

**CHARGING SYSTEM**

<b>Alternator</b>	
Type	Three-phase, self-rectifying
- MARELLI (55-90, 60-90, 70-90, 80-90)	4787598
- MARELLI { (90-90, 100-90)	4787673
- BOSCH }	4765725
Rated voltage	14 Volts
Rotation (seen from pulley side)	Clockwise
Cut-in speed at 12 V and 25°C	1050 to 1150 rpm
Output at 14 V across battery after warm-up (°):	
- MARELLI, at 7000 rpm (55-90, 60-90, 70-90, 80-90)	45A min
- BOSCH and MARELLI, at 7000 rpm (90-90, 100-90)	65A min
Rotor winding resistance	
— BOSCH	3.4 to 3.7 Ohm
— MARELLI	3.4 to 3.8 Ohm
On-machine alternator speed (at engine governed speed)	
— 55-90, 60-90, 70-90, 80-90	4450 rpm
— 90-90, 100-90	4475 rpm
Drive ratio	
— 55-90, 60-90, 70-90, 80-90	1.780 to 1
— 90-90, 100-90	1.910 to 1
<b>Voltage regulator</b>	
Type	Integral, transistor
Alternator test speed	4000 rpm
Voltage setting	
— Bosch 4765725	13.7 to 14.5 V
— Marelli 4787598, 4787673	13.6 to 14 V

(°) Applicable to fully bedded-in brushes.

## ELECTRICAL SYSTEM: Specification and Data

### MARELLI STARTER (models 55-90, 60-90)

Type	MARELLI MT-71AA
Voltage rating	12 V
Rated output	2.5 kW
Rotation (seen from pinion end)	Clockwise
Starter drive ratio	9/110
No. of poles	4
Field winding	Series
Control	Freewheel
Operation	Through solenoid
<b>Bench Test Data</b>	
Running torque at 20°C	
— Current	500 A max.
— Torque	16.6 Nm (12.3 ft. lb. 1.7 kgm)
— Speed	1300 rpm
— Voltage	8.3 V
Lock torque at 20°C	
— Current	950 A max
— Voltage	4.8 V
— Torque	36 Nm (26.7 ft. lb., 3.7 kgm) min.
— Overall internal resistance	0.005 ± 0.0005 Ohm
Light running torque at 20°C	
— Current	60 A max
— Voltage	11.6 V
— Speed	8500 rpm
<b>Mechanical Data</b>	
Brush spring load (not worn)	12.2 to 15.2 (1.25 to 1.55 kg, 2.75 to 3.4 lb)
Mica undercut depth	1 mm (0.040 in)
Clutch slip torque (pinion rotating torque)	6 to 8 kgcm (0.4 to 0.6 lb ft)

(follows)

**MARELLI STARTER (models 55-90, 60-90)**

(continued)

Commutator dia. . . . .	44.840 to 45.000 mm (1.7653 to 1.7716 in)
— Maximum wear limit . . . . .	43.5 mm (1.7126 in)
— Maximum ovality . . . . .	0.08 mm (0.0031 in)
— Armature end float . . . . .	0.1 to 0.4 mm (0.004 to 0.016)
<b>Solenoid</b>	
Winding resistance at 20°C . . . . .	0.22 ± 0.02 Ohm
Current consumption at 12 V . . . . .	54 A
Activation voltage . . . . .	5.5 V max
Moving contact travel . . . . .	3 mm (0.118 in)
Plunger stroke . . . . .	13.8 to 14.9 mm (0.5433 to 0.5866 in)
End of stroke plunger load at 12 V . . . . .	392 N (40 kg, 88 lb) max
<b>Fitting Data</b>	
Pole shoe I.D. . . . .	75.830 to 76.000 mm (2.9854 to 2.9921 in)
Armature O.D. . . . .	74.900 to 74.950 mm (2.9488 to 2.9508 in)
Drive end bushing I.D. . . . .	12.475 to 12.502 mm (0.4911 to 0.4922)
Pinion journal dia. . . . .	12.425 to 12.440 mm (0.4892 to 0.4900 in)
Pinion clearance in bushing . . . . .	0.035 to 0.077 mm (0.0014 to 0.0030 in)
Intermediate bushing I.D. . . . .	20.200 to 20.264 mm (0.7953 to 0.7978 in)
Shaft journal dia. . . . .	19.967 to 20.00 mm (0.7861 to 0.7878 in)
Shaft clearance in bushing . . . . .	0.200 to 0.297 mm (0.0080 to 0.0117 in)
Commutator end bushing I.D. . . . .	14.000 to 14.270 mm (0.5512 to 0.5618 in)
Shaft journal dia. . . . .	13.957 to 13.984 mm (0.5495 to 0.5505 in)
Shaft clearance in bushing . . . . .	0.016 to 0.313 mm (0.0006 to 0.0123 in)
<b>Lubrication Data</b>	
Starter drive helical groove (during overhaul) . . . . .	<b>grassofiat TUTELA MR 3</b>
Commutator end thrust washer . . . . .	<b>grassofiat TUTELA MR3</b>

## ELECTRICAL SYSTEM: Specification and Data

### LUCAS STARTER (models 55-90, 60-90)

Type	M45 G 26390/D
Voltage rating	12 V
Rated output	2.6 kW
Rotation (seen from pinion end)	Clockwise
Starter drive ratio	9/110
No. of poles	4
Field winding	Compound
Control	Sprag clutch
Operation	Pre-engagement
<b>Bench Test Data</b>	
Running torque at 20°C	
— Current	600 A max.
— Torque	22.5 Nm (2.3 kgm 16.6 ft. lb.)
— Speed	1000 rpm min.
— Voltage	8.9 V
Light running torque at 20°C	
— Current	100 A max.
— Voltage	12 V
— Speed	5000 to 7000 rpm
Overall internal resistance at 20°C	0.0078 Ohm
<b>Mechanical Data</b>	
Brush spring load (not worn)	14.7 to 19.6 N (1.5 to 2 kg, 3.3 to 4.4 lb)
Armature end play	0.025 to 1.420 mm (0.0009 to 0.0559 in)
Commutator dia.	41.150 to 41.400 mm (1.620 to 1.629 in)
— Wear limit	38.89 mm (1.53 in)
— Maximum ovality	0.076 mm (0.003 in)

(follows)

**LUCAS STARTER (models 55-90, 60-90)**

(continued)

<p><b>Solenoid</b></p> <p>Resistance at 20°C { Holding coil Actuating coil</p> <p>Current consumption at 12 V { Holding coil Actuating coil</p> <p>Activation voltage</p> <p>Plunger stroke</p>	<p>0.46 to 0.56 Ohm 0.145 to 0.165 Ohm</p> <p>21.5 to 26.1 A 73 to 83 A</p> <p>8 V</p> <p>0.585 mm (0.023 in)</p>
<p><b>Fitting Data</b></p> <p>Pole shoe I.D.</p> <p>Armature O.D.</p> <p>Armature bushing fitted I.D.</p> <p>— Pinion</p> <p>— Intermediate</p> <p>— Commutator</p> <p>Armature shaft journal dia.</p> <p>— Pinion</p> <p>— Intermediate</p> <p>— Commutator</p> <p>Armature shaft clearance in bushing</p> <p>— Pinion</p> <p>— Intermediate</p> <p>— Commutator</p> <p>Pinion bushing fitted I.D.</p> <p>Armature shaft journal dia. over pinion bushing</p> <p>Armature shaft clearance in pinion bushing</p>	<p>75.38 to 75.74 mm (2.967 to 2.982 in)</p> <p>74.40 to 74.47 mm (2.929 to 2.932 in)</p> <p>14.287 to 14.313 mm (0.562 to 0.563 in)</p> <p>28.500 to 28.530 mm (1.122 to 1.123 in)</p> <p>12.700 to 12.725 mm (0.499 to 0.501 in)</p> <p>14.20 to 14.22 mm (0.559 to 0.560 in)</p> <p>28.356 to 28.433 mm (1.116 to 1.119 in)</p> <p>12.65 to 12.67 mm (0.498 to 0.499 in)</p> <p>0.067 to 0.113 mm (0.0026 to 0.0044 in)</p> <p>0.067 to 0.174 mm (0.0026 to 0.0068 in)</p> <p>0.03 to 0.075 mm (0.0012 to 0.562 in)</p> <p>14.26 to 14.29 (0.561 to 0.562 in)</p> <p>14.20 to 14.22 (0.559 to 0.560 in)</p> <p>0.04 to 0.09 mm (0.0015 to 0.0035 in)</p>
<p><b>Lubrication Data</b></p> <p>Starter drive helical groove (during overhaul)</p>	<p><b>grassofiat TUTELA MR3</b></p>

