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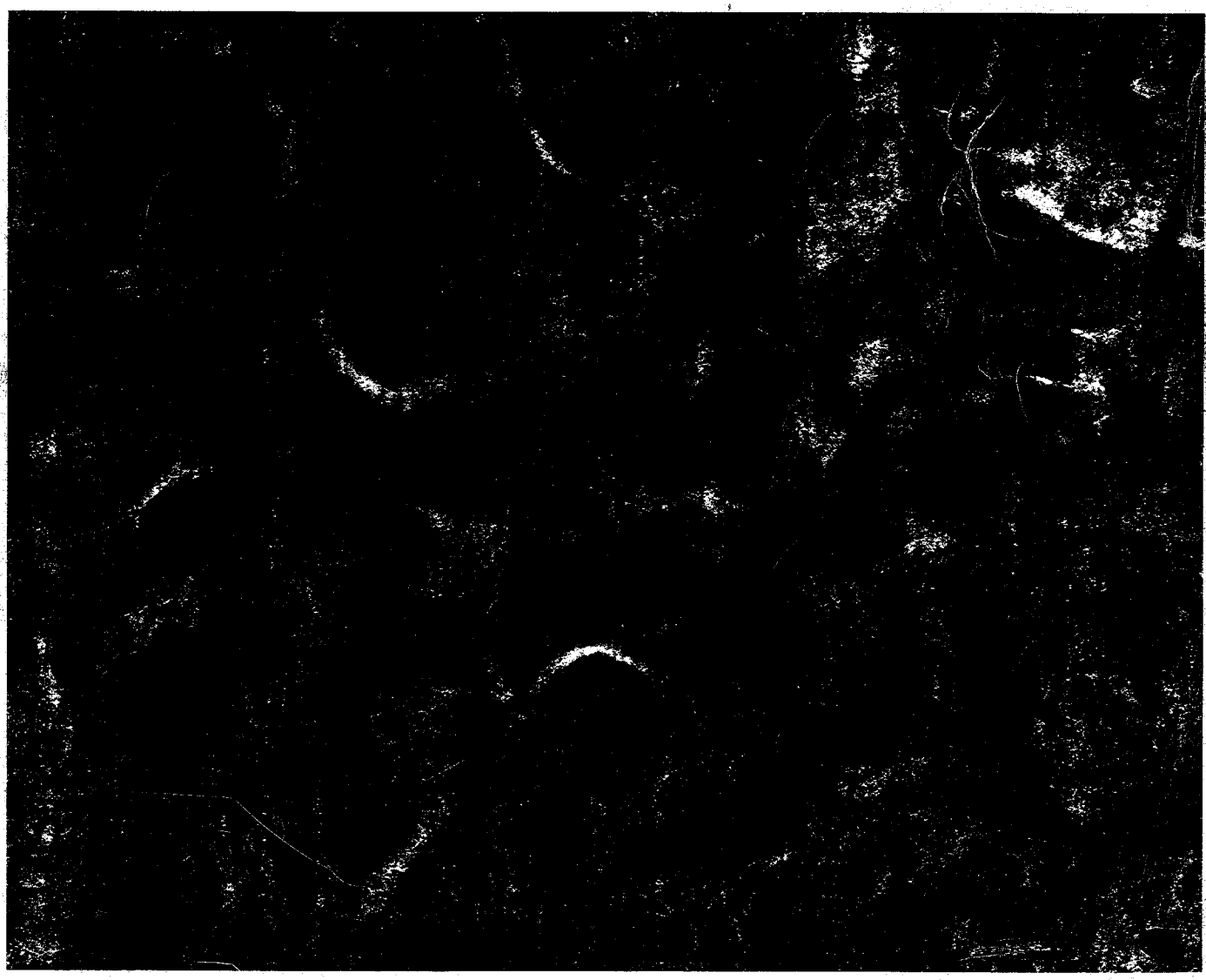
COLUMBIA

Service Manual

1963 to 1978 • DE/DE-3/DE-4
DEF/DEC
HARLEY-DAVIDSON®
Electric Golf Car



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1963 to 1978 ELECTRIC CAR SERVICE MANUAL

The maintenance and repair information in this manual applies to the 1
Electric Car. Models DE, DE-3, DE-4, DEF and DEC.

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FOREWORD

This service and repair manual has been prepared with two purposes in mind. First, it will acquaint the reader with the construction of the product and assist him in performing basic maintenance and repair. Secondly, it will introduce to the professional Golf Car mechanic the latest field-tested and factory-approved major repair methods. We sincerely believe that this manual will make your association with Columbia products more pleasant and profitable.

HOW TO USE YOUR SERVICE MANUAL

Your Service Manual is arranged for quick, easy reference. This manual is divided into numbered sections entitled "Product," "Chassis" and "Electrical." Sections are then divided into sub-sections. Sub-sections are listed on divider in front of each section.

Use this manual as follows:

1. Check the *Table of Contents* located in the front of each section to find subject desired.

2. Page number is listed across from subject.

3. Each section is printed with section number for quick general location of subject. Page number consists of section number and sub-section letter and sub-section page number.

4. Information is presented in a definite order as follows:

Minor adjustments	Cleaning
Minor maintenance or repair	Major maintenance or repair
Complete disassembly	Assembly

SERVICE BULLETINS

In addition to the information given in this Service Manual, Service Bulletins are issued to Authorized Dealers from time to time, which cover interim engineering changes and supplementary information. Service Bulletins should be consulted for complete information on the models covered by this manual.

In figure legends the number following a name of a part indicates the quantity necessary for one complete assembly.

All information for servicing a part should be read *before* repair work is started to avoid needless disassembly.

USE GENUINE REPLACEMENT PARTS

To insure a satisfactory and lasting repair job, follow the manual instructions carefully and use only genuine Columbia replacement parts.

This is your insurance that the parts you are using will fit right, operate properly and last longer. When you use genuine Columbia parts you use the best.

1. Check the Table of Contents located in the front of each section to find subject desired.

Any information for servicing a part should be read before repair work is started to avoid needless assembly.

Columbia ParCar products are manufactured under one or more of the following U.S. patents: 2986162, 2987934, 2993809, 3116089, 3144631, 3144860, 3226994, 3229792, 3434887, 3559773, 3673359, 3680403, 3683716, 3709317. Des. 225626.

WARNINGS AND CAUTIONS

Statements in this manual preceded by the following words are of special significance.

WARNING

Means there is the possibility of personal injury to yourself or others.

CAUTION

Means there is the possibility of damage to the vehicle.

We recommend that you take special notice of these statements. Read them carefully before proceeding with repair or service.

The following precautions are of extreme importance. These and other precautions appear throughout this manual.

CAUTION

Disconnect the battery leads whenever servicing the motor, electrical or control systems.

WARNING

Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing.

ANTIDOTE – External – Flush with water.
Internal – Drink large quantities of milk or water followed by milk of magnesia, vegetable oil, or beaten eggs. Call doctor immediately.
Eyes – Flush with water and get immediate medical attention.

Batteries produce explosive hydrogen gas at all times, especially when being charged. Keep cigarettes, open flame, and sparks away from the battery at all times. Ventilate area when charging battery. Always protect hands and eyes with shield or goggles when working near a battery or acid. KEEP BATTERIES AND ACID OUT OF THE REACH OF CHILDREN!

WARNING

Observe warning cautions given on labels of cleaning compounds to prevent personal injury or damage to your vehicle.

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PRODUCT

1

TABLE OF CONTENTS

2. Accelerator pedal operates the car in 3 successive speeds as pedal is depressed. NOTE: 1967 and later Models DE, DE-3, DE-4 and DEC have an automatically controlled intermediate speed to advance into third speed.

Depress accelerator to operate car in desired speed.

3. Depress pedal to operate brake.

Model DE, DE-3, DE-4, 1968 and Earlier Model DEC

To lock brake for parking, depress and tilt pedal forward.

Brake automatically releases when accelerator pedal is depressed.

3A. Pull parking brake hand lever all the way out to apply parking brake.

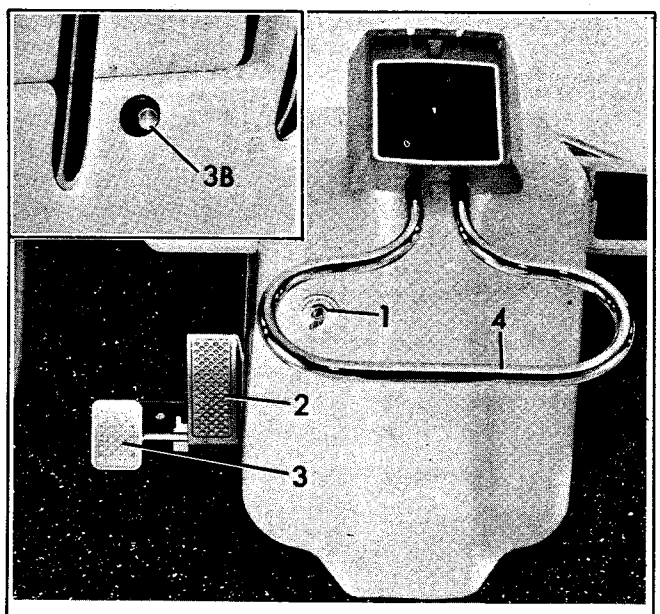
3B. Automatic Seat Brake and Lockout Button.

