ELECTRICAL SYSTEM GROUP

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ELECTRICAL SPECIFICATIONS
R-110 THROUGH RF-210
(NOT RA-120, RA-140)

ENGINE MODELS	SD-220 SD-240	BD-269 BD-282	RD-372 RD-406 RD-450
GENERATOR (Delco-Remy)	DR-1100019	DR-1102785	DR-1102785
Field current (at 6 volts) amperes	1.85-2.03	1.90-2.05	1.90-2.05
Cold output: - Amperes. . . . . Volts . . . . R.P.M.	 35 8 2650	 45 8 2450	 45 8 2450
Hot output: - Amperes, Volts, R.P.M. { Controlled by current regulator }	. . . .	. . . .	. . . .
Regulation.	volt. and current	volt. and current	volt. and current
Brush tension (ounces)	28	28	28
Bearing - commutator end	bronze	bronze	bronze
Bearing - drive end	ball	ball	ball
Rotation (viewed from drive end).	CW	CW	CW
Type of drive.	belt	belt	belt

ELECTRICAL SPECIFICATIONS
RA-120, RA-140

ENGINE MODEL	SD-220
GENERATOR (LOW SPEED CUT-IN) (Delco-Remy)	DR-1105876
Field current (at 6 volts) amperes	1.62-1.82
Cold output: -	
Amperes	25
Volts	8.0
Hot output: -	
Amperes — Controlled by current regulator	
Volts — Controlled by current regulator	
R.p.m. — Controlled by current regulator	
Regulation	
Brush tension (ounces)	28
Bearing - commutator end	ball
Bearing - drive end	ball
Rotation (viewed from drive end)	CW
Type of drive	belt

ELECTRICAL SPECIFICATIONS
R-110 THRU RF-210
(NOT RA-120, RA-140)

ENGINE MODELS	SD-220 SD-240	BD-269 BD-282	RD-372 RD-406 RD-450
VOLTAGE REGULATOR (Delco-Remy)	DR-1118731	DR-1118732	DR-1118732
Amps	35	45	45
Type	vibrating	vibrating	vibrating
Current regulator: - *Current setting-amps. (hot) . . Air gap.	 38 .075"	 47 .075"	 47 .075"
Voltage regulator: - *Voltage setting-volts. (hot). . . Air gap.	 7.4 .075"	 7.4 .075"	 7.4 .075"
Cutout relay: - *Closing voltage-volts. (hot) . . Air gap. . . . . Point opening.	 6.4 .020" .020"	 6.4 .020" .020"	 6.4 .020" .020"

ENGINE MODEL	SD-220 (RA-120, RA-140)
VOLTAGE REGULATOR-25 AMP. LOW SPEED CUT-IN (Delco-Remy)	DR-1118350
Type	vibrating
Current regulator: - *Current setting-amps. (hot) . . Air gap.	 25 .075"
Voltage regulator: - *Voltage setting-volts (hot) . . . Air gap.	 7.2 .075"
Cutout relay: - *Closing voltage-volts (hot) . . . Air gap. . . . . Point opening.	 6.4 .020" .020"

* Current and voltage specifications apply only at operating temperature. Operating temperature shall be assumed to exist after not less than 15 minutes of continuous operation with a charge rate of 8-10 amperes.

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ELECTRICAL SPECIFICATIONS
R-170 and RF-170 Series, R-180 thru 184, RC-180, 181, 182

ENGINE MODEL	BD-282
STARTING MOTOR (Delco-Remy)	DR-1108009
Voltage.	6
Number of field coils	4
Bearing - commutator end.	cast iron
Bearing - center	bronze
Bearing - drive end	bronze
Brush tension (ounces)	24-28
No-load test (with Solenoid or Magnetic Switch): -	
Maximum amperes	70
Volts	5.65
R.p.m. approx	5500
Lock test: -	
Maximum amperes	570
Volts	3.15
Torque (lb. ft.) (min.)	13.5
Rotation (viewed from drive end).	CW

ENGINE MODEL	BD-282
DISTRIBUTOR (Delco-Remy)	DR-1112359
Initial setting (engine degrees)	6^{o} B.T.C.

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
COIL (Delco-Remy)	DR-1115327	DR-1115327	DR-1115327	DR-1115327	DR-1115327	DR-1115327	DR-1115251
DISTRIBUTOR	DR-1112355	DR-1112355	DR-1112359	DR-1112357	DR-1112357	DR-1112357	
Type	vac. auto	vac. auto	automatic	automatic	automatic	automatic	automatic
Cam angle	31°-37°	31°-37°	35°	35°	35°	35°	
Initial setting (engine degrees)	2° BTC	2° BTC	3° BTC	5° BTC	5° BTC	5° BTC	
Vacuum advance (engine degrees)	15°	15°	none	none	none	none	
Automatic advance (engine degrees)	30°	30°	27°	22°	22°	22°	
Total advance (engine degrees)	32°	32°	30°	27°	27°	27°	
Retard (engine degrees)	selective 20°	selective 20°	none none	none none	none none	none none	
Contact point setting	.022"	.022"	.018-.024	.018-.024	.018-.024	.018-.024	
Contact point pressure (ounces)	17-21	17-21	17-21	17-21	17-21	17-21	
Rotation (viewed from top)	CCW	CCW	CW	CW	CW	CW	CCW
Firing order	153624	153624	153624	153624	153624	153624	
*DISTRIBUTOR TEST DATA							
Start advance:-							
Engine r.p.m.	500	500	400	500	500	500	
Engine degrees	2°	2°	1.5°	1.5°	1.5°	1.5°	
Intermediate advance:-							
Engine r.p.m.	1800	1800	1800	1400	1400	1400	
Engine degrees	20°	20°	20°	13°	13°	13°	
Macimum advance:-							
Engine r.p.m.	3000	3000	2700	**3200	**3200	**3200	
Engine degrees	30°	30°	27°	22°	22°	22°	
Distributor vacuum control (Delco-Remy)	DR-1116049	DR-1116049	.....	.....	.....	.....	.....

* Distributor Test Stand figures will be one-half of these specifications.

** Test Stand r.p.m. only. For maximum engine r.p.m. see "Engine Section."

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
GENERATOR-50 AMP. (Delco-Remy)	DR-1106757	DR-1106757	DR-1106757	DR-1106757	DR-1106757	DR-1106757	DR-1106822
Field current (at 6 volts) amperes	1.70-1.95	1.70-1.95	1.70-1.95	1.70-1.95	1.70-1.95	1.70-1.95	
Cold output:-							
Amperes................	50	50	50	50	50	50	50
Volts	7.5	7.5	7.5	7.5	7.5	7.5	7.5
R.p.m.	1410	1410	1410	1410	1410	1410	
Hot output:-							
Amperes } Controlled	.....	.....	.....	.....	.....	.....	.....
Volts } by current	.....	.....	.....	.....	.....	.....	.....
R.p.m. } regulator	.....	.....	.....	.....	.....	.....	.....
Regulation.	volt. and current	volt. and current	volt. and current	volt. and current	volt. and current	volt. and current	volt. and current
Brush tension (ounces)	25	25	25	25	25	25	
Bearing - commutator end.....	ball	ball	ball	ball	ball	ball	
Bearing - drive end	ball	ball	ball	ball	ball	ball	
Rotation (viewed from drive-end).	CW	CW	CW	CW	CW	CW	
Type of drive.	belt	belt	belt	belt	belt	belt	belt
GENERATOR (LOW SPEED CUT-IN) (Delco-Remy).	DR-1106758	DR-1106758	.....	.....	.....	.....	.....
Field current (at 6 volts) amperes	1.70-1.95	1.70-1.95	.....	.....	.....	.....	.....
Cold output:-							
Amperes................	40	40	.....	.....	.....	.....	.....
Volts	7.5	7.5	.....	.....	.....	.....	.....
R.p.m.	1165	1165	.....	.....	.....	.....	.....
Hot output:-							
Amperes } Controlled	.....	.....	.....	.....	.....	.....	.....
Volts } by current	.....	.....	.....	.....	.....	.....	.....
R.p.m. } regulator	.....	.....	.....	.....	.....	.....	.....
Regulation.	volt. and current	volt. and current	.....	.....	.....	.....	.....
Brush tension (ounces)	20	20	.....	.....	.....	.....	.....
Bearing - commutator end.....	ball	ball	.....	.....	.....	.....	.....
Bearing - drive end	ball	ball	.....	.....	.....	.....	.....
Rotation (viewed from drive end).	CW	CW	.....	.....	.....	.....	.....
Type of drive.	belt	belt	.....	.....	.....	.....	.....

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
GENERATOR-30 AMP. (Delco-Remy)	DR-1102714	DR-1102714	DR-1102714	DR-1102714	DR-1102714	DR-1102714	.....
Field current (at 6 volts) amperes	1.75-1.90	1.75-1.90	1.75-1.90	1.75-1.90	1.75-1.90	1.75-1.90	.....
Cold output:-							
Amperes	30	30	30	30	30	30	.....
Volts	8	8	8	8	8	8	.....
R.p.m.	1750	1750	1750	1750	1750	1750	.....
Hot output:-							
Amperes (Controlled by current regulator)	.....	.....	.....	.....	.....	.....	.....
Volts (Controlled by current regulator)	.....	.....	.....	.....	.....	.....	.....
R.p.m. (Controlled by current regulator)	.....	.....	.....	.....	.....	.....	.....
Regulation	volt. and current	volt. and current	volt. and current	volt. and current	volt. and current	volt. and current	.....
Brush tension (ounces)	24-28	24-28	24-28	24-28	24-28	24-28	.....
Bearing - commutator end	bronze	bronze	bronze	bronze	bronze	bronze	.....
Bearing - drive end	ball	ball	ball	ball	ball	ball	.....
Rotation (viewed from drive end)	CW	CW	CW	CW	CW	CW	.....
Type of drive	belt	belt	belt	belt	belt	belt	.....

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
VOLTAGE REGULATOR-30 AMP. (Delco-Remy)	DR-1118303	DR-1118303	DR-1118303	DR-1118303	DR-1118303	DR-1118303	.....
Type	vibrating	vibrating	vibrating	vibrating	vibrating	vibrating	.....
Current regulator:-							
*Current setting-amps. (hot)	30	30	30	30	30	30	.....
Air gap	.075"	.075"	.075"	.075"	.075"	.075"	.....
Voltage regulator:-							
*Voltage setting-volts (hot)	7.4	7.4	7.4	7.4	7.4	7.4	.....
Air gap	.075"	.075"	.075"	.075"	.075"	.075"	.....
Cutout relay:-							
*Closing voltage-volts (hot)	6.4	6.4	6.4	6.4	6.4	6.4	.....
Air gap	.020"	.020"	.020"	.020"	.020"	.020"	.....
Point opening	.020"	.020"	.020"	.020"	.020"	.020"	.....
VOLTAGE REGULATOR-50 AMP. HIGH OUTPUT (Delco-Remy)	DR-1118333	DR-1118333	DR-1118333	DR-1118333	DR-1118333	DR-1118333	DR-1118368
Type	vibrating	vibrating	vibrating	vibrating	vibrating	vibrating	vibrating
Current regulator:-							
*Current setting-amps. (hot)	50	50	50	50	50	50	50
Air gap	.082"	.082"	.082"	.082"	.082"	.082"	.075"
Voltage regulator:-							
*Voltage setting-volts (hot)	7.4	7.4	7.4	7.4	7.4	7.4	14.3
Air gap	.075"	.075"	.075"	.075"	.075"	.075"	.075"
Cutout relay:-							
*Closing voltage-volts (hot)	6.4	6.4	6.4	6.4	6.4	6.4	12.8
Air gap	.020"	.020"	.020"	.020"	.020"	.020"	.020"
Point opening	.020"	.020"	.020"	.020"	.020"	.020"	.020"
VOLTAGE REGULATOR-40 AMP. LOW SPEED CUTIN (Delco-Remy)	DR-1118366	DR-1118366	.....	.....	.....	.....	.....
Type	vibrating	vibrating	.....	.....	.....	.....	.....
Current regulator:-							
*Current setting-amps. (hot)	40	40	.....	.....	.....	.....	.....
Air gap	.075"	.075"	.....	.....	.....	.....	.....
Voltage regulator:-							
*Voltage setting-volts (hot)	7.4	7.4	.....	.....	.....	.....	.....
Air gap	.075"	.075"	.....	.....	.....	.....	.....
Cutout relay:-							
*Closing voltage-volts (hot)	6.4	6.4	.....	.....	.....	.....	.....
Air gap	.020"	.020"	.....	.....	.....	.....	.....
Point opening	.020"	.020"	.....	.....	.....	.....	.....

* Current and voltage specifications apply only at operating temperature. Operating temperature shall be assumed to exist after not less than 15 minutes of continuous operation with a charge rate of 8-10 amperes.

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
SPARK PLUGS							
"standard" heavy service — production: AC	44 Com	44 Com.	45 Com.	43 Com.	43 Com.	43 Com.	82 Com.
Champion	J-7	J-7	J-8	J-6	J-6	J-6	5 Com.
Auto-Lite	AN5	AN5	AN7	AN5	AN5	AN5	BT4
"hot" moderate service: AC	45 Com.	45 Com.	45 Com.	44 Com.	44 Com.	44 Com.	. . . . .
Champion	J-8	J-8	J-8	J-7	J-7	J-7	. . . . .
Auto-Lite	AN7	AN7	AN7	AN7	AN7	AN7	. . . . .
"standard" heavy service: AC	44 Com.	44 Com.	45 Com.	43 Com.	43 Com.	43 Com.	82 Com.
Champion	J-7	J-7	J-8	J-6	J-6	J-6	5 Com.
Auto-Lite	AN5	AN5	AN7	AN5	AN5	AN5	BT4
"cold" severe service: AC	43 Com.	43 Com.	44 Com.	43 Com.	43 Com.	43 Com.	. . . . .
Champion	J-6	J-6	J-7	J-6	J-6	J-6	. . . . .
Auto-Lite	AN5	AN5	AN5	AN5	AN5	AN5	. . . . .
Spark plug size	14 mm	14 mm	14 mm	14 mm	14 mm	14 mm	18 mm
Spark plug gap	.028-.032	.028-.032	.028-.032	.028-.032	.028-.032	.028-.032	.023-.027
STARTING MOTOR (Delco-Remy)	DR-1107074	DR-1107074	DR-1107967	DR-1108217	DR-1109004	DR-1109004	. . . . .
Voltage	6	6	6	6	6	6	12
Number of field coils	2	2	4	4	6	6	6
Bearing - commutator end	cast iron	cast iron	cast iron	cast iron	cast iron	cast iron	bronze
Bearing - center	. . . . .	. . . . .	. . . . .	cast iron	cast iron	cast iron	. . . . .
Bearing - drive end	bronze	bronze	bronze	bronze	bronze	bronze	bronze
Brush tension (ounces)	24-28	24-28	24-28	24-28	36-40	36-40	36-40
No-load test (with Solenoid or Magnetic Switch):-							
Maximum amperes	75	75	60	70	70	70	65
Volts	5.7	5.7	5.0	5.0	5.7	5.7	11.4
R.p.m. approx.	5000	5000	6000	3500	2200	2200	6000
Lock test:-							
Maximum amperes	525	525	600	600	600	600	725
Volts	3.4	3.4	3.0	3.0	3.0	3.0	5.0
Torque (lb.ft.)(min.)	12	12	15	22	35	35	44
Rotation (viewed from drive end)	CW	CW	CW	CW	CW	CW	CW
MAGNETIC SWITCH (Delco-Remy)	DR-1465	DR-1465	DR-1465	DR-1465	DR-1465	DR-1465	
Current consumption (at 6 volts)	5.7-7.0	5.7-7.0	5.7-7.0	5.7-7.0	5.7-7.0	5.7-7.0	

ELECTRICAL SPECIFICATIONS

ENGINE MODELS	SD-220	SD-240	BD-269	RD-372	RD-406	RD-450	Cont. R-6602
HEADLIGHT SEALED-BEAM UNIT (Guide)...........	924791	924791	924791	924791	924791	924791	5930856
IGNITION SWITCH (Delco-Remy).	1116465	1116465	1116465	1116465	1116465	1116465	1116465
LAMPS (BULBS)							
Stop and tail light bulb:-							
Voltage.................	6-8	6-8	6-8	6-8	6-8	6-8	12-16
Candle power.............	21-3	21-3	21-3	21-3	21-3	21-3	21-6
Contact.................	DC	DC	DC	DC	DC	DC	DC
Parking light bulb:-							
Voltage.................	6-8	6-8	6-8	6-8	6-8	6-8	12-16
Candle power.............	3	3	3	3	3	3	3
Contact.................	SC	SC	SC	SC	SC	SC	SC
Instrument light bulb:-							
Voltage.................	6-8	6-8	6-8	6-8	6-8	6-8	12-16
Candle power.............	2	2	2	2	2	2	1.5
Contact.................	SC	SC	SC	SC	SC	SC	SC
Beam Indicator bulb:-							
Voltage.................	6-8	6-8	6-8	6-8	6-8	6-8	12-16
Candle power.............	1	1	1	1	1	1	1
Contact.................	SC	SC	SC	SC	SC	SC	SC
STORAGE BATTERY							
Type (Auto-Lite)...........	2H-105	2H-105	2H-135R	4H-152R	4H-152R	4H-152R	4H-152R
Specific gravity:-							
Fully charged at...........	1.280-1.290	1.280-1.290	1.280-1.290	1.280-1.290	1.280-1.290	1.280-1.290	1.280-1.290
Recharge at.............	1.225	1.225	1.225	1.225	1.225	1.225	1.225
Voltage.................	6	6	6	6	6	6	6
Amperes hours at 20-hour rate..	105	105	135	152	152	152	152
Amperes-20 minute rate......	133	133	170	180	180	180	180
Terminal grounded..........	positive	positive	positive	positive	positive	positive	positive

Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to amm.
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ign. sw. to ign. coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12	H. B. feed
17	16	H. B. head lt. leads
17	16	H. B. indicator
18	14	L. B. feed
18	16	L. B. head lt. leads
20	16	Parking feed
20	18	Parking light leads
21	14x16	Tail light
22	14x16	Stop light
26	14	Horn to relay
26	12	Horn relay feed
27	16	Instrument feed
29	18	Fuel gauge
30	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
71	16	Wiper switch feed
80	16	Ignition coil to dist.
91	16	Head light ground
A	16	Nat. with cir. letter "A" or black (wiper)
B	4	Battery ground
D	12	Cab ground
E	1	Battery cable
F	16	Nat. with cir. letter "F" or red (wiper)
G	14	Instrument bus bar
H	16	Horn push button
P	16	Nat. with cir. letter "P" or green (wiper)

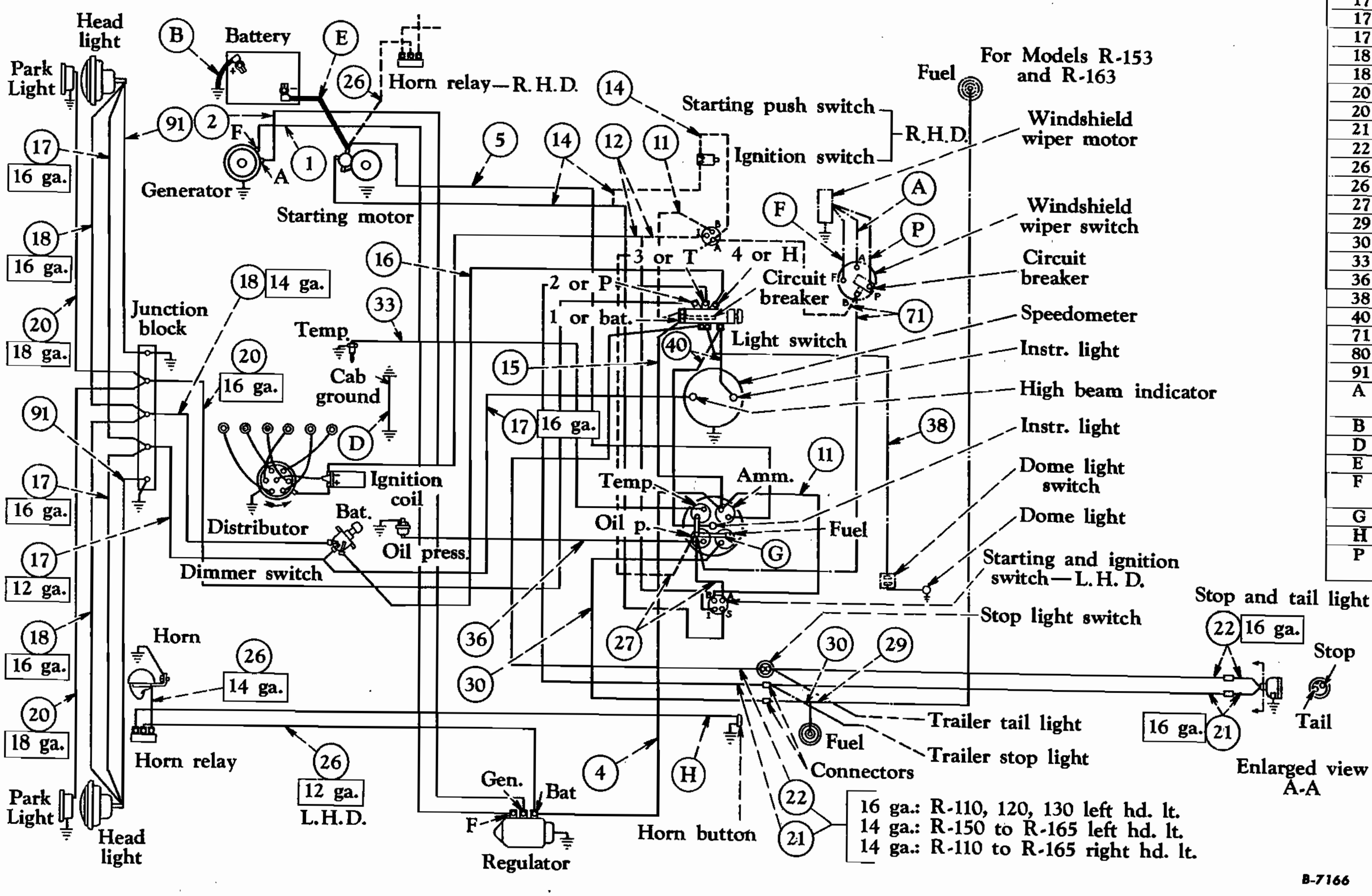

Fig. 1 - Wiring circuit diagram. (R-110, R-120, R-130, R-150, R-160 series trucks)

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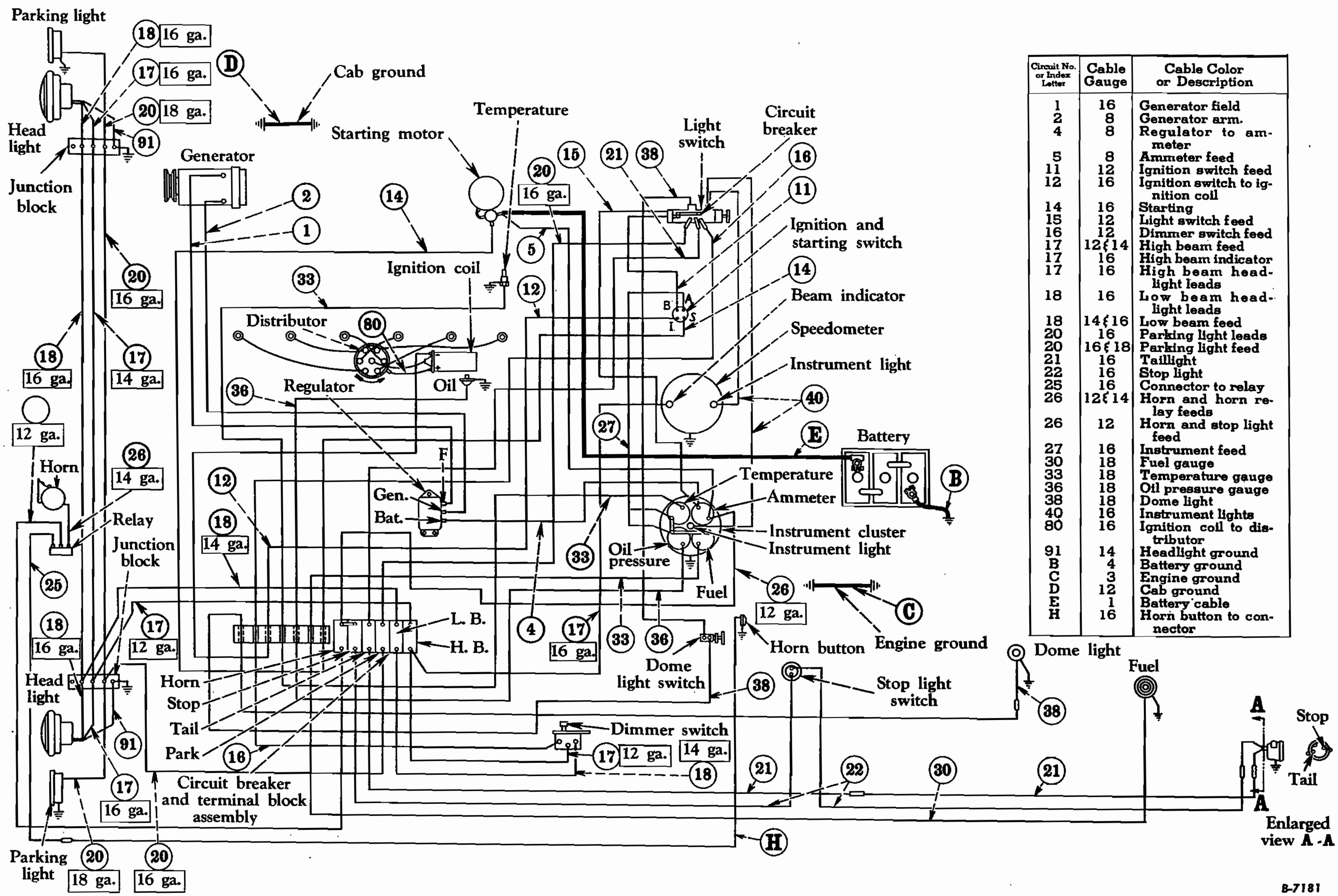

Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to ammeter
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ignition switch to ignition coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12 & 14	High beam feed
17	16	High beam indicator
17	16	High beam headlight leads
18	16	Low beam headlight leads
18	14 & 16	Low beam feed
20	16	Parking light leads
20	16 & 18	Parking light feed
21	16	Taillight
22	16	Stop light
25	16	Connector to relay
26	12 & 14	Horn and horn relay feeds
26	12	Horn and stop light feed
27	16	Instrument feed
30	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
80	16	Ignition coil to distributor
91	14	Headlight ground
B	4	Battery ground
C	3	Engine ground
D	12	Cab ground
E	1	Battery cable
H	16	Horn button to connector

Fig. 2 - Wiring circuit diagram. (RM-120, RM-150 series trucks)