## ELECTRICAL SYSTEM: Specification and Data

### BOSCH STARTER (models 55-90, 60-90)

Type	JF→ 12V 0.001.362.039
Voltage rating	12 V
Rated output	1.8 kW
Rotation (seen from pinion end)	Clockwise
Starter drive ratio	9/110
No. of poles	4
Field winding	Series
Control	Sliding
Operation	Solenoid
<b>Bench Test Data</b>	
Running torque at 20°C	
— Current	735 ÷ 765 A
— Torque	24.5 Nm (2.5 Kgm, 18.1 ft.lb)
— Speed	950 to 1250 rpm
— Voltage	9 V
Lock torque at 20°C	
— Current	700 to 880 A
— Voltage	4.5 V
— Torque	0 Nm
— Overall internal resistance	0.00573 Ohm
Light running torque at 20° C	
— Current	65 to 95 A
— Voltage	11.5 V
— Speed	6500 to 8500 rpm
<b>Mechanical Data</b>	
Brush spring load (not worn)	11.3 to 12.7 N (1.15 to 1.3 kg, 2.5 to 2.9 Lb)
Armature end play	0.1 to 0.3 mm (0.004 to 0.012 in)
Mica undercut depth	0.5 to 0.8 mm (0.020 to 0.032 in)
Commutator diameter	42 mm (1.65 in)
— Wear limit	39.5 mm (1.55 in)
— Maximum ovality of lamination pack	0.05 mm (0.0020 in)
— Maximum ovality of commutator	0.03 mm (0.0012 in)

(follows)

**BOSCH STARTER (models 55-90, 60-90)**

(continued)

<p><b>Solenoid</b></p> <p>Resistance at 20°C</p> <ul style="list-style-type: none"> <li>— Holding coil</li> <li>— Actuating coil</li> </ul> <p>Current consumption at 12 V</p> <p>Activation voltage</p> <p>Plunger stroke</p>	<p>1.05 Ohm</p> <p>0.25 Ohm</p> <p>60 A</p> <p>7.5 V</p> <p>12 to 14 mm (0.472 to 0.551 in)</p>
<p><b>Fitting Data</b></p> <p>Pole shoe I.D.</p> <p>Armature O.D.</p> <p>Armature bushing fitted I.D.</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft journal dia.</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft clearance in bushing</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Pinion bushing fitted I.D.</p> <p>Armature shaft journal dia. over pinion bushing</p> <p>Armature shaft clearance in pinion bushing</p>	<p>75.85 to 75.98 mm (2.986 to 2.991 in)</p> <p>73 mm (2.874 in)</p> <p>12.475 to 12.502 mm (0.491 to 0.492 in)</p> <p>19.020 to 19.072 mm (0.749 to 0.751 in)</p> <p>12.475 to 12.502 mm (0.491 to 0.492 in)</p> <p>12.425 to 12.440 mm (0.489 to 0.490 in)</p> <p>18.927 to 18.960 mm (0.745 to 0.746 in)</p> <p>12.425 to 12.440 mm (0.489 to 0.490 in)</p> <p>0.035 to 0.077 mm (0.0014 to 0.0030 in)</p> <p>0.060 to 0.145 mm (0.0023 to 0.0057 in)</p> <p>0.035 to 0.077 mm (0.0014 to 0.0030 in)</p> <p>14.245 to 14.272 mm (0.561 to 0.562 in)</p> <p>14.123 to 14.150 mm (0.556 to 0.557 in)</p> <p>0.095 to 0.149 mm (0.0037 to 0.0059 in)</p>
<p><b>Lubrication Data</b></p> <p>Starter drive helical groove (during overhaul)</p>	<p><b>grassofiat TUTELA MR 3</b></p>

## ELECTRICAL SYSTEM: Specification and Data

### MARELLI STARTER (models 70-90 and 80-90)

Type	MARELLI MT 68 AB
Voltage rating	12
Rated output	3,5 kW
Rotation (seen from pinion end)	Clockwise
Starter drive ratio	9/110
No. of poles	4
Field winding	Series
Control	Lever and free wheel
Operation	Solenoid
<b>Bench Test Data</b>	
Running torque at 20°C	
— Current	700 A max.
— Torque	19.6 Nm (2 kgm, 14.5 ft.lb)
— Speed	1400 to 1800 rpm
— Voltage	9 V
Lock torque at 20°C	
— Current	1400 A max.
— Voltage	5 V
— Torque	49 Nm (5 kgm, 36.2 ft.lb)
— Overall internal resistance	0,004 ± 0,0004 Ohm
Light running torque at 20°C:	
— Current	85 A max.
— Voltage	12 V
— Speed	7000 to 10000 rpm
Main series field winding resistance at 20°C	0,002 ± 0,0002 Ohm
<b>Mechanical Data</b>	
Brush spring load (not worn)	14.7 to 17.4 N (1.5 to 1.8 kg, 3.3 to 3.9 lb)
Mica undercut depth	1 mm (0.040 in)
Clutch slip torque (pinion rotating torque)	6 to 8 kgcm (0.4 to 0.6 ft.lb)

(follows)



**MARELLI STARTER (models 70-90 and 80-90)**

(continued)

Commutator dia. — Maximum wear limit — Maximum ovality — Armature end float	44.840 to 45.000 mm (1.7653 to 1.7716 in) 43.5 mm (1.7126 in) 0.08 mm (0.0031 in) 0.1 to 0.4 mm (0.004 to 0.016 in)
<b>Solenoid</b> Winding resistance at 20°C Current consumption at 12 V Activation voltage Moving contact travel Plunger stroke End of stroke plunger load at 12 V	0.22 ± 0.02 Ohm 54 A 5.5 V Max. 3 mm (0.118 in) 13.8 to 14.9 mm (0.5433 to 0.5866 in) 392 N (40 kg, 88 lb) max.
<b>Fitting</b> Pole shoe I.D. Armature O.D. Drive end bushing I.D. Pinion journal dia. Pinion clearance in bushing Intermediate bushing I.D. Shaft journal dia. Shaft clearance in bushing Commutator end bushing I.D. Shaft journal dia. Shaft clearance in bushing	75.830 to 76.000 mm (2.9854 to 2.9921 in) 74.900 to 74.950 mm (2.9488 to 2.9508 in) 12.475 to 12.502 mm (0.4911 to 0.4922 in) 12.425 to 12.440 mm (0.4892 to 0.4900 in) 0.035 to 0.077 mm (0.0014 to 0.0030 in) 20.200 to 20.264 mm (0.7953 to 0.7978 in) 19.677 to 20.000 mm (0.7774 to 0.7874 in) 0.200 to 0.587 mm (0.0080 to 0.0231 in) 14.000 to 14.022 mm (0.5512 to 0.5520 in) 13.957 to 13.984 mm (0.5495 to 0.5505 in) 0.016 to 0.065 mm (0.0006 to 0.0025 in)
<b>Lubrication Data</b> Starter drive helical groove (during overhaul) Commutator end thrust washer	<b>grassofiat TUTELA MR 3</b> <b>grassofiat TUTELA MR 3</b>