Brake locks when drivers' weight is removed from the seat. Drivers' weight on the seat releases brake. To lockout brake for towing or moving, apply downward pressure to seat so that button on left side of body next to the seat can be depressed. Hold button in this position and release pressure on the seat. To release brake, apply downward pressure to the seat.

4. Steering tiller provides simple control of car. Move handle opposite to direction of turn.

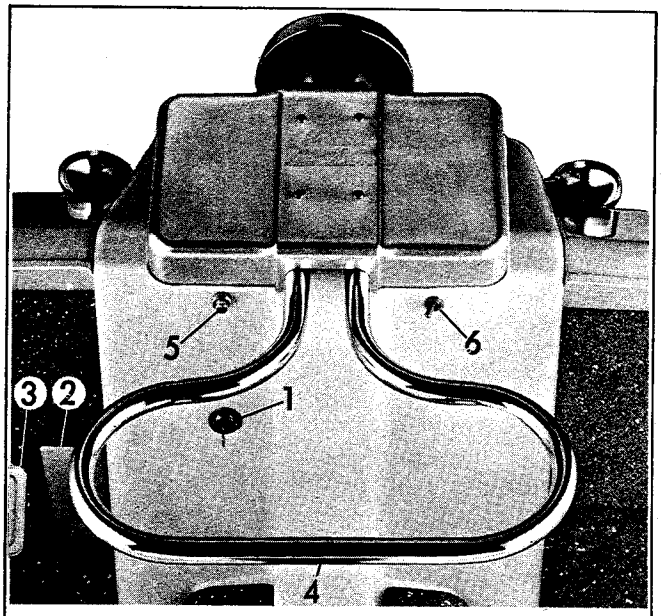
4A. Steering Wheel

5. Horn Button
Press button to operate horn.



1. Key switch
2. Accelerator pedal
3. Brake pedal
3B. Seat brake lockout button
4. Steering tiller

Figure 1-1. Controls - Model DE, DE-3



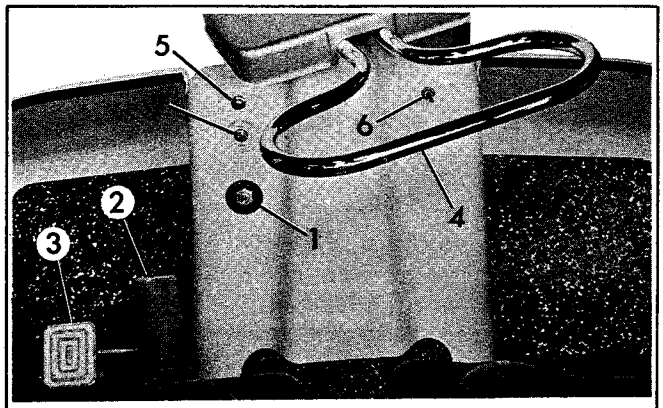
1. Key switch
2. Accelerator pedal
3. Brake pedal
4. Steering tiller
5. Horn button
6. Headlamp switch

Figure 1-2. Controls Model 1963-1965 DEC, DEF

6. Headlamp Switch
Left position "off".
Right position "on".

DRIVING TIPS

Operating the electric car requires the normal precautions and driving ability such as are used when



1. Key switch
2. Accelerator pedal
3. Brake pedal
4. Steering tiller
5. Horn button
6. Headlamp switch
7. Speed range switch

Figure 1-3. Controls, 1966-1968 Model DEC

GENERAL

SPECIFICATIONS

GENERAL FEATURES

MODELS:
DE,DE-3, DE-4
DEF Personnel Carrier
DEC Utilicar

3 Selected Speeds With Reverse Except 1966-1968 DEC - 6 Speeds With Reverse

Maximum Speed On Level . . . . . 10 M.P.H.

Turning Radius
Model DE, DE-3 . . . . . Tiller 9 ft.-4 in.
Steering wheel 7 ft.-1 in.
Model DE-4 Steering wheel 10 ft.-4 in.
Model DEC . . . Tiller 10 ft.-10 in. (2.63:1 ratio)
or 7 ft. 9 in. (1.45:1 ratio)
Steering Wheel 8 ft.-7 in.

	Model DEC			Model DE and DE-3			Model DE-4
Dimensions	1965	1966-1967	1969-1970	1963-1965	1966	1967-1978	1972-1974
Wheelbase	59.5"	60.5"	70.5"	59.5"	59.5"	60.5"	67.0"
Overall Length	92.0"	93.5"	98.5"	89.5"	91.0"	91.0"	102.0"
Overall Width	45.2"	45.2"	45.2"	45.2"	46.0"	46.0"	45.2"
Overall Height	36.0"	38.0"	38.0"	36.0"	40.2"	40.2"	42.0"
Ground Clearance	4.6"	5.1"	5.1"	4.6"	4.4"	4.00"	4.0"
Weight (With batteries-less charger)	861 lbs.	985 lbs.	1014 lbs.	826 lbs.	878 lbs.	976 lbs.	1119 lbs.

TRACTION MOTOR

Type . . . . . Series wound, reversible
Rating . . . 1974 & Earlier - 1-1/2 HP @ 2800 RPM, 7 HP Intermittent @ 800 RPM
1977 & Later - 2 HP @ 2800 RPM, 10 HP Intermittent @ 800 RPM
Mfr. . . . . 1975 & Earlier - General Electric or Westinghouse
1977 & Later - General Electric or AMF

TRANSMISSION

Motor to differential shaft
1963-1965. . . . . 3 V-Belts, 3/8 x 5/16 x 31.5
1966 & Later . . . . . Direct Drive to Differential

Forward and Reverse	Motor To Differential	Differential To Axle	Overall
Drive Ratio 1963-1965	2.39	5.17	11.84
Drive Ratio 1966 and Later	Direct	12.25	12.25

Differential Capacity . . . . 1972 & Earlier - 16 oz. Transmission Lubricant
1973-1975 - 32 oz. Differential Lubricant
1977 & Later - 24 oz. Transmission Lubricant

BRAKE DE, DE-3,
DE-4 . . . Disc brake on drive shaft mechanically operated. Brake pedal incorporates ratchet lock for parking, with automatic release controlled by accelerator pedal. Automatic seat brake is an optional accessory on the 1972 and later models. Brake locks when driver's weight is removed from the seat. Driver's weight on seat releases the brake.
DEC . . . Expanding shoe brakes inside rear wheel brake drums mechanically or hydraulically operated. Mechanical brake pedal incorporates ratchet lock for parking, with automatic release controlled by accelerator pedal. Hydraulic type brake system incorporates a cable operated parking brake.

TIRES

Model	Size	Air Pressure (Front and Rear)
DE, DE-3, DE-4	8.50 x 8	12 psi
	9.50 x 8	
DEF, DEC	5.70 x 8	25 psi
	9.50 x 8	12 psi

BATTERIES

Type . . . . . 6 volt, lead storage battery - 6 used
Rating . . . . . 190 ampere-hours each
Charge Rate (total for 6 batteries in series) . . . . . Maximum: 25 amperes with automatic charger reduction to low rate.

IDENTIFICATION

The Vehicle Identification Number (V.I.N.) is stamped on a plate on frame near left rear tire on 1977 and later models and on frame cross member on 1975 and earlier models.

Example

Letters	Model No.	Serial No.	Mfgr.	Year
DE-3	4B	10,000 and up (5 digits)	H Harley-Davidson	8 (1978)

Traction Motor
Serial No. . . . . Identification plate located on motor frame.

IMPORTANT: Always give these identification numbers when ordering parts or making inquiries.

CONTROLS AND OPERATION

CONTROLS (Figures 1-1, 1-2, 1-3, 1-4 and 1-5)

Four controls are used to operate the Harley-Davidson Electric Car. To drive, move key switch to desired position and depress accelerator with right foot. Depress brake pedal with left foot to stop.

1. The switch requires key to operate and locks in "OFF" position when key is removed. Turn to "FORWARD" position to run car forward. Turn to "REVERSE" position and hold while running car in reverse.

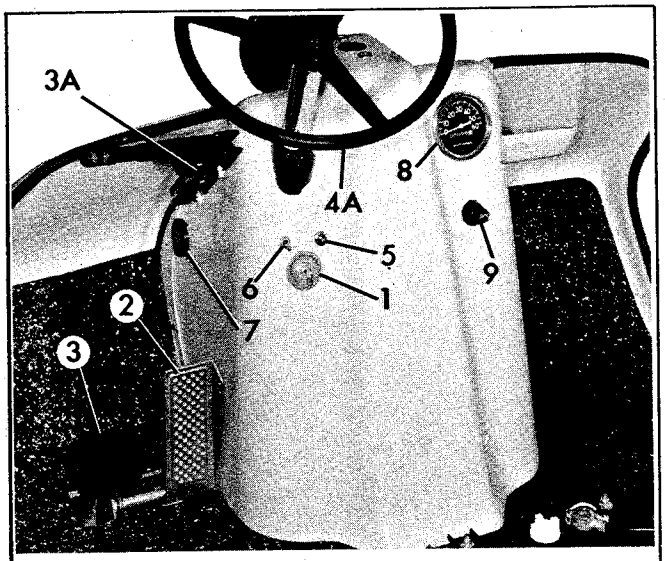
driving any vehicle. However special care is recommended when driving over rough and hazardous terrain.

