5 mm.) mild-steel rod.
5. ⅜ in. B.S.F. thread.
6. Spring.
7. 3 in. (76·2 mm.).
8. 10 in. (254 mm.).
9. 3 in. (76·2 mm.).
10. ⅝ in. (15·9 mm.).
11. ⅜ in. (9·5 mm.).
12. 12 in. (304·8 mm.).

Connect the small centre terminal on the solenoid unit by way of a switch to a 6-volt supply and connect the other side of the supply to one of the solenoid fixing bolts (see Fig. N.18).

Close the switch (this throws the drive assembly forward into the engaged position) and measure the distance between the pinion sleeve and the washer on the armature shaft extension. This measurement must be made with the pinion pressed lightly towards the armature to take up any play in the engagement linkage.

To adjust, rotate the eccentric pivot pin until the correct setting of between ·020 and ·030 in. (·50 and ·76 mm.) is obtained. It should be noted that the arc of the pivot pin adjustment is 180° and the head of the arrow marked on the pivot pin must be set only between the heads of the arrow on the drive end bracket casting.

After setting, tighten the pivot pin locknut, taking care not to disturb the setting.

NOTE.—In the event of a replacement motor or drive end bracket being fitted, check the out-of-mesh clearance between the leading edge of the starter pinion and the engine flywheel, which must be ⅛ in. (3·18 mm.) with a tolerance of $\frac{1}{32}$ in. (·800 mm.) either way.

Testing on the bench

The following tests on the reassembled starter motor should be carried out, using a fully charged 12-volt battery having a capacity of 128 amp.-hr. at the 10-hour rate.

(1) With the starter motor securely clamped in a vice and connected to a 12-volt battery, check the light running current, which should have a maximum reading of 90 amps. at 8,000 to 9,000 r.p.m. This is inclusive of the solenoid shunt windings (hold-on coil) current of 16 amps.

(2) Carry out a lock torque test (Fig. N.20). The lock torque should be 32·5 lb. ft. (4·49 kg. m.) with 900 amps. at 6·4 terminal volts. (If a constant voltage supply is used, it is important to regulate the voltage at the starter terminal to 6·4 volts when testing.)

Section N.17

SOLENOID

The solenoid unit consists of a closing coil, a hold-on coil, and a plunger operating a set of contacts. The coils are wound on the same core, while the contacts are housed in a moulded cover at the front of the unit.

When the starter switch button is depressed the coils are energized and the plunger is drawn into the core of the solenoid. Closure of the solenoid switch contacts shorts out the closing coil and the plunger is held fully in by the hold-on coil until the starter switch button is released.

To remove the solenoid, disconnect the cables from the battery terminals and remove the starter and solenoid switch cables.

Disconnect the copper link from the lower terminal on the solenoid and the yoke of the starter motor.

Unscrew the two bolts and spring washers securing the solenoid to the starter driving end bracket and withdraw the solenoid, carefully disengaging the solenoid plunger from the starter drive engagement lever.

To test

Carry out the following tests with the solenoid cold and connected to a 4-volt D.C. supply, using cables of adequate size.

Closing coil

Connect the supply between the solenoid terminal marked 'STA' and the small centre terminal. A current of 24 to 28 amps. should pass.

Hold-on coil

Connect the supply between the solenoid body and the small centre terminal. A current of 5·1 to 5·8 amps. should pass.

If a constant voltage supply is not available check the coil resistances, using an accurate method of measuring low resistance values, such as the Wheatstone Bridge. Proceed as follows.

Closing coil

Connect the measuring instrument in the manner described for measuring current. The coil resistance should be between ·144 and ·166 ohm.