## ELECTRICAL SYSTEM: Specification and Data

### BOSCH STARTER (models 70-90 and 80-90)

Type Voltage rating Rated output Rotation (seen from pinion end) Starter drive ratio Number of poles Field winding Control Operation	BOSCH JD→ 12V 0.001.359.102  12 V 2.94 kW Clockwise 9/110 4 Compound Lever and freewheel Through solenoid				
<b>Bench Test Data</b>  Running torque at 20°C — Current — Torque — Voltage  Light running torque at 20°C — Current — Voltage — Speed	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px solid black; padding: 5px;">               760 to 900 A (*)                45 N (4.6 kgm, 33 ft lb)                4 V             </td> <td style="width: 50%; padding: 5px;">               650 to 800 A (°)                38 N (3.9 kgm, 28 ft lb)                3.5 V             </td> </tr> <tr> <td colspan="2" style="padding: 5px;">               60 to 90 A                11.5 V                4800 to 6800 rpm             </td> </tr> </table>	760 to 900 A (*) 45 N (4.6 kgm, 33 ft lb) 4 V	650 to 800 A (°) 38 N (3.9 kgm, 28 ft lb) 3.5 V	60 to 90 A 11.5 V 4800 to 6800 rpm	
760 to 900 A (*) 45 N (4.6 kgm, 33 ft lb) 4 V	650 to 800 A (°) 38 N (3.9 kgm, 28 ft lb) 3.5 V				
60 to 90 A 11.5 V 4800 to 6800 rpm					
<b>Mechanical Data</b>  Brush spring load (not worn) Armature end play Mica undercut depth Commutator diameter — Maximum wear limit — Maximum ovality of lamination pack — Maximum ovality of commutator	25.5 to 27.4 (2.6 to 2.8 kg or 5.7 to 6.2 lb)  0.1 to 0.3 mm (0.004 to 0.012 in)  0.5 to 0.8 mm (0.020 to 0.032 in)  42 mm (1.65 in) 39.5 mm (1.55 in) 0.05 mm (0.0020 in) 0.03 mm (0.0012 in)				

(\*) Battery charged. (°) Battery discharged.

(follows)

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**BOSCH STARTER (models 70-90 and 80-90)**

(continued)

<p><b>Solenoid</b></p> <p>Resistance at 20°C</p> <ul style="list-style-type: none"> <li>— Holding coil</li> <li>— Actuating coil</li> </ul> <p>Current consumption at 12 V</p> <ul style="list-style-type: none"> <li>— Holding coil</li> <li>— Actuating coil</li> </ul> <p>Activation voltage (minimum)</p> <p>Plunger stroke</p>	<p style="text-align: right;">1.05 Ohm</p> <p style="text-align: right;">0.25 Ohn</p> <p style="text-align: right;">11.4 A</p> <p style="text-align: right;">50 A</p> <p style="text-align: right;">8 V</p> <p style="text-align: right;">12 to 14 mm (0.47 to 0.55 in)</p>
<p><b>Fitting Data</b></p> <p>Pole shoe I.D.</p> <p>Armature O.D.</p> <p>Armature self-lubricating bushing fitted I.D.</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft journal diameter</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft clearance in bushing</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Pinion bushing fitted I.D.</p> <p>Armature shaft journal diameter over pinion bushing</p> <p>Armature shaft clearance in pinion bushing</p>	<p style="text-align: right;">75.85 to 75.98 mm (2.986 to 2.991 in)</p> <p style="text-align: right;">73 mm (2.874 in)</p> <p style="text-align: right;">12.475 to 12.502 mm (0.4911 to 0.4922 in)</p> <p style="text-align: right;">19.020 to 19.072 mm (0.7488 to 0.7509 in)</p> <p style="text-align: right;">14.000 to 14.018 mm (0.5512 to 0.5519 in)</p> <p style="text-align: right;">12.425 to 12.440 mm (0.4891 to 0.4897 in)</p> <p style="text-align: right;">18.777 to 18.910 mm (0.7392 to 0.7445 in)</p> <p style="text-align: right;">13.932 to 13.950 mm (0.5485 to 0.5492 in)</p> <p style="text-align: right;">0.035 to 0.077 mm (0.0014 to 0.0030 in)</p> <p style="text-align: right;">0.110 to 0.195 mm (0.0043 to 0.0077 in)</p> <p style="text-align: right;">0.050 to 0.086 mm (0.0020 to 0.0034 in)</p> <p style="text-align: right;">14.245 to 14.272 mm (0.5608 to 0.5619 in)</p> <p style="text-align: right;">14.123 to 14.150 mm (0.5560 to 0.5571 in)</p> <p style="text-align: right;">0.095 to 0.149 mm (0.0037 to 0.0059 in)</p>
<p><b>Lubrication Data</b></p> <p>Starter drive helical groove (at overhaul)</p>	<p style="text-align: center;"><b>grassofiat TUTELA MR 3</b></p>

## ELECTRICAL SYSTEM: Specification and Data

### MARELLI STARTER (models 90-90 and 100-90)

Type	MARELLI MT 68 LB
Voltage rating	12 V
Rated output	3,5 kW
Rotation (seen from pinion end)	clockwise
Starter drive ratio	9/127
No. of poles	4
Field winding	series
Control	lever and freewheel
Operation	through solenoid
<b>Bench test data</b>	
Running torque at 20°C:	
— Current	700 A max.
— Torque	19 Nm min. (1.9 kgm) (13.75 ft.lb.)
— Speed	1700 rpm
— Voltage	9.1 V
Lock torque at 20°C:	
— Current	1550 A max.
— Voltage	5.7 V
— Torque	52 Nm min. (5.3 kgm) (38.3 ft.lb.)
Light running torque at 20°C:	
— Current	80 A max.
— Voltage	11.6 V min.
— Speed	7000 rpm min.
<b>Mechanical data</b>	
Brush spring pressure (new brushes)	bar (kg/cm <sup>2</sup> )
	1.28 to 1.52 bar (18.56 to 22 p.s.i.)
Mica undercut depth	1 mm max. (.040 in)
Clutch slip torque (pinion rotating torque)	.6 to .8 Nm (.06 to .08 kgm) (.4 to .6 ft.lb.)

(follows)

**MARELLI STARTER (models 90-90 and 100-90)**

*(continued)*

Commutator dia. — Maximum wear limit — Maximum ovality — Armature end float	45.000 to 45.840 mm (1.7716 to 1.8047 in.) 44.000 mm (1.732 in.) .1 mm (.0039 in.) .1 to .4 mm (.004 to .016 in.)																		
<b>Solenoid</b>  Winding resistance at 20°C Current consumption at 12 V Activation voltage Moving contact travel Plunger stroke End of stroke plunger load at 12 V	<table border="0"> <tr> <td style="vertical-align: middle;">{</td> <td style="vertical-align: middle;">hold-in winding pull-in winding</td> <td style="vertical-align: middle;">.23 ± .01 Ohm .78 ± .04 Ohm</td> </tr> <tr> <td></td> <td></td> <td>70 A max.</td> </tr> <tr> <td></td> <td></td> <td>7 V max.</td> </tr> <tr> <td></td> <td></td> <td>2.2 to 3.5 mm (.086 to .137 in.)</td> </tr> <tr> <td></td> <td></td> <td>14.3 mm (.562 in.)</td> </tr> <tr> <td></td> <td></td> <td>392 N or 40 Kg min (88 lb.)</td> </tr> </table>	{	hold-in winding pull-in winding	.23 ± .01 Ohm .78 ± .04 Ohm			70 A max.			7 V max.			2.2 to 3.5 mm (.086 to .137 in.)			14.3 mm (.562 in.)			392 N or 40 Kg min (88 lb.)
{	hold-in winding pull-in winding	.23 ± .01 Ohm .78 ± .04 Ohm																	
		70 A max.																	
		7 V max.																	
		2.2 to 3.5 mm (.086 to .137 in.)																	
		14.3 mm (.562 in.)																	
		392 N or 40 Kg min (88 lb.)																	
<b>Installation data</b>  Pole shoe I.D. Armature O.D. Drive end bushing I.D. Pinion journal O.D. Pinion clearance in bushing Intermediate bushing I.D. Shaft journal dia. Shaft clearance in bushing Commutator end bushing I.D. Shaft journal dia. Shaft clearance in bushing	75.830 to 76.000 mm (2.9854 to 2.9921 in.) 74.900 to 74.950 mm (2.9488 to 2.9508 in.) 12.475 to 12.502 mm (.4911 to .4922 in.) 12.425 to 12.440 mm (.4892 to .4900 in.) .035 to .077 mm (.0014 to .0030 in.) 20.200 to 20.264 mm (.7953 to .7978 in.) 19.967 to 20.000 mm (.7861 to .7874 in.) .200 to .297 mm (.0080 to .0116 in.) 14.000 to 14.027 mm (.5512 to .5522 in.) 13.957 to 13.984 mm (.5505 to .549 in.) .016 to .070 mm (.0006 to .0027 in.)																		
<b>Lubrication data</b>  Starter drive helical groove (during overhaul) Commutator end thrust washer	<b>grassofiat MR 3</b> <b>grassofiat MR 3</b>																		