— Drive slowly when making sharp turns.
— Drive slowly when making turns on an incline.
— If possible, drive straight up and down hills and inclines.
— Drive in highest speed to provide maximum power for climbing hills.
— Do not leave car unattended unless key switch is "OFF" and brake is locked, since accidental movement of the accelerator pedal will put car in motion, or car may coast down an incline.
— Do not use accelerator to hold car on a hill - use brake.
— Do not ride the brake since this causes drag and extra drain on battery.
— Do not use key switch in place of accelerator to operate car.
— Do not change Model DEC speed range switch position while car is in motion.

7. Speed range switch 1965-1968 (Model DEC only) controls battery voltage to electric motor either 36 volts (batteries series connected) or 18 volts (2 sets of 3 batteries parallel connected).

If car is operated mostly at maximum speed (accelerator pedal all the way down), keep switch in "HIGH" position. Also keep switch in "HIGH" position when changing batteries.

If car is operated mostly at low speed (accelerator pedal part way down), keep switch in "LOW" position to prevent unnecessary drain on batteries.



1. Key Switch
2. Accelerator Pedal
3. Brake Pedal
3A. Parking Brake
4A. Steering Wheel
5. Horn Button
6. Headlamp Switch
7. Charger Plug
8. Speedometer
9. Lighter

Figure 1-4. Controls 1969-1970 Model DEC

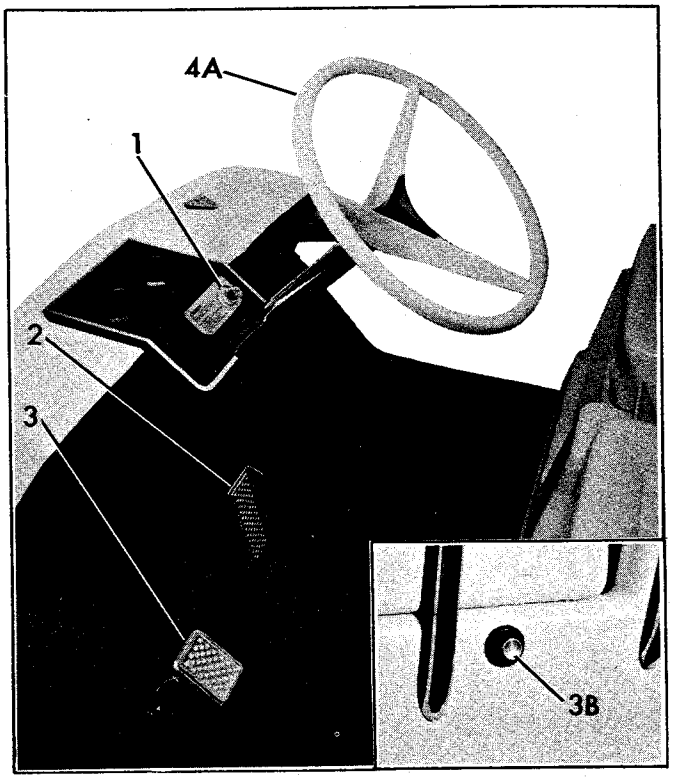


Figure 1-5. Controls 1972 & Later Model DE-4

SERVICE

IMPORTANT: Adequate preventive maintenance, which is conscientiously applied at regular intervals, is the best guarantee for keeping the Harley-Davidson Electric Car in good operating condition, so that it will give economical and dependable service. It is in the best interests of both the car owner and servicing dealer to carefully follow the service procedures recommended in this section.

SERVICING A NEW ELECTRIC CAR

PRE-DELIVERY AND 30 DAY SERVICE AND INSPECTION

Before a new car is put into operation, make a predelivery inspection and service check to see that car is in good operating condition. Again, after 30 days, make another check to be sure that car remains in good operating condition and to uncover any minor misadjustments or conditions in the early stages before any serious trouble can develop.

Recommended new car service and inspection check operations, which should be performed by the Harley-Davidson dealer, are shown in the INITIAL SERVICE CHART below.

CAUTION

Always disconnect battery cables before performing any service on the car.

All operations are fully described in sections pertaining to particular part of car. See TABLE OF CONTENTS for location and detailed description.

INITIAL SERVICE CHART

Check		Item	Service Operation
Pre-Delivery	30 Day		
X		Differential	Check lubricant level.
X	X	Brake	Check operation and adjust if necessary.
X	X	Tiller or Steering Wheel	Check operation and adjust if necessary.
X	X	Tires	Check pressure and correct if necessary. (See "Specifications", Section 1A)
X	X	Chassis, Body and Wiring Connections	Check tightness of all nuts, bolts and screws.
	X	Lubrication	Grease and oil (See REGULAR SERVICE CHART on next page.)
X	X	Batteries	Check electrolyte level and charge condition.
X		Appearance	Deliver in clean condition. Wash or wipe clean as required.
X	X	Test	Check for correct operation of car and make any readjustment necessary.

REGULAR SERVICE INTERVALS

The following chart outlines recommended maintenance and lubrication service operations to be performed regularly after new car checks have been made. Refer to Figures 1-6, 1-7, 1-8, 1-9 and 1-10 when using the chart.

REGULAR SERVICE CHART

Regular Service Interval	Fig. Index No.	Service	Fig. Index No.	Lubrication
Daily	13	Charge batteries after each usage as shown in chart below.		
Weekly	1	Check electrolyte.	13	Clean tops of batteries and terminals.
Every Month	2	Check tire pressure. (See "Specifications," Section 1A)		
	12	Adjust brake shoes.		
	16	Adjust automatic seat brake.		
Every 2 Months	1	Check electrolyte and charge batteries when in storage.	5 10, Fig. 2-42	Oil body hinges Grease suspension tubes. Grease axle support arms.
Every Year	8	Check motor brushes and commutator.	9	Check lubricant level in differential housing.
				Oil
			6	Speed switch rod
			7	Brake cable ends
			11	Tiller chain
			15	Brake and accelerator pedal bearing
				Grease
			3	Speed switch arm
			4	Brake shoe cam
			14	Fork sides
	10	Adjust V-Belts (1965 & earlier).	13	Oil terminal felts
	11	Adjust tiller chain to eliminate free play (do not over-tighten).		
		Check steering wheel play and adjust if necessary.		
	16	Clean steering slider block and channel. Lubricate with dry lubricant.		

CHARGING TIME CHART

Using Harley-Davidson automatic charger

GOLF CAR USAGE	CHARGING TIME
9 Holes	7 Hours
18 Holes or More	12 Hours

LUBRICANTS TO USE

Use Harley-Davidson Grease-All Grease, Light Oil (58W) and Transmission Lubricant and Differential Lubricant as recommended.