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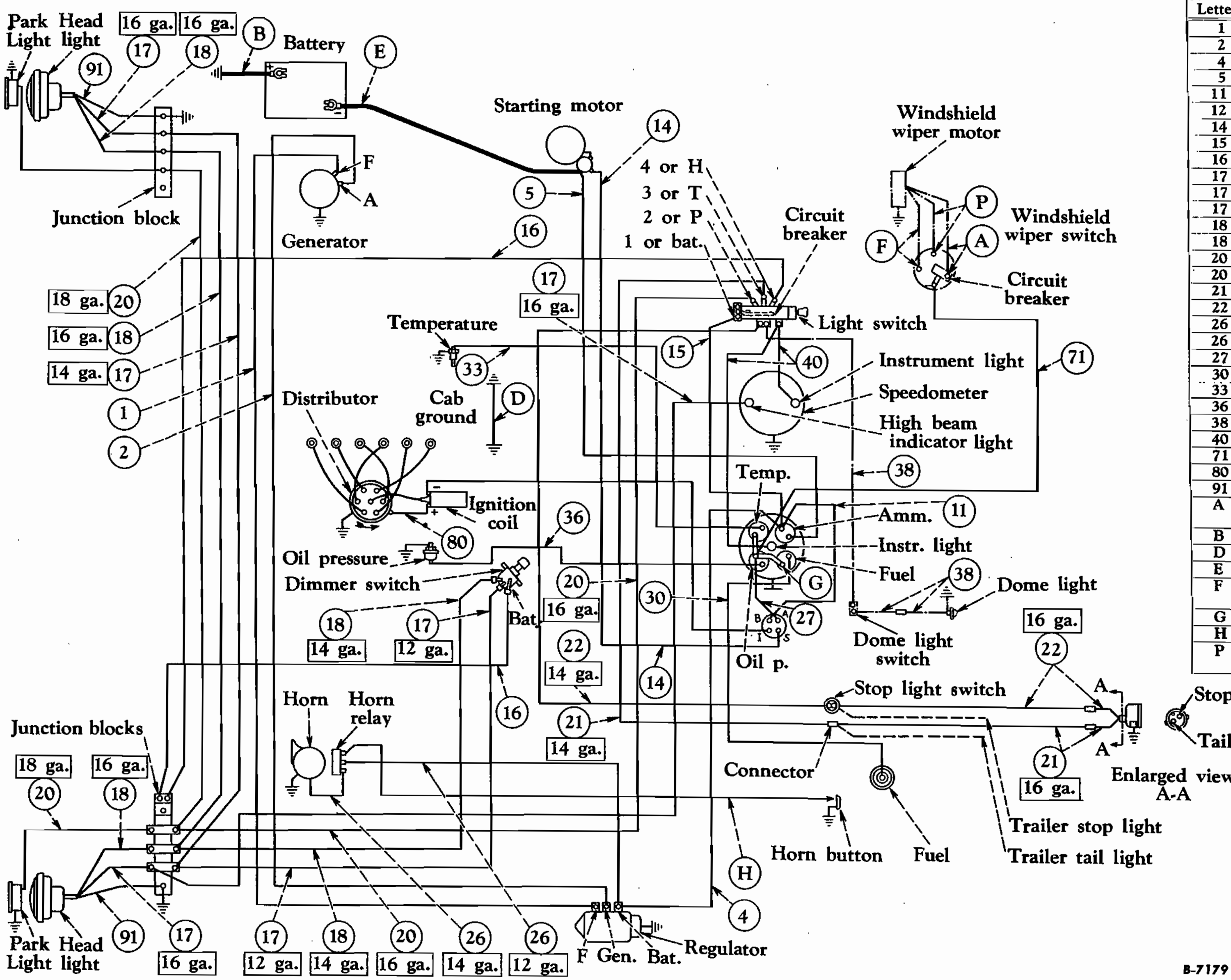


Fig. 3 - Wiring circuit diagram. (RC-160 series trucks)

Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to amm.
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ign. sw. to ign. coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12x14	H. B. feed
17	16	H. B. head lt. leads
17	16	H. B. indicator
18	14x16	L. B. feed
18	16	L. B. head lt. leads
20	16x18	Parking feed
20	18	Parking light leads
21	14x16	Tail light
22	14x16	Stop light
26	14	Horn lead
26	12	Horn relay feed
27	16	Instrument feed
30	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
71	16	Wiper switch feed
80	16	Ignition coil to dist.
91	16	Head light ground
A	16	Nat. with cir. letter "A" or black (wiper)
B	4	Battery ground
D	12	Cab ground
E	1	Battery cable
F	16	Nat. with cir. letter "F" or red (wiper)
G	14	Instrument bus bar
H	16	Horn push button
P	16	Nat. with cir. letter "P" or green (wiper)

Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to amm.
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ign. sw. to ign. coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12	H. B. feed
17	16	H. B. head lt. leads
17	16	H. B. indicator
18	14	L. B. feed
18	16	L. B. head lt. leads
20	16	Parking feed
20	18	Parking light leads
21	14x16	Tail light
22	14x16	Stop light
26	10or12	Horn & stop lt. feed
26	12x14	Horn and horn relay feeds
27	16	Instrument feed
29	18	Fuel gauge
30	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
71	16	Wiper switch feed
80	16	Ignition coil to dist.
91	16	Head light ground
A	16	Nat. with cir. letter "A" or black (wiper)
B	4	Battery ground
C	3	Engine ground
D	12	Cab ground
E	1	Battery cable
F	16	Nat. with cir. letter "F" or red (wiper)
G	14	Instrument bus bar
H	16	Horn push button
P	16	Nat. with cir. letter "P" or green (wiper)

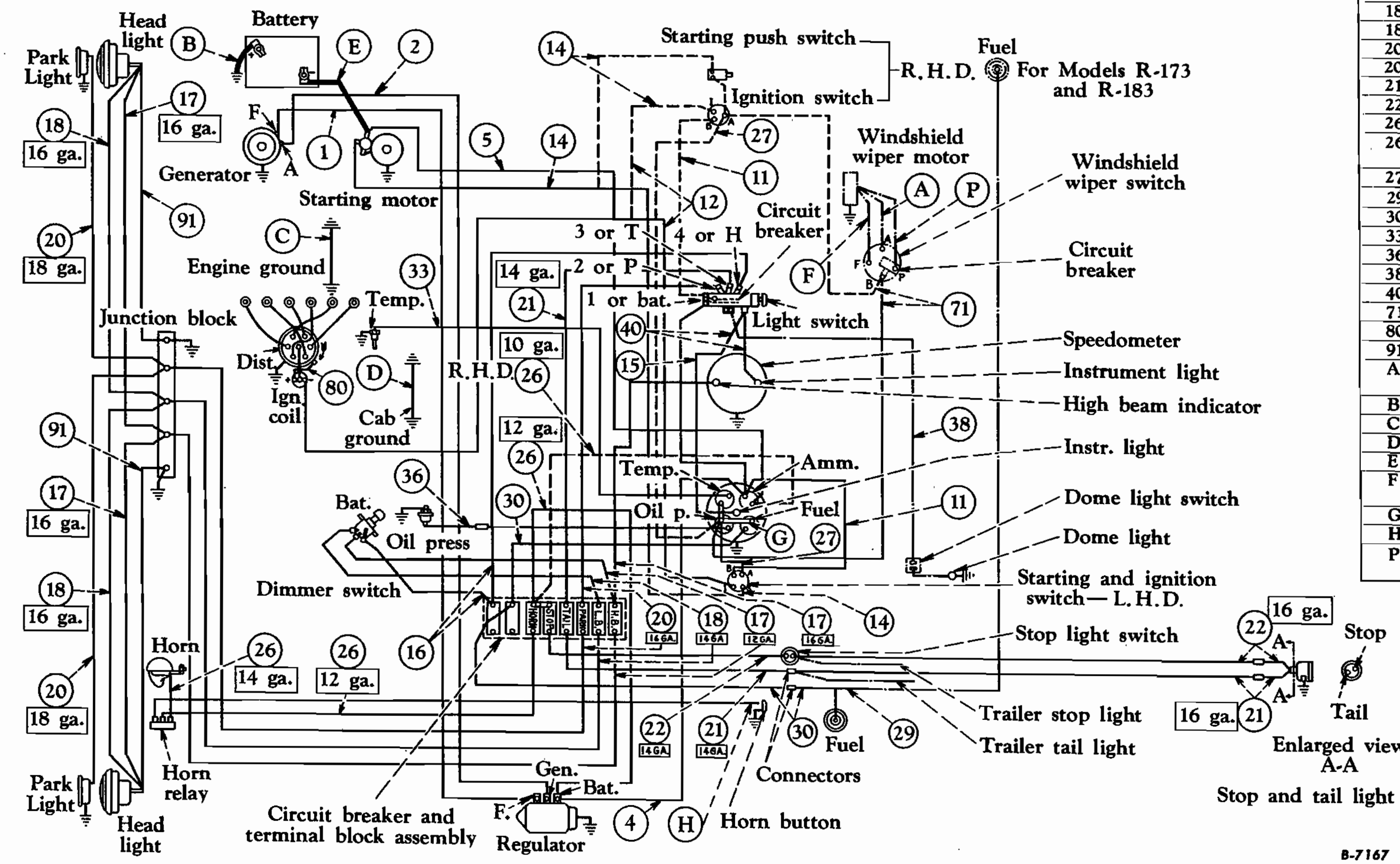
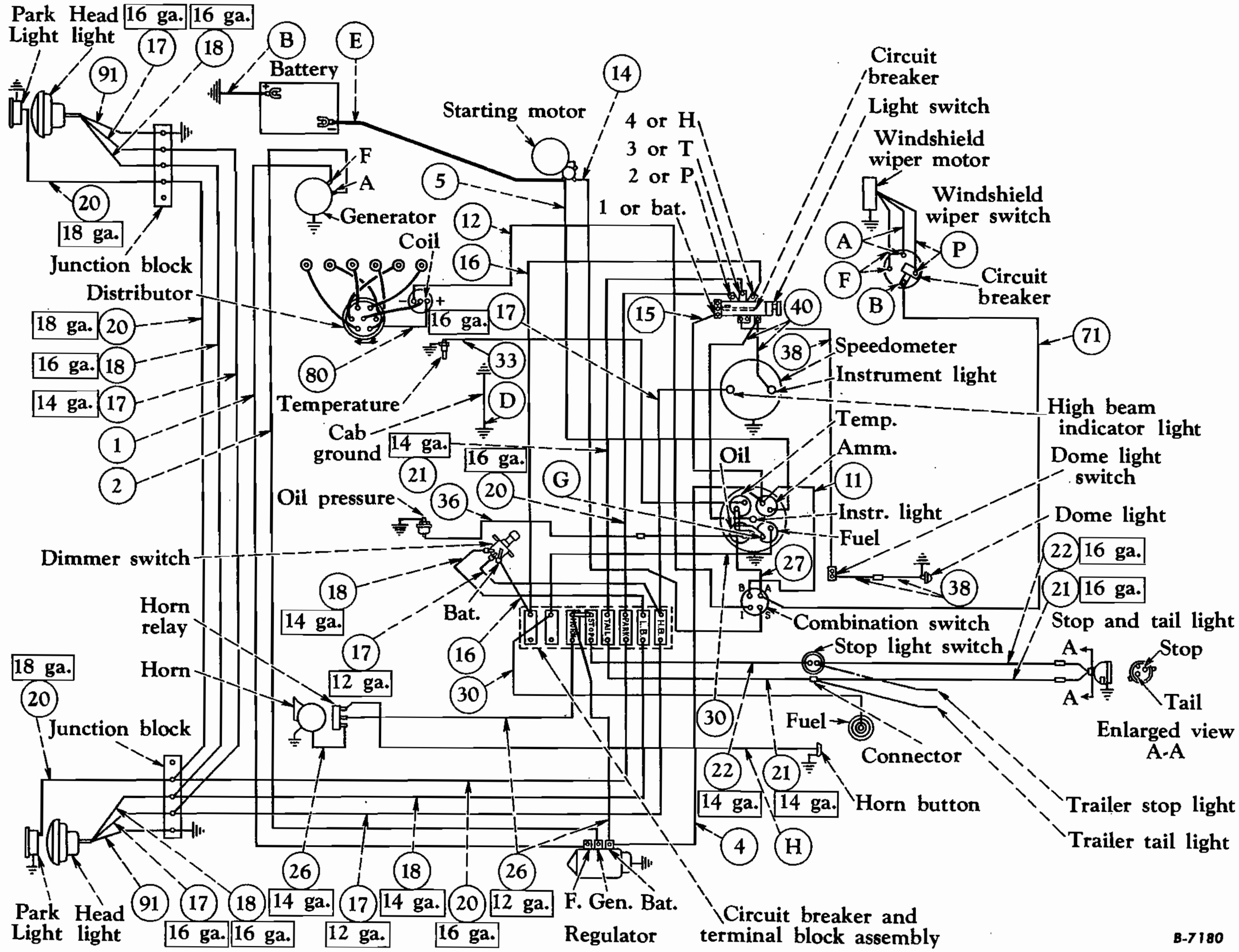


Fig. 4 - Wiring circuit diagram. (R-170, RF-170, R-180 series trucks-not R-185)



Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to amm.
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ign. sw. to ign. coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12x14	H. B. feed
17	16	H. B. head lt. leads
17	16	H. B. indicator
18	14x16	L. B. feed
18	16	L. B. head lt. leads
20	16x18	Parking feed
20	18	Parking light leads
21	14x16	Tail light
22	14x16	Stop light
26	12	Horn & stop lt. feed
26	12x14	Horn and horn relay feeds
27	16	Instrument feed
30	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
71	16	Wiper switch feed
80	16	Ignition coil to dist.
91	16	Head light ground
A	16	Nat. with cir. letter "A" or black (wiper)
B	4	Battery ground
D	12	Cab ground
E	1	Battery cable
F	16	Nat. with cir. letter "F" or red (wiper)
G	14	Instrument bus bar
H	16	Horn push button
P	16	Nat. with cir. letter "P" or green (wiper)

Fig. 5 - Wiring circuit diagram. (RC-180 series trucks)

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Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	16	Generator field
2	8	Generator arm.
4	8	Regulator to amm.
5	8	Ammeter feed
11	12	Ignition switch feed
12	16	Ign. sw. to ign. coil
14	16	Starting
15	12	Light switch feed
16	12	Dimmer switch feed
17	12x14	H. B. feed
17	16	H. B. head lt. leads
17	16	H. B. indicator
18	14x16	L. B. feed
18	16	L. B. head lt. leads
20	16x18	Parking feed
20	18	Parking light leads
21	14x16	Tail light
22	14x16	Stop light
26	10x12	Horn & stop lt. feed
26	12x14	Horn and horn relay feeds
27	16	Instrument feed
28	18	Fuel gauge
29	18	Fuel gauge
33	18	Temperature gauge
36	18	Oil pressure gauge
38	18	Dome light
40	16	Instrument lights
71	16	Wiper switch feed
80	16	Ignition coil to dist.
91	16	Head light ground
A	16	Nat. with cir. letter "A" or black (wiper)
B	4	Battery ground
C	4	Engine ground
D	12	Cab ground
E	1	Battery cable
F	16	Nat. with cir. letter "F" or red (wiper)
G	14	Instrument bus bar
H	16	Horn push button
K	14	Lighter
P	16	Nat. with cir. letter "P" or green (wiper)

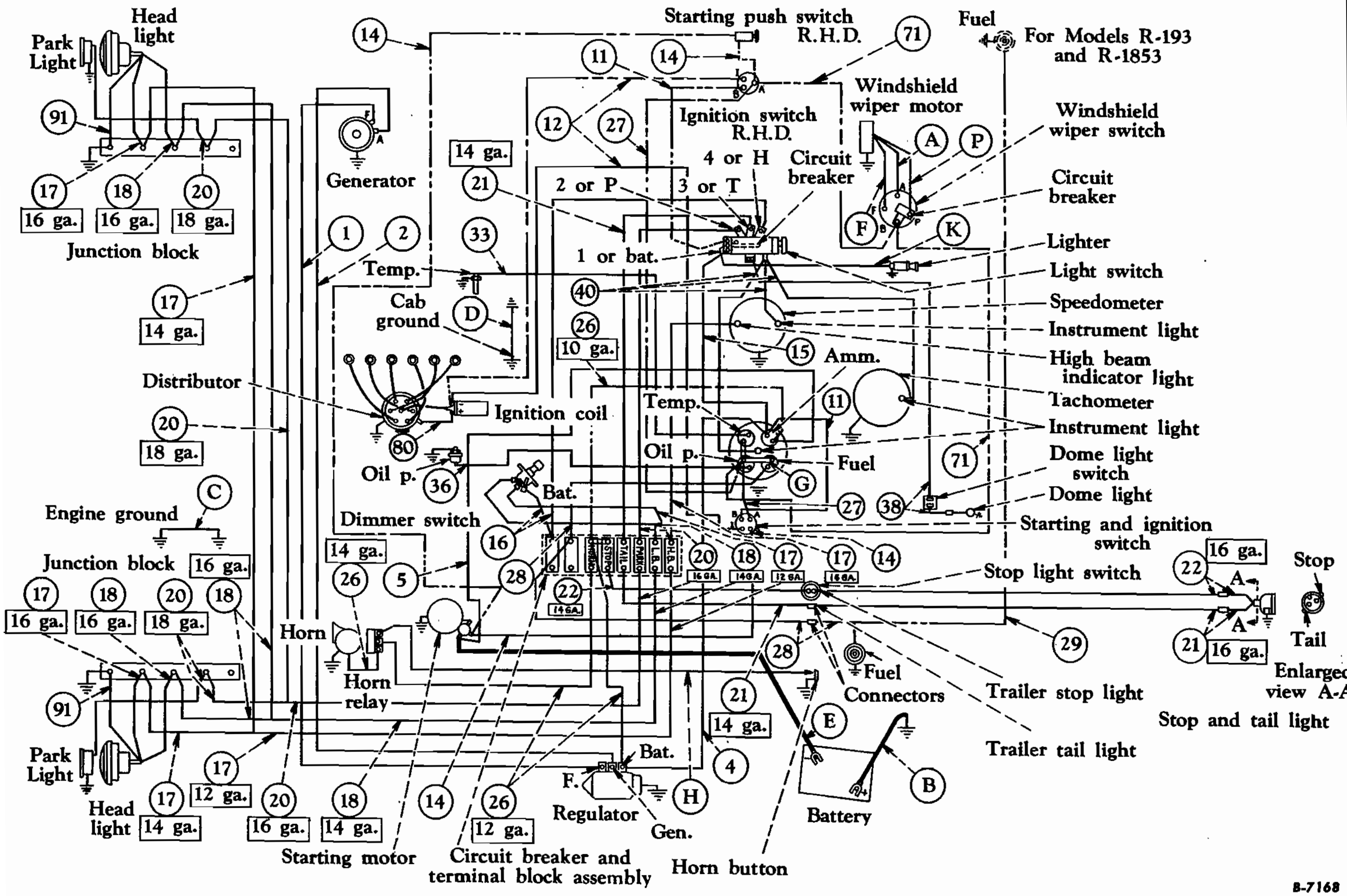
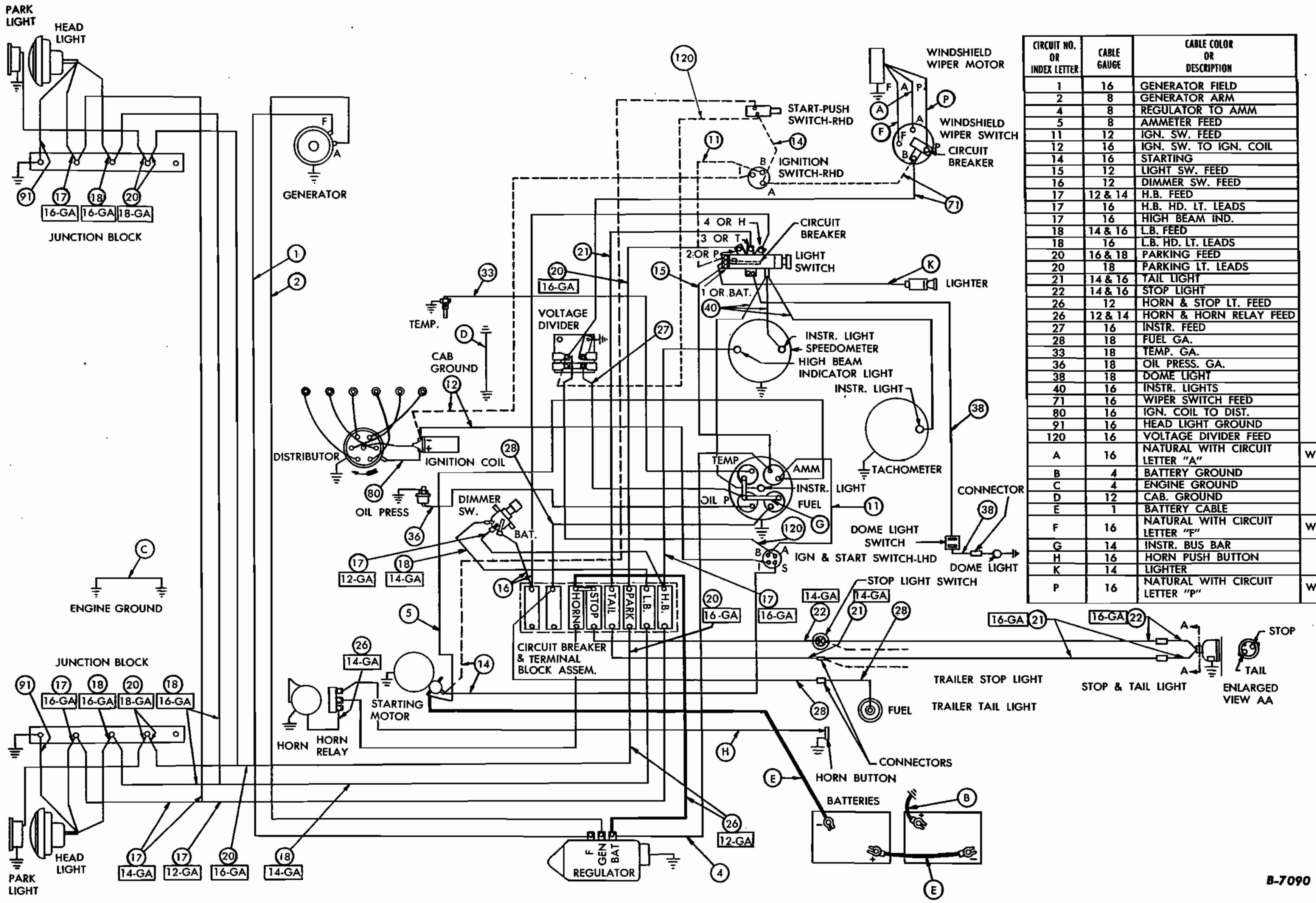


Fig. 6 - Wiring circuit diagram. (R-185 truck and R-190, RF-190, R-200, R-210, RF-210 series trucks)



CIRCUIT NO. OR INDEX LETTER	CABLE GAUGE	CABLE COLOR OR DESCRIPTION	
1	16	GENERATOR FIELD	
2	8	GENERATOR ARM	
4	8	REGULATOR TO AMM	
5	8	AMMETER FEED	
11	12	IGN. SW. FEED	
12	16	IGN. SW. TO IGN. COIL	
14	16	STARTING	
15	12	LIGHT SW. FEED	
16	12	DIMMER SW. FEED	
17	12 & 14	H.B. FEED	
17	16	H.B. HD. LT. LEADS	
17	16	HIGH BEAM IND.	
18	14 & 16	L.B. FEED	
18	16	L.B. HD. LT. LEADS	
20	16 & 18	PARKING FEED	
20	18	PARKING LT. LEADS	
21	14 & 16	TAIL LIGHT	
22	14 & 16	STOP LIGHT	
26	12	HORN & STOP LT. FEED	
26	12 & 14	HORN & HORN RELAY FEED	
27	16	INSTR. FEED	
28	18	FUEL GA.	
33	18	TEMP. GA.	
36	18	OIL PRESS. GA.	
38	18	DOME LIGHT	
40	16	INSTR. LIGHTS	
71	16	WIPER SWITCH FEED	
80	16	IGN. COIL TO DIST.	
91	16	HEAD LIGHT GROUND	
120	16	VOLTAGE DIVIDER FEED	
A	16	NATURAL WITH CIRCUIT LETTER "A"	WIPER
B	4	BATTERY GROUND	
C	4	ENGINE GROUND	
D	12	CAB. GROUND	
E	1	BATTERY CABLE	
F	16	NATURAL WITH CIRCUIT LETTER "F"	WIPER
G	14	INSTR. BUS BAR	
H	16	HORN PUSH BUTTON	
K	14	LIGHTER	
P	16	NATURAL WITH CIRCUIT LETTER "P"	WIPER

Fig. 7 - Wiring circuit diagram, 12-Volt System. (R-185 to R-210, RF-190 and RF-210 trucks)

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CIRCUIT DIAGRAMS

Electrical circuits for the various L-Line trucks are illustrated on following pages.

Cables are protected wherever necessary by loom or conduit and by rubber grommets, to prevent chafing where contact is made with the chassis, cab or body. Cables are also securely clipped at important points and connectors are used to facilitate inspection and servicing.

All electrical connections must be kept tight and clean.

Wiring Harness Individual Cable Circuit Identification

Wiring harness cable circuit identification has been established by ("Number Coding") imprinting numerals at regular intervals along the individual cables, except for short cables which are numbered only at the ends. The prime purpose of cable identification is to facilitate wiring harness installation since, in harness, generally only the extreme ends of the individual cables are visible.

The accompanying circuit numbered list (from No. 1 to 124) itemizes circuit numerals used on L-Line. Wherever a particular circuit is used on a vehicle, the identification numeral for that circuit will always be the same. For example, the generator field circuit cable will consistently be Circuit No. 1; the generator armature circuit will always be Circuit No. 2, etc. (see list). In the same manner, if a circuit is not used on a vehicle, the numeral for that circuit will not be used. For example, vehicles not having a 24-volt radio-feed cable will not have a circuit No. 48 in the harness.

Circuit numbers on the list for which no circuit description is given are not presently used by International and these circuits have been reserved for possible future assignment.

Circuit Nos. 28 to 31, inclusive, each pertain to fuel tank-to-receiver unit circuits. Because of the variety of possible combinations for these hook-ups, reference should be made to the illustrations for proper connection of cables. (Fig. 1)

Circuit Diagrams

Wiring circuit diagrams are illustrated in the owner's and driver's manuals and in the service manuals. With each of these illustrations, there is a key to the diagram which contains pertinent information as to circuit number and cable gauge.

Individual Cable Replacement

It is recognized that replacement of one or more individual cables may be necessary and that complete harness replacement may be impractical. For this reason, the chart on each circuit diagram specifies the proper-gauge cable to be used and which can be made up locally from bulk stock.

Circuit Numbers And Circuit Names

CIRCUIT NO.	CIRCUIT NAME
1.	Generator field circuit.
2.	Generator armature circuit.
3.	Generator ground circuit.
4.	Generator regulator to ammeter or shunt.
5.	Ammeter (or shunt) to starter switch.
6.	Battery to starting motor switch mounted on starting motor.
7.	Battery ground (including master switch if in this circuit).
8.	Shunt to ammeter positive.
9.	Shunt to ammeter negative.
10.	Circuit breaker, common feed to any point fed from regulator (Bat).
11.	Ignition switch feed (or magneto ground).
12.	Ignition switch to ignition coil (or booster switch to booster coil).
13.	Magneto ground.
14.	Magnetic starting motor switch to push button switch to feed.
15.	Main light switch feed.
16.	Light switch (HT) to service headlight or dimmer switch.
17.	Dimmer switch to upper beam and to beam indicator.
18.	Dimmer switch to lower beam.

19. Light switch (Bod) to blackout driving lamp, including resistor.

20. Light switch (BHT) to parking lamps or marker light.

21. Light switch (R) or (HT) on blackout switch to service tail light.

22. Light switch (H) or (S) on blackout switch to service stop light.

23. Light switch (BS) to blackout stop light.

24. Light switch (BHT) to blackout tail light.

25. Horn switch (including feed) to horn (or horn relay).

26. Horn relay feed and horn relay to horn.

27. Instruments feed (instruments with polarity).

28. }
29. } Fuel gauge sender to receiver --
30. } See illustrations Figure 1.
31. }

32. Oil level gauge sender to receiver.

33. Water (and oil) temperature gauge sender to receiver.

34. Low engine oil pressure warning light circuit (including feed).

35. High water temperature warning light circuit (including feed).

36. Oil pressure gauge sender to receiver.

37. Outlet socket or junction block.

38. Dome light circuit (including breaker and switch).

39. Map light circuit.

40. Instrument light circuit.

41. Starting motor to battery (-) (series parallel switch hook-up).

42. Series parallel switch (B+) to battery (+).

43. Series parallel switch (A-) to battery (-).

44. Series parallel switch to ground.

45. Series parallel switch (B-) to starting motor.

46. 12-Volt radio circuit (including radio master switch).