## ELECTRICAL SYSTEM: Specification and Data

### BOSCH STARTER (models 90-90 and 100-90)

Type	BOSCH JD→ 12V A 001 - 806.499
Voltage rating	V 12
Rated output	2.95 kW
Rotation (seen from pinion end)	Clockwise
Starter drive ratio	9/127
Number of poles	4
Field winding	Compound
Control	Lever and freewheel
Operation	Through solenoid
<b>Bench Test Data</b>	
Running torque at 20°C (68°F)	
— Current	760 to 900 A (*)      650 to 800 A (°)
— Torque	45 N (4.6 kgm, 33 ft lb)      38 N (3.9 kgm, 28 ft lb)
— Voltage	4 V      3.5 V
Light running torque at 20°C (68°F)	
— Current	60 to 90 A
— Voltage	11.5 V
— Speed	4800 to 6800 rpm
<b>Mechanical Data</b>	
Brush spring load (not worn)	25.5 to 27.4 N (2.6 to 2.8 Kg or 5.7 to 6.2 lb)
Armature end play	0.1 to 0.3 mm (0.004 to 0.012 in)
Mica undercut depth	0.5 to 0.8 mm (0.020 to 0.032 in)
Commutator diameter	42 mm (1.65 in)
— Maximum wear limit	39.5 mm (1.55 in)
— Maximum ovality of lamination pack	0.05 mm (0.0020 in)
— Maximum ovality of commutator	0.03 mm (0.0012 in)

(follows)

(\*) Battery charged. (°) Battery discharged.

**BOSCH STARTER (models 90-90 and 100-90)**

(continued)

<p><b>Solenoid</b></p> <p>Resistance at 20° C°</p> <ul style="list-style-type: none"> <li>— Holding coil</li> <li>— Actuating coil</li> </ul> <p>Current consumption at 12 V</p> <ul style="list-style-type: none"> <li>— Actuating coil</li> </ul> <p>Activation voltage (minimum)</p> <p>Plunger stroke</p>	<p>1.05 Ohm</p> <p>0.25 Ohm</p> <p>60 A</p> <p>9 V</p> <p>12 to 14 mm (0.47 to 0.55 in)</p>
<p><b>Fitting Data</b></p> <p>Pole shoe I.D.</p> <p>Armature O.D.</p> <p>Armature self-lubricating bushing fitted I.D.</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft journal diameter</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Armature shaft clearance in bushing</p> <ul style="list-style-type: none"> <li>— Pinion</li> <li>— Intermediate</li> <li>— Commutator</li> </ul> <p>Pinion bushing fitted I.D.</p> <p>Armature shaft journal diameter over pinion bushing</p> <p>Armature shaft clearance in pinion bushing</p>	<p>75.85 to 75.953 mm (2.986 to 2.99 in)</p> <p>73 mm (2.874 in)</p> <p>12.475 to 12.502 mm (0.4911 to 0.4922 in)</p> <p>19.020 to 19.072 mm (0.7488 to 0.7509 in)</p> <p>14.00 to 14.018 mm (0.5512 to 0.5519 in)</p> <p>12.425 to 12.440 mm (0.4891 to 0.4897 in)</p> <p>18.887 to 18.910 mm (0.743 to 0.7445 in)</p> <p>13.932 to 13.950 mm (0.5485 to 0.5492 in)</p> <p>0.035 to 0.077 mm (0.0014 to 0.0030 in)</p> <p>0.110 to 0.195 mm (0.0043 to 0.0077 in)</p> <p>0.050 to 0.086 mm (0.0020 to 0.0034 in)</p> <p>14.245 to 14.272 mm (0.5608 to 0.5619 in)</p> <p>14.123 to 14.150 mm (0.5560 to 0.5571 in)</p> <p>0.095 to 0.149 mm (0.0037 to 0.0059 in)</p>
<p><b>Lubrication Data</b></p> <p>Starter drive helical groove (at overhaul)</p>	<p><b>grassofiat TUTELA MR3</b></p>

# ELECTRICAL SYSTEM: Specification and Data

## BATTERY

Type	Models 55-90 and 60-90	}	MARELLI 434395
	Early models 70-90 and 80-90		SCAINI 59270
	Late models 70-90 and 80-90	}	FIAT 12V 100AH 460A (●)
	Models 90-90 and 100-90. Late models (70-90 and 80-90 (optional))		MARELLI 6 ATM 25Z-A
			SCAINI 14046
			MARELLI 6ATM 25A
			SCAINI 14047
Voltage			FIAT 12 V 100AH 460 A (●)
		V	MARELLI 434470 ES (●)
			MARELLI 456580 ES (●)
Nominal capacity (20 h discharge rate)	FIAT 12 V 100 AH 460 A	Ah	12V
	MARELLI 434395	Ah	100 (●)
	MARELLI 434470 ES	Ah	88
	MARELLI 6ATM 25Z-A	Ah	100 (●)
	MARELLI 6ATM 25A	Ah	110
	MARELLI 456580 ES	Ah	132
	SCAINI 59270	Ah	132 (●)
SCAINI 14046	Ah	92	
SCAINI 14047	Ah	120	
		Ah	140
Max dimensions (length x width x height):			
— FIAT 12V 100 AH 460A(●)	mm	330x174x240	
— SCAINI 59270	mm	325x175x224	
— MARELLI 434470 ES (●)	mm	373x175x190	
— MARELLI 434395	mm	381x174x205	
— SCAINI 14046 - SCAINI 14047 - MARELLI 6ATM 25Z-A- MARELLI 6ATM 25A	mm	508x174x205	
— MARELLI 456580 E●	mm	513x174x205	

● Maintenance-free battery.

## FUSES

Eight 8 Amp, one 16 Amp and three 25 Amp fuses, housed in box		
Fuses	PROTECTED CIRCUITS	Ampère
1	Thermostarter or start-pilot	25
2	High beam and indicator	8
3	Low beam	8
4	Flood light - Front L.H. parking light - Rear R.H. parking light - Instrument panel light - Cab light.	8

(follows)



**FUSES**

Fuses	PROTECTED CIRCUITS	Ampère
5	Front R.H. parking light - Rear L.H. parking light - Parking light indicator - Cigar lighter light.	8
6	Low engine oil level sending unit and indicator - PTO on indicator - Water temperature indicator - Fuel gauge - Battery charge indicator - Parking brake indicator - Differential lock indicator - Front wheel drive indicator - Tractor and trailer stop light circuit - Cigar lighter - Air cleaner restriction indicator and sending unit - Oil pressure sending unit and indicator - Auxiliary fuel tank reserve circuit and indicator (●)	8
7	Parking brake indicator circuit - Horn - Low brake fluid indicator.	8
8	Turn signals - Fuel sedimenter restriction indicator and sending unit	8
9	Cab circuits	25
10	Engine shutoff solenoid	8
11	Hazard warning light - Single pole power point	16
12	Cab circuits	25

Unprotected circuits: starting and generating circuits.

(●) 90-90 and 100-90 only.

**LIGHTING - SIGNALS - ACCESSORIES**

Headlamps Asymmetric, high and low beam, 45/40 W, double filament, white or yellow.
Front lights: — Parking, 5W, white lens; — Turn signal, 21 W, orange lens;
Rear lights: — Parking light, 5 W, red lens; — Turn signal, 21 W, orange lens; — Stop, 21 W, red lens; — License plate light.
Floodlight, integral switch, 35 W, white
Reflex reflectors at rear.