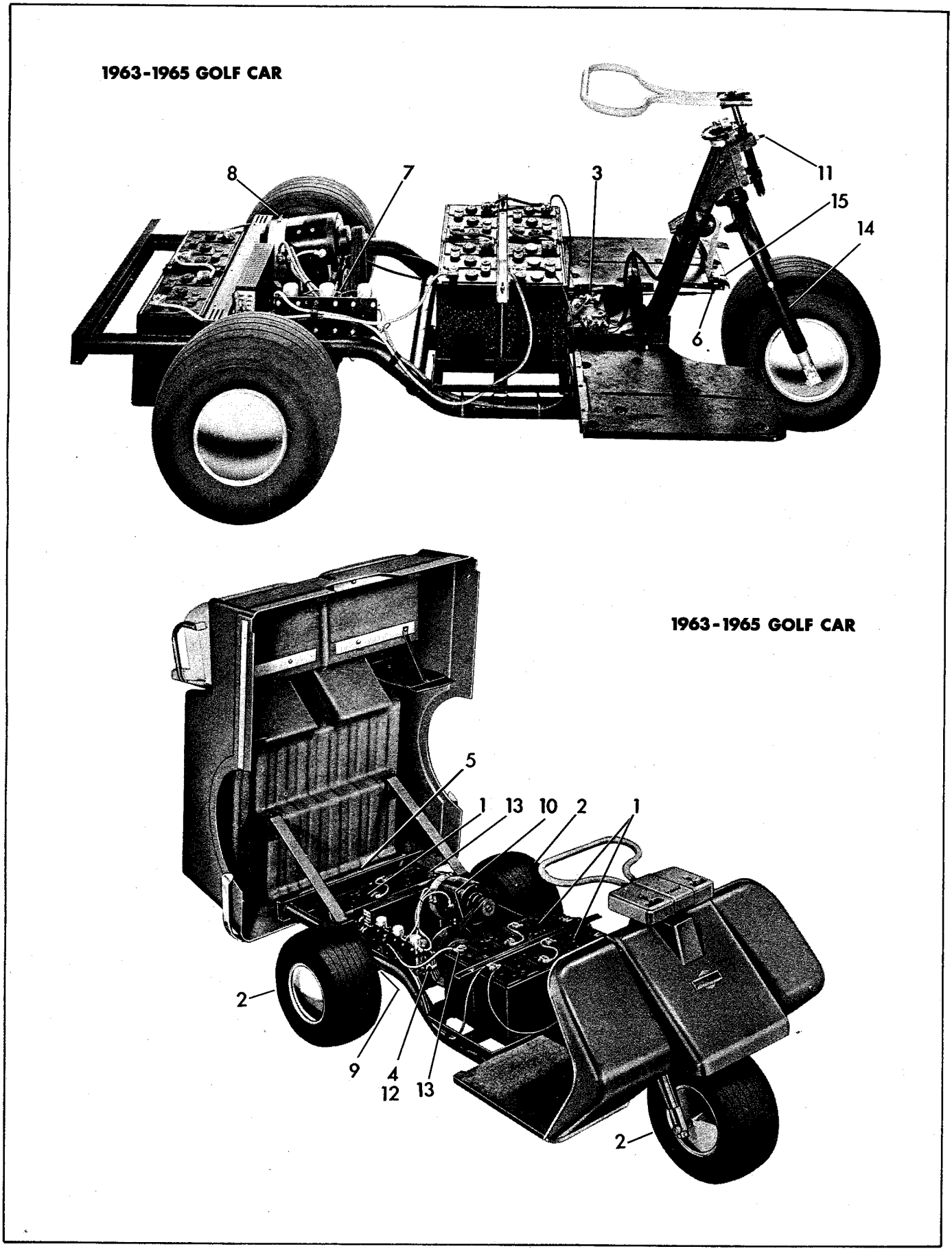


Figure 1-6. Lubrication and Service Chart

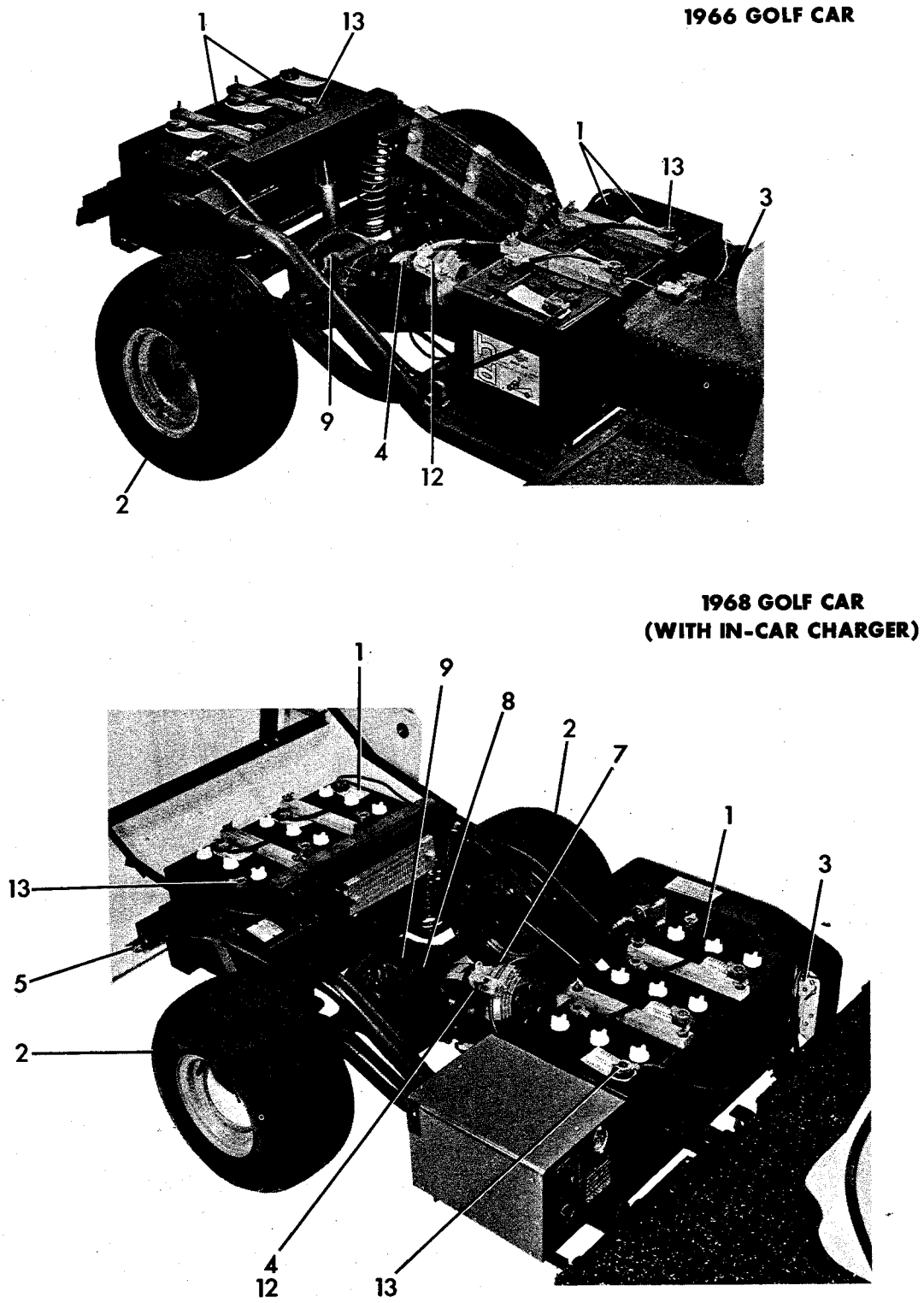


Figure 1-7. Lubrication and Service Chart

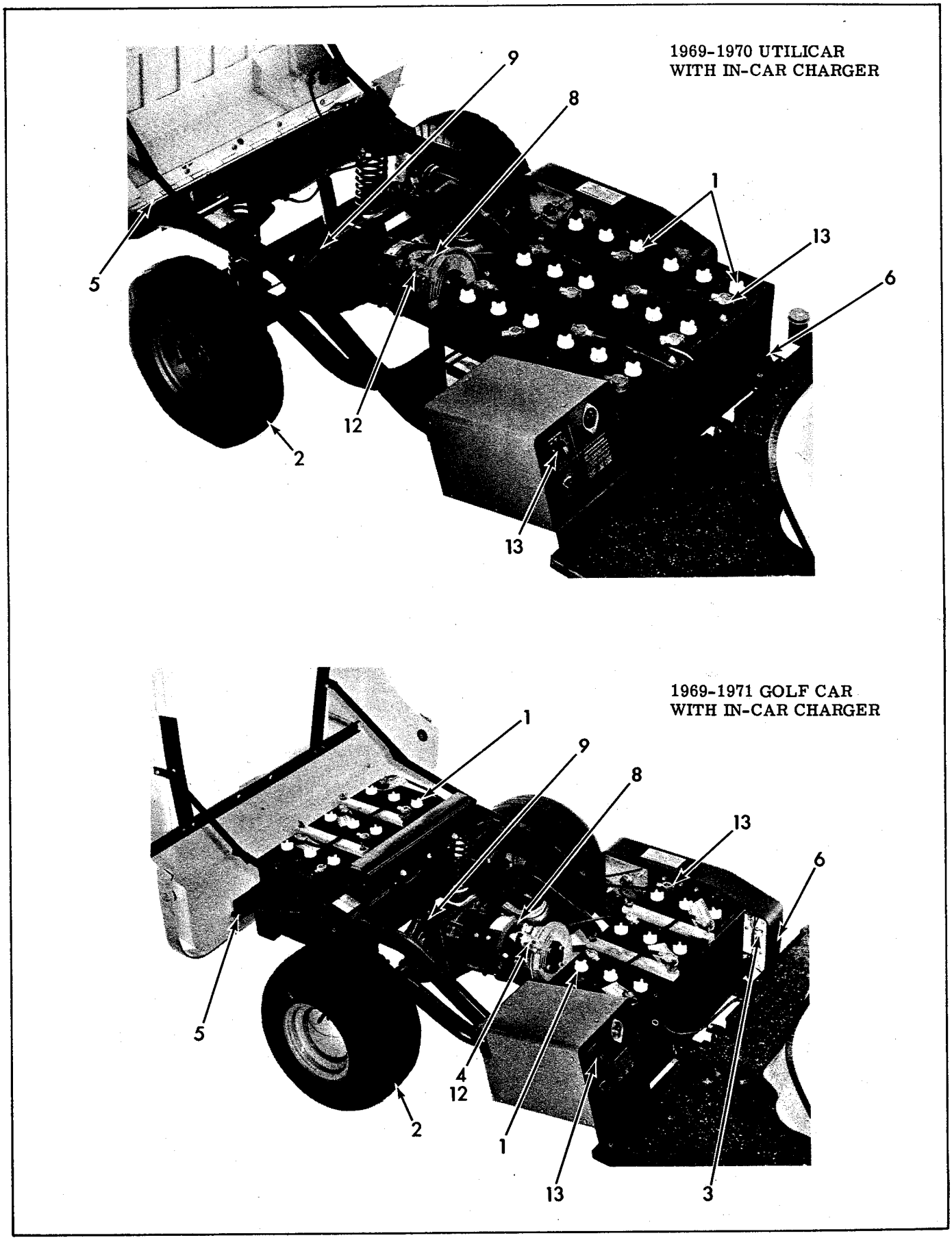


Figure 1-8. Lubrication and Service Chart

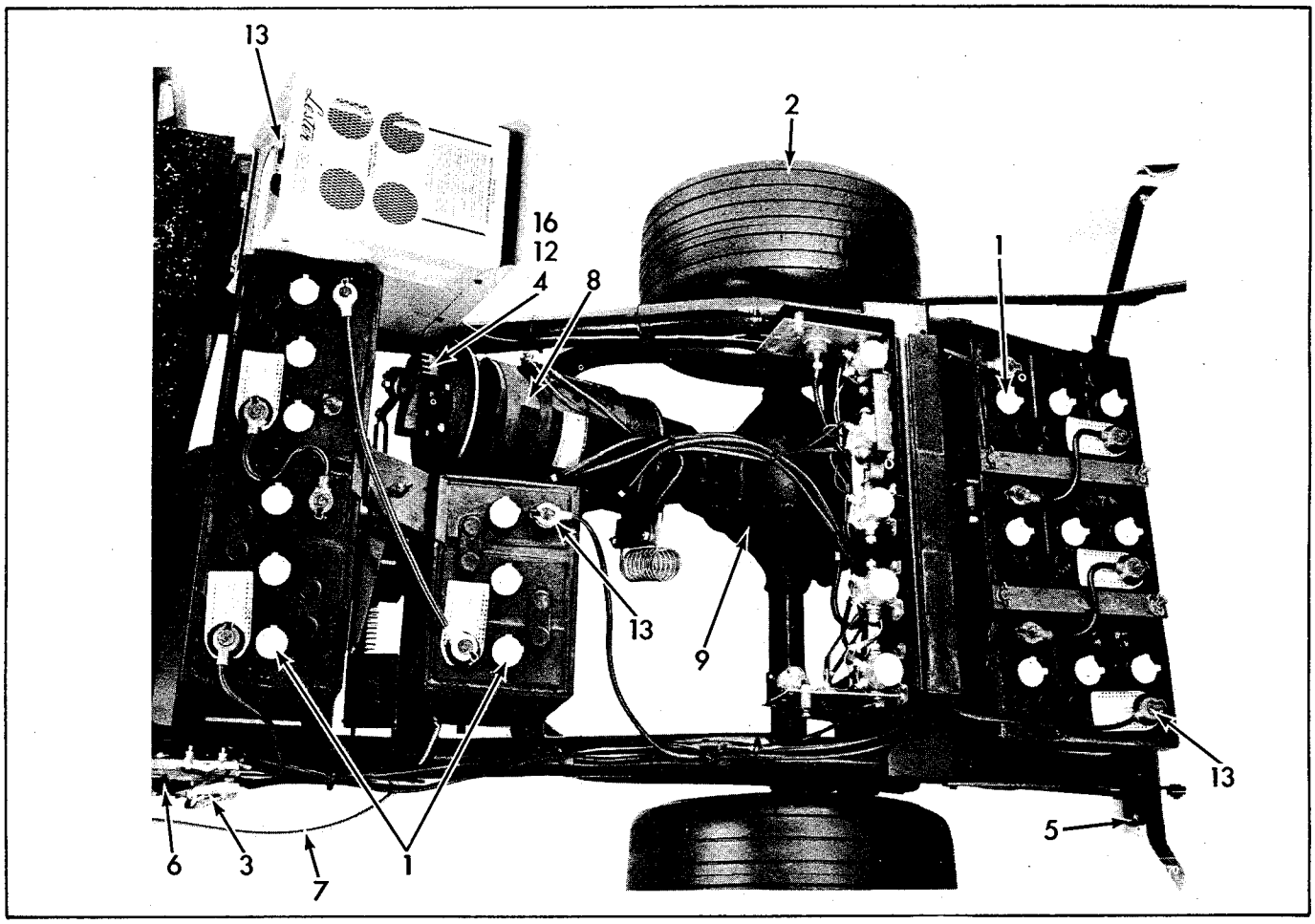


Figure 1-9. 1972-1975 Golf Car, Models DE and DE-4, with In-Car Charger and Seat Brake (Accessory)

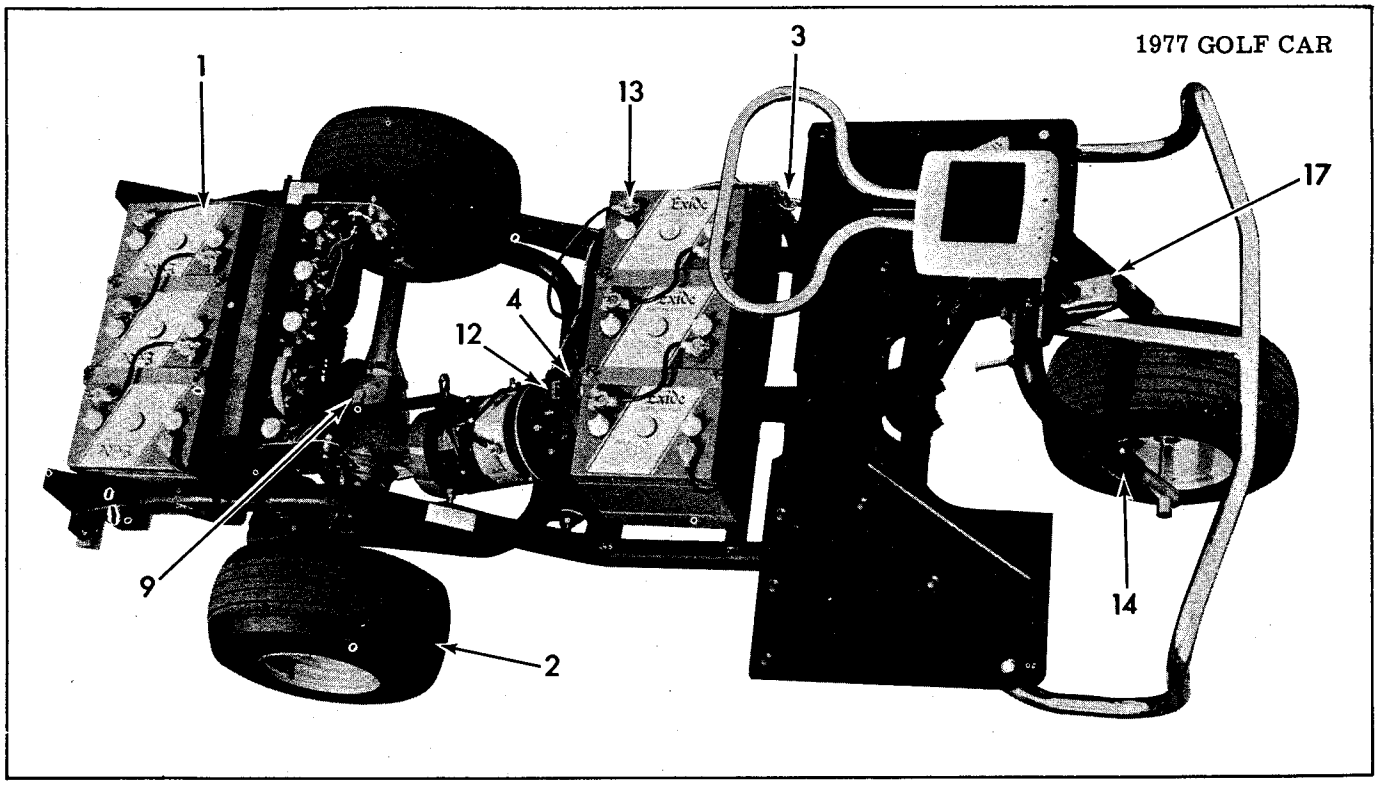


Figure 1-10. 1977 and Later Golf Car, Model DE-3

LOCATING TROUBLES

Your Harley-Davidson Electric Car will operate a long time without repairs if it is given proper care and maintenance. The following check list will be helpful in locating operating difficulties should they occur. The check list includes the difficulty, probable causes and suggested checks to make. The procedures used in making these checks can be found in the sections of the service manual referred to.