47. Slip ring feed.

48. 24 Volt radio feed.

49. Receptacle, Auxiliary power outlet, positive lead.

50. Receptacle, Auxiliary power outlet, negative lead.

51. -

52. 6-Volt tap on tail light dropping resistor to tail light.

53. Electric brake control circuit.

54. Fuel cut-off circuit.

55. Flame primer low tension circuit.

56. Flame primer high tension circuit.

57. Instrument panel ground.

58. Compass light circuit.

59. Cab (or hull) ventilating fan circuit.

60. -

61. Auxiliary generator field.

62. Auxiliary generator armature.

63. Auxiliary generator ground.

64. Auxiliary generator regulator to battery (including heater transfer switch).

65. Auxiliary generator starter relay circuit (including switch and feed).

66. Auxiliary generator starter to transfer switch (including starter or relay).

67. Emergency stop switch ground.

68. Battery interconnecting cables.

69. Resistor to ground terminal on trailer coupling.

70. Regulator ground.

71. Windshield wiper circuit.

72. Low transmission oil pressure indicator, circuit, with feed.

73. Radio terminal box to ground.

74. Series parallel switch to solenoid relay.

75. Stop switch circuit (SW to SS on blackout SW).
76. Fuel pump control feed.
77. Fuel pump switch to fuel pump (left side).
78. Fuel pump switch to fuel pump (right side).
79. Fuel gauge sender ground.
80. Ignition coil to distributor.
81. Battery to starting motor switch (or term. block) including master switch.
82. Starting motor switch (or term. block) to starting motor.
83. Blackout light switch (TT) to tail connection on trailer receptacle.
34. Blackout light switch (SS) to stop light connection on trailer receptacle.
85. Low air pressure indicator buzzer (or light).
86. Ground on series parallel switch to ammeter (including circuit breaker).
87. Spotlight circuit for trucks and wreckers.
88. Winch torque limiter control.
89. Automatic choke.
90. Trailer receptacle to ground.
91. Headlight to ground.
92. Parking light to ground.
93. Starting motor relay to ground.
94. Starting motor relay auxiliary grounding circuit.
95. Tail light to ground.
96. Speedometer sender feed.
97. Tachometer transmitter feed.
98. Tachometer transmitter positive (+) to tachometer positive (+).
99. Tachometer transmitter negative (-) to tachometer negative (-).
100. Tachometer transmitter to ground.
101. Defroster switch to defroster motor including feed.
102. Heater switch to heater motor including feed.
103. Cigar lighter.
104. Fog light switch to fog light including feed.
105. Tractor light (Back-up).
106. Carburetor idle fuel shut-off valve.
107. Marker or identification light circuit.
108. Clearance light circuit.
109. Mico brake lock circuit.
110. Fuel gauge switch (C) to ground (dual safety tanks).
111. Lockoff solenoid valve to switch (including feed).
112. Auxiliary ammeter to ground-negative.
113. 6-Volt radio circuit (including ratio master switch).
114. Direction signal, left turn-front.
115. Direction signal, left turn-rear.
116. Direction signal, right turn-front.
117. Direction signal, right turn-rear.
118. Direction signal, feed circuit.
119. Voltage divider ground.
120. Voltage divider feed or instrument resistor feed.
121. Overdrive relay to ignition switch.
122. Overdrive relay to overdrive governor (including kickdown and overdrive switch).
123. Overdrive solenoid to ignition coil (including kickdown switch).
124. Overdrive solenoid to battery (including relay feed).

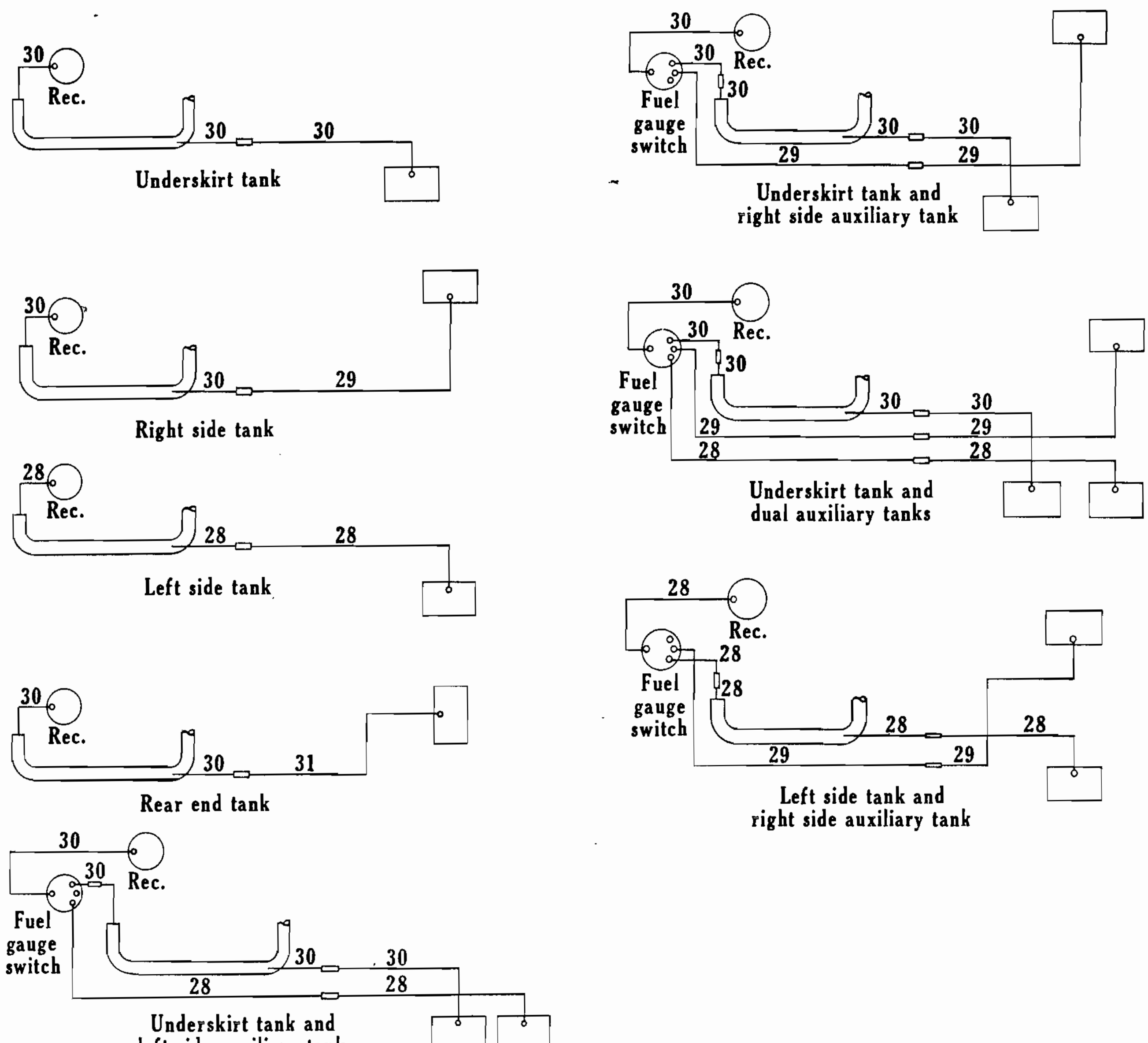

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Fig. 1 - Fuel tank to receiver circuits. Because of the variety of possible combinations for these hook-ups, reference should be made to the above chart for proper connection of cables.

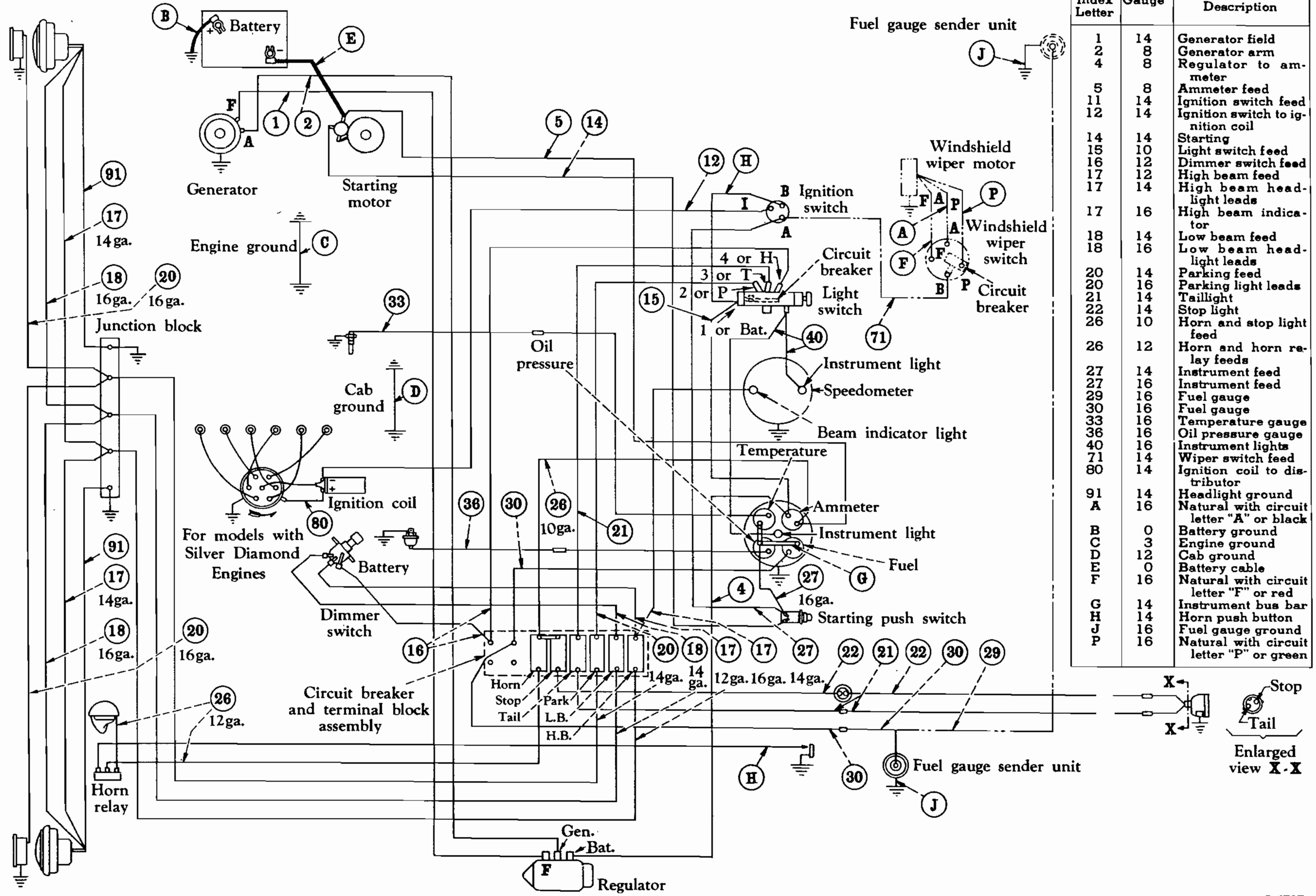

Fig. 2 - Circuit Diagram - L-110 Series to L-180 Series inclusive (Not "Metro")

Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	14	Generator field
2	8	Generator arm
4	8	Regulator to ammeter
5	8	Ammeter feed
11	14	Ignition switch feed
12	14	Ignition switch to ignition coil
14	14	Starting
15	10	Light switch feed
16	12	Dimmer switch feed
17	12	High beam feed
17	14	High beam headlight leads
17	16	High beam indicator
18	14	Low beam feed
18	16	Low beam headlight leads
20	14	Parking feed
20	16	Parking light leads
21	14	Taillight
22	14	Stop light
26	10	Horn and stop light feed
26	12	Horn and horn relay feeds
27	14	Instrument feed
27	16	Instrument feed
29	16	Fuel gauge
30	16	Fuel gauge
33	16	Temperature gauge
36	16	Oil pressure gauge
40	16	Instrument lights
71	14	Wiper switch feed
80	14	Ignition coil to distributor
91	14	Headlight ground
A	16	Natural with circuit letter "A" or black
B	0	Battery ground
C	3	Engine ground
D	12	Cab ground
E	0	Battery cable
F	16	Natural with circuit letter "F" or red
G	14	Instrument bus bar
H	14	Horn push button
J	16	Fuel gauge ground
P	16	Natural with circuit letter "P" or green

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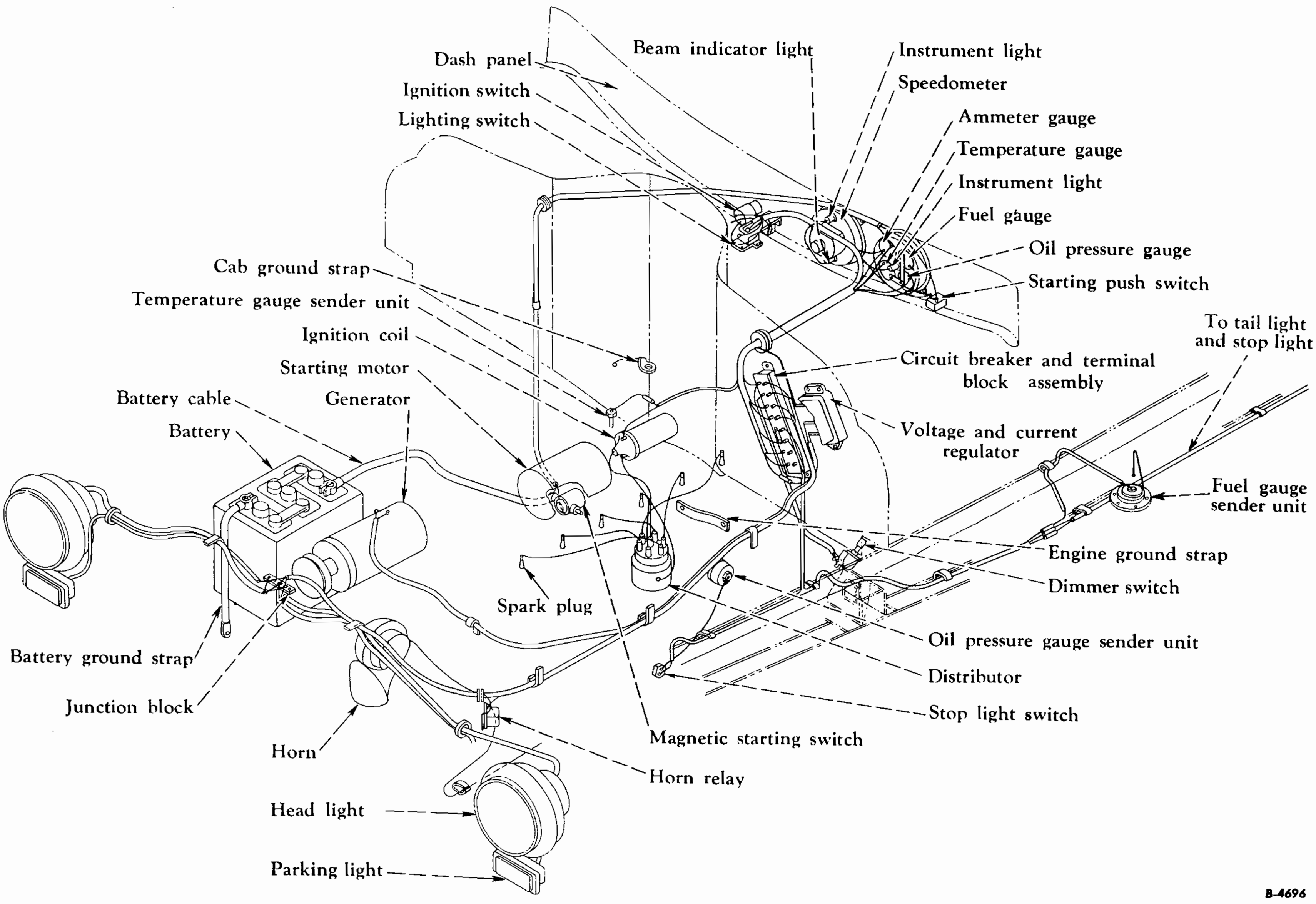
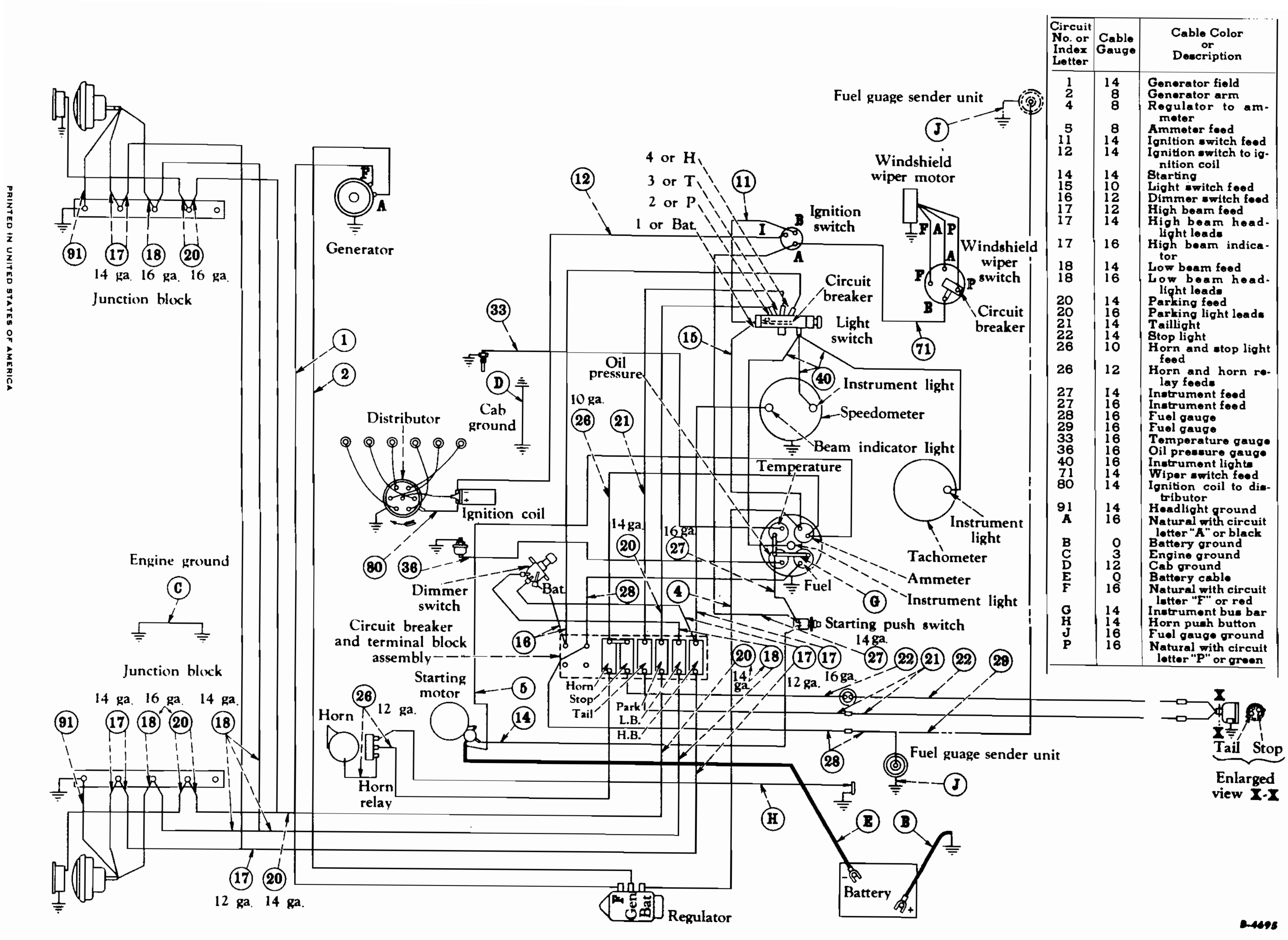


Fig. 3 - Diagram showing location of various electrical units. L-110 Series to L-180 Series inclusive (Not "Metro").



Circuit No. or Index Letter	Cable Gauge	Cable Color or Description
1	14	Generator field
2	8	Generator arm
4	8	Regulator to ammeter
5	8	Ammeter feed
11	14	Ignition switch feed
12	14	Ignition switch to ignition coil
14	14	Starting
15	10	Light switch feed
16	12	Dimmer switch feed
17	12	High beam feed
17	14	High beam headlight leads
17	16	High beam indicator
18	14	Low beam feed
18	16	Low beam headlight leads
20	14	Parking feed
20	16	Parking light leads
21	14	Taillight
22	14	Stop light
26	10	Horn and stop light feed
26	12	Horn and horn relay feeds
27	14	Instrument feed
27	16	Instrument feed
28	16	Fuel gauge
29	16	Fuel gauge
33	16	Temperature gauge
36	16	Oil pressure gauge
40	16	Instrument lights
71	14	Wiper switch feed
80	14	Ignition coil to distributor
91	14	Headlight ground
A	16	Natural with circuit letter "A" or black
B	0	Battery ground
C	3	Engine ground
D	12	Cab ground
E	0	Battery cable
F	16	Natural with circuit letter "F" or red
G	14	Instrument bus bar
H	14	Horn push button
J	16	Fuel gauge ground
P	16	Natural with circuit letter "P" or green

Fig. 4 - Circuit Diagram - L-190 Series And Up.

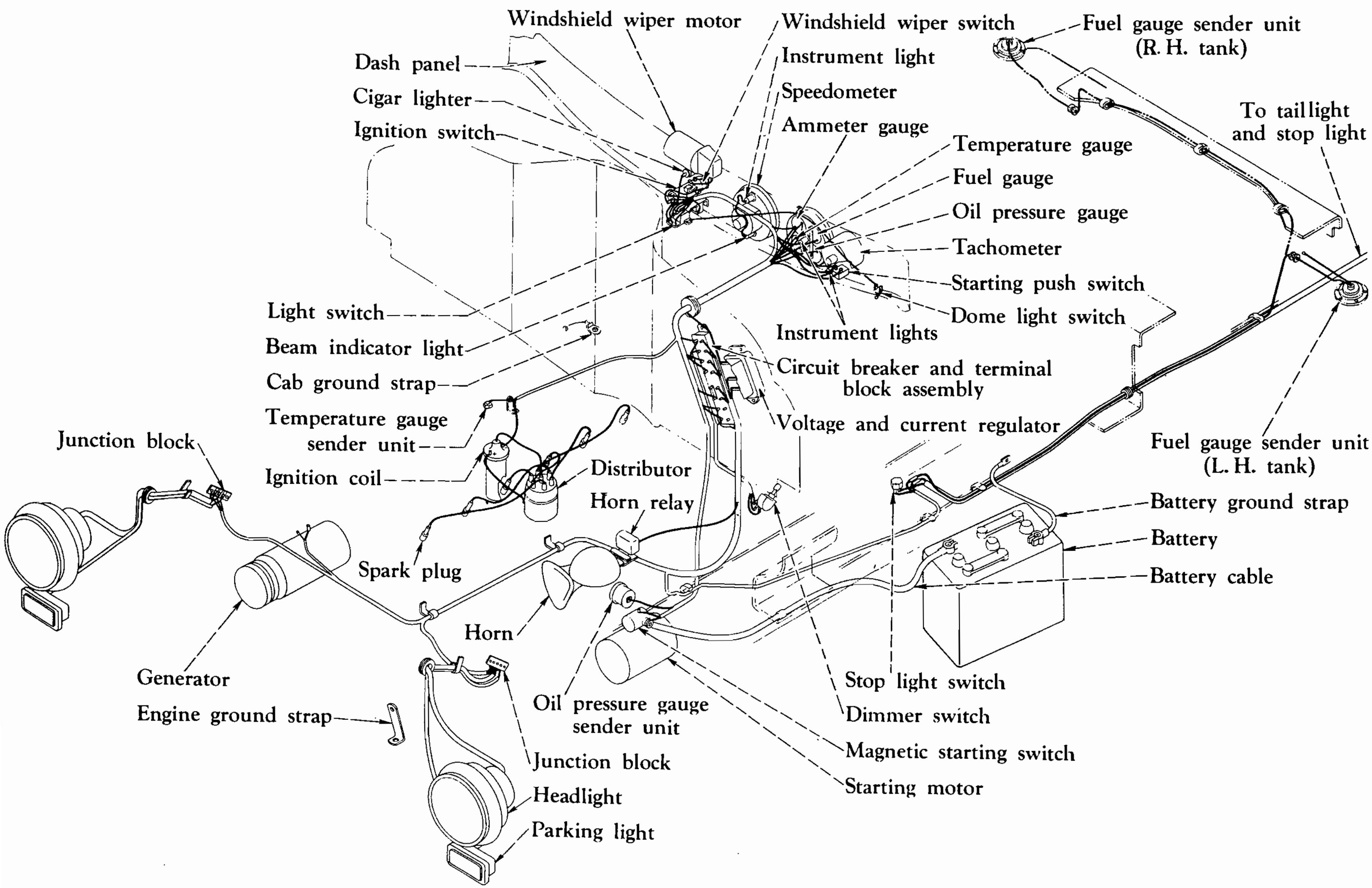


Fig. 5 - Diagram showing location of various electrical units - L-190 And Up.

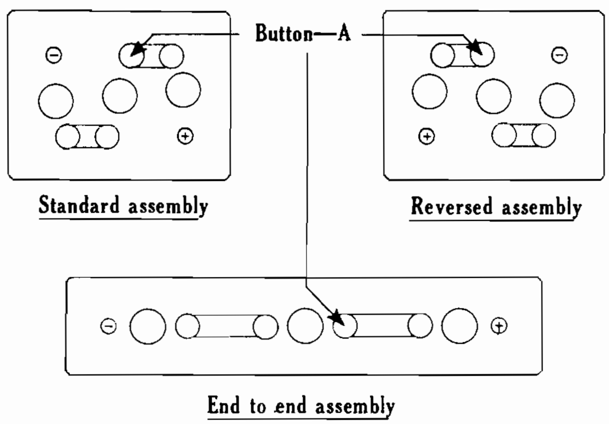
BATTERY

Storage Battery Equipment

Present production trucks are equipped with Auto-Lite batteries.

Code Dating

Each Auto-Lite Battery bears a shipping code stamped on one button of one cell connector of the battery. This button is indicated as "A" in Fig. 1.



Positive button — center cell — 6-volt assembly.

Positive button — cell adjacent to positive terminal cell — 12-volt assembly.

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Fig. 1

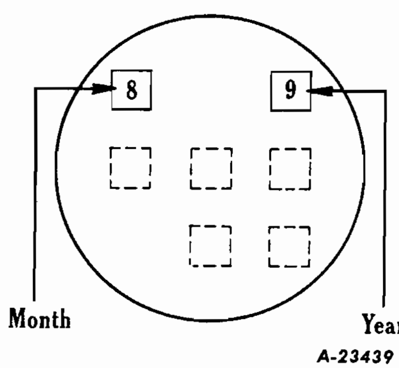

Fig. 2

The code date will be found stamped on the positive connecter button on the cell adjacent to the positive terminal cell. See Fig. 2.

In the first row are two symbols: the first is the month, the second is the year of shipment, for example - "8-9" which decodes August - 1949.

In the third row, the second space is used to indicate whether the battery was built "dry" or "wet." If there is no symbol in the space - the battery was built wet. If the space contains a letter "Y" - the unit was built dry. If the letter "Y" is encircled thus - Ⓨ the battery was built dry and made wet before shipment.