(follows)

## ELECTRICAL SYSTEM: Specification and Data

### LIGHTING - SIGNALS - ACCESSORIES

(continued)

## Indicators, 3 W

- Battery charge (red);
- Low engine oil pressure (red);
- Air cleaner restriction (red)
- Parking brake (flasher) (red);
- Parking lights (green);
- High beam (blue)
- Tractor turn signal lights (green);
- First trailer turn signal lights (green);
- Second trailer turn signal lights (green);
- Power take-off (yellow);
- Fuel sedimenter restriction (red);
- Low brake fluid (red);
- Low engine oil level (green);
- Floodlight (yellow);
- Differential lock (yellow)
- Front wheel drive (yellow);
- Auxiliary tank fuel reserve (yellow) (●).

## Thermostarter or Start-pilot.

## Cigar lighter

(●) 90-90 and 100-90 only.

### STARTER SWITCH

CO BO, Type, 4-position, 50 A.	
Position	CIRCUIT COMPLETED
Position 0 30	Off.(●)
Position 1 30-15/54      57-58/57	Lighting switch - Fuel gauge - Water temp. gauge - Battery charge indicator - Low engine oil pressure indicator - Turn signal lights and indicators - Parking brake indicator - Tractor and trailer stop lights - Cigar lighter - Horn - Low brake fluid indicator - Engine shutoff solenoid - PTO indicator - Front wheel drive indicator - Air cleaner restriction indicator - Fuel Sedimenter restriction indicator - Thermostarter circuit - Auxiliary tank fuel reserve circuit (°).
Position 2 30-15/54-50    57-58/57	Lighting switch - Fuel gauge - Water temp. gauge - Battery charge indicator - Low engine oil pressure indicator - Turn signal lights and indicators - Parking brake indicator - Tractor and trailer stop lights - Cigar lighter - Horn - Low brake fluid indicator - Engine shutoff solenoid - PTO indicator - Front wheel drive indicator - Air cleaner restriction - Fuel sedimenter restriction indicator - Thermostarter circuit - Auxiliary tank fuel reserve circuit (°) - Starter.
Position 3 30-57	Front R.H. and rear L.H. parking lights - Front L.H. and rear R.H. parking light - Parking lights indicator - Instrument panel lights - Cigar lighter light - Floodlight switch enabling.

(●) Key removable - (°) Only 90-90 and 100-90.

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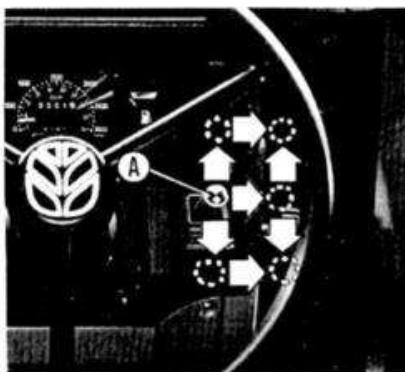
**LIGHTING SWITCH (Integral Horn Push)**

4 - position type,		
Positions	CIRCUITS COMPLETED	
Position 0 V-T                      D-H		
Position 1 V-L                      D-I	Front R.H. and rear L.H. parking lights-Front L.H. and rear R.H. parking lights - Instrument panel light - Parking lights indicator - Floodlight switch enabling	
Position 2 L-G                      I-U	Front R.H. and rear L.H. parking lights-Front L.H. and rear R.H. parking lights - Instrument panel light - Parking lights indicator - Flood light switch enabling - Low/high beam switch enabling.	

**FLOODLIGHT SWITCH**

3 position type.		
Positions	Circuit completed	
Position 0 V-T                      D-H	Off.	
Position 1 V-L                      D-I	Cab rear floodlights - Rear floodlight and indicator.	
Position 2 L-G                      I-U	Cab rear floodlights - Rear floodlight and indicator - Cab front floodlights.	

**CONTROLS AND INSTRUMENTS**



**Control board**

A. Lighting switch and horn push - B. Starter switch - C. Single-conductor power point - D. Cigar lighter - E. Hazard warning switch with indicator - F. Fuse box.

## CONTROLS AND INSTRUMENTS

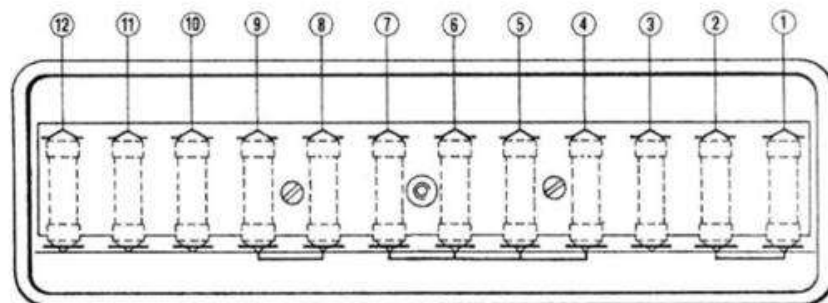


**Instrument panel.**

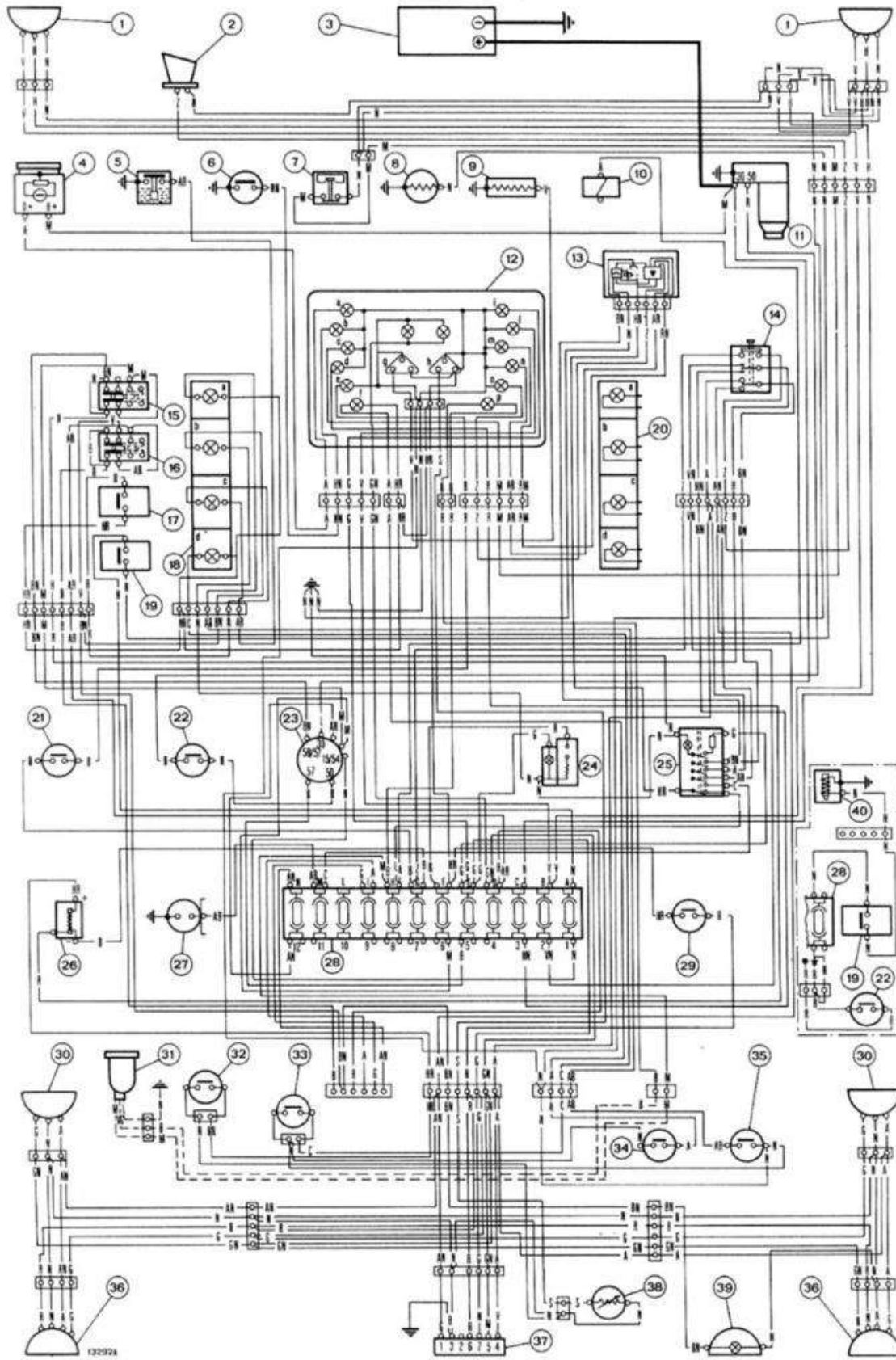
1. Battery charge indicator (red) - 2. Low engine oil pressure indicator (red) - 3. Air cleaner restriction indicator (red) - 4. Parking brake flashing indicator (red) - 5. Low brake fluid indicator (red) - 6. Water temperature gauge - 7. PTO indicator (yellow) - 8. Tractor meter - 9. Fuel gauge - 10. Fuel sedimenter restriction indicator (red) - 11. Parking light indicator (green) - 12. High beam indicator (blue) - 13. Tractor turn signal indicator (green) - 14. 1st trailer turn signal indicator (green) - 15. 2nd trailer turn signal indicator (green) - 16. Lighting switch - 17. Floodlight switch - 18. Engine oil level check pushbutton - 19. Thermostat or start-pilot switch - 20. Differential lock indicator (yellow) - 21. Floodlight indicator (yellow) - 22. Engine oil level indicator - (green) - 23. Front wheel drive indicator (yellow) - 24. Spare - 25. Spare - 26. Auxiliary fuel tank reserve indicator (yellow, 90-90 and 100-90 only) - 27. Spare - 28. Lighting switch and horn push.