1963-1966 MODEL DE, DEC
TROUBLE LOCATION CHART

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
LOW RUNNING TIME PER BATTERY CHARGE		
1. BATTERIES NOT RECEIVING FULL CHARGE		
Defective battery.	Check condition of battery cells.	5 BATTERY
Low electrolyte level.	Check electrolyte level.	5 BATTERY
Poor charging circuit.	Check for loose or corroded battery terminals and charger plug connection on car.	5 BATTERY 5 WIRING DIAGRAM
Charger defective.	Check output of battery charger.	5 BATTERY
2. EXTRANEOUS BATTERY DRAIN	Check for corrosion and dirt on battery and speed switch contacts.	5 BATTERY
	Check for loose terminals.	5 SWITCHES
	Check for bare wire shorts especially at solenoids and speed switch.	5 WIRING DIAGRAM
	Motor trouble.	5 TRACTION MOTOR
3. DRAG ON CAR		
Brakes adjusted too tight.	Check brake adjustment.	2 BRAKE
Operator riding brake.	Check operating procedure.	1 DRIVING
Low tire pressure.	Check tire pressure.	2 WHEELS
Drive belt too tight (1963-65 Models).	Check belt tension.	5 DRIVE
Wheel bearing friction.	Check wheel bearing lubrication.	2 WHEELS
Differential friction.	Check differential and lubrication.	2 DRIVE
Car overloaded.	Check operating procedure.	1 CONTROLS AND OPERATION
4. DRIVE BELTS SLIPPING (1963-65 Models)	Check belt tension.	5 DRIVE
CAR WILL NOT OPERATE IN EITHER DIRECTION		
Drive belts slipping.	Check belt tension.	2 DRIVE

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR WILL NOT OPERATE IN EITHER DIRECTION (Cont)		
Batteries discharged.	Check condition of batteries.	5 BATTERY
Key switch defective.	Check operation of key switch.	5 SWITCHES
Linkage from foot pedal to speed Switch broken or disconnected - Speed switch defective.	Check operation of speed switch.	5 SWITCHES
Micro-switch defective.	Check operation of micro-switch.	5 SWITCHES
Solenoids not closing.	Check operation of solenoids.	5 SWITCHES
Drive motor field, brushes or armature circuit defective.	Check condition of motor brushes and internal circuits.	5 MOTOR
Poor contact between battery posts and battery cable terminals.	Check for corroded or loose battery post connections.	5 BATTERY
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids to other components.	5 WIRING DIAGRAM
CAR JERKS		
Loose or broken wires.	Check tightness of all terminals and wiring continuity.	5 WIRING DIAGRAM
Broken resistor.	Check resistor.	5 SWITCHES
Solenoids "hanging up".	Check solenoid operation.	5 SWITCHES
CAR WILL GO FORWARD, BUT NOT BACKWARD		
Key switch defective in reverse position.	Check operation of key switch.	5 SWITCHES
Reverse solenoids (C and/or D) defective.	Check operation of reverse solenoids.	5 SWITCHES
Forward solenoids (A and/or B) stuck closed.	Check operation of forward solenoids.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch to other components.	5 WIRING DIAGRAM
CAR WILL GO BACKWARD, BUT NOT FORWARD		
Key switch defective in forward position.	Check operation of key switch.	5 SWITCHES
Reverse solenoids (C and/or D) stuck closed.	Check operation of reverse solenoids.	5 SWITCHES
Forward solenoids (A and/or B) defective.	Check operation of forward solenoids.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM

1963-1966 MODEL DE, DEC
TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR OPERATES IN FIRST SPEED ONLY		
Second speed solenoid (E) and third speed solenoid (F) defective.	Check operation of second and third speed solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM
CAR OPERATES IN FIRST AND THIRD SPEEDS, BUT NOT IN SECOND SPEED		
Solenoid (E) defective.	Check operation of second speed solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM
CAR OPERATES IN FIRST AND SECOND SPEEDS, BUT NOT IN THIRD SPEED		
Speed switch not making good contact between third speed contact and movable contact on speed switch arm.	Check condition of speed switch.	5 SWITCHES
Solenoid (F) defective.	Check operation of third speed solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity and insulation.	5 WIRING DIAGRAM
CAR WILL NOT OPERATE IN FIRST SPEED, BUT 2nd AND 3rd SPEEDS OPERATE NORMALLY		
.2 OHM section of resistor (between terminal marked .3 and terminal marked .1) is open.	Check wiring continuity, and resistor for open circuit.	5 WIRING DIAGRAM
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM
CAR OPERATES NORMALLY IN FIRST SPEED, THEN JUMPS TO THIRD SPEED		
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity of red and yellow wires from speed switch to solenoids.	5 WIRING DIAGRAM
Solenoid (E) defective.	Check operation of second speed solenoid.	5 SWITCHES
CAR WILL NOT OPERATE IN FIRST & SECOND SPEEDS, WILL OPERATE IN THIRD SPEED		
.1 OHM section of resistor (between unmarked terminal and terminal marked .1) is open or both resistor sections are open.	Check resistor continuity.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity of wire from resistor common terminal to solenoid.	5 WIRING DIAGRAM

1963-1966 MODEL DE, DEC
TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR STARTS OUT IN THIRD SPEED AS SOON AS PEDAL IS DEPRESSED		
Third speed solenoid (F) stuck closed.	Check operation of third speed solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity of blue and red wires from speed switch to solenoids.	5 WIRING DIAGRAM
CAR STARTS OUT IN SECOND AS SOON AS PEDAL IS DEPRESSED, THIRD SPEED OPERATES NORMALLY		
Second speed solenoid (E) stuck closed.	Check operation of second speed solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity and insulation of wires from speed switch to solenoids.	5 WIRING DIAGRAM
CAR STARTS FORWARD AS SOON AS KEY SWITCH IS TURNED ON		
Speed switch is stuck in first, second or third speed.	Check speed switch.	5 SWITCHES
CAR WILL NOT STOP WITH KEY ON		
Speed switch not returning to off position.	Check speed switch, linkage and return spring.	5 SWITCHES
CAR WILL NOT STOP WITH KEY OFF		
Key switch shorted.	Check operation of key switch.	5 SWITCHES

THE FOLLOWING APPLY ONLY TO 1966-68 MODEL DEC

Car operates normally in high range, with no speed difference in low range (locked in high range).	Check speed range switch connections.	5 SWITCHES
Car operates normally in low range, with no speed difference in high range (locked in low range).	Check speed range switch and connections. Check speed range solenoids G and H.	5 SWITCHES
Car operates normally in high range, does not operate in low range. Car operates normally in low range, does not operate in high range.	Check speed range solenoids G and H.	5 SWITCHES
Front row of 3 batteries depleted long before rear row.	Check solenoid H.	5 SWITCHES
Rear row of 3 batteries depleted long before front row.	Check solenoid G.	5 SWITCHES
Fuse melts when light is turned on.	Check for short in lighting circuit.	5 WIRING DIAGRAM
Fuse melts when horn is blown.	Check for short in horn circuit.	5 WIRING DIAGRAM
Fuse melts when accessories are not in use.	Check for grounded wire to frame somewhere in electrical circuit.	5 WIRING DIAGRAM

1967 AND LATER MODEL DE, DE-3, DE-4, 1969-1970 MODEL DEC TROUBLE LOCATION CHART

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
LOW RUNNING TIME PER BATTERY CHARGE		
1. BATTERIES NOT RECEIVING FULL CHARGE		
Defective battery.	Check condition of battery cells.	5 BATTERY
Low electrolyte level.	Check electrolyte level.	5 BATTERY
Poor charging circuit.	Check for loose or corroded battery terminals and charger plug connection on car.	5 BATTERY 5 WIRING DIAGRAM
Speed switch.	Check adjustment and contacts.	5 SWITCHES
Charger defective.	Check output of battery charger.	5 BATTERY
Accelerator pedal binding	Check operation of accelerator pedal and speed switch	
2. EXTRANEOUS BATTERY DRAIN	Check for corrosion and dirt on battery and speed switch contacts.	5 BATTERY
	Check for loose terminals.	5 SWITCHES
	Check for bare wire shorts especially at solenoids and speed switch.	5 WIRING DIAGRAM
	Motor trouble.	5 TRACTION MOTOR
	Motor diode leakage.	5 SWITCHES
3. DRAG ON CAR		
Brakes adjusted too tight.	Check brake adjustment.	2 BRAKE
Operator riding brake.	Check operating procedure.	1 DRIVING
Low tire pressure.	Check tire pressure.	2 WHEELS
Wheel bearing friction.	Check wheel bearing lubrication.	2 WHEELS
Differential friction.	Check differential and lubrication.	2 DRIVE
Car overloaded.	Check operating procedure.	1 CONTROLS AND OPERATION
CAR WILL NOT OPERATE IN EITHER DIRECTION		
Batteries discharged.	Check condition of batteries.	5 BATTERY
Key switch defective.	Check operation of key switch.	5 SWITCHES
Linkage from foot pedal to speed switch broken or disconnected - speed switch defective.	Check operation of speed switch.	5 SWITCHES