The following chart is the key to the code datings found on Auto-Lite batteries used in International Motor Trucks of later manufacture:

Month	Month Symbol	Year	Year Symbol
January	1		
February	2		
March	3	1949	9
April	4	1950	0
May	5	1951	1
June	6	1952	2
July	7	1953	3
August	8	1954	4
September	9	1955	5
October	10	1956	6
November	11	1957	7
December	12	1958	8

Atmospheric Temperature Affects Battery Capacity

The specific gravity of the electrolyte (distilled water and acid solution) must be maintained at 1.225 to 1.250 and the level of the solution should be at the star level in cell covers. A fully charged battery has a specific gravity of 1.280-1.290 at 80 degrees (F.).

To eliminate the possibility of harmful sulfation of plates, a battery with a specific gravity of 1.225 or less should be recharged to 1.280-1.290 at 80 degrees (F.) battery temperature.

The following chart shows the effect of atmospheric temperature on the capacity of a battery:

State of Charge	Temperature (F.)	Percentage Capacity
Full	80 degrees above 0°	100
Full	60 degrees above 0°	88
Full	40 degrees above 0°	75
Full	20 degrees above 0°	62
Full	Zero degrees	45
Full	20 degrees below 0°	20

Specific Gravity Affects Freezing Point of Electrolyte

Specific gravity of the electrolyte determines the temperature at which a battery will be harmed or damaged by freezing.

The following chart gives the freezing point of battery electrolyte at given specific gravities:

Electrolyte Specific Gravity	Freezing Point (F.)
1.280	90 degrees below 0°
1.220	30 degrees below 0°
1.210	20 degrees below 0°
1.180	10 degrees below 0°
1.160	Zero degrees
1.140	10 degrees above 0°
1.100	20 degrees above 0°
1.000	32 degrees above 0°

Battery Record Card, Form CTS-7

The Form CTS-7 Battery Record Card is the record or history of each battery received and shipped. The card has spaces provided for all necessary information pertaining to the battery. One of these record cards must be maintained for each battery and it should reveal the complete history of the unit while in your possession.

Upon receipt of a shipment of trucks from one of the factories or from another Branch, the batteries must be removed immediately and battery record cards filled out for each battery. THERE MUST BE NO DEVIATION FROM THIS PRACTICE.

The date received, battery type, code marking, truck model, and chassis serial number must be entered on a separate record card for each battery.

The specific gravity of each cell must be recorded on the card under TEST RECORD. The date and the inspector's initials should also be shown in the space provided. Any battery showing a specific gravity reading of less than 1.225 must be placed on the charging line and brought up to 1.280-1.290 at 80 degrees (F.) (battery temperature).

Subsequent inspections of the battery shall be made every thirty days and the specific gravity readings recorded, and distilled water added if necessary. This procedure shall follow during the stay of the battery in your stock.

Upon delivery of battery in a truck, the record card shall be completed by recording the specific gravity readings of each cell, date of delivery, truck model and chassis serial number, and the name of the purchaser. The card will then be filed in a manner similar to the Customer's Record Card. If the battery is delivered in a truck being transferred in another District, the battery record card shall accompany the battery and shall be continued by the receiving branch.

Battery Maintenance

The Ft. Wayne and Springfield factories are exercising every care in the handling and rotation of batteries to assure the delivery of a fresh and fully charged battery with each and every truck delivered to the territory.

The territory must also follow this practice of rotation, using the oldest batteries first as determined by the code datings stamped on the center cell connector button.

To facilitate truck movement in and around the District or Warehouse, a service battery should be prepared having long cables and clip ends.

Battery Recharging

Suitable and adequate equipment for battery charging is available through the Motor Truck Service Section, Chicago Office.

The general procedure in battery charging is as outlined:

1. With vent plugs in place, wash the top of the battery if necessary, using a solution of water and common baking soda. Rinse with clear water.

2. Remove vent plugs from each cell.

3. Fill the battery cells with pure distilled water to star level in cell covers.

4. Connect battery to the charger unit in series, connecting the positive terminal outlet from the supply line to the positive terminal post of the first battery. Connect the negative terminal of the first battery to the positive terminal of the second battery and so on through the number of batteries being charged. (Do not attempt to exceed the capacity of the battery charging equipment in the number of batteries to be charged at one and the same time.) The last battery must have its negative terminal connected to the negative outlet of the charging unit.

5. Adjust the charging rate in amperes to the lowest normal charge rate of the smallest size battery according to the following chart.

Batteries should remain on charge for a period of time sufficient to obtain normal voltage and specific gravity readings of each cell. The required length of time will vary from 12 to 48 hours, depending upon the state of discharge of the battery at the time it was placed on the charging line.

Type of Battery	Volts	No. of Plates	Normal Charge Rate
2H-105, 2H-105R	6	15	7 Amperes
2H-120, 2H-120R	6	17	8 Amperes
2H-135R	6	19	9 Amperes
3H-136R	6	17	8 Amperes
4H-152R	6	19	9 Amperes
8T-200	12	25	12 Amperes

Temperature readings should be taken frequently to prevent the electrolyte temperature exceeding 110 degrees (F.) at any time. Should the temperature rise higher than 110 degrees (F.), the charging should be discontinued and the electrolyte allowed to cool. The charging of the battery may then, and only then, be continued.

6. Cell voltage is determined by a normal electrolyte temperature of 80 degrees (F.). Voltage readings are to be taken while the battery is on charge at the normal rate as specified in the foregoing chart.

The cell voltage of a fully charged battery on charge at the normal rate should read as follows:

Temp. 80 degrees (F.) - Voltage between 2.5 and 2.6 volts
Temp. 100 degrees (F.) - Voltage between 2.4 and 2.6 volts
Temp. 110 degrees (F.) - Voltage between 2.35 and 2.55 volts

A battery is fully charged when the cell voltage values are as shown in above table and there is no further rise in voltage over a period of two hours.

7. Add water as necessary, disconnect batteries from the charging line, replace vent plugs, wash the tops of the batteries, and place in attachment room.

Excessive Evaporation of Electrolyte Indicates Overcharging

When excessive evaporation of the electrolyte is experienced, you may be sure that it is an indication that the battery is being overcharged.

Necessity for too frequent battery recharging may indicate that the battery is being undercharged.

Battery Not to Blame for Failure When Conditions Adverse

It has been shown that temperature plays an important part in affecting the capacity of a battery, and that the colder the temperature - the lower the battery capacity. Bearing this in mind, it will be seen that a fully charged battery is only partially capable at subzero temperatures. This fact, coupled with the condition in which many engines are found, brings about complaints regarding the size, quality, and construction of the standard equipment battery.

There are times when it is necessary to increase the size of the battery or starting motor, but such action should not be considered a "cure-all" for hard starting complaints during winter months. Even when special equipment of this nature is installed, it is still essential to:

1. Use a lubricating oil with the correct body for Winter Service.
2. Maintain distributer points in good condition and properly spaced.
3. Have clean and properly spaced spark plug electrodes.
4. Have good compression in the engine.
5. Maintain all joints and connections between the carburetor, manifolds, and engine in a gas-tight condition.
6. Ascertain that the carburetor choke valve is operating properly.
7. Determine that the engine is well grounded and that the ground straps are securely fastened to clean contacts.

Battery Warranties and Manufacturers' Policy

Storage batteries used in International Motor Trucks are limited to a free repair or replacement warranty of 90 days against defective material and workmanship, beginning on the date the battery is placed in service.

In accordance with this arrangement, service adjustments after 90 days are based on miles of service or months of service - whichever occurs first. Miles of service are mentioned for there are occasions when a customer will attain the limit of miles of service prior to the time limit set forth. In such cases, the adjustment will be made on the miles of service and not on the time limit.

Auto-Lite Batteries, whether installed as factory equipment by the International Harvester Company or sold as replacements to

International Harvester Truck owners, are subject to adjustment as outlined below.

Factory equipment or replacement batteries are adjusted according to the following table:

Service Adjustment Chart

Battery Equipment Type	Mileage Adjustment	Time Adjustment
2H-105, 2H-105R	15,000	7-1/2 Months
2H-120, 2H-120R	18,000	9 Months
2H-135R	21,000	10-1/2 Months
3H-136R	18,000	9 Months
4H-152R	18,000	9 Months
8T-200	24,000	8 Months

Complaints on Battery Performance

Any complaints pertaining to battery performance should be referred to the nearest Auto-Lite Service Station.

Complaints on Service Facilities

Complaints on service facilities of Auto-Lite distributors must be referred to the Sales Department, Motor Truck Service Division, Chicago Office. Accompany complaint with all details concerning the battery and the truck from which it was removed. The matter will be handled with the manufacturer from the Chicago Office and not by the District direct.

Batteries Older Than Four Months at Time of Delivery

Motor Truck Service Bulletin No. 82, 1931, pertained to batteries which were on hand and which were older than four months according to code dating. That bulletin advised that these batteries should be delivered in proper rotation but that they should be properly identified by stamping the letters "IHC" on the center cell connector button. Battery Record Cards, Form CTS-7, were to be notated with this information. Customer Record Cards were to bear a notation to the effect that the battery was past the four months' code dating.

PROPER AND CONSISTENT ROTATION OF BATTERIES IN STOCK MUST BE FOLLOWED, AND THE OLDEST BATTERIES ACCORDING TO CODE DATINGS DELIVERED FIRST.

Strict Adherence to Instructions Necessary

All persons who have occasion to handle batteries or battery transactions should thoroughly familiarize themselves with the instructions pertaining to maintenance of batteries, with battery warranties, and the manufacturer's policy. There should be no departure from the instructions as outlined.

It must be remembered that while the manufacturer is under certain obligations in accordance with the warranty policy of the batteries, we too, are not absolved of obligation to the manufacturer to do our part of the arrangement and policy.

It is felt that of all the instructions outlined herein that the following are the most important and no excuse can be accepted for departure from them:

1. REMOVAL OF ALL BATTERIES FROM THE TRUCKS AT THE TIME THEY ARE RECEIVED AT THE BRANCH, AND KEEPING THEM IN THE ATTACHMENT ROOM OR BATTERY ROOM UNTIL THE TIME OF DELIVERY.
2. INSPECTION OF BATTERIES EVERY THIRTY DAYS, AND MAINTAINING THEM AT THE PROPER WATER LEVEL AND AT THE PROPER SPECIFIC GRAVITY READINGS.
3. KEEPING OF FULL AND COMPLETE RECORDS OF THE BATTERY ON THE BATTERY RECORD CARD, FORM CTS-7.
4. PROPER AND CONSISTENT ROTATION OF BATTERIES IN STOCK, DELIVERING THE OLDEST BATTERIES FIRST.
5. INSTRUCTIONS TO THE CUSTOMERS IN THE PROPER CARE OF THE BATTERY AND A CAREFUL STUDY OF THE REQUIREMENTS ON THE BATTERY AND CORRECTIONS FOR SAME IN THE CUSTOMER'S TRUCK.

General Instructions

Do not add anything other than distilled water or drinking water which is colorless, tasteless, and odorless to a storage battery. The use of patent electrolytes or battery "dopes" are injurious and void the guarantee.

Use a strong solution of soda and hot water for removing terminal corrosion and cleaning the battery. To prevent corrosion apply vaseline or cup grease to the terminals.

Moist Uncharged Storage Batteries

To prepare a battery for service which has been shipped dry, all cells should be filled to 3/8" above the tops of the spacers with the electrolyte specific gravity of 1.345.

CAUTION!

NEVER POUR WATER INTO SULPHURIC ACID.

Important Instructions

To prepare 1.345 specific gravity electrolyte from full-strength sulphuric acid stir constantly while adding one volume of 1.835 acid to two volumes of water. THIS MUST BE DONE VERY SLOWLY AS A GREAT DEAL OF HEAT IS GENERATED.

Use only glass or earthenware containers for storing and for mixing the acid.

In some localities acid can be purchased already mixed to 1.345 specific gravity.

Table 1

Cold Climate				Warm or Tropical Climate			
Filling Acid		Final Adjustment		Filling Acid		Final Adjustment	
Sp. Gr.	Baumé	Sp. Gr.	Baumé	Sp. Gr.	Baumé	Sp. Gr.	Baumé
1.345	3.7	1.290	31.5	1.245	28.5	1.225	26.4

A tropical climate is that in which the temperature never falls below the freezing point of water (32° F.) (0° C.).

Place the battery on charge at the ampere rate given below:

Battery Equipment Type	Ampere
2H-105R	7
2H-120R	8
2H-135R	9
3H-136R	8
4H-152R	9
8T-200	12

For converting dry batteries to wet, use a constant rate charger. Do not use a constant potential charger.

The total initial charge must be for 52 hours.

However, should the temperature of the electrolyte while on charge reach 115° F. (46° C.), discontinue the charge and allow the battery to cool. Then resume charging.

The electrolyte at the end of 52 hours' charge with battery temperature at 80° F. (26.7° C.) should be at the value given in Table 1. Make corrections for temperature, when necessary, according to previous directions. Adjust electrolyte specific gravity by adding distilled water to weaken and 1.400 specific gravity acid to strengthen.

When adjusting electrolyte, charge the battery for one hour before taking a final reading. At the end of 52 hours the cell voltage of the battery while on charge at the proper rate should be between 2.5 and 2.7 volts at 80° F.

Replace vent plugs, wash externally to remove traces of acid, and dry. Battery is now ready for service.

INSTALLATION OF CABLES

When making replacement of original battery cables, starting motor cables or other wires utilizing protective loom or grommets, it is essential that the service cable be equipped with the same type loom or grommet protection as was removed on the replaced cable or wire. Cables that are replaced without proper loom protection create a fire hazard. The wiring circuits on new vehicles are closely checked and approved by Underwriter Companies, therefore, the original circuits should be maintained both as to location and protective devices.

The loom or grommet is placed on cables for the purpose of safeguarding against chafing or cutting through the insulation at points where the cables contact the chassis.

When replacing cables on customers trucks or when making sales of cables, make certain that protective loom or proper grommets are provided where required.

The storage battery can deliver only what the battery cables are able to carry to the electrical system. The battery cannot operate efficiently if it has to overcome the resistance of a worn-out, corroded or undersize cable. Faulty battery performance may indicate cable trouble.

Care should be taken when installing a cable terminal. It should never be hammered into place. To do so may drive some of the active material from the battery plates into the bottom of the battery container or crack the cell cover. Also some metal may be sheared from the post, making it too small for good contact when the next replacement is necessary. The best practice is to pry the jaws of the terminal apart before slipping it over the post.

IGNITION COILS

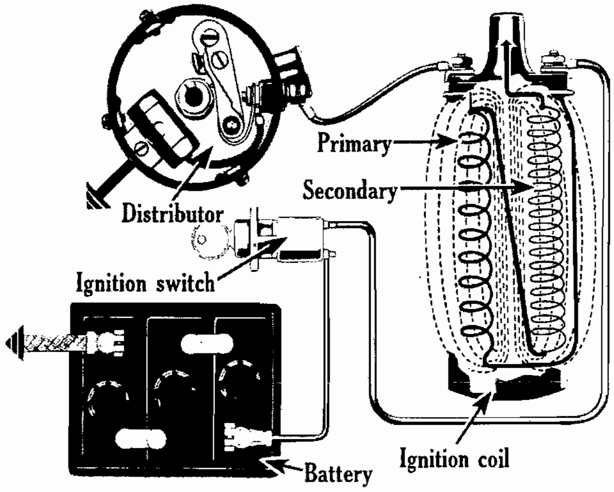

Fig. 1 - Schematic wiring diagram of the primary circuit of an ignition system.

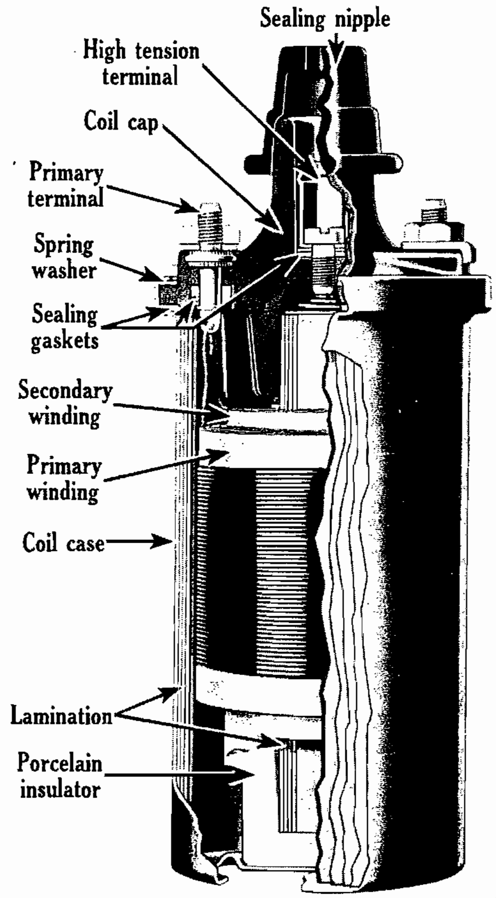

Fig. 2 - Cutaway view of oil filled coil.

DELCO-REMY MODEL 1115327 IGNITION COIL

The Delco-Remy (Model 1115327) Ignition Coil is oil-filled and hermetically sealed to prevent the entrance of moisture The high tension terminal is protected by a bakelite insulator which has high resistance to leakage across its surface and is not damaged by leakage which might occur. The coil should be mounted vertically with the high tension terminalddown or horizontally with primary terminals in same horizontal plane. Make sure the coil is mounted so the case is grounded and that the leads are tightly connected to the coil terminals.

If the coil is defective it must be replaced, since the coil can not be repaired. But before a coil is discarded, it should be carefully checked on a good tester to determine that it is actually defective.

Construction and Operation

The ignition coil is a pulse transformer that transforms or steps-up the low battery or generator voltage to the high voltage necessary to jump the gaps at the spark plugs in the engine cylinders. This voltage may reach as much as 20,000 volts.

The ignition coil contains three essential parts; a primary winding consisting of a few hundred turns of relatively heavy wire, a secondary winding consisting of many thousand turns of very fine wire, and laminated soft iron which serves to concentrate the magnetic field. The primary winding is assembled around the outside of the secondary winding, and the laminated iron is distributed so that one portion serves as a core for the windings and the remainder as a shell around the entire subassembly. This subassembly is then placed in the coil case and the remaining space nearly filled with insulating compound or oil, and the coil cap assembled into place.

Fig. 3 illustrates a heavy-duty ignition coil used on motor-coach, truck and marine applications. This coil also is hermetically sealed against the entrance of air or moisture and is oil filled for greater insulation protection. The fins cast in the one-piece case plus the oil filling permits improved heat radiation which is a factor in efficient ignition coil performance.

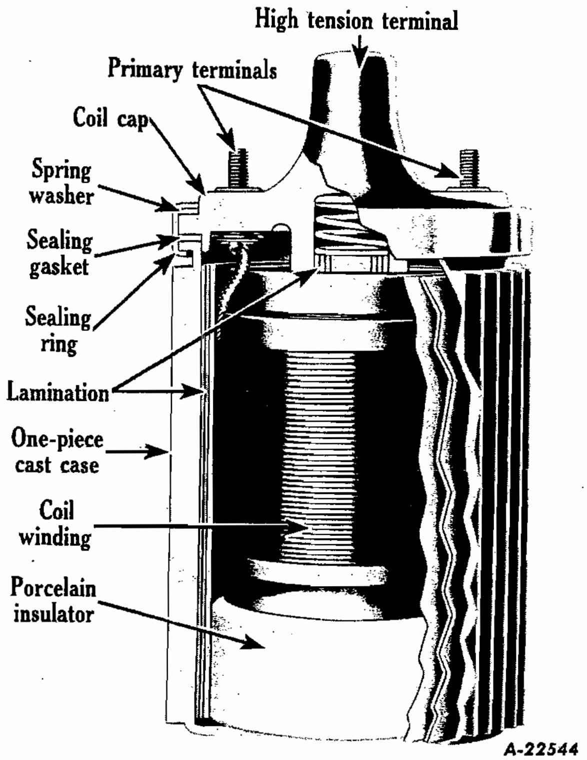

Fig. 3 - Cutaway view of heavy duty oil-filled coil. Coil case utilizes fins to aid in cooling for better ignition coil performance.

Coil Service

Ignition coils do not normally require any service except to keep all terminals and connections clean and tight. In addition, the coil should be kept reasonable clean, but it must not be subjected to steam cleaning or similar cleaning methods which may cause moisture to enter the coil unless it is of the hermetically sealed type. Rubber nipples on the high voltage terminals are valuable in preventing "tracing" or leakage of current across exposed surfaces.

If poor ignition performance is obtained and the coil is suspected of being the cause, the coil may be tested on the truck or it may be removed for the test.

DISTRIBUTORS

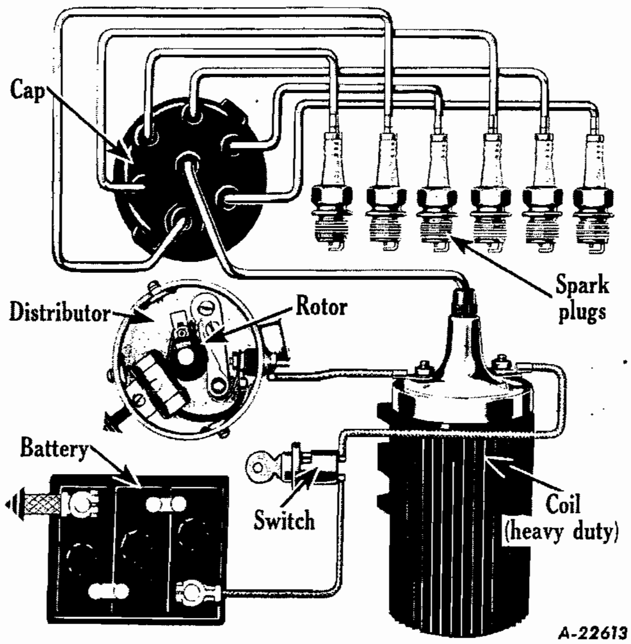

Fig. 1 - Ignition system circuit. Showing relationship of various units.

IGNITION DISTRIBUTORS

The ignition system (Fig. 1) consists of the ignition coil, condenser, ignition distributor, ignition switch, low and high tension wiring, spark plugs, and a source of electrical energy (battery or generator).

The ignition system has the function of producing high voltage surges and directing them to the spark plugs in the engine cylinders. The sparks must be timed to appear at the plugs at the correct instant near the end of the compression stroke with relation to piston position. The spark ignites the fuel-air mixture under compression so that the power stroke follows in the engine.

Function of Distributor

The distributor has three jobs. First, it opens and closes the low tension circuit between the source of electrical energy and the ignition coil so that the primary winding is supplied with intermittent surges of current. Each surge of current builds up a magnetic field in the coil. The distributor then opens its circuit so that the magnetic field will collapse and cause the coil to produce a high voltage surge. The second job that the distributor has is to time these surges with regard to the engine requirements. This is accomplished by the centrifugal and vacuum advance mechanism. Third, the

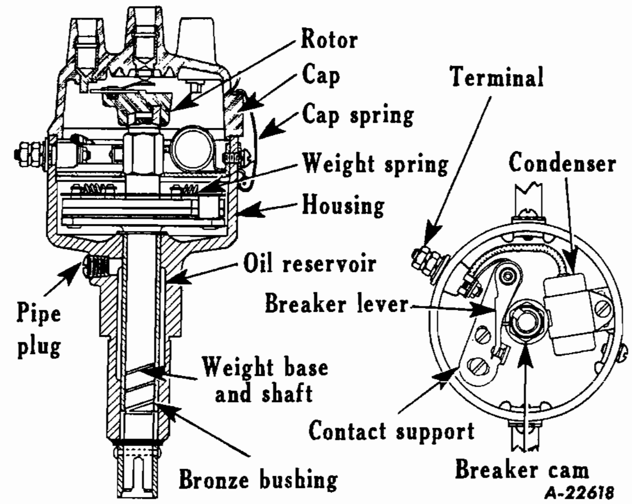

Fig. 2 - Sectional view of distributor.

distributor directs the high voltage surge through the distributor rotor, cap and high tension wiring to the spark plug which is ready to fire.

There are thus two separate circuits through the ignition distributor. One of these is the primary circuit which includes the distributor contact points and condenser. The other is the secondary or high tension circuit which includes the distributor cap and rotor.

DELCO-REMY DISTRIBUTOR

The Delco-Remy Distributors used on BD and RD engines are full automatic units with centrifugal advance mechanism. The SD engine uses a distributor having the vacuum-automatic mechanism.

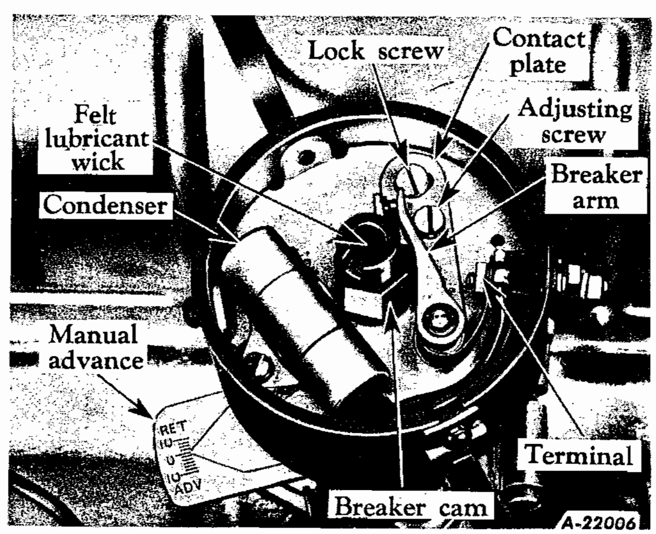

Fig. 3 - Full automatic distributor. Cover removed.

Distributor Maintenance

LUBRICATION - Do not remove pipe plug in distributor oil reservoir. This reservoir back of the shaft bushing is filled with light engine oil and sealed before the unit is shipped. The supply of oil is sufficient to last for 25,000 miles of operation under normal conditions. Thus the plug need not be removed oftener than every 25,000 miles (or at time of overhaul) for lubrication except when unusual heat or other operating conditions are experienced. Grade SAE #20 oil should be added when needed. Seal the plug with sealing compound that will hold against oil.

A trace of high melting point ball-bearing grease should be placed on the breaker cam every 1000 miles. Every 5000 miles put one drop of light engine oil on the breaker lever pivot and a few drops on the felt wick under the rotor.

Inspection

The cap should be removed at regular intervals and the contact points, rotor, and cap examined. Check the high tension wiring for frayed or damaged insulation and poor connections at the cap or plugs. Replace if necessary. Replace the cap or rotor if they are cracked or show carbonized paths indicating the secondary current is leaking to ground over the surface of the material.

CONTACT POINTS - That are burned or pitted should be replaced or dressed with a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. NEVER USE EMERY CLOTH TO CLEAN CONTACT POINTS. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are not functioning satisfactorily.

OXIDIZED CONTACT POINTS - May be caused by high resistance or loose connections in the condenser circuit, oil or foreign materials on the contact surfaces, or most commonly, high voltages. Check for these conditions where burned contacts are experienced.

THE CONTACT POINT OPENING - Must be set to specification. Points set too closely may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed. The point opening of new points may be checked with a feeler gauge. Use of a feeler gauge on used points is not recommended, since the roughness of used points make it impossible to set the point opening accurately by this method. A dial indicator or a contact angle meter is recommended to check the point opening of used points. When necessary to check and adjust point opening with a feeler gauge proceed as follows:

Rotate breaker cam until breaker lever rubbing block is on the high point of the cam lobe thus giving the maximum point opening. Loosen the clamp screw holding the contact support and adjust point opening by turning the eccentric screw in the contact support. Tighten clamp screw, check with gauge again after tightening clamp screw. THE CONTACT POINTS SHOULD BE CLEANED BEFORE ADJUSTING IF THEY HAVE BEEN IN SERVICE. The cam or contact angle is the angle in degrees of cam rotation through which the points remain closed. This angle increases with decreased point opening. As the rubbing block of a new breaker arm wears in, rounding the corners of the rubbing surface, the contact angle increases.