**Fuse Unit.**

(For references see pages 16 and 17)







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**WIRING DIAGRAM (Early models 55-90, 60-90, 70-90, 80-90)**

*NOTA - Detail shows installation of start-pilot device 40 which cannot be fitted together with thermostarter.*

★ To starter connection 50.

● To starter switch connection 50.

1. Headlamps.
2. Horn.
3. Battery.
4. Alternator.
5. Low engine oil level sending unit.
6. Low engine oil pressure sending unit.
7. Air cleaner restriction sending unit.
8. Thermostarter.
9. Water temperature gauge sending unit.
10. Engine shutoff solenoid.
11. Starter.
12. Multiple gauge:
  - a. Battery charge indicator;
  - b. Low engine oil pressure indicator;
  - c. Air cleaner restriction indicator;
  - d. Parking brake indicator;
  - e. Brake fluid level indicator;
  - f. PTO indicator;
  - g. Water temperature gauge;
  - h. Fuel gauge;
  - i. Parking light indicator.
  - l. High beam indicator;
  - m. Tractor turn signal indicator;
  - n. 1st trailer turn signal indicator;
  - o. 2nd trailer turn signal indicator;
  - p. Fuel sedimenter restriction indicator (optional).
13. Hazard warning light and indicator.
14. Lighting switch and horn button.
15. Lighting switch.
16. Floodlight switch.
17. Engine oil level check pushbutton.
18. Indicator cluster (L.H.):
  - a. Differential lock;
  - b. Floodlight;
  - c. Engine oil level;
  - d. Front wheel drive.
19. Thermostarter or start pilot switch.
20. Indicator cluster (R.H.):
  - a. Spare;
  - b. Spare;
  - c. Spare;
  - d. Spare.
21. Low brake fluid sending unit.
22. Starter inhibitor switch.
23. Starter switch.
24. Cigar lighter.
25. Hazard warning light switch with indicator.
26. Parking brake flasher.
27. Single-conductor power point.
28. Fuse box.
29. Stop light switch.
30. Front parking lights and turn signals.
31. Fuel sediment filter.
32. Parking brake indicator sending unit.
33. Front wheel drive indicator sending unit.
34. PTO indicator sending unit.
35. Differential lock indicator sending unit.
36. Rear parking, turn signal and stop lights.
37. Seven-conductor power point.
38. Tank unit.
39. Rear floodlight.
40. Start-pilot (optional instead of thermostarter).

**CABLE COLOUR CODE**

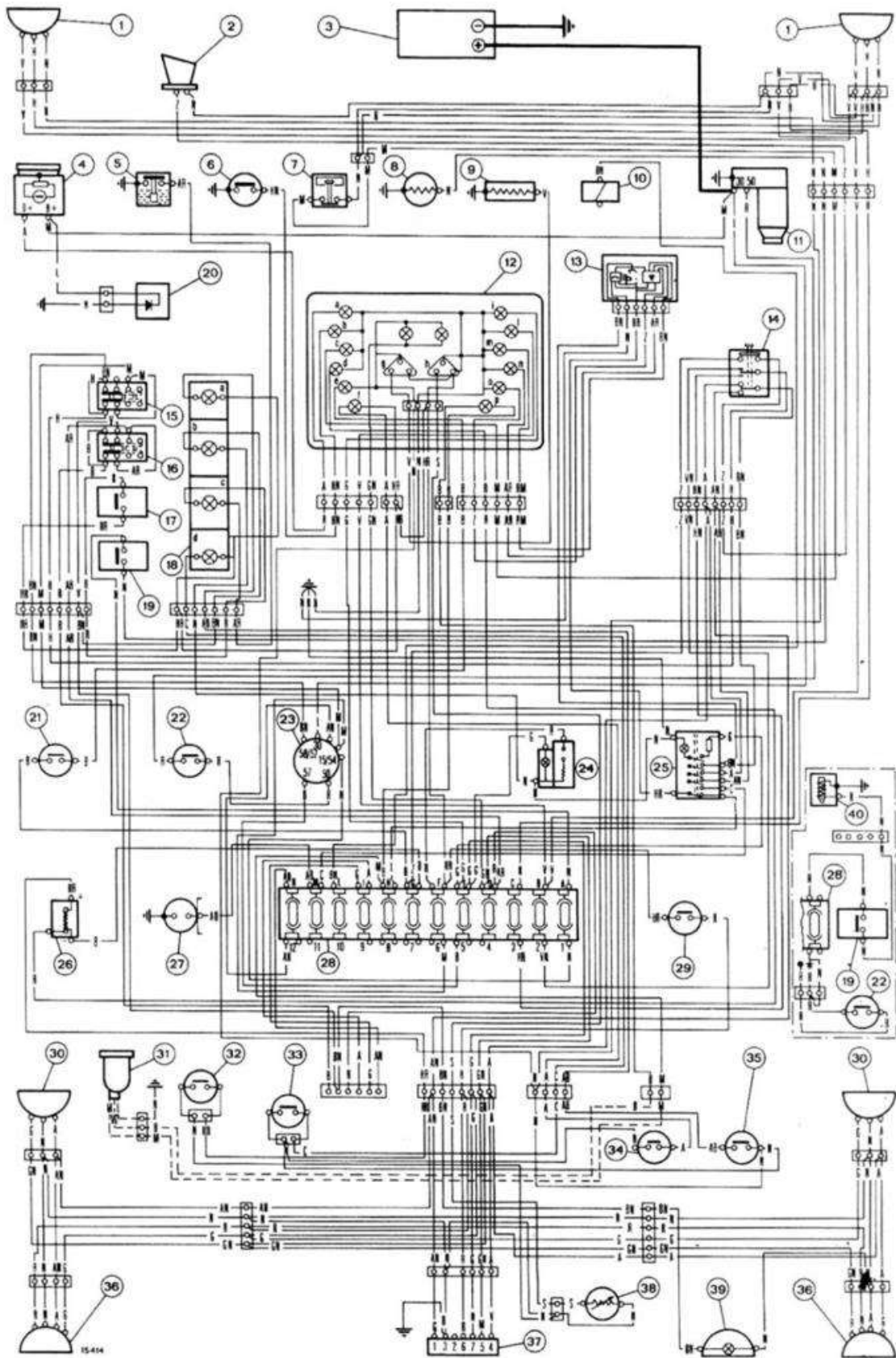
<b>A</b> = Light blue	<b>H</b> = Grey	<b>R</b> = Red
<b>B</b> = White	<b>L</b> = Dark blue	<b>S</b> = Pink
<b>C</b> = Orange	<b>M</b> = Brown	<b>V</b> = Green
<b>G</b> = Yellow	<b>N</b> = Black	<b>Z</b> = Mauve