1967 AND LATER MODEL DE, DE-3, DE-4, 1969-1970 MODEL DEC TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR WILL NOT OPERATE IN EITHER DIRECTION (Cont)		
Solenoids not closing.	Check operation of solenoids (B) (R) or (F).	5 SWITCHES
Circuit breaker open.	Check operation.	5 SWITCHES
Drive motor field, brushes or armature circuit defective.	Check condition of motor brushes and internal circuits.	5 MOTOR
Burned out motor diodes.	Incorrect battery hookup.	5 BATTERY
Poor contact between battery posts and battery cable terminals.	Check for corroded or loose battery post connections.	5 BATTERY
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids to other components.	5 WIRING DIAGRAM
CAR JERKS INTERMITTENTLY (ACCELERATOR DEPRESSED)		
Loose or broken wires.	Check tightness of all terminals and wiring continuity.	5 WIRING DIAGRAM
Broken resistor.	Check resistor.	5 SWITCHES
Speed switch contacts dirty or corroded.	Check speed switch.	5 SWITCHES
Solenoids "hanging up".	Check solenoid operation.	5 SWITCHES
CAR WILL GO FORWARD, BUT NOT BACKWARD		
Key switch defective in reverse position.	Check operation of key switch.	5 SWITCHES
Forward or reverse solenoids (F or R) defective.	Check operation of solenoids.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch to other components.	5 WIRING DIAGRAM
CAR WILL GO BACKWARD, BUT NOT FORWARD		
Key switch defective in forward position.	Check operation of key switch.	5 SWITCHES
Forward or reverse solenoids (F or R) defective.	Check operation of solenoids.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM
CAR OPERATES IN FIRST SPEED ONLY		
Diode (A) open.	Check diode operation.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring contunity leading from speed switch and solenoids.	5 WIRING DIAGRAM

1967 AND LATER MODEL DE, DE-3, DE-4, 1969-1970 MODEL DEC TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR OPERATES IN FIRST AND SECOND SPEEDS, BUT NOT IN THIRD AND FOURTH SPEEDS		
Speed switch not making good contact between third speed contact and movable contact on speed switch arm.	Check condition of speed switch.	5 SWITCHES
Micro-switch misadjusted or defective.	Check micro-switch and adjustment.	5 SWITCHES
Solenoid (A) open.	Check operation of solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity and insulation.	5 WIRING DIAGRAM
CAR OPERATES IN FIRST, SECOND AND THIRD SPEEDS, BUT LACKS POWER OR HESITATES IN FOURTH SPEED		
Delay tube, delay tube socket or resistor defective (1967).	Tube loose in socket. Check tube by substituting. Check resistor continuity.	5 WIRING DIAGRAM
CAR WILL NOT OPERATE IN FIRST SPEED, BUT SECOND, THIRD AND FOURTH SPEEDS OPERATE NORMALLY		
Diode (A) shorted.	Check diode operation.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM
Speed switch not making good contact between first speed contact and arm contact.	Check condition of speed switch.	5 SWITCHES
CAR OPERATES NORMALLY IN FIRST SPEED, THEN JUMPS TO THIRD AND FOURTH SPEEDS		
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity of red and yellow wires from speed switch to solenoids.	5 WIRING DIAGRAM
Micro-switch misadjusted or defective.	Check micro-switch and adjustment.	5 SWITCHES
CAR JERKS BETWEEN SECOND AND FOURTH SPEEDS (NO THIRD SPEED)		
Delay tube defective (contacts welded closed).	Check delay tube.	5 SWITCHES
CAR STOPS AND STARTS WHILE IN FOURTH SPEED		
Defective circuit breaker.	Check circuit breaker operation.	5 SWITCHES
Overload or short in electrical system.	Check motor. Check wiring and components.	5 MOTOR 5 WIRING DIAGRAM
CAR STARTS OUT IN THIRD SPEED (NO FIRST OR SECOND SPEEDS)		
Solenoid (A) stuck closed.	Check solenoid operation.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity of wires from speed switch to solenoids.	5 WIRING DIAGRAM

1967 AND LATER MODEL DE, DE-3, DE-4, 1969-1970 MODEL DEC TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR STARTS OUT IN SECOND, FOURTH SPEED OPERATES NORMALLY (NO FIRST OR THIRD SPEED)		
Solenoid (C) stuck closed.	Check solenoid operation.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity and insulation of wires from speed switch to solenoids.	5 WIRING DIAGRAM
Defective (open) resistor, loose wire connections.	Check continuity of resistor and connections.	
CAR STARTS FORWARD AS SOON AS KEY SWITCH IS TURNED ON		
Speed switch is stuck in first, second or fourth speed.	Check speed switch.	5 SWITCHES
Solenoid A stuck closed (shorted at coil terminals).	Check solenoid A.	
CAR WILL NOT STOP WITH KEY ON		
Speed switch not returning to off position.	Check speed switch, linkage and return spring.	5 SWITCHES
CAR WILL NOT STOP WITH KEY OFF		
Key switch defective.	Check operation of key switch.	5 SWITCHES

Note: A special testing procedure for the electrical system of 1972 and later cars is given in Section 5.

TORQUE REQUIREMENTS

GENERAL FASTENER TIGHTENING SPECIFICATIONS

Torque to the values given in this table unless specified otherwise below. Torque figures are in ft.-lbs.

FINE OR COURSE THREAD FASTENER	GRADE DESIGNATION	TENSILE STRENGTH MINIMUM	MATERIAL	SCREW, STUD, OR BOLT SHANK SIZE OR DIAMETER															
				2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
CAP SCREW	S. A. E. 2 A. S. T. M. A-307 STEEL	64,000 P. S. I.	Low Carbon Steel								6	11	19	30	45	66	93	150	202	300
CAP SCREW	S. A. E. 3 STEEL	100,000 P. S. I.	Medium Carbon Steel								9	17	30	47	69	103	145	234	372	551
CAP SCREW	A. S. T. M. A-449 S. A. E. 5 STEEL	105,000 P. S. I.	Medium Carbon Steel or Low Alloy Heat Treated								9	18	31	50	75	110	150	250	378	583
CAP SCREW	A.S.T.M.354BB STEEL																			
CAP SCREW	A.S.T.M. A-325 *														100		200	355	525	790
CAP SCREW	A. S. T. M. A-354-BC STEEL	125,000 P. S. I.	Low Alloy or Med. Carb. Quenched Tempered								11	20	34	54	81	119	167	269	427	644
CAP SCREW	S. A. E. 6 STEEL	133,000 P. S. I.	Med. Carbon Steel Quenched Tempered								12.5	24	43	69	106	150	209	350	550	825
CAP SCREW	S. A. E. 7 STEEL		Med. Carbon Alloy, quenched Tempered Roll Threaded																	
CAP SCREW	S.A.E. 8 STEEL	150,000 P. S. I.	Med. Carbon Alloy Quenched Tempered								13	28	46	75	115	165	225	370	591	893
CAP SCREW	A-354-BD. A490*	150,000 P. S. I.	Med. Carbon Alloy Quenched Tempered										55	90	138	198	270	444	709	1071

SPECIFIC FASTENER TIGHTENING SPECIFICATIONS

TORQUES

DIFFERENTIAL — 1976 and EARLIER

Ring Gear
Mounting Bolts . . . . . 45 ft.-lbs. (6.3 kgm)
Pinion Nut . . . . . 50-70 ft.-lbs. (7.0-9.8 kgm)
Bearing Cap Bolts . . . . . 45 ft.-lbs. (6.3 kgm)
Differential Cover Bolts . . . 20 ft.-lbs. (2.8 kgm)
Axle Nut . . . . . 50 ft.-lbs. (7.0 kgm)

DIFFERENTIAL — 1977 and LATER

Ring Gear
Mounting Bolts . . . . 35-40 ft.-lbs. (4.9-5.6 kgm)
Axle Housing
Mounting Bolts . . . . 60-65 ft.-lbs. (8.4-9.1 kgm)
Axle Nut . . . . . 100 ft.-lbs. (14 kgm)
Axle Hub
Mounting Bolts . . . . 35-40 ft.-lbs. (4.9-5.6 kgm)
Differential
Cover Bolts . . . . . 15-18 ft.-lbs. (2.1-2.5 kgm)

Rear Axle
Mounting Bolts . . . . . 30 ft.-lbs. (4.2 kgm)

Motor Cover to
Differential Bolts . . . . . 30 ft.-lbs. (4.2 kgm)

Tie Rod Balljoint
Castle Nut . . . . . 25-28 ft.-lbs. (3.5-3.9 kgm)

After torquing, back off until slot lines up with hole and insert cotter pin.

COMMON CONVERSION FACTORS

7.2 x kgm - ft.-lbs.
0.14 x ft.-lbs. - kgm
28.3 x ounces - grams
0.035 x grams - ounces
0.45 x pounds - kilograms
2.2 x kilograms - pounds

For inch to millimeter and millimeter to inch conversions, see next page.