CONTACT POINT PRESSURE - Must fall within the limits given. Weak tension will cause point chatter and ignition miss at high speed, while excessive tension will cause undue wear of the contact points, cam and rubbing block.

USE OF DISTRIBUTOR TEST FIXTURE - The distributor test fixture accurately checks cam angle, spark advance and synchronization on distributors removed from the car. It will also show excessive distributor shaft eccentricity as indicated by variation in synchronization.

After a distributor has been repaired, the calibration of the centrifugal automatic mechanism should be checked. Proper engine performance cannot be obtained unless the centrifugal curve is within the limits specified for the particular engine.

THE CONDENSER - Four factors affect condenser performance and each factor must be considered in making any condenser tests. BREAKDOWN is a failure of the insulating material, a direct short between the metallic elements of the condenser. This prevents any condenser action. LOW INSULATION RESISTANCE or leakage prevents the condenser from holding a charge. A condenser with low insulation resistance is said to be "weak." All condensers are subject to leakage, which up to a certain limit is not objectionable. When it is considered that the ignition condenser performs its function in approximately 1/12,000 of a second, it can be seen that leakage can be large without detrimental effects. It must be considered, however, in any condenser test. HIGH SERIES resistance is excessive resistance in the condenser circuit due to broken strands in the condenser lead or to defective connections. This will cause burned points and ignition failure upon initial start and at high speeds. CAPACITY is built into the condenser and is determined by the area of the metallic elements and the insulating and impregnating materials. For a complete check of the condenser, it is desirable to use a tester which will check for the above four conditions.

Vacuum Automatic

Vacuum controlled spark is combined with centrifugal-automatic type distributors to obtain greater economy and improved engine performance. The centrifugal-automatic spark mechanism is calibrated to give proper spark advance for the full load, wide-open throttle requirements of the particular engine.

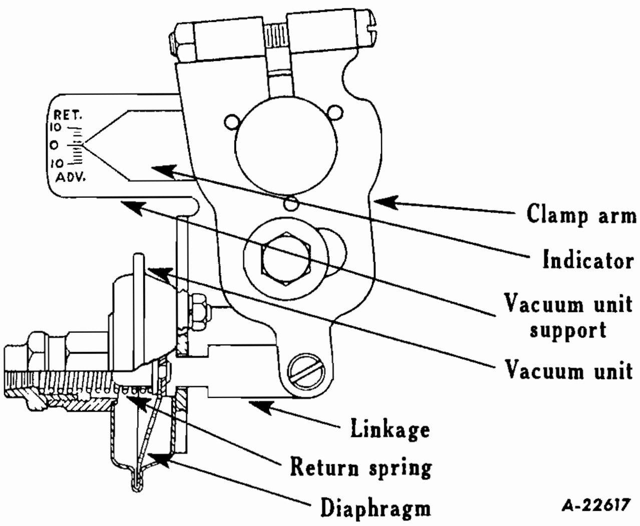

Fig. 4 - Details of the vacuum advance mechanism.

The use of the vacuum unit is accomplished by mounting it to the distributor clamp arm assembly. The diaphragm in the unit is linked to the distributor so that advance and retard is obtained by moving the distributor in its mounting. The movement of the diaphragm is actuated by vacuum from the engine manifold and a calibrated return spring.

When the engine is idling the vacuum unit has no action on the distributor. When the throttle is opened slowly the vacuum is high and spark will be given additional advance to that of the centrifugal advance. On full load wide-open throttle when the vacuum is low or at high speed, the vacuum unit will not advance the spark. Under these low vacuum conditions spark advance depends upon the centrifugal mechanism in the distributor.

Full Automatic

There is no manually operated spark advance with this type of spark control, thus making the variation of the spark dependent entirely upon the centrifugal automatic mechanism.

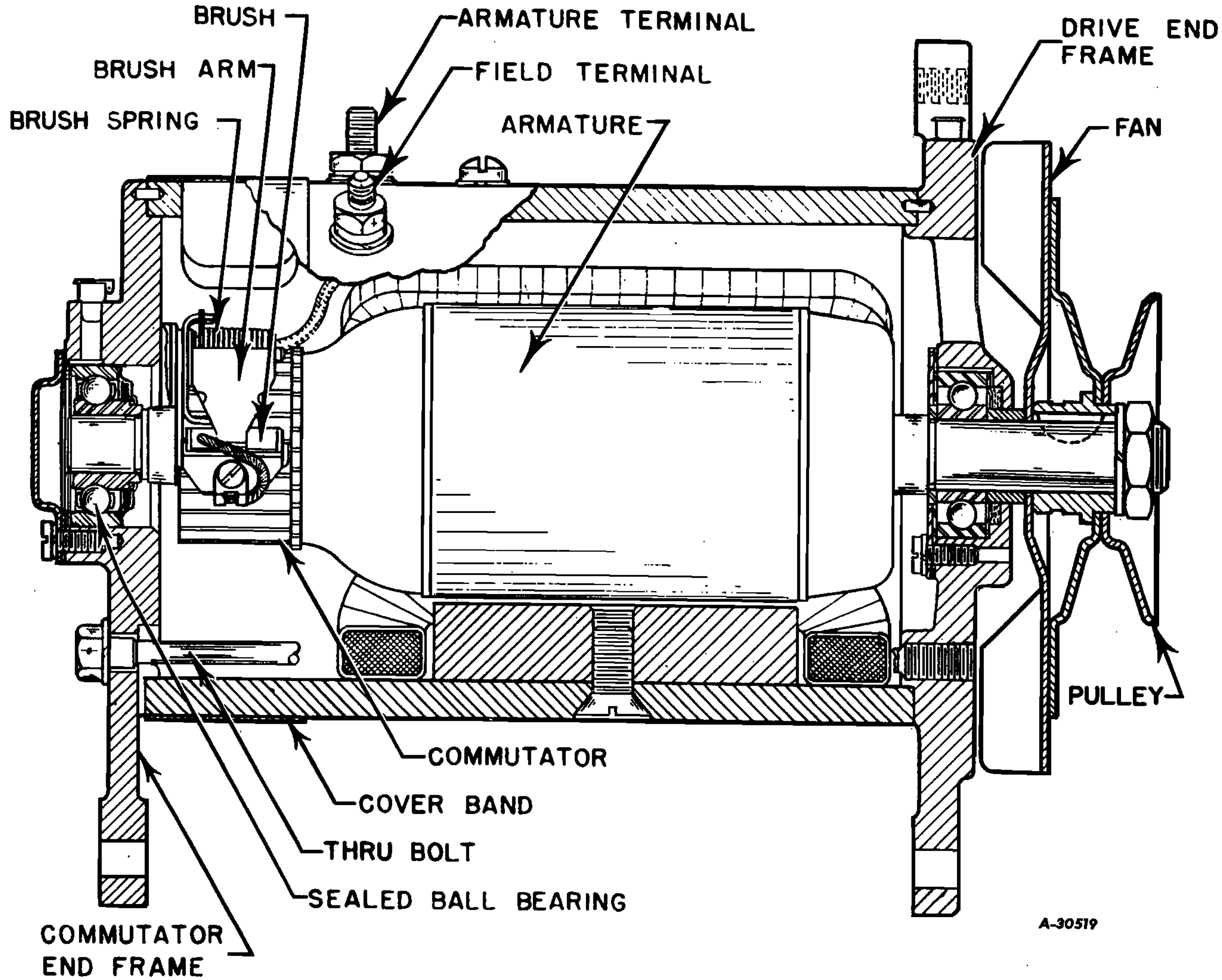

Fig. 1 - Sectional View of Generator (Delco-Remy Model 1100019 and Model 1102785)

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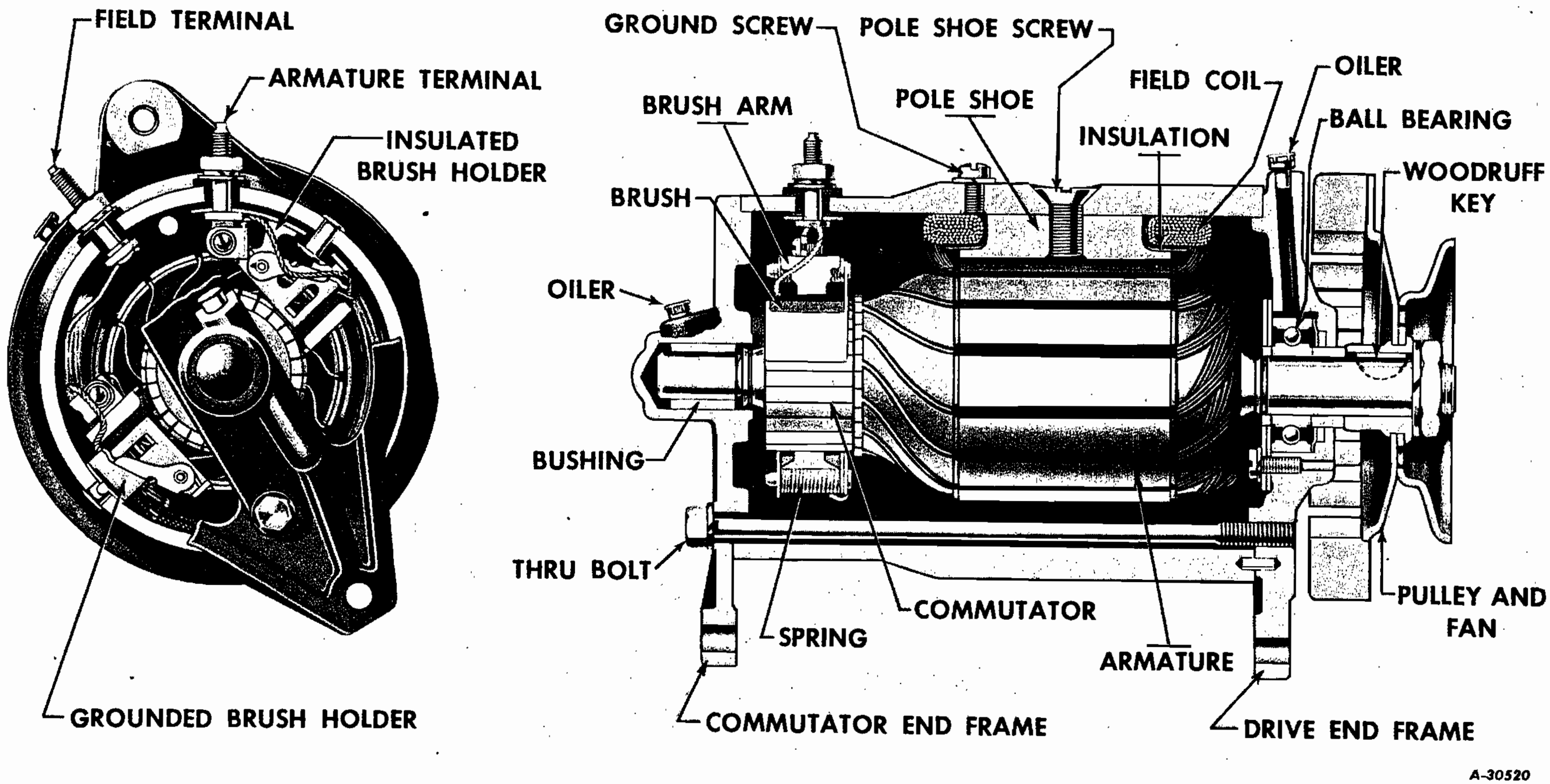


Fig. 2 - Sectional View of Generator (Delco-Remy Model 1105876)

GENERATORS

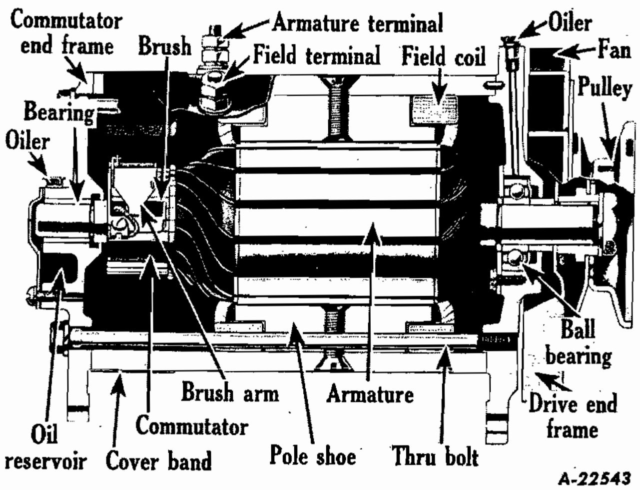


Fig. 1 - Sectional view of generator.

DELCO-REMY GENERATORS MODELS 1102674 AND 1102714

The Delco-Remy Models 1102674 and 1102714 Generators Fig. 1 are 6 volt, 4-9/16 inch diameter frame size, ventilated, two-brush shunt units, with a ball bearing supporting the armature at the drive end and a bronze bushing in the commutator end. They are force-draft ventilated by means of a fan, mounted back of the drive pulley, which rotates with the armature shaft. The generator output is regulated by the correct settings of the current and voltage regulator.

Generator Maintenance

Generator maintenance may be divided into two sections, normal maintenance required to assure continued operation of generator, and the checking and repair of inoperative units.

Normal Generator Maintenance

LUBRICATION - The two hinge cap oilers should be supplied with 10 to 20 drops of light engine oil every 1000 miles of operation. Do not oil excessively. NEVER OIL COMMUTATOR.

INSPECTION - The cover band should be removed and the commutator and brushes inspected at regular intervals. If the commutator is dirty, it may be cleaned with #00 sandpaper. Blow out all dust after cleaning. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR. If the commutator is rough, out of round, or has high mica, it should be turned down on a lathe and the mica undercut.

Worn brushes should be replaced. They can be seated with a brush seating stone. When held against the revolving commutator, the abrasive material carries under the brushes, seating them in a few seconds. Blow out abrasive particles after seating brushes.

Check brush spring tension, which should be approximately 24-28 ounces.

Generator Disassembly

At regular intervals, the actual mileage or time depending on the type of operation, the generator should be disassembled for a thorough cleaning and inspection of all parts. Never clean the armature or fields in any degreasing tank, or with grease dissolving materials, since these may damage the insulation. The ball bearing should be cleaned and repacked with a good grade of ball bearing grease. The commutator should be trued in a lathe and the mica undercut if necessary. All wiring and connections should be checked. Rosin flux should be used in making all soldered connections. ACID FLUX MUST NEVER BE USED ON ELECTRICAL CONNECTIONS.

Checking Inoperative Generator

Several conditions may require removal of the generator from the engine and further checking of the generator, as follows:

1. NO OUTPUT

Remove cover band and check for sticking or worn brushes and burned commutator bars. Burned bars, with other bars fairly clean, indicate open circuited coils. If brushes are making good contact with commutator, and commutator looks okay, use test leads and light and check as follows:

a. Raise grounded brush, check with test points from "A" terminal to frame. Light should not light. If it does, the generator is grounded; raise other brush from commutator and check field, commutator and brush holder to locate ground.

b. If generator is not grounded check field for open circuit.

c. If the field is not open, check for shorted field. Field draw at 6 volts should be 1.75 to 1.90 amperes. Excessive current draw indicates shorted field.

d. If trouble has not yet been located, remove armature and check on growler for short circuit.

2. UNSTEADY OR LOW OUTPUT

Check as follows:

a. Check drive belt tension.

b. Check brush spring tension and brushes for sticking.

c. Inspect commutator for roughness, grease and dirt, dirt in slots, high mica, out of round, burned bars. With any of these conditions, the commutator must be turned down in a lathe and the mica undercut.

In addition, with burned bars which indicate open circuit, the open circuit condition must be eliminated or the armature replaced.

3. EXCESSIVE OUTPUT

Excessive output usually results from a grounded generator field - grounded either internally, or in the regulator Opening the field circuit (disconnecting lead from "F" terminal of regulator or generator) with the generator operating at a medium speed will determine which unit is at fault. If the output drops off, the regulator is causing the condition. If the output remains high, the field is grounded in the generator, either at the pole shoes, leads, or at the "F" terminal.

4. NOISY GENERATOR

Noisy generator may be caused by loose mounting or drive pulley, or worn, dry or dirty bearings, or improperly seated brushes. Brushes may be seated by using brush seating stone, referred to under Normal Generator Maintenance.

Installation Caution

After the generator is reinstalled on the engine, or at any time after leads have been disconnected and then reconnected to the generator, a jumper lead should be connected MOMENTARILY between the BATTERY and ARMATURE terminals of the regulator, <u>before starting the engine</u>. This allows a momentary surge of current from the battery to the generator which correctly polarizes the generator with respect to the battery it is to charge.

HEADLIGHTS

Sealed-Beam Headlights

The optical parts are so constructed that the light source, reflector, lens, and gasket are all assembled in one complete, securely sealed unit.

Among the advantages of Sealed-Beam head lights are: (a) relief from glare in "TRAFFIC (LOWER) BEAM" because of better light distribution; (b) maintained lighting efficiency since the optical parts of the unit are permanently sealed against dirt, moisture, and corrosion; (c) longer-lived filaments: (d) replacement of complete optical unit in field assures original lighting efficiency, thereby avoiding poor lighting results through use of improper lens, reflectors, or bulbs.

Sealed-Beam headlights provide two separate and distinct beams and produce considerable more light than former-type headlights. There is a "COUNTRY (UPPER) BEAM" and a "TRAFFIC (LOWER) BEAM.

The "COUNTRY (UPPER) BEAM" is designed to give even road illumination for a considerable distance and is intended for use on the open highway when other vehicles are not approaching.

The "TRAFFIC (LOWER) BEAM" is intended for use in traffic. It is low enough on the left side to avoid glare in the eyes of oncoming drivers, and at the same time the distribution of light on the right side will illuminate the road as far ahead as practical without causing glare on curves.

Changing from "COUNTRY (UPPER) BEAM" to "TRAFFIC (LOWER) BEAM" is accomplished through use of the foot dimmer switch. CAUTION: Always use the "TRAFFIC (LOWER) BEAM" when meeting other vehicles.

Replacements (Sealed-Beam Units)

Should a filament burn out or a lens break, the entire Sealed-Beam unit must be replaced. Maximum lighting efficiency is thus assured. The added cost of the replacement unit will be balanced or offset by the longer-lived filament used in the construction of the sealed unit.

Replacement of a bulb or lens is accomplished only through the replacement of the entire unit. To do this:

1. Loosen door retaining screw on headlight body. Remove door. (See Fig. 1.)

Fig. 1 - Removing headlight door.

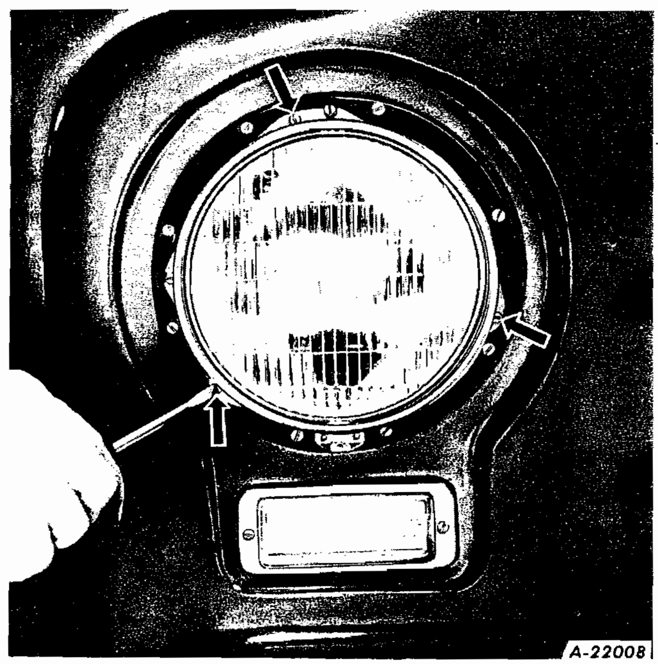


Fig. 2 - Remove retainer ring screws.

2. Remove unit retaining ring by removing three screws. (See Fig. 2.)
3. Remove unit from headlight body and disconnect three-way connector at the rear. (See Fig. 3.)

Reassembly is accomplished by reversing the foregoing procedure.

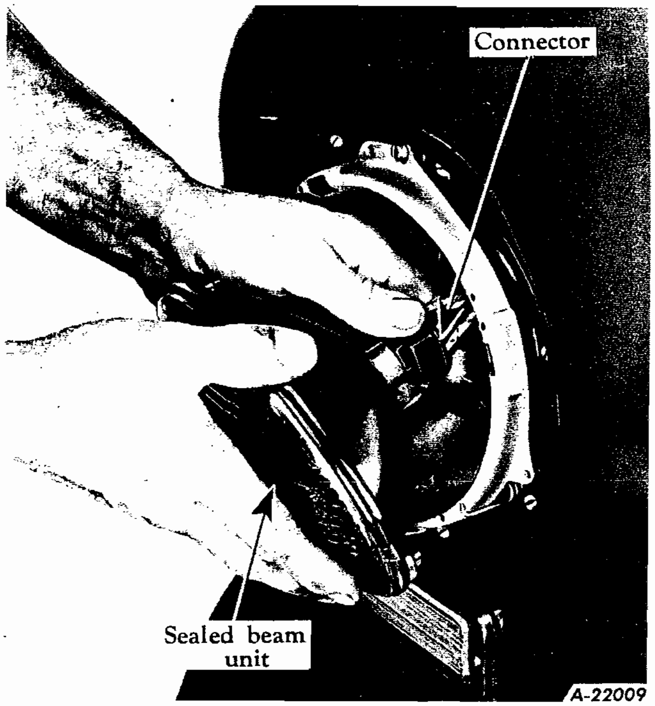


Fig. 3 - Removing sealed-beam unit.

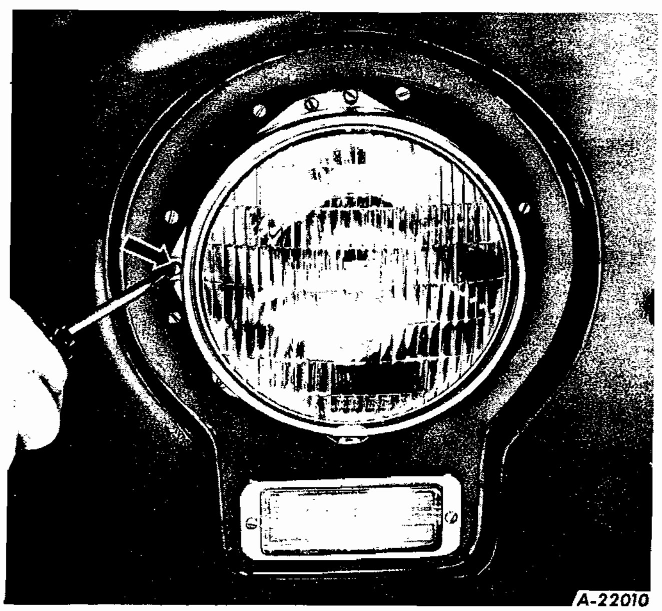


Fig. 4 - Adjusting lateral or side beam.

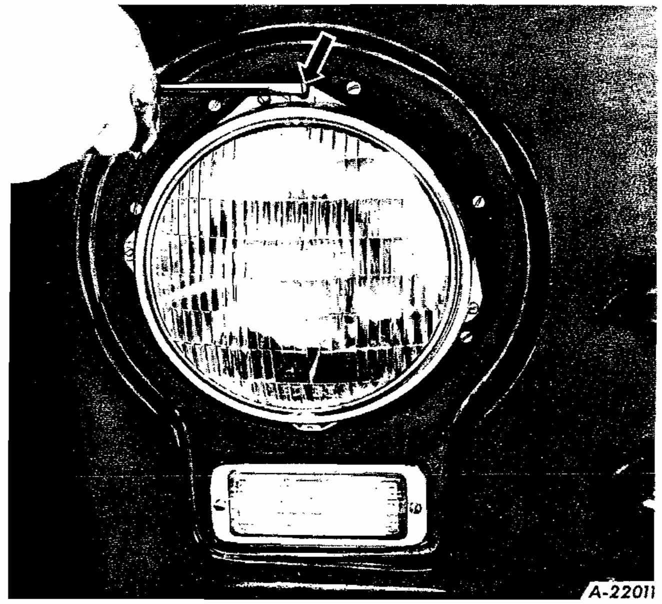


Fig. 5 - Adjusting vertical beam.

Vertical or up-and-down adjustment is accomplished at screw in Fig. 5.

When suitable headlight testing equipment is not available, the following chart will be helpful.

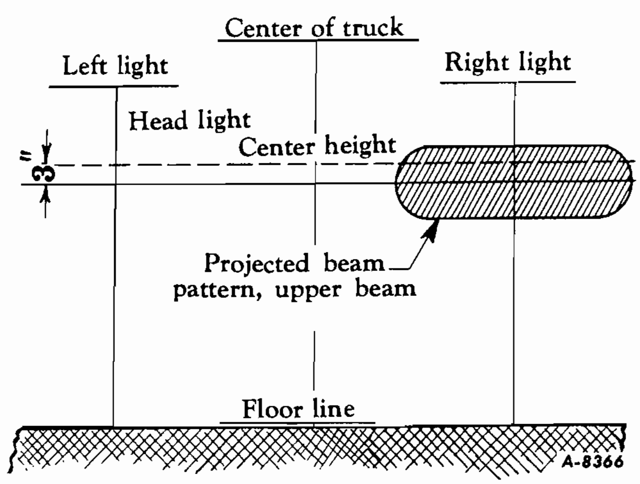


Fig. 6

Adjustment

Headlight adjustment should always be effected on a level floor, otherwise aiming of projected beams will be inaccurate. Truck should be empty.

Laterial or side adjustment is accomplished at screw in Fig. 4.

Aiming of headlights of Sealed-Beam type is effected by projecting the "COUNTRY (UPPER) BEAM" of each individual headlight upon a screen or chart at a distance of twenty-five feet from the headlight. The truck should be squarely lined up with the screen. Vertical lines on the chart mark the distance between the center lines of the headlights and are equally spaced from the center line of the chart.

A horizontal line on the chart shall be placed at a level 3 inches below the height of the headlight centers above the floor. Each headlight must be adjusted so that the hot spot of the beam will be centered over the point of intersection of the vertical and horizontal lines. (In some states this aiming conflicts with existing laws and regulations; wherever such is the case the legal requirements control and these instructions should be modified accordingly.)

Fig. 6 illustrates the beam pattern to be attained.

PARKING LIGHTS

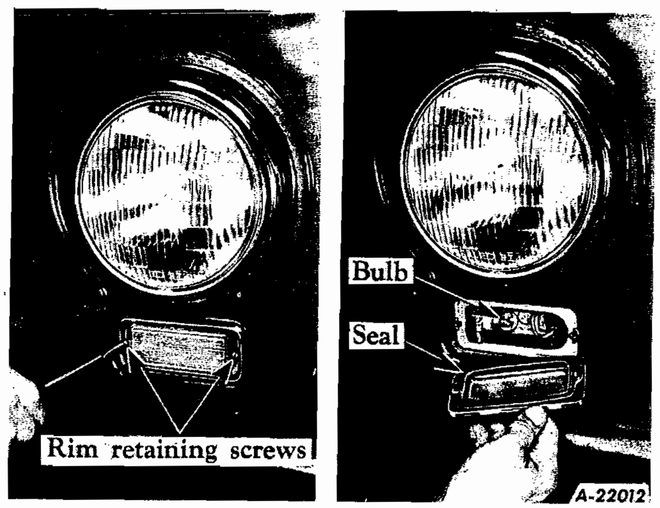


Fig. 7

The parking lights, located just below the headlights, are equipped with ordinary filament bulbs. Should it become necessary to replace either a parking light lens or bulb, remove the rim retaining screws, as shown, replace the necessary parts and reassemble.

CIRCUIT BREAKERS

Independent current circuit breakers are used to protect the headlight high-and-low beam circuits, parking lights, tail lights, stop lights, and horn circuits from possible damage should a short circuit occur.