# ELECTRICAL SYSTEM: Specification and Data



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**WIRING DIAGRAM (Late models 55-90, 60-90, 70-90 and 80-90)**

*NOTA - Detail shows installation of start-pilot device 40 which cannot be fitted together with thermostarter.*

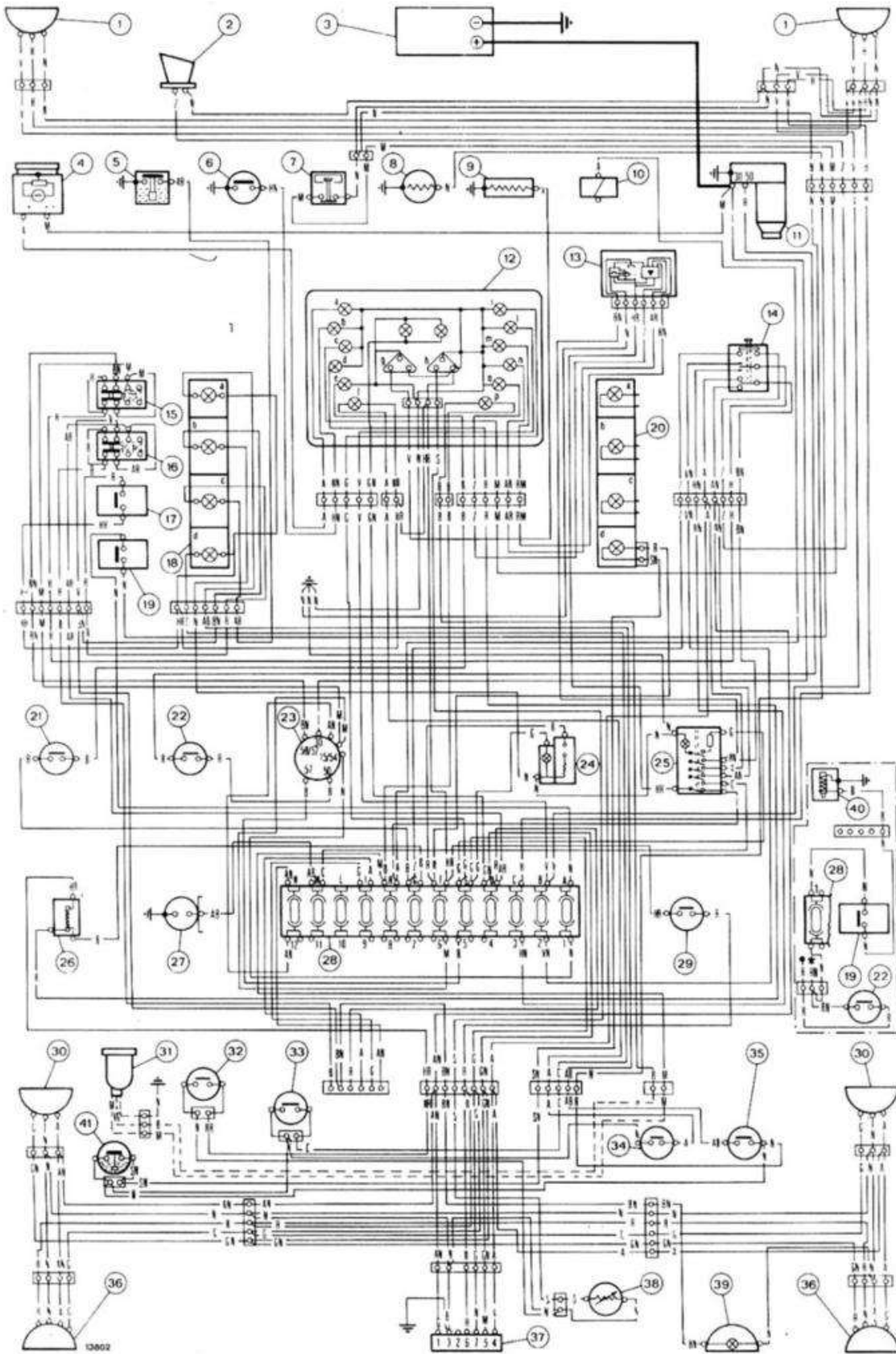
- ★ To starter connection 50.
- To starter switch connection 50.
- 1. Headlamps.
- 2. Horn.
- 3. Battery.
- 4. Alternator.
- 5. Low engine oil level sending unit.
- 6. Low engine oil pressure sending unit.
- 7. Air cleaner restriction sending unit.
- 8. Thermostarter.
- 9. Water temperature gauge sending unit.
- 10. Engine shutoff solenoid.
- 11. Starter.
- 12. Multiple gauge:
  - a. Battery charge indicator;
  - b. Low engine oil pressure indicator;
  - c. Air cleaner restriction indicator;
  - d. Parking brake indicator;
  - e. Brake fluid level indicator;
  - f. PTO indicator;
  - g. Water temperature gauge;
  - h. Fuel gauge;
  - i. Parking light indicator;
  - l. High beam indicator;
  - m. Tractor turn signal indicator;
  - n. 1st trailer turn signal indicator;
  - o. 2nd trailer turn signal indicator;
  - p. Fuel sediment restriction indicator (optional).
- 13. Hazard warning light and indicator.
- 14. Lighting switch and horn button.
- 15. Lighting switch.
- 16. Floodlight switch.
- 17. Engine oil level check pushbutton.
- 18. Indicator cluster (L.H.);
  - a. Differential lock;
  - b. Floodlight;
  - c. Engine oil level;
  - d. Front wheel drive.
- 19. Thermostarter or start pilot switch.
- 20. Voltage peak protection.
- 21. Low brake fluid sending unit.
- 22. Starter inhibitor switch.
- 23. Starter switch.
- 24. Cigar lighter.
- 25. Hazard warning light switch with indicator.
- 26. Parking brake flasher.
- 27. Single-conductor power point.
- 28. Fuse box.
- 29. Stop light switch.
- 30. Front parking lights and turn signals.
- 31. Fuel sediment filter.
- 32. Parking brake indicator sending unit.
- 33. Front wheel drive indicator sending unit.
- 34. PTO indicator sending unit.
- 35. Differential lock indicator sending unit.
- 36. Rear parking, turn signal and stop lights.
- 37. Seven-conductor power point.
- 38. Tank unit.
- 39. Rear floodlight.
- 40. Start-pilot (optional instead of thermostarter).

**CABLE COLOUR CODE**

<b>A</b> = Light blue	<b>H</b> = Grey	<b>R</b> = Red
<b>B</b> = White	<b>L</b> = Dark blue	<b>S</b> = Pink
<b>C</b> = Orange	<b>M</b> = Brown	<b>V</b> = Green
<b>G</b> = Yellow	<b>N</b> = Black	<b>Z</b> = Mauve







## WIRING DIAGRAM (Early models 90-90 and 100-90)

*NOTA - Detail shows installation of start-pilot device 40 which cannot be fitted together with thermostarter.*