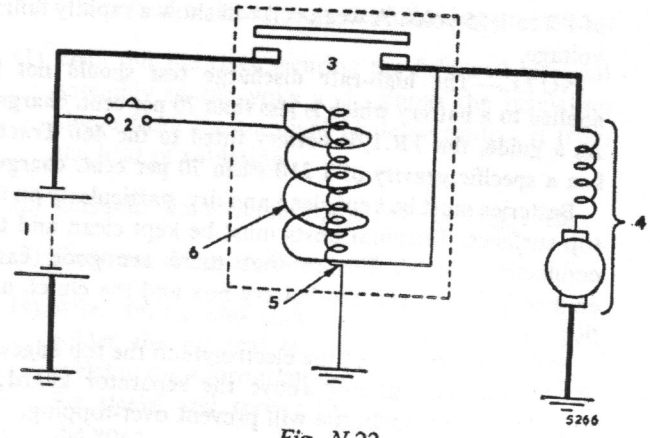


Fig. N.22

Solenoid circuit

1. Battery.
2. Starter push.
3. Contacts.
4. Starter motor.
5. Hold-on coil.
6. Closing coil.

Hold-on coil

Connect the measuring instrument in the manner described for measuring current. The coil resistance should be between ·688 and ·792 ohm.

The spring pressure required to close the solenoid contacts should be 4 to 7 lb. (1·81 to 3·18 kg.), checked with the spring removed.

The spring pressure required to push the plunger right in should be 10·5 to 16 lb. (4·76 to 7·26 kg.), checked with the spring removed.

The movement of the push-rod to close the contacts must be between ·116 and ·189 in. (2·95 and 4·80 mm.) and the total push-rod movement must be between ·263 and ·273 in. (6·68 and 6·93 mm.).

Section N.18

MAINTENANCE OF BATTERIES ON STORED TRACTORS

Batteries fitted to stored or laid-up tractors must be given a refresher charge at least once in four weeks. Failure to maintain batteries in a fully charged condition could reduce their service life and may possibly overload starter motors.

Check the state of the charge by measuring the specific gravity of the electrolyte in each cell with a hydrometer. Refer to Section N.1 for full details.

High-rate discharge test

Apply the prongs of a discharge tester, having a capacity of 300 amperes, to each cell in turn for a period of 10 seconds. A satisfactory cell will maintain a reading

of 1·2 to 1·55 volts. A weak cell will show a rapidly falling voltage.

NOTE.—The high-rate discharge test should not be applied to a battery which is less than 70 per cent. charged. As a guide, the TR.19E battery fitted to the 460 Tractor has a specific gravity of 1·210 when 70 per cent. charged.

Batteries must be kept clean and dry, particularly on the top surfaces. Terminal posts must be kept clean and the connections tight. Ensure that there are good earth connections between the battery box and the clutch and flywheel housings.

Maintain the level of the electrolyte to the top edges of the separators, but not above the separator guard; a Lucas battery filler bottle will prevent over-topping.

Section N.19

DYNAMO (C40A)

A dynamo of modified construction is fitted to all tractors commencing at No. 38243.

The dynamo is a Lucas Model C40A shunt-wound, two-pole, two-brush, non-ventilated machine arranged to work in conjunction with a compensated voltage control regulator unit.

The instructions for dismantling and reassembling the dynamo are the same as those detailed in Section N.4, except that the modified dynamo is fitted with Lucar push-on connectors and therefore there is no field terminal nut and washer to remove.

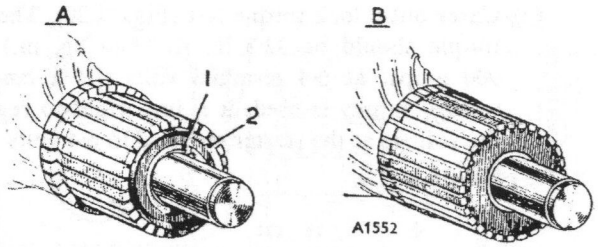


Fig. N.23

The dynamo commutator

A. Fabricated type.
B. Moulded type.
1. Metal roll-over.
2. Insulating cone.

Brushes

Test the brushes for sticking as described in Section N.5. Brushes worn down to a length of $\frac{9}{32}$ in. (7·14 mm.) or less must be renewed.

Test the brush spring pressures, using a spring balance held radially to the commutator. With a commutator diameter of 1·485 to 1·490 in. (37·72 to 37·85 mm.) the maximum pressure must not exceed 30 oz. (850 gm.) on a new brush nor fall below a minimum of 13 oz. (369 gm.) on a brush worn to the limit specified above. Fit new springs if the tension is low.