Each circuit breaker is a sealed non-adjustable unit and consists of a bi-metal plate, contact points, and is connected in series with its respective circuit.

Six (6) circuit breakers and two (2) terminal blocks are included in the assembly as illustrated in Fig. 8, and are located on the vehicle at the engine side of the cab dash panel. The circuit breakers and terminal blocks are similar in outward appearance but different in inward construction and function. Circuit

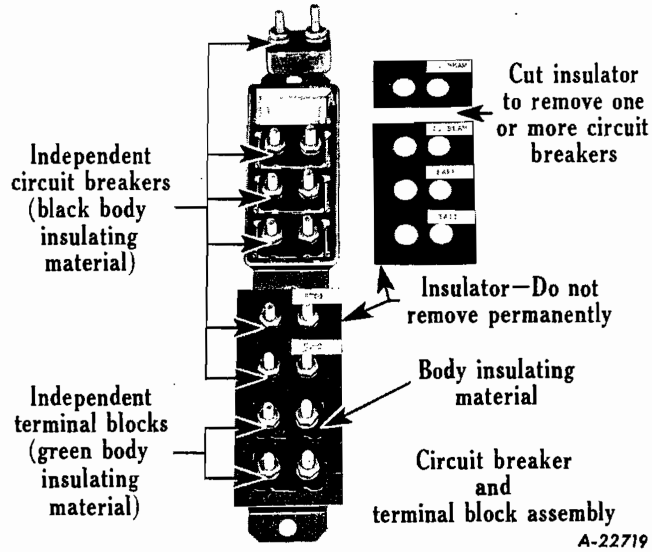


Fig. 8 - Circuit breakers.

breakers can be identified by their "green" color body insulating material, whereas terminal blocks have "black" color body insulating material.

The headlight upper beam circuit and lower beam circuit have independent circuit breakers to eliminate failure of both circuits at the same time should a short occur. For example: Should a short occur in the headlight upper beam circuit, the lower beam circuit would not be affected and could be utilized immediately by depressing the dimmer switch.

Individual replacement of a circuit breaker can be accomplished by disconnecting cables and cutting the insulator between the circuit breakers as shown in Fig. 8. Remove circuit breaker from frame by pulling on terminal screws with pliers. To install, press circuit breaker into frame by hand.

A dead short in a circuit will cause the circuit breaker bi-metal plate to heat sufficiently and pull away from its contact points immediately cutting off the flow of current. A partial short will cause intermittent current flow causing the lights to dim and flicker, this should be taken as a warning and the vehicle brought to a safe stop as soon as possible.

In other units in addition to headlights, a dead short can be detected by the ammeter indicating a heavy discharge momentarily until such time as the circuit breaker opens and the circuit is broken. A partial short can be detected by abnormal fluctuation of the ammeter. The two (2) terminal blocks in the assembly are used to connect circuits for fuel guage units, dimmer switch feed cable, side mounted fuel tanks, fog lights, directional signals, etc.

Testing The Circuit Breaker

Should current-flow in one of the circuits employing a circuit breaker be interrupted, it is possible that there is a short in the circuit or that the circuit breaker is defective and is holding open. To check for current-flow through the circuit breaker remove the cables from both circuit breaker terminals and connect a hot lead cable to the circuit breaker terminal marked "BAT" and a test light to the remaining terminal marked "AUX". If test light fails to light, the circuit breaker is defective and should be replaced.

LIGHT SWITCH REMOVAL (DELCO-REMY)

1. Pull light switch knob outward to headlight bright position.
2. Depress shaft release button (Fig. 9) on switch body and pull switch knob and shaft out of switch body.
3. Remove ferrule nut by positioning a punch in one of the indentations in nut face, and tap punch lightly turning nut in a counter-clockwise direction.
4. Unscrew switch retainer nut (also shaft bushing) out of switch.
5. Remove various electrical cables from switch.
6. The light switch pull knob can be removed by inserting a thin tool in the small hole in the knob, and pushing the spring lock inside the knob forward (toward knob end of switch). Hold spring lock in forward position and pull knob off of shaft.
7. Installation of the light switch follows:
8. Install electrical cables.
9. Align flat on switch shaft with flat in rheostat assembly in switch (see Fig. 9) and push light switch shaft into its bore in switch body. Install switch retainer nut and ferrule nut. Use same method for installing ferrule nut as prescribed for removal except turn nut clockwise.
10. Align flat on light switch knob with flat on shaft and push knob on shaft by following detailed instructions outlined below:

Instructions for Installing Control Knobs.

Place the control knob in position on the shaft until the end of the shaft just begins to engage the locking hole in the tab portion of the knob retainer spring. (Upon engagement with the retaining spring, the knob cannot be easily pushed into position since the spring, contacting the end of the shaft, prevents further movement).

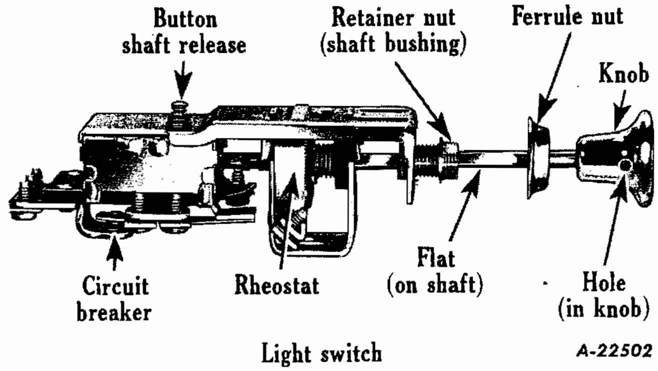


Fig. 9

With the knob in position as shown (Fig. 10) and with the end of the thumb at the top edge of the knob face, press the knob with a combination lifting and pushing motion, performed simultaneously, into position on the shaft.

The lifting motion serves to deflect the knob retainer spring tab, and the pushing motion forces the knob into position.

Installation of the control button on the windshield wiper switch requires that the above instruction be carried out in detail, since unreasonable pressure against the shaft of the windshield wiper switch is apt to damage the switch mechanism. When the control knobs are installed as instructed, no difficulty should be experienced and the operation can be performed with ease.

NOTE: The carburetor hand throttle control knob, the windshield wiper control knob, and the choke wire control knob are removed in the same manner as prescribed for the light switch control knob.

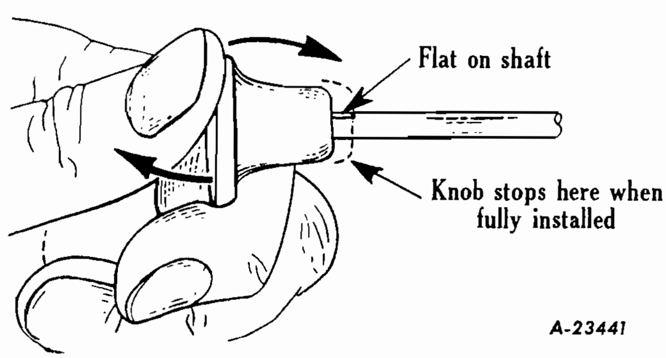


Fig. 10

HORN

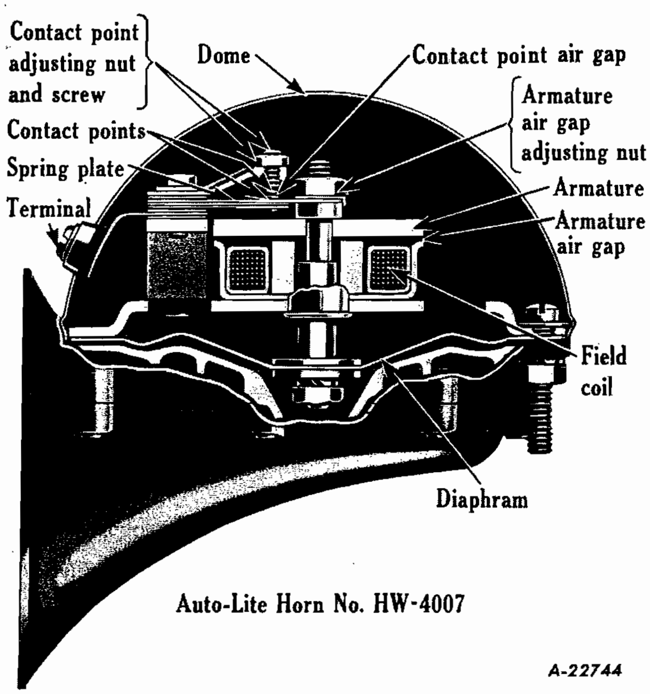


Fig. 1

Electrically Operated Horn

The electrically operated horns are vibrating type units that operate on a magnetic principle to produce the warning signal. Current from the battery flows through the windings within the horn power plant when the circuit is completed at the horn push-button switch. The magnetic attraction of the armature toward the pole causes a tension and slight movement of the diaphragm. This movement opens the contact points in series with the horn windings, breaking the circuit. When the current is interrupted, the armature returns to its original position, relieving the tension of the diaphragm. The slight return movement of the armature and diaphragm allows the contact points to close, completing the circuit. This cycle is repeated a great many times per second, resulting in a rapid vibration of the diaphragm. Each horn is designed to operate at a predetermined number of cycles per second to produce its characteristic warning signal. The pitch of the horns depends upon the number of vibrations per second, the high note horns having the greater frequency.

Conditions Affecting Horn Performance

The following conditions affect the performance of the horns and should be checked before attempting to make any adjustments to the instruments:

Low Horn Voltage

If the horn produces a weak signal, the voltage at the horn should be checked. Connect a voltmeter from the horn terminal to ground when checking horns having one terminal. Connect the voltmeter across the horn terminals when checking horns having two terminals. The voltage readings should not be less than 5.25 volts (six-volt system) or 11 volts (twelve-volt system). A lower reading would indicate either a low battery or a high resistance in the horn circuit.

Low Battery

Check the battery with a voltmeter or hydrometer for condition of charge. If low, the battery should be recharged.

Loose or Corroded Connections in Horn Circuit

Clean and tighten connections wherever necessary. Check for defective wiring by connecting separate test leads from the horn to the battery. A loose connection or poor contact at the horn push-button switch may cause the horn to operate intermittently. Shunt around the horn button to determine whether there is poor contact at the push-button switch.

Loose or Damaged Parts

Horns usually have a rasping sound when vital parts are loose or broken. A loose dome may affect the tone. Tighten all mounting nuts and replace all damaged parts.

Adjustment (For Auto-Lite Horn No. HW-4007)

1. Remove the horn dome. To remove, pry under the edge of the dome with a screwdriver at a point approximately opposite the terminal. On horns using a gasket under the dome, place the screwdriver between the dome bead and the projector and loosen with a twist of the screwdriver.

2. It is important that the horn circuit breaker contact points be kept clean. Rub briskly with crocus cloth, then clean with linen tape and carbon tetrachloride. Remove all residue by drawing a piece of clean tape between the contacts.

3. Tighten all flange bolts.

4. Tighten the two screws holding the circuit breaker, with a socket wrench. Be sure contacts are aligned and that the circuit

breaker spring does not rub against the armature bolt.

5. Check the resistance of the resistor which is connected across the contact points. Its resistance should be 2.5 to 2.8 ohms and is measured by placing a card between the contacts and measuring across the resistor terminals.

6. Check the armature air gap on all sides. Adjust to .0495" by loosening the lock nut and turning the armature. Tighten the lock nut, then recheck the gap making sure the gauge is a snug fit on all sides.

   NOTE: Sometimes the armature spring plate sticks to the armature and prevents it from turning. To loosen, tap the armature spring plate lightly with a screwdriver.

7. Connect for tuning test with the ammeter in series with the horn terminal and a 6 volt battery and the horn frame grounded to the other battery terminal. Connect the voltmeter from the horn terminal to a clean spot on the horn frame. Adjust the amperage draw for each horn to 15 amperes at 6.2 volts by loosening the lock nut on the circuit breaker contact and turning the adjusting screw. Retighten the lock nut.

Horn Relay

The horn relay is connected into the horn and battery circuit so as to make a more direct connection between the battery and horns, eliminating the horn button wiring from the horn circuit proper so that higher voltage becomes available at the horns and better horn performance is obtained. The horn relay consists of a winding assembled on a core above which an armature is placed. The armature has a point positioned above a stationary point.

Horn Relay Operation

When the horn button is depressed, the circuit from the battery is completed through the horn relay winding; this causes a magnetic field which pulls the relay armature down so that the circuit between the battery and horns is completed. The horns function and will continue to function as long as the horn button remains in the closed position.

Horn Relay Checks and Adjustments

Three checks and adjustments are required on the horn relay: air gap, point opening and closing voltage. The air gap and contact point opening checks and adjustments should be made with the battery disconnected.

Air Gap

The air gap should not normally require adjustment unless the relay has been misadjusted. Check the air gap with the points barely touching and adjust if necessary by bending the lower point support.

Contact Point Opening

Check the contact point opening and adjust by bending the upper armature stop.

Closing Voltage

To check the relay closing voltage, connect a variable resistance of 10 ohms in series with the relay "B" terminal and connect a voltmeter between the "S" and the "B" terminals as shown in Fig. 2. With the horn button closed, slowly decrease the amount of resistance in order to check the relay closing voltage. Adjust the closing voltage by bending the armature spring post. Bending down to increase the spring tension increases the closing voltage while bending up decreases the closing voltage.

NOTE: Late type horn relay terminals do not carry any markings, but relationship of the terminals is as shown in Fig. 2.

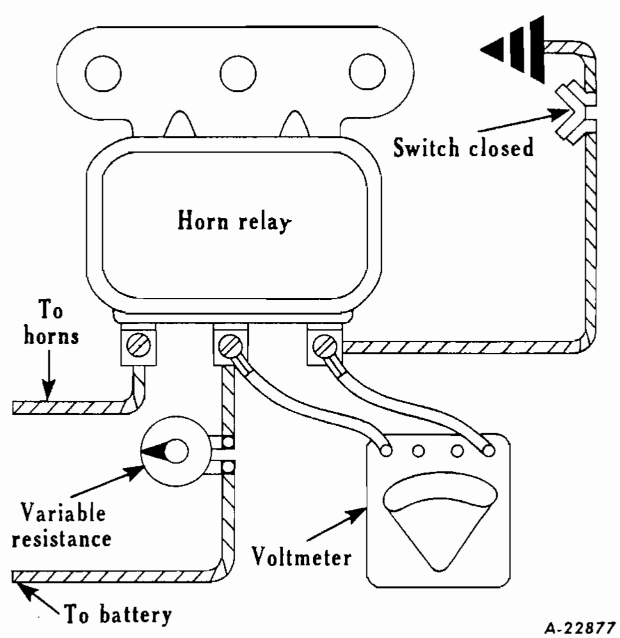


Fig. 2

REGULATORS

Three-Unit Regulator

The Delco Remy three-unit regulator is designed for use with shunt-type generators with externally grounded field circuits. The regulator contains a cutout relay, a voltage regulator, and a current regulator (Fig. 1.)

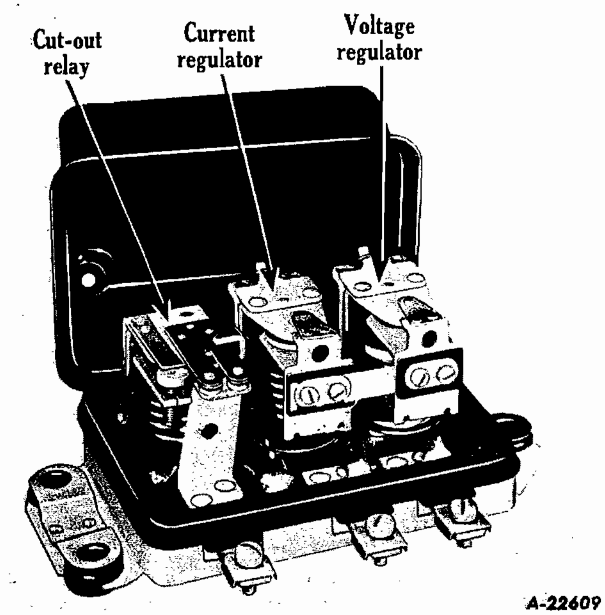


Fig. 1 - Three-unit regulator. Cover removed to show the Cut-out relay, Current regulator and Voltage regulator.

Cutout Relay

The cutout relay has two windings assembled on one core, a series winding of a few turns of heavy wire and a shunt winding of many turns of fine wire. The shunt winding is shunted across the generator so that generator voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that generator output passes through it (Fig. 2.)

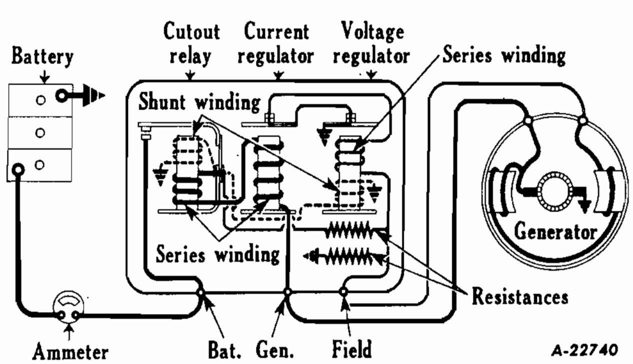


Fig. 2 - Wiring circuit of three-unit regulator.

The relay core and windings are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is centered just above the end of the core. The armature has one or two contact points which are located just above a similar number of stationary contact points. When the generator is not operating the armature contact points are held away from the stationary points by the tension of a flat spring riveted on the side of the armature.

CUTOUT RELAY ACTION--When the generator voltage builds up to a value great enough to charge the battery, the magnetism induced in the relay windings is sufficient to overcome the armature spring tension and pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in the proper direction to add to the magnetism holding the armature down and the contact points closed.

When the generator slows down or stops, current begins to flow from the battery to the generator. This reverses the direction that the current flows through the series winding, thus causing a reversal of the series winding magnetic field. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now magnetically oppose so that the resultant magnetic field becomes insufficient to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

VOLTAGE REGULATOR ACTION--When the generator voltage reaches the value for which the voltage regulator is adjusted, the magnetic field produced by the two windings (shunt and series) overcomes the armature spring tension and pulls the armature down so that the contact points separate. This inserts resistance into the generator field circuit so that the generator field current and voltage are reduced. Reduction of the generator voltage reduces the magnetic field of the regulator shunt winding. Also, opening the regulator points opens the regulator series winding circuit so that its magnetic field collapses completely. The consequence is that the magnetic field is reduced sufficiently to allow the spiral spring to pull the armature away from the core so that the contact points again close. This directly grounds the generator field circuit so that generator voltage and output increase. The above cycle of action again takes place and the cycle continues at a rate of 150 to 250 times a second, regulating the voltage to a constant value. By thus maintaining a constant voltage the generator supplies varying amounts of current to meet the varying states of battery charge and electrical load.

CURRENT REGULATOR ACTION--When the load demands are heavy, as for example, when electrical devices are turned on and the battery is in a discharged condition, the voltage may not increase to a value sufficient to cause the voltage regulator to operate. Consequently, generator output will continue to increase until the generator reaches rated maximum. This is the current value for which the current regulator is set. Therefore, when the generator reaches rated output, this output flowing through the current regulator winding, creates sufficient magnetism to pull the current regulator armature down and open the contact points. With the points open, resistance is inserted into the generator field circuit so that the generator output is reduced.

As soon as the generator output starts to fall off, the magnetic field of the current regulator winding is reduced, the spiral spring tension pulls the armature up, the contact points close and directly connect the generator field to ground. Output increases and the above cycle is repeated. The cycle continues to take place while the current regulator is in operation 150 to 250 times a second, preventing the generator from exceeding its rated maximum.

When the electrical load is reduced (electrical devices turned off or battery comes up to charge), then the voltage increases to that the voltage regulator begins to operate and tapers the generator output down. This prevents the current regulator from operating. Either the voltage regulator or the current regulator operates at any one time - the two do not operate at the same time.

Resistances

The current and voltage regulator circuits use a common resistor (Fig. 2) which is inserted in the field circuit when either the current or voltage regulator operates. A second resistor (Fig. 2) is connected between the regulator field terminal and the cutout relay frame, which places it in parallel with the generator field coils. The sudden reduction in field current occuring when either the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic field changes. These surges are partially dissipated by the two resistors, thus preventing excessive arcing at the contact points.

Temperature Compensation

Voltage regulators are compensated for temperature by means of a bi-metal thermostatic hinge on the armature. This causes the regulator to regulate for a higher voltage when cold which partly compensates for the fact that a higher voltage is required to charge a cold battery. Many current regulators also have a bi-metal thermostatic hinge on the armature. This permits a somewhat higher generator output is cold but causes the output to drop off as temperature increases.

Regulator Polarity

Some regulators are designed for use with negative grounded batteries while other regulators are designed for use with positive grounded batteries. Using the wrong polarity regulator on an installation will cause the regulator contact points to pit badly and give very short life. As a safeguard against installation of the wrong polarity regulator, all 1118300 type regulators have the model number and the polarity clearly stamped on the end of the regulator base.

REGULATOR MAINTENANCE

General Instructions

1. Mechanical checks and adjustments (air gaps, point opening) must be made with battery disconnected and regulator preferably off the vehicle.

CAUTION: The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units which would seriously damage them.

2. Electrical checks and adjustments may be made either on or off the vehicle. The regulator must always be operated with the type generator for which it is designed.

3. The regulator must be mounted in the operating position when electrical settings are checked and adjusted and it must be at operating temperature.

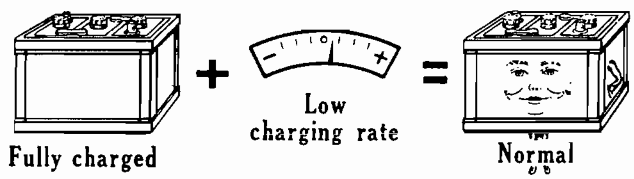
4. After any tests or adjustments the generator on the vehicle must be repolarized after leads are connected but before the engine is started, as follows:

Repolarizing Generator

After reconnecting leads, momentarily connect a jumper lead between the "GEN" and "BAT" terminals of the regulator. This allows a momentary surge of current to flow through the generator which correctly polarizes it. CAUTION! Failure to do this may result in severe damage to the equipment since reversed polarity causes vibration, arcing and burning of the relay contact points.

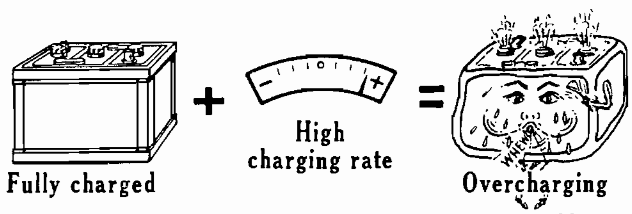
QUICK CHECKS OF GENERATOR AND REGULATOR

In analyzing complaints of generator-regulator operation, any of several basic conditions may be found.



A-22715

1. FULLY CHARGED BATTERY AND LOW CHARGING RATE--This indicates normal generator-regulator operation. Regulator settings may be checked as outlined on following pages.



A-22615

2. FULLY CHARGED BATTERY AND A HIGH CHARGING RATE--This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will damage the battery and the accompanying high voltage is very injurious to all electrical units.

   This operating condition may result from:

   (a) Improper voltage regulator setting.

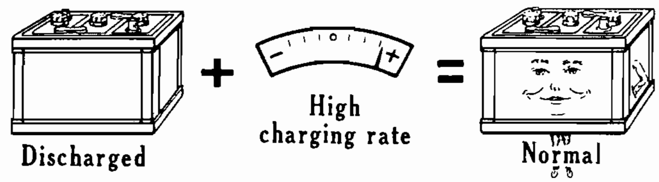
   (b) Defective voltage regulator unit.

   (c) Grounded generator field circuit (in either generator, regulator or wiring).

   (d) Poor ground connection at regulator.

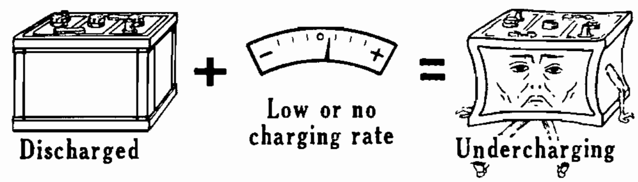
   (e) High temperature which reduces the resistance of the battery to charge so that it will accept a high charging rate even thouth the voltage regulator setting is normal.

If the trouble is not due to high temperature, determine the cause of trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring harness. If the output drops off the regulator is at fault and it should be checked for a high voltage setting or grounds.



A-22616

3. DISCHARGED BATTERY AND HIGH CHARGING RATE--This is normal generator-regulator action. Regulator settings may be checked as outlined in the following section



A-22614

4. DISCHARGED BATTERY AND LOW OR NO CHARGING RATE--

   This condition could be due to:

   (a) Loose connections, frayed or damaged wires.

   (b) Defective battery.

   (c) High circuit resistance.

   (d) Low regulator setting.

   (e) Oxidized regulator contact points.

   (f) Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, proceed as follows to locate cause of trouble.

To determine whether the generator or regulator is at fault, momentarily ground the "F" terminal of the regulator and increase generator speed. If the output does not increase, the generator is probably at fault. If the generator output increases, the trouble is due to:

   (a) A low voltage (or current) regulator setting.

   (b) Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that output remains low.

(c) Generator field circuit open within the regulator at the connections or in the regulator winding.

5. BURNED RESISTANCES, WINDINGS OR CONTACTS--These result from open circuit operation, open resistance units, or high resistance in the charging circuit. Where burned resistances, windings or contacts are found, always check car wiring before installing a new regulator. Otherwise, the new regulator may also fail in the same way.

6. BURNED RELAY CONTACT POINTS--This may be due to reversed generator polarity. Generator polarity must be corrected as explained on page 2 after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

Cleaning Contact Points

The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. On negative grounded regulators which have the flat contact point on the regulator armatures, loosen the contact bracket mounting screws so that bracket can be tilted to one side (Fig. 3). On positive grounded regulators, the flat point is in the upper contact bracket so the bracket must be removed for cleaning the points. A flat file cannot be used successfully to clean the flat contact points since it will not touch the center of the flat point where point wear is most apt to occur. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN THE CONTACT POINTS.

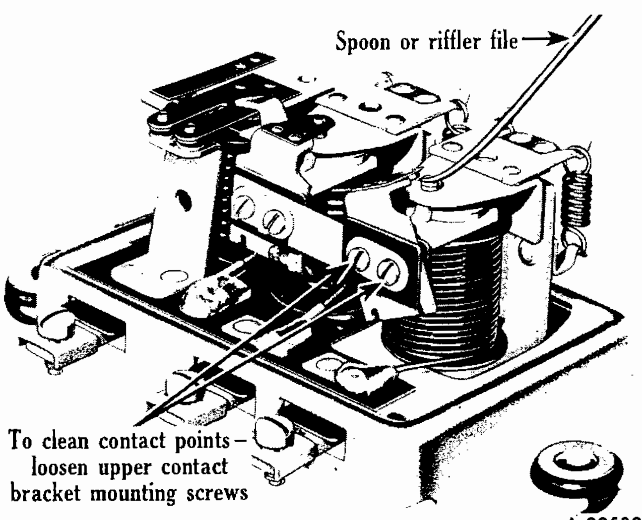


Fig. 3 - Use spoon or riffler file to clean flat contact points in regulator.

THREE-UNIT REGULATOR CHECKS AND ADJUSTMENTS

Cutout Relay

The cutout relay requires three checks and adjustments: air gap, point opening and closing voltage. The air gap and point opening adjustments must be made with the battery disconnected.