- ★ To starter connection 50.
- To starter switch connection 50.
- 1. Headlamps
- 2. Horn
- 3. Battery
- 4. Alternator
- 5. Low engine oil level sending unit.
- 6. Low engine oil pressure sending unit.
- 7. Air cleaner restriction sending unit
- 8. Thermostarter.
- 9. Water temperature gauge sending unit.
- 10. Engine shutoff solenoid
- 11. Starter
- 12. Multiple gauge
  - a. Battery charge indicator;
  - b. Low engine oil pressure indicator;
  - c. Air cleaner restriction indicator;
  - d. Parking brake indicator;
  - e. Brake fluid level indicator;
  - f. PTO indicator;
  - g. Water temperature gauge;
  - h. Fuel gauge;
  - i. Parking light indicator;
  - l. High beam indicator;
  - m. Tractor turn signal indicator;
  - n. 1st trailer turn signal indicator;
  - o. 2nd trailer turn signal indicator;
  - p. Fuel sedimenter restriction indicator (optional).
- 13. Hazard warning light and indicator
- 14. Lighting switch and horn button.
- 15. Lighting switch
- 16. Floodlight switch
- 17. Engine oil level check pushbutton.
- 18. Indicator cluster (L.H.):
  - a. Differential lock;
  - b. Floodlight;
  - c. Engine oil lever;
  - d. Front wheel drive.
- 19. Thermostarter or start pilot switch.
- 20. Indicator cluster (R.H.):
  - a. Spare;
  - b. Spare;
  - c. Spare;
  - d. Auxiliary fuel tank reserve.
- 21. Low brake fluid sending unit
- 22. Starter inhibitor switch.
- 23. Starter switch
- 24. Cigar lighter
- 25. Hazard warning light switch with indicator.
- 26. Parking brake flasher.
- 27. Single-conductor power point.
- 28. Fuse box.
- 29. Stop light switch
- 30. Front parking lights and turn signals
- 31. Fuel sediment filter.
- 32. Parking brake indicator sending unit
- 33. Front wheel drive indicator sending unit
- 34. PTO indicator sending unit.
- 35. Differential lock indicator sending unit
- 36. Rear parking, turn signal and stop lights
- 37. Seven-conductor power point.
- 38. Tank unit
- 39. Rear floodlight
- 40. Start-pilot (optional instead of thermostarter)
- 41. Auxiliary Fuel Tank reserve indicator sending unit

### CABLE COLOUR CODE

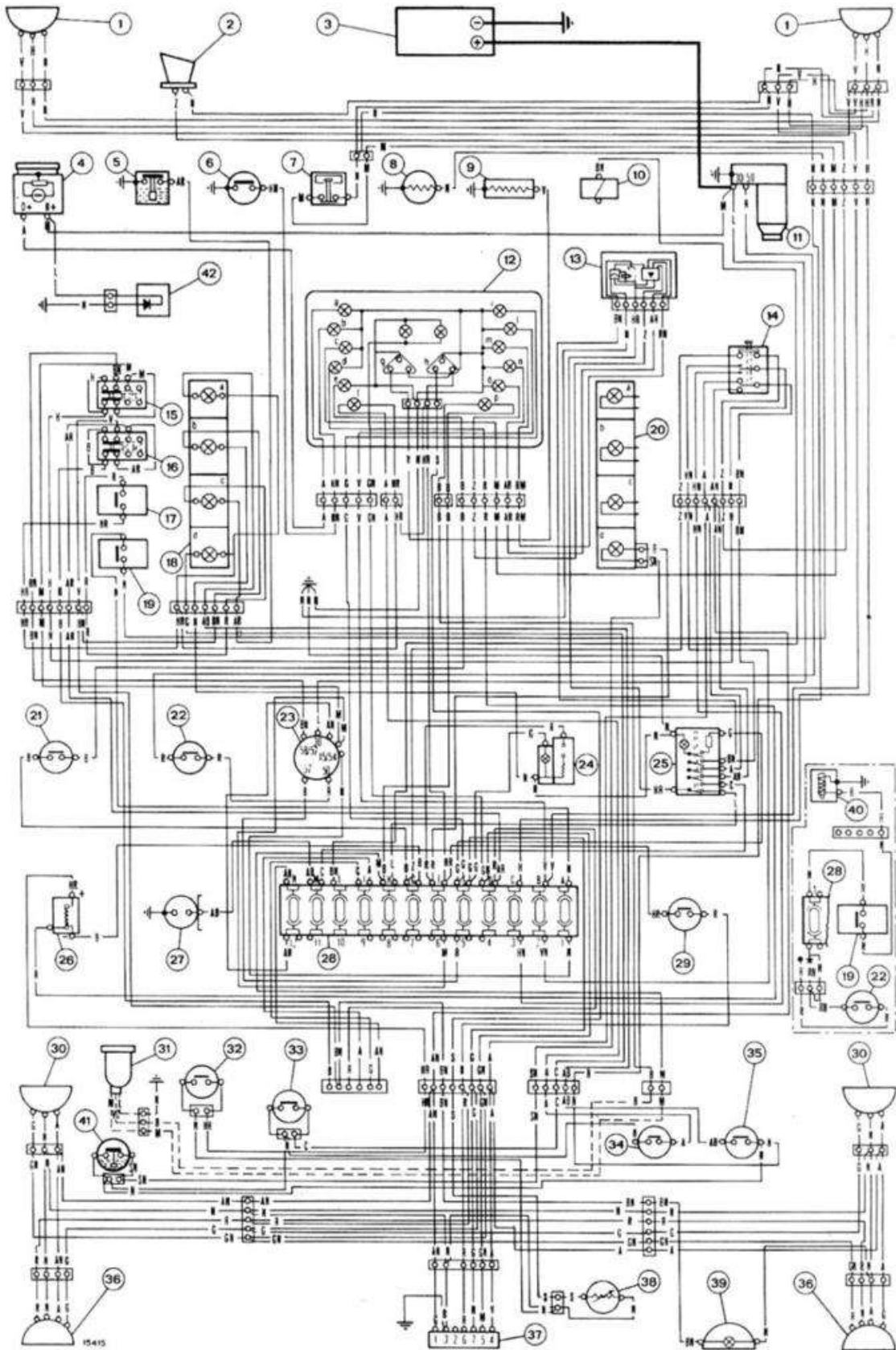
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# ELECTRICAL SYSTEM: Specification and Data



### WIRING DIAGRAM (Late models 90-90 and 100-90)

**NOTA** - Detail shows installation of start-pilot device 40 which cannot be fitted together with thermostarter.

- ★ To starter connection 50.
- To starter switch connection 50.

1. Headlamps.
2. Horn.
3. Battery.
4. Alternator.
5. Low engine oil level sending unit.
6. Low engine oil pressure sending unit.
7. Air cleaner restriction sending unit.
8. Thermostarter.
9. Water temperature gauge sending unit.
10. Engine shutoff solenoid.
11. Starter.
12. Multiple gauge:
  - a. Battery charge indicator;
  - b. Low engine oil pressure indicator;
  - c. Air cleaner restriction indicator;
  - d. Parking brake indicator;
  - e. Brake fluid level indicator;
  - f. PTO indicator;
  - g. Water temperature gauge;
  - h. Fuel gauge;
  - i. Parking light indicator;
  - l. High beam indicator;
  - m. Tractor turn signal indicator;
  - n. 1st trailer turn signal indicator;
  - o. 2nd trailer turn signal indicator;
  - p. Fuel sedimenter restriction indicator (optional)
13. Hazard warning light and indicator.
14. Lighting switch and horn button;
15. Lighting switch.
16. Floodlight switch.
17. Engine oil level check pushbutton.
18. Indicator cluster (L.H.):
  - a. Differential lock;
  - b. Floodlight;
  - c. Engine oil level;
  - d. Front wheel drive
19. Thermostarter or start-pilot switch
20. Indicator cluster (R.H.):
  - a. Spare;
  - b. Spare;
  - c. Spare;
  - d. Auxiliary fuel tank reserve.
21. Low brake fluid sending unit
22. Starter inhibitor switch.
23. Starter switch.
24. Cigar lighter.
25. Hazard warning light switch with indicator
26. Parking brake flasher.
27. Single-conductor power point.
28. Fuse box.
29. Stop light switch.
30. Front parking lights and turn signals
31. Fuel sediment filter.
32. Parking brake indicator sending unit.
33. Front wheel drive indicator sending unit.
34. PTO indicator sending unit.
35. Differential lock indicator sending unit
36. Rear parking, turn signal and stop lights
37. Seven-conductor power point
38. Tank unit.
39. Rear floodlight.
40. Start-pilot (optional instead of thermostarter).
41. Auxiliary fuel tank reserve indicator sending unit.
42. Voltage peak protection.

#### CABLE COLOUR CODE

A = Light blue	H = Grey	R = Red
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C = Red	M = Brown	V = Green
G = Yellow	N = Black	Z = Mauve