Commutator

Most commutators fitted to the C40A dynamo are of moulded construction, although some types are of the more familiar fabricated type. Moulded commutators

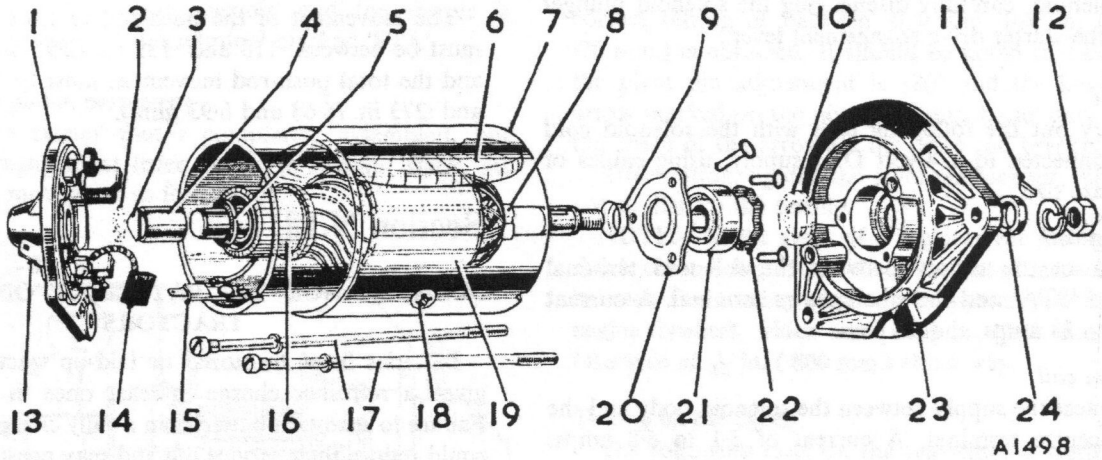


Fig. N.24

The components of the C40A dynamo

1. Commutator end bracket.
2. Felt ring.
3. Felt ring retainers.
4. Porous bronze bush.
5. Fibre thrust washer.
6. Field coils.
7. Yoke.
8. Shaft collar.
9. Collar retaining cap.
10. Felt ring.
11. Shaft key.
12. Shaft nut.
13. Output terminal 'D'.
14. Brush.
15. Field terminal 'F'.
16. Commutator.
17. Through-bolts.
18. Pole-shoe securing screw.
19. Armature.
20. Bearing retaining plate.
21. Ball bearing.
22. Corrugated washer.
23. Driving end bracket.
24. Bearing collar.

may be recognized by the exposed end, which is quite smooth, unlike that of fabricated commutators, from which a metal roll-over and an insulating cone protrude.

A moulded commutator can be reskimmed during service, as described in Section N.5 for the fabricated type, but care must be exercised to ensure that the finished diameter is not less than 1·450 in. (36·83 mm.). If a moulded commutator cannot be completely cleaned up without going below the specified diameter the armature must be renewed.

The insulation between the segments must be undercut to a depth of ·020 to ·035 in. (·508 to ·900 mm.) and a width not exceeding ·040 in. (1·02 mm.). It is important to see that the insulating material is cleaned from the **sides** of each slot to a minimum depth of ·015 in. (·381 mm.).

Armature and field coils

Test the armature and field coils in the same manner as described in Section N.5.

To fit new field coils carry out the following procedure

(1) Drill out the rivet securing the field coil terminal assembly to the yoke and remove the insulating sleeve from the terminal blade to protect it from the heat of soldering.

(2) Unsolder the terminal blade and earthing eyelet.

(3) Continue the procedure detailed in Section N.5.

(4) After fitting and tightening the new field coils solder the original terminal blade and earthing eyelet to the appropriate coil ends. Refit the insulating sleeve and rerivet the terminal assembly to the yoke.

(5) Refit the insulation piece behind the junction of the two coils.