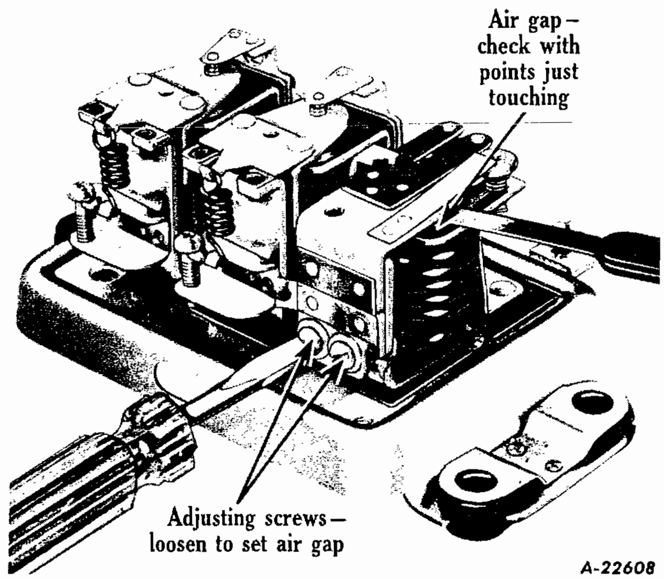


Fig. 4 - Air gap check and adjustment. Battery must be disconnected when this check is made.

AIR GAP--Place fingers on armature directly above core and move armature down until points just close and then measure air gap between armature and center of core (Fig. 4). On multiple contact point relays, make sure that all points close simultaneously. If they do not, bend spring finger so they do. To adjust air gap, loosen two screws at the back of relay and raise or lower the armature as required. Tighten screws after adjustment.

POINT OPENING--Check point opening and adjust by bending the upper armature stop (Fig. 5).

CLOSING VOLTAGE--To check the closing voltage of the cutout relay, connect the regulator to the proper generator and battery, connect a voltmeter between the regulator "GEN" terminal and regulator base, and connect an ammeter into the charging circuit at the regulator "BAT" terminal as shown in Fig. 6. Slowly increase the generator speed and note relay closing voltage. Decrease generator speed and make sure that cutout relay contact points open. Adjust closing voltage by turning adjusting screw (Fig. 7). Turn screw clockwise to increase spring tension and closing voltage, and turn screw counterclockwise to decrease closing voltage.

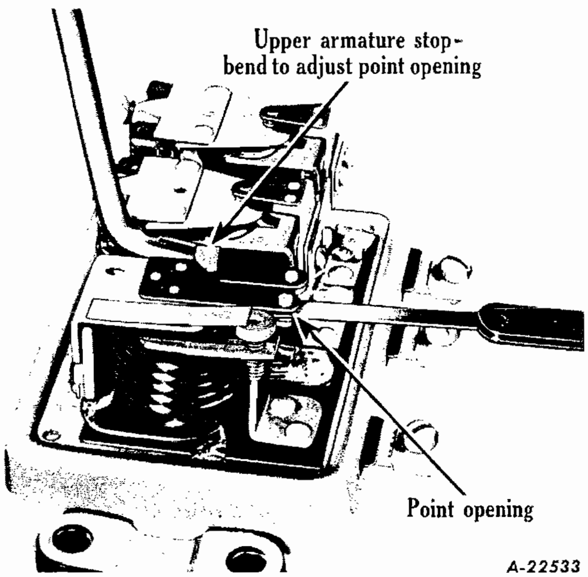


Fig. 5 - Cut-out relay point opening check and adjustment. Battery must be disconnected when this check is made.

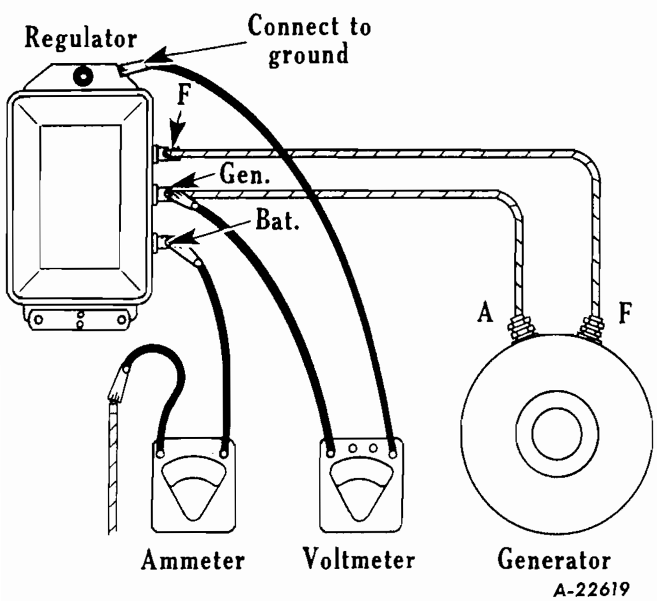


Fig. 6 - Connections to be made when checking relay closing voltage and reverse current to open relay points.

Voltage Regulator

Two checks and adjustments are required on the voltage regulator, air gap and voltage setting.

AIR GAP--To check air gap, push armature down until the contact points are just touching and then measure air gap (Fig. 13). Adjust by loosening the contact mounting screws and raising or lowering the contact bracket as required. Be sure the points are lined up, and tighten screws after adjustment.

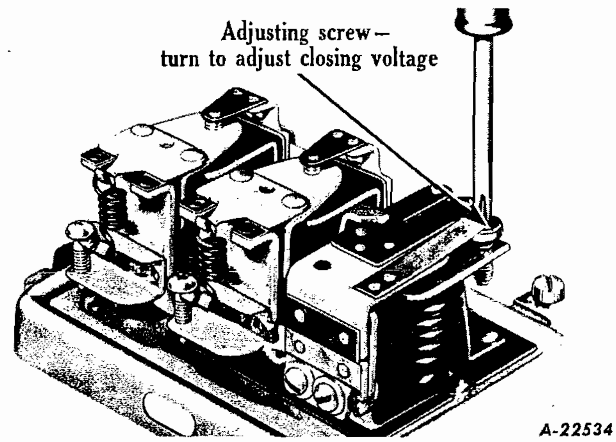


Fig. 7 - Adjusting cutout relay closing voltage.

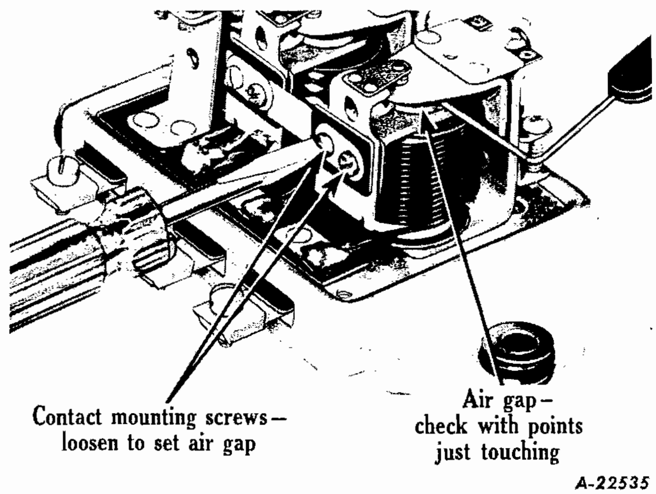


Fig. 8 - Voltage regulator air gap check.

VOLTAGE SETTING--There are two ways to check the voltage setting--the fixed resistance method and the variable resistance method (Figs. 9 and 10).

FIXED RESISTANCE METHOD--With the fixed resistance method, a fixed resistance is substituted for the external charging circuit by disconnecting the battery lead at the regulator and connecting the resistance between the regulator "BAT" terminal and ground. A test voltmeter is connected in parallel with the fixed resistance as shown in Fig. 9. The resistance must be 3/4 ohm* for 6 volt units, 1-1/2 ohms* for 12 volt units, 7 ohms for 24 volt units, and must be capable of carrying 10 amperes without any change of resistance with temperature changes.

* - See note on following page.

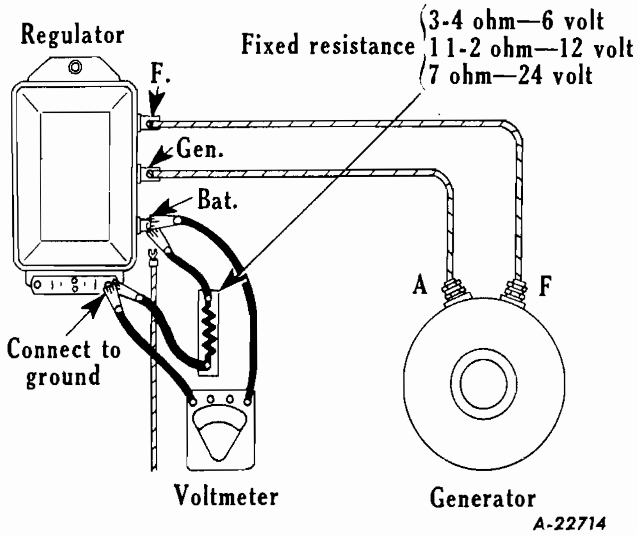


Fig. 9 - Fixed resistance and voltmeter connections to check voltage regulator setting by fixed resistance method. Connections are similar for both two-unit and three unit regulators.

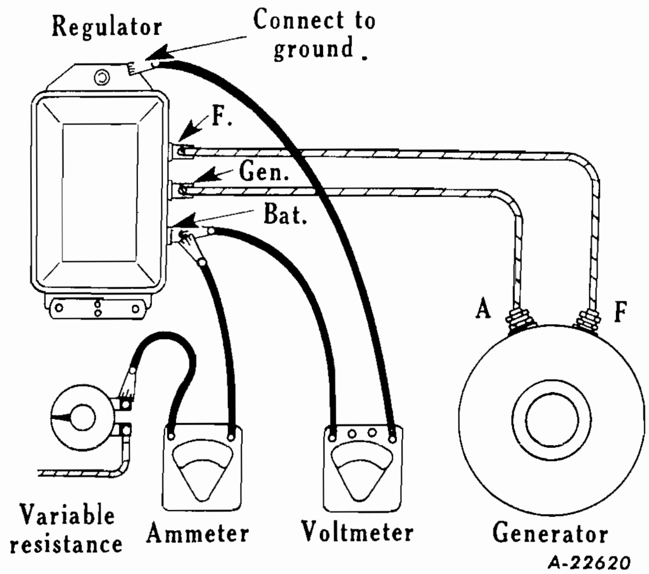


Fig. 10 - Voltmeter ammeter and variable resistance connections for checking voltage regulator setting by the variable resistance method.

*NOTE: With all 6 volt regulators having current ratings less than 15 amperes, it is necessary to use a 1-1/2 ohm fixed resistance to avoid interference from the current regulator. With all 12 volt regulators having current ratings less than 15 amperes, a 2-1/4 ohm fixed resistance (3/4 ohm and 1-1/2 ohm resistors in series) must be used for the same reason.

With generator operating 25 per cent above rated output speed and with regulator at operating temperature, note voltage setting. Cover must be in place.

To adjust voltage setting, turn adjusting screw (Fig. 11). Turn screw clockwise to increase voltage setting and counterclockwise to decrease voltage setting.

CAUTION: If adjusting screw is turned down (clockwise) beyond normal adjustment range, spring support may fail to return when pressure is relieved. In such case, turn screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of the unit should always be approached by increasing spring tension, never by reducing it. If setting is too high, adjust unit below required value, and then raise to exact setting by increasing spring tension.

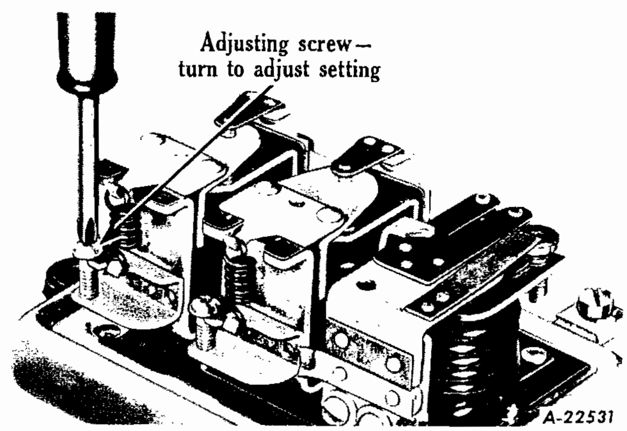


Fig. 11 - Adjusting voltage regulator setting.

If the unit is badly out of adjustment, refer to section headed REGULATOR SPRING REPLACEMENT.

After each adjustment and before taking voltage reading, replace the regulator cover, reduce generator speed until relay points open and then bring the generator back to speed again.

VARIABLE RESISTANCE METHOD--Connect ammeter into charging circuit at "BAT" terminal of regulator with 1/4 ohm variable resistance in series. Connect voltmeter from regulator "BAT" terminal to ground as shown in Fig. 10. Increase generator speed to 25 per cent above rated output speed. If less than 8 amperes is obtained (or less than 4 amperes on low output 6 and 12 volt generators), turn on lights to permit increased generator output. Cut in resistance until output is reduced to 8-10 amperes (4-6 amperes on 6 and 12 volt generators having current ratings less than 15 amperes). Operate until regulator reaches operating temperature. Retard generator speed until relay points open, then bring generator back to speed and note voltage setting. Voltage readings must be taken with regulator at operating temperature and with 8-10 amperes flowing (4-6 amperes on low output units). Cover must be in place.

NOTE: It is very important that the variable resistance be connected at the "BAT" terminal as shown in Fig. 10 rather than at the "GEN" terminal, even though these terminals are in the same circuit. An examination of the wiring diagram, Fig. 2, will show that the regulation begins at the point where the shunt windings are connected to the series circuit. Any small resistance added to the circuit between the generator and this point will simply be offset by a rise in generator voltage without affecting the output shown at the ammeter.

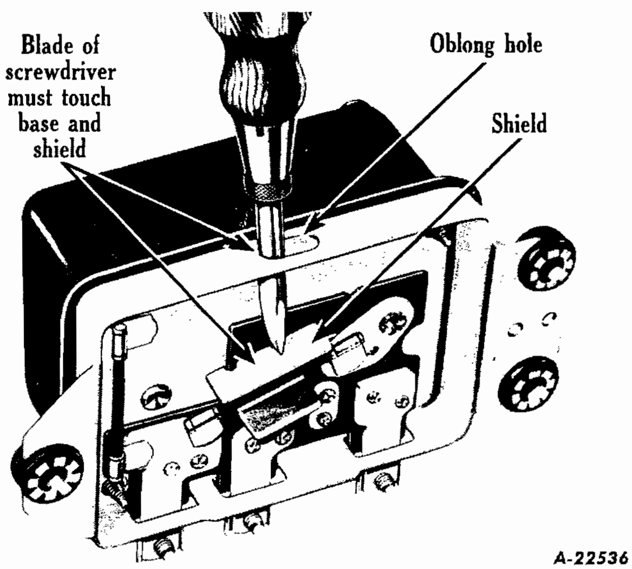


Fig. 12 - Quick method for cutting out voltage regulator in order to check current regulator setting.

Adjust regulator as previously explained. In using the variable resistance method, it is necessary to readjust the variable resistance after each voltage adjustment, and then reduce and increase generator speed before taking the voltage reading.

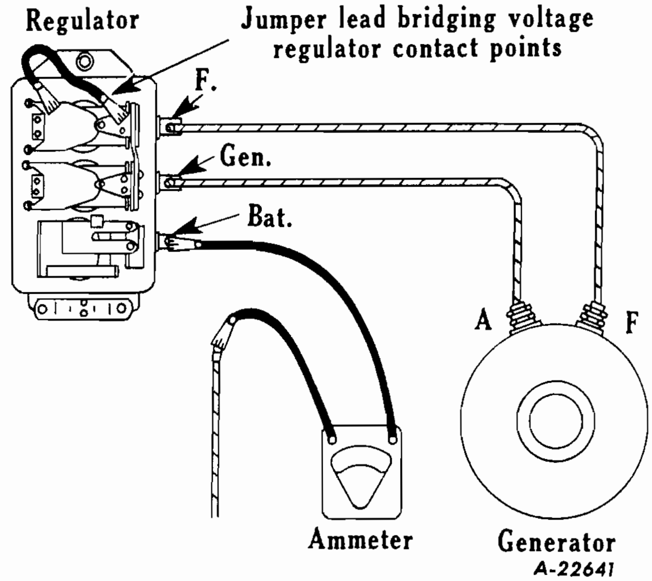


Fig. 13 - Ammeter and jumper lead connections for checking current regulator setting by the jumper lead method.

Current Regulator

Two checks and adjustments are required on the current regulator, air gap and current setting. The air gap on the current regulator is checked and adjusted in exactly the same manner as for the voltage regulator already described.

CURRENT SETTING--To check the current regulator setting, the voltage regulator must be prevented from operating. Four methods of preventing voltage regulator operation are available. Regardless of the method used, an ammeter must be connected into the charging circuit at the regulator "BAT" terminal. The first method should be used for preliminary checks whenever possible since it does not require removal of the regulator cover. The four methods are as follows:

1. QUICK CHECK METHOD--Insert screwdriver blade through oblong hole in base of regulator until contact is made with shield around resistor (Fig. 12). Be sure to keep screwdriver at right angles to base, and hold firmly in place during check so that blade touches regulator base and shield at same time. This temporarily cuts out voltage regulator unit. Turn on lights and accessories to prevent high voltage during the test.

With ammeter connected as in Fig. 13 and regulator at operating temperature, operate generator at 50 per cent above rated output speed, and note current setting. If necessary to adjust, remove cover and adjust in same manner as voltage regulator unit (Fig. 11) by turning adjusting screw clockwise to increase current setting or counterclockwise to decrease setting. See CAUTION note under Voltage Setting of Voltage Regulator. If unit is badly out of adjustment readjust as explained under REGULATOR SPRING REPLACEMENT.

2. JUMPER LEAD METHOD--Remove the regulator cover and connect a jumper lead across the voltage regulator contact points (Fig. 13). Turn on lights and accessories to prevent high voltage during the test. With generator operating 50 per cent above rated output speed and with regulator at operating temperature, note the current setting.

3. BATTERY DISCHARGE METHOD--Partly discharge battery by cranking the engine for 30 seconds with ignition turned off. Never use cranking motor more than 30 seconds continuously since this would overheat and damage it. Immediately after cranking, start engine, turn on lights and accessories and note current setting with engine operating 50 per cent above rated output speed.

4. LOAD METHOD--If a load approximating the current regulator setting is placed across the battery during the time that the current regulator setting is being checked, the voltage will not increase sufficiently to cause the voltage regulator to operate. This load may be provided by a carbon pile or a bank of lights.

REPAIR SECTION

Regulator Spring Replacement

If it becomes necessary to replace the spiral spring on either the current or voltage regulator unit, the new spring should first be hooked on the lower spring support and then stretched up until it can be hooked at the upper end. Stretch the spring only by means of a screwdriver blade inserted between the turns (or in a similar manner) - do not pry the spring into place as this is likely to bend the spring supports. After installing a new spring, readjust the unit setting as already described.

Replacing Contact Support Brackets

Voltage or current regulator contact support brackets can be replaced by following the relationship illustrated in Fig. 19. Note particularly that the connector strap is insulated from the voltage regulator contact mounting screws while it is connected to the current regulator contact mounting screws. New bushings should always be used when installing a contact support bracket since the old bushing may be distorted or damaged.

Radio By-Pass Condensers

The installation of radio by-pass condensers on the field terminal of the regulator or generator will cause the regulator contact points to burn and oxidize so that generator output will be reduced and a run-down battery will result. If a condenser is found to have been connected to either of these terminals, disconnect the condenser and clean the regulator contact points as previously explained.

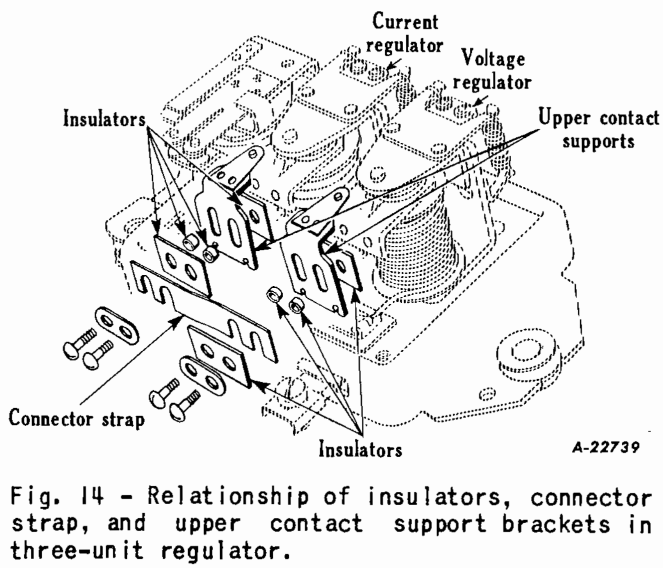


Fig. 14 - Relationship of insulators, connector strap, and upper contact support brackets in three-unit regulator.

SPARK PLUGS

The sole purpose of a spark plug is to create a spark between the electrodes to ignite the fuel in the engine. Therefore, if anything is wrong with the spark plug that will prevent its firing, all the other units in the electrical system will have functioned in vain.

From a cold start, a spark plug must operate under extremely high temperatures in just a few seconds, and must withstand repeated terrific explosion pressures. These conditions can be duplicated only in an engine. Therefore the only reliable test of a spark plug is to operate it in an engine under actual operating conditions.

Removal of Spark Plugs

A. Disconnect Ignition Wires:

Detach ignition wires from each spark plug. Most engines carry snap-on type connectors which simply pull off. Some have screw-type terminal connections in which case it is necessary to remove these terminal nuts before lifting off the ignition wires.

B. Select The Proper Size Deep Socket Wrench:

It is highly advisable to use the proper size deep socket type wrench to remove the spark plug from an engine. Improper wrenches are often the cause of spark plug insulator breakage.

C. Loosen Each Spark Plug Two Turns:

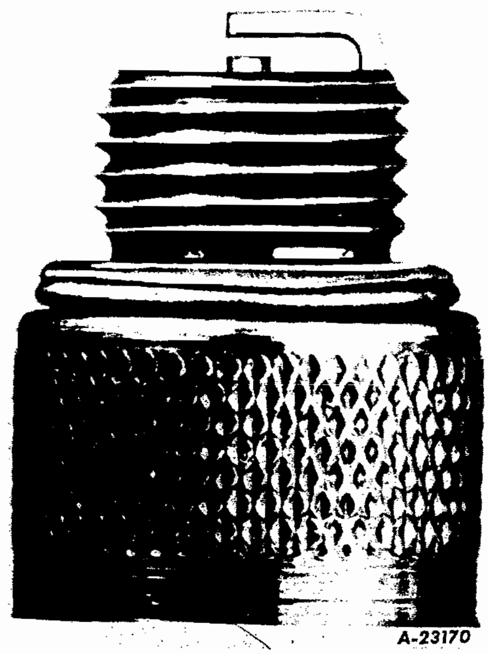
Using the proper size deep socket wrench (an extension shaft between wrench and handle is highly desirable), loosen each spark plug two complete turns only. All spark plugs loosen in a counter-clockwise direction.

D. Blow Out The Spark Plug Ports:

The action of loosening each spark plug two turns will also loosen any accumulation of dirt which may be embedded around the base of the spark plug. Use a blast of compressed air to remove this debris and prevent its falling into the cylinder combustion chamber when the spark plug is removed.

E. Remove Spark Plugs:

In most cases it is possible to remove each spark plug from the engine by hand. Place each spark plug and its gasket in a suitable holder in the order of removal from the engine.



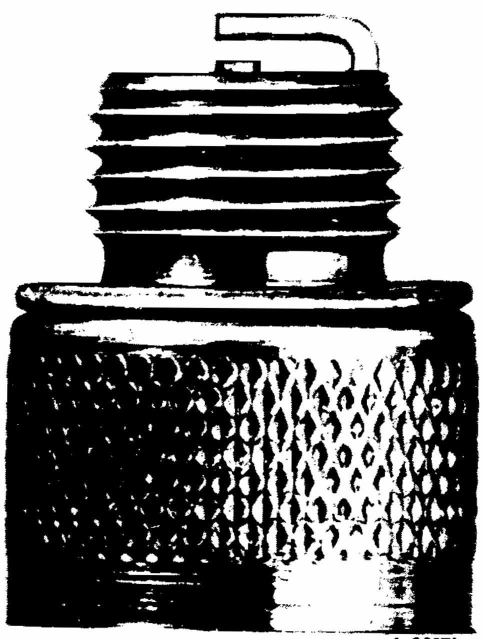
A-23170

Fig. 1

Visual Inspection

A. Gaskets:

If the gaskets are not flattened (Fig. 1) or compressed it is an indication that the spark plugs have not been properly tightened to prevent blow-by between the spark plug and cylinder head. This condition results in excessive burning of the electrodes and overheats the insulator tip which may cause preignition.

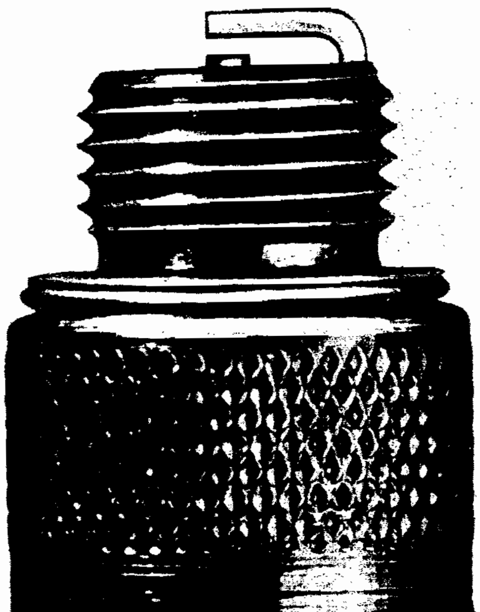


A-23171

Fig. 2

If the gaskets are flattened or compressed to the point where they have become distorted (out of round) or torn, it is an indication that the spark plugs have been tightened to the extent that damage may have been inflicted on the spark plug itself (Fig. 2).

Excessive torque often causes strains on the steel shell of the spark plug which result in cracked insulators, distortion of metal shell and gap setting, as well as blow-by between the component parts of the spark plug.



A-23172

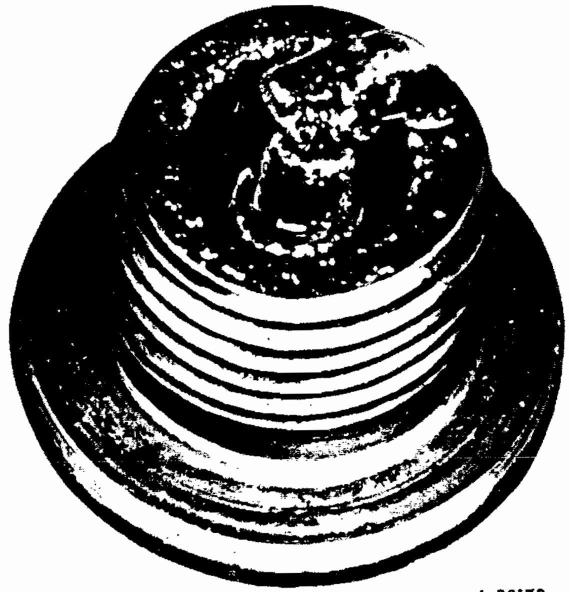
Fig. 3

If the gasket is properly compressed (approximately half of original thickness) showing a flat, clean, even surface, it is an indication that the spark plugs have been properly installed (Fig. 3).

B. Condition of Insulator (Firing End):

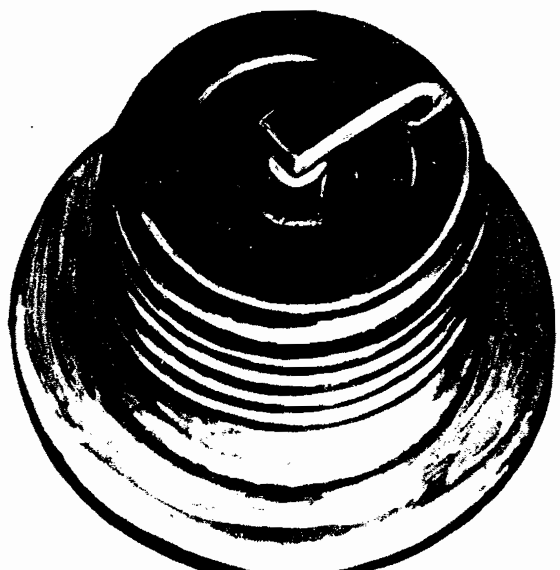
(1) OIL FOULING (Fig. 4) is usually identified by the wet, black shiny deposit which results from the following engine and spark plug conditions:

- Worn rings and pistons.
- Worn valve stems or guides.
- Weak battery.
- Faulty ignition wires.
- Distributor trouble.
- Weak coil.
- Too cold a spark plug.



A-23173

Fig. 4

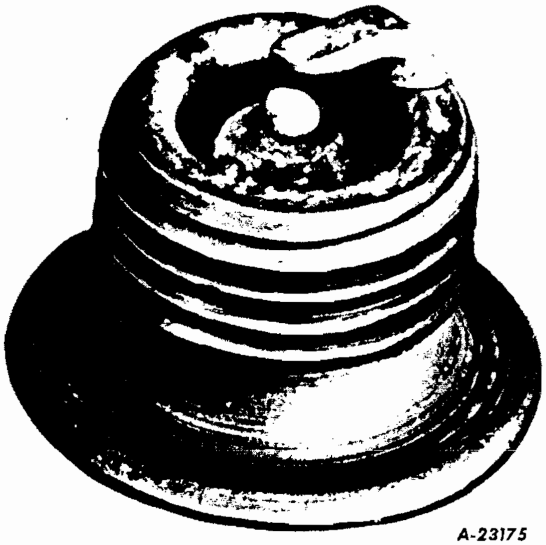


A-23174

Fig. 5

(2) GAS FOULING (Fig. 5) is usually identified by a black, dry fluffy deposit which results from:

- Excessive use of choke.
- Improper adjustment of automatic choke.
- Too rich an air-fuel mixture.
- Prolonged periods of engine idling.
- Too cold a spark plug.

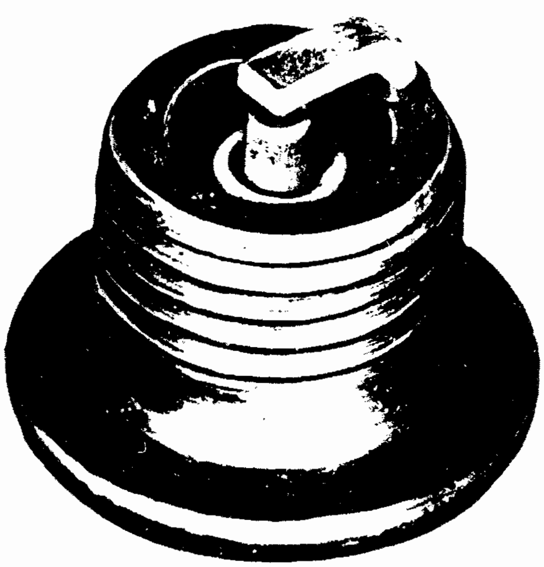


A-23175

Fig. 6

(3) BURNED OR OVERHEATED spark plugs (Fig. 6) are identified usually by dry, shiny, glassy deposits on the insulator, or cracks in the insulator tip itself, which result from:

Too lean an air-fuel mixture.
Inefficient engine cooling.
Poorly seated valves.
Improper ignition timing.
Too hot a spark plug for the service.
Improper installation of spark plugs.
Compression leakage through spark plug.



A-23176

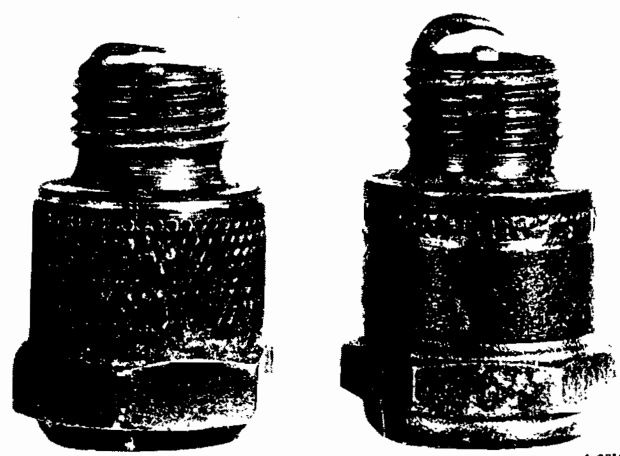
Fig. 7

(4) NORMAL CONDITIONS where regular or unleaded gasolines have been used, are identified by a rusty brown to grayish tan powdery deposit, indicating a balanced ignition and combustion condition (Fig. 7).

A-23177

Fig. 8

(5) NORMAL CONDITIONS where highly leaded gasolines have been used, are identified usually by white powdery or yellowish glazed deposits (Fig. 8). Such deposits or "encrustments" do not interfere with spark plug operation and should merely be cleaned off at regular service intervals.



A-23169

Fig. 9

C. Conditions Of Electrodes:

The extent of service and mileage to which a spark plug has been subjected is generally best indicated by the degree of wear of the electrodes. When the center electrode has become worn away, or the ground electrode has become so badly eroded at the sparking area that resetting of the gap is either difficult or impossible, the spark plug is not fit for further efficient engine service even if cleaned.

D. Preliminary Examination:

If the spark plug in question exhibits insulator cracks, worn electrodes or other obviously unsatisfactory conditions, the spark plug does not warrant further attention and should be discarded.

Cleaning And Adjusting

A. Remove Gaskets:

Regardless of the condition of the old gaskets, they should be removed from the spark plug before cleaning. If new replacement gaskets are available the old ones should be discarded.

B. Degrease (If Necessary):

Before abrasive cleaning, any spark plugs which have oily deposits on the firing end or the outside of the spark plug should be degreased by brushing with gasoline, naptha or other suitable solvent which will dry quickly by wiping with a cloth or by air blast. Failure to do this with oil fouled spark plugs will result in packing of the cleaner abrasive inside the firing end of the spark plug.

C. Apply Abrasive Blast:

Place the spark plug in the rubber cleaner adapter of the correct size. Hold the spark plug at the terminal end and while applying the abrasive blast, "wobble" the top of the spark plug in a circle. By this method the abrasive will be able to properly clean the insulator tip and the electrodes. Three seconds time should be sufficient to clean most spark plugs. However, the extent of cleaning time should be limited to only that which is necessary to clean off the deposits on the insulator nose. Prolonged use of the abrasive blast will wear away the insulator causing irreparable damage to the spark plug. Visual inspection will indicate when the spark plug has been properly cleaned. Loose abrasive remaining inside the firing end should be removed by the use of the "air blast" jet on the cleaner. Do not use picks, screwdrivers, etc. to remove deposits inside the firing end of the spark plug.

D. Clean Threads:

Remove loose abrasive or other foreign material from the spark plug threads by means of a wire brush (a stiff tooth brush is also satisfactory) to complete the job of cleaning.

E. Dress Spark Plug Gaps:

Before actually setting the gap of a cleaned spark plug it is highly desirable to pass a thin point file or nail file between the sparking areas of the center and ground electrodes. This helps to produce flat, parallel surfaces which resist growth better than sharp or uneven areas, and facilitates more accurate gap gauging.

F. Reset Spark Plug Gaps:

Reset all gaps by moving the ground (or side) electrode only. Do not touch the center electrode as insulator tip fracture may result.

Bend the ground electrode towards the center electrode.

Use a good feeler gauge to measure the clearances between the electrodes. Refer to specifications for correct gap settings.

A very slight drag should be felt when the feeler gauge passes between the electrodes.

The spark plug is now ready for testing.

SUITABLE SPARK PLUG CLEANING EQUIPMENT IS AVAILABLE UNDER SE-1634 AND SE-1637. BOTH ITEMS ARE ABRASIVE TYPE CLEANERS.

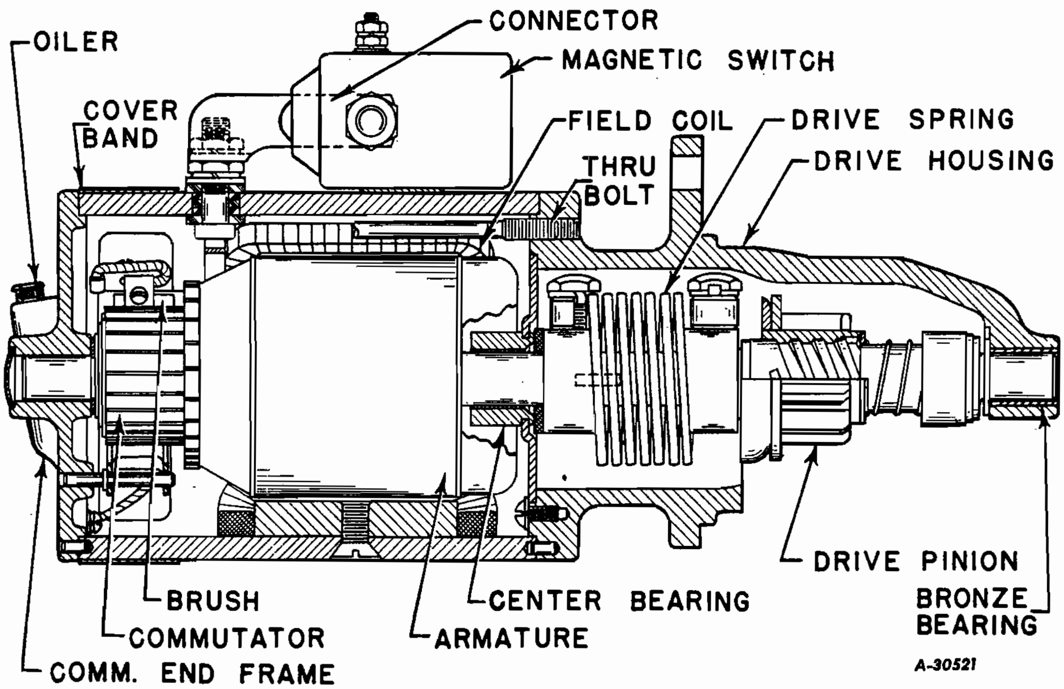


Fig. 1 - Starter (Delco-Remy 1108009)

STARTING MOTORS - (CRANKING MOTORS)

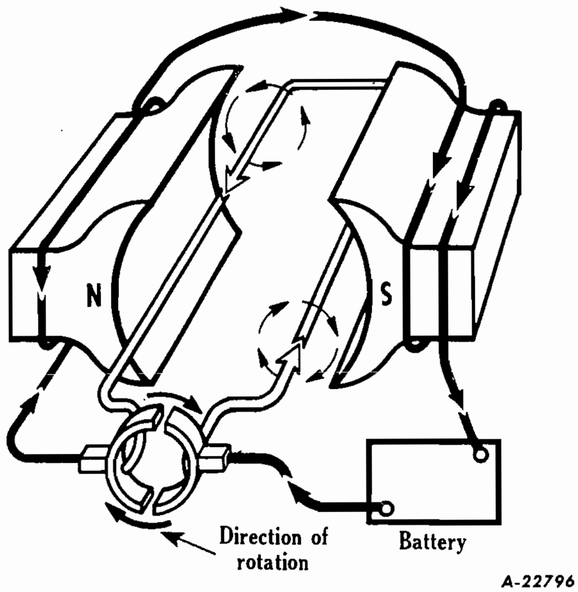


Fig. 1 - Wiring diagram of simple electric motor. Showing current flow. The armature windings and field windings are connected in series. Delco-Remy starter motors are all series-wound units.

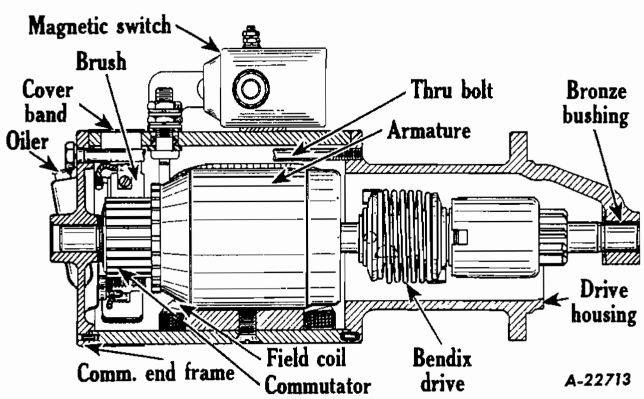


Fig. 2 - Delco-Remy Starter 1107074.

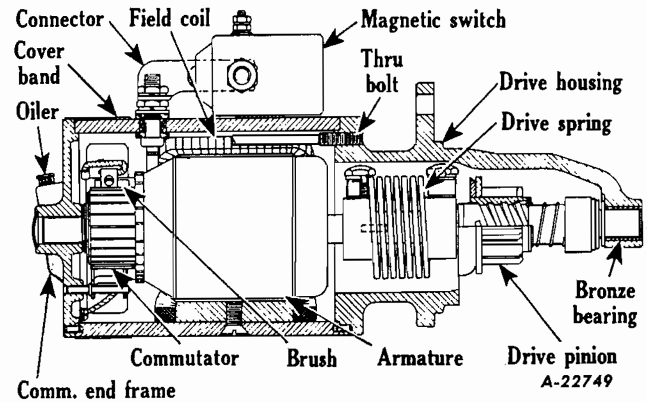


Fig. 3 - Delco-Remy Starter 1107967.

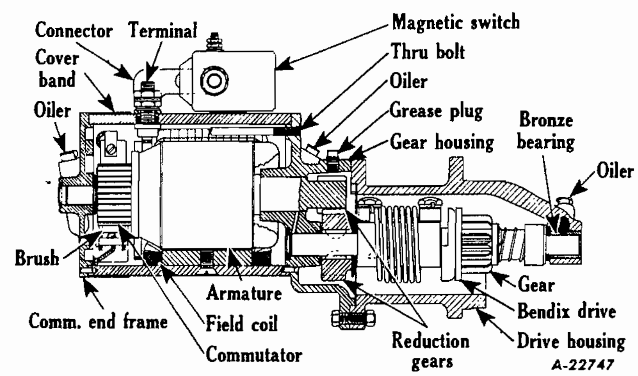


Fig. 4 - Delco-Remy Starter 1108217.

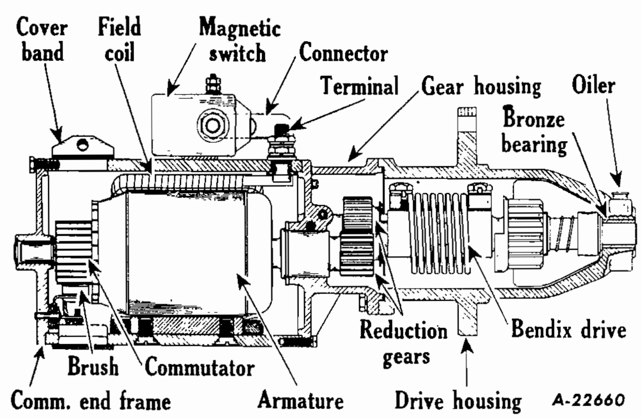


Fig. 5 - Delco-Remy Starter 1109004.

Starting Motors or Cranking Motors

The best assurance of obtaining maximum service from cranking motors with minimum trouble is to follow a regular inspection and maintenance procedure. Periodic lubrication where required, inspection of the brushes, commutator and drive arrangement are essentials in the inspection procedure. In addition, disassembly and thorough overhauling of the cranking motor at periodic intervals are desirable as a safeguard against road failures from accumulations of dust and grease and from normal wear of parts. This is particularly desirable on commercial vehicles where maintenance of operating schedules is of especial importance. In addition to the cranking motor itself, the external circuit between the cranking motor and the battery must be kept in good condition since defective wiring, loose or corroded connections will prevent normal cranking action.

Lubrication

Bearings provided with hinge cap oilers should have 8 to 10 drops of light engine oil every 5,000 miles. Grease cups should be turned down one turn every 5,000 miles and refilled with medium cup grease when required. On tractor, marine, or stationary applications, lubricate every 300 hours of operation as above. Grease plugs on gear reduction cranking motors should be removed every six months so the grease reservoir can be repacked with medium grade graphite grease.

On some models, oil wicks are used to lubricate the center and drive end bushings. The wicks are saturated with oil before assembly, and should be saturated again whenever the cranking motor is taken off the engine or disassembled.

Some cranking motors are equipped with oil-less bushings. These should be supplied with a few drops of light engine oil at any time that the cranking motor is disassembled for repair or service.

Avoid excessive lubrication since this might cause lubricant to be forced out onto the commutator where it would gum and cause poor commutation with a resulting decrease in cranking motor performance.

Lubricating The Bendix Drive Mechanism

Bendix drives should be lubricated with a small amount of light engine oil whenever the cranking motor is removed from the engine for servicing. Heavy oil or grease must not be used as this may retard or prevent normal action of the drive mechanism. The overrunning clutch drive is packed with lubricant during original assembly and requires no additional lubrication.

Never lubricate the commutator and do not attempt to lubricate the cranking motor while it is being operated. Be sure to keep grease or oil clean. Lubricant should be kept in closed containers.

Periodic Inspection

At periodic intervals the cranking motor should be inspected to determine its condition. The frequency with which this should be done will be determined by the type and design of cranking motor as well as the type of service in which it is used. Frequent starts, as in city operation or door-to-door delivery service, excessively long cranking periods caused by a hard-starting engine condition, excessively dirty or moist operating conditions, heavy vibration, all will make it necessary that the inspection checks be made at more frequent intervals. Generally speaking, passenger car and other standard-duty cranking motors should be inspected at approximately 5,000 mile intervals. Heavy-duty units may not require as frequent inspection. However, where special operating conditions such as outlined above exist, inspection at more frequent intervals may be required.

INSPECTION PROCEDURE:

Cranking motor action is indicative, to some extent, of the cranking motor condition. Thus, a cranking motor that responds normally when the cranking motor switch is closed is usually considered to be in good condition. (Checking a cranking motor that does not operate normally is discussed in a following section.) However, the inspection procedure should include more than a mere check of the cranking motor operation; the following items should also be inspected. The mounting, wiring and connections should be tight and in good condition. The magnetic switch or solenoid (where used) should be firmly mounted and should operate freely and without binding.

Next, remove the cover band so the commutator, brushes and internal connections can be checked. Examine the cover band for thrown solder which results if the cranking motor is subjected to excessively long cranking periods so it overheats. This overheating causes the solder at the commutator riser bars to melt and be thrown out during cranking. Bad connections consequently develop which in turn result in arcing and burning of the commutator bars and ultimate ruination of the armature. If the bars are not too badly burned, the armature can often be saved by resoldering the connections at the riser bars (using rosin, not acid, flux) turning the commutator and undercutting the mica between bars. Some cranking motor armatures are of welded construction, with the armature coil leads welded, not soldered, to the commutator bars. This type of armature should not be repaired by ordinary soldering methods.

NOTE: Regardless of the type of construction, never operate the cranking motor more than 30 seconds at a time without pausing to allow the cranking motor to cool off for at least two minutes. Overheating, caused by excessively long cranking periods, may seriously damage the cranking motor.

When checking the brushes, make sure they are not binding and that they are resting on the commutator with sufficient tension to give good, firm contact. Brush leads and screws should be tight. If the brushes are worn down to one-half their original length, (compare with new brushes) they should be replaced.

Note the condition of the commutator. If it is glazed or dirty, it can be cleaned in a few seconds by holding a strip of number 00 sandpaper against it with a piece of wood while the cranking motor is operated. A brush seating stone can also be used for this purpose. Move the sandpaper or stone back and forth across the commutator while the armature is spinning. Never operate the cranking motor more than 30 seconds at a time without pausing for a few minutes to allow the cranking motor to cool. Blow out all dust after the commutator is cleaned.

If the commutator is rough, out of round, has high mica, or is extremely dirty, it will require turning down in a lathe and undercutting of the mica between the bars.

Quick Checks When in Trouble

When trouble develops in the cranking motor system, and the cranking motor cranks the engine slowly or not at all, several preliminary checks can be made to determine whether the trouble lies in the battery, in the cranking motor, in the wiring circuit between them, or elsewhere. Many conditions besides defects in the cranking motor can result in poor cranking performance.

To make a quick check of the cranking motor system, turn on the headlights. They should burn with normal brilliance. If they do not, the battery may be run down and it should be checked with a hydrometer. If the battery is in a charged condition so the lights burn brightly, operate the cranking motor. Any one of three things will happen to the lights. They will go out, dim considerably, or stay bright without any cranking action taking place.

If the lights go out as the cranking motor switch is closed, it indicates that there is a poor connection between the battery and the cranking motor. This poor connection will most often be found at the battery terminals, and correction is made by removing the cable clamps from the terminals, cleaning the terminals and clamps, replacing the clamps and tightening them securely. A coating of corrosion-inhibitor may be applied to the clamps and terminals to retard formation of corrosion.

If lights dim considerably as the cranking motor switch is closed and the cranking motor operates slowly or not at all, the battery may be run down. Or, there may be some mechanical condition in the engine or the cranking motor that is throwing a heavy burden on the cranking motor. This imposes a high discharge rate on the battery which causes noticeable dimming of the lights. Check the battery with a hydrometer. If it is charged, the trouble probably lies in either the engine or cranking motor itself. In the engine, tight bearings or pistons, or heavy oil place an added burden on the cranking motor.

Low temperatures also hamper cranking motor performance since it thickens engine oil and makes the engine considerably harder to crank and start. Also, the battery is less efficient at low temperatures. In the cranking motor, a bent armature shaft, loose pole shoe screws or worn bearings, any of which may allow the armature to drag, will reduce cranking performance and increase current draw.

In addition, more serious internal damage is sometimes found. Thrown armature windings or commutator bars, which sometimes occur on overrunning clutch type cranking motors, are usually caused by excessive overrunning after starting. This is a result of such conditions as the driver's keeping his foot on the cranking motor switch too long after the engine has started, the driver's opening the throttle too wide in starting, or improper throttle cracker adjustment. Any of these subject the overrunning clutch to extra strain so it tends to seize, spinning the armature at high speed with resulting armature damage.

On Bendix drive cranking motors, broken Bendix housings and wrapped-up Bendix springs may result if the driver closes the cranking motor switch during engine rockback after the engine starts and then stops again. Another cause may be engine backfire during cranking which may result, among other things, from ignition timing being too far advanced. To avoid such failures, the driver should pause a few seconds after a false start to make sure the engine has come completely to rest before another start is attempted. In addition, the ignition timing should be reset if engine backfiring has caused the trouble.

The third condition which may be encountered when the cranking motor switch is closed with the lights turned on is that the lights stay bright, but no cranking action takes place. This indicates an open circuit at some point, either in the cranking motor, or in the cranking motor switch or control circuit. Where the application is solenoid-operated, the solenoid control circuit can be eliminated momentarily by placing a heavy jumper lead across the solenoid main terminals to see if the cranking motor will operate. This connects the cranking motor directly to the battery and, if it operates, it indicates that the control circuit is not functioning normally. The wiring and control units must be checked to locate the trouble. If the cranking motor does not operate, it will probably have to be removed from the engine so it can be analyzed in detail.

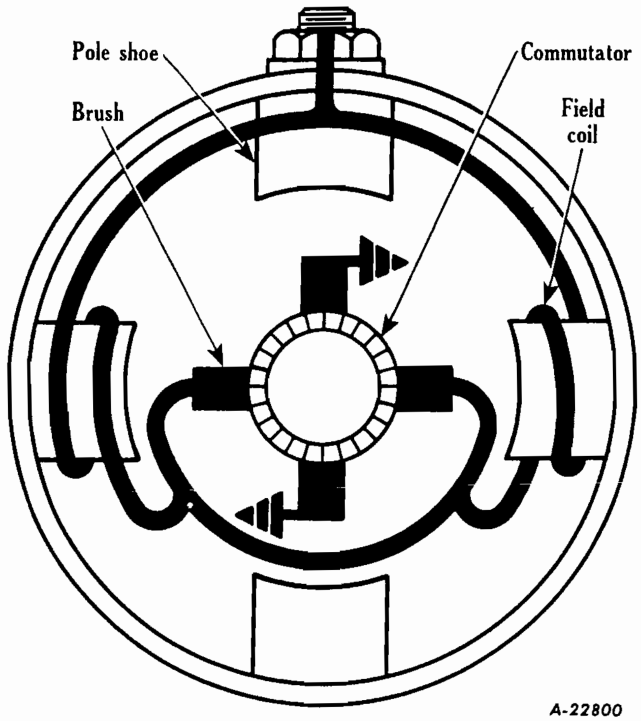


Fig. 6 - Schematic wiring diagram of two-pole, four-brush, series-wound cranking motor.

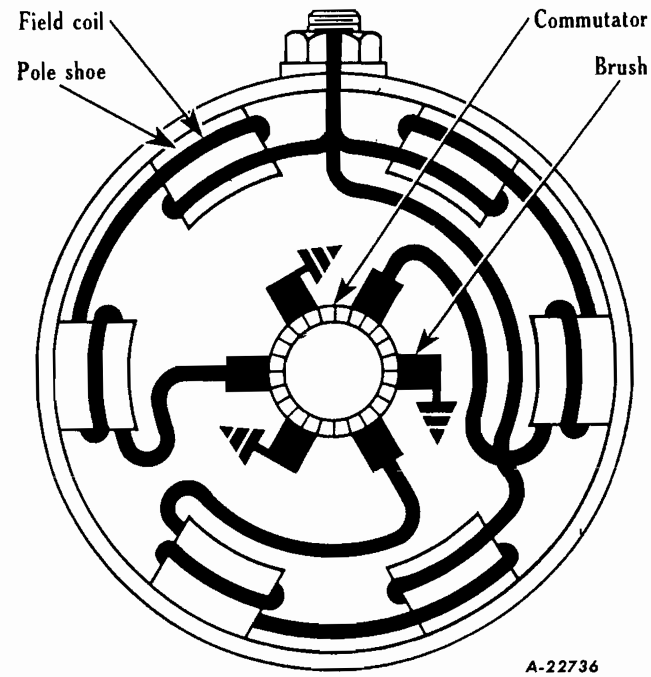


Fig. 8 - Schematic wiring diagram of six-pole, six-brush, series-wound cranking motor.

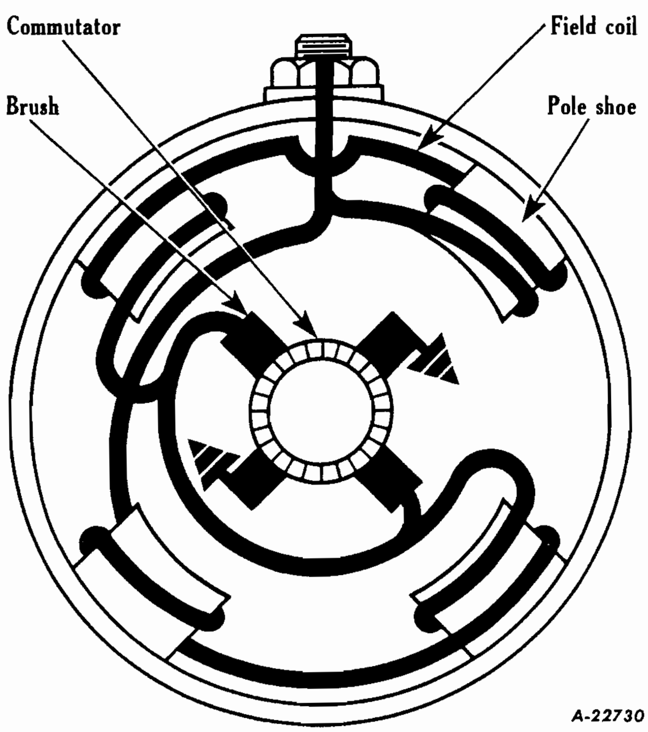


Fig. 7 - Schematic wiring diagram of four-pole, four-brush, series-wound cranking motor.