METRIC CONVERSION TABLE

MILLIMETERS to INCHES (mm x 25.40 = inches)								INCHES to MILLIMETERS (inches x 0.03937 = mm)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

CHASSIS 2

TABLE OF CONTENTS

DRIVE

DANA AXLE (1963-1975 MODELS DE, DE-4, DEF AND DEC)

DIFFERENTIAL AND AXLE

GENERAL

The differential lubricant level should be checked yearly and filled to level of the filler plug opening. See Figure 2-1. Harley-Davidson Transmission or Differential Lubricant, or another approved hypoid lubricant is required per specifications in Section I of this manual. It is not recommended to mix various brands of hypoid lubricants. If replacing lubricant with a different brand, it is advisable to flush axle housing with light engine oil. Never use kerosene for flushing. Remove differential housing cover, fastened with bolts, to drain and flush.

Wheel bearings receive their lubrication from grease packed in bearings when assembled.

Rear axle noise can be confused with other noises in the car. Considerable care should be taken in the diagnosis of noises before deciding that the trouble is in the rear axle assembly.

If the rear axle is properly maintained, little difficulty will be experienced. However, due to conditions beyond normal control, a few cases may require repair. Considering the precise nature of the differential, special tools and fixtures are required to perform some adjustments. For this reason, rear axle and differential should be taken to an automotive axle shop which specializes in this type work.

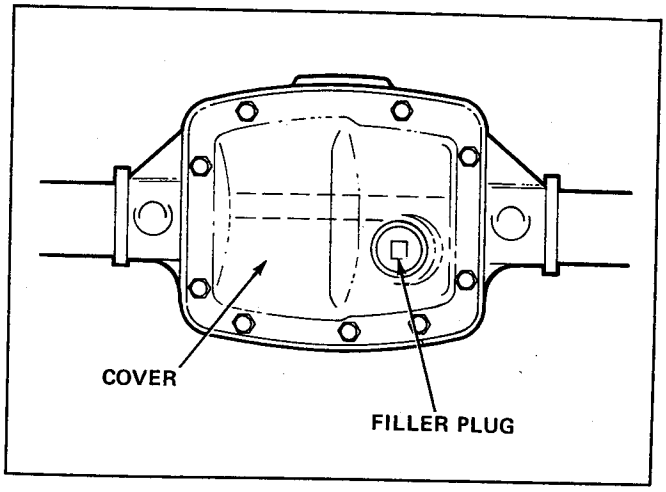


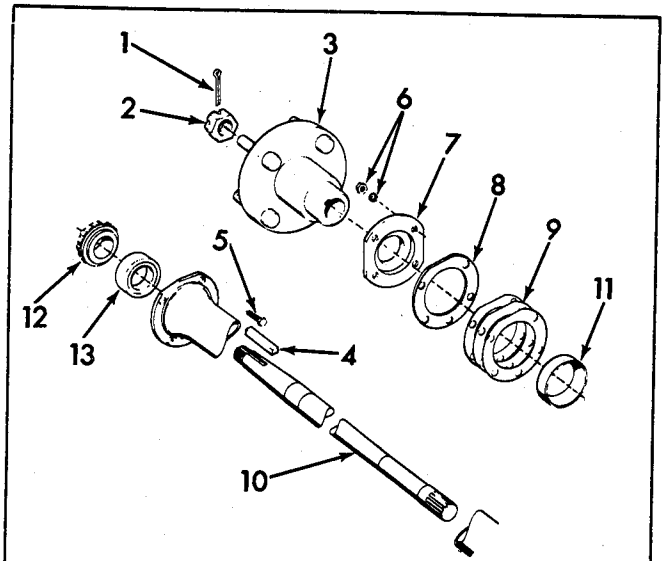
Figure 2-1. Dana Differential Filler Plug and Cover

REAR AXLES

REMOVING AXLE SHAFT (Fig. 2-2)

If an axle shaft must be removed from the housing for reason of straightening or replacement, it can be removed without removing entire differential and axle assembly from the car.

Block car clear of ground and remove wheel (see Wheels, Section 2). Remove cotter pin (1) and axle shaft nut (2). Wheel hub (3) fits a tapered, keyed shaft and can be removed with an automotive type hub puller. Remove key (4). On models equipped with rear wheel brakes, remove brake parts as described in section 2. Wash flange end of axle free of dirt. Remove the four bolts (5), washers and nuts (6), holding plate to axle housing flange. Remove oil seal (7), retainer plate (8) and any shims (9) found between plate and axle housing flange. The axle shaft (10) is held in the axle housing by the bearing cup (11). The end of the shaft in the differential is a splined fit in the differential bevel gear and can be pulled out of the housing when outer bearing cup is freed from its press fit in the housing flange. If some difficulty is experienced in freeing the outer bearing cup, use an axle puller or put axle nut on axle and tap in an outward direction using brass drift and light hammer. After shaft has been removed, bearing cone (12) can be pressed off shaft using U plate and arbor press. Bearing cone and cup should be washed free of grease in solvent, then inspected to determine whether they are suitable for further service. Inspect oil seal (13) and replace it if it is damaged or worn. If axle is to be straightened, this work should be done by a shop specializing in axle and differential repair.



1. Cotter pin
2. Axle shaft nut
3. Wheel hub
4. Key
5. Bolt (4)
6. Washer and nut (4)
7. Oil seal
8. Retainer plate
9. Shims (variable no.)
10. Axle shaft
11. Bearing race
12. Bearing cone
13. Oil seal

Figure 2-2. Rear Axle - Exploded View - 1963-1975 Models DE, DE-4, DEF and DEC

INSTALLING AXLE SHAFT (Fig. 2-2)

Press bearing cone (12) onto axle shaft (10) using pressing sleeve and arbor press. (Sleeve should butt against bearing inner race not roller retainer.) Pack bearing with Harley-Davidson Grease-All lubricant and insert axle shaft into housing lining up splines on shaft and in bevel gear in differential, so that shaft can be pushed in against axle spacer in differential. Install bearing race (11), retainer plate (8) and spacing shims (9), fastening temporarily with two opposite bolts (5), washers and nuts (6). With bolts tight, check the end play of shaft. Overall end play should be between .003 and .012. In making this check, be sure both wheels are blocked clear of floor. Add or remove shims until end play is within specifications. On final assembly, install new oil seal (7) and four bolts (5) with nuts and lockwashers (6). Put a thin coat of grease on the lip of the oil seal before installing. After tightening the four bolts, recheck the shaft end play. Install key (4) and wheel hub (3). Turn on axle shaft nut (2) and tighten to 50 ft. lbs. torque. Then tighten until nearest cotter pin hole lines up. Install cotter key (1).

DIFFERENTIAL

REMOVING REAR AXLE AND DIFFERENTIAL ASSEMBLY (Fig. 2-4)

When repairs to the rear axle housing or differential become necessary, the entire rear end drive assembly must be removed.

Disconnect drive coupling from 1965 and earlier rear axle and differential (see "Drive Coupling," Section 4). Remove rear wheels (See Wheels, Section 2). Block car clear of ground, supporting rear frame section, not under differential housing. Remove four axle mounting bolts (1) from frame and remove rear axle and differential (2) as an assembly.

Remove motor from 1966 and later Electric Car axle and differential assembly. (See "Motor," Section 5).

DISASSEMBLING DIFFERENTIAL CASE AND DRIVE PINION (Fig. 2-4)

NOTE

Wheels, axle shafts and wheel bearings must be removed from axle and differential housing prior to disassembling this unit. This is described in preceding paragraph under AXLES.

1. Clean outside of housing thoroughly. Place rear axle and differential assembly (2) on a holding fixture or large vise, gripping tube with carrier cover facing upward.

2. Remove cover bolts and cover (3) and gasket (4).

3. Clean differential gears, bearings, and other internal parts of gear carrier with a solvent. At this point, rotate drive gear, check drive gear back face for runout with a dial test indicator. See Figure 2-3. Total indicator reading in excess of .006" might indicate loose drive gear or a sprung differential case.

A .003" feeler should not enter between differential bearing cap and cup. If .003" feeler enters, it could denote the differential bearing had turned in the carrier.

4. Remove differential bearing cap bolts (5) and caps (6), (Figure 2-4). Note matching marks on carrier and differential bearing caps. Refer to Figure 2-5.

5. Pry differential case assembly (7) loose with large screwdriver or bar and lift from carrier. NOTE: Pry out differential case assembly as straight up as possible using leverage against differential and carrier to prevent damage.

6. Remove cups (8) from differential case bearings (9). NOTE: If bearing cones and cups are not worn or damaged and are to be reassembled, make certain that each mating cup and cone are paired together.

7. Drive out lock pin (10) securing differential pinion mate shaft to case (11). See Figure 2-6.

8. Remove differential bearing cones (9). Care must be taken to insure that bearing puller is located in cast recesses of differential case so as not to pull on bearing cage. See Figure 2-7.

9. Remove shims (12). NOTE: If drive gear and drive pinion are to be reassembled, note position of shims and replace accordingly.

10. Remove screws (13) and drive gear (14).

11. Remove differential pinion mate shaft (15), differential pinion mates (16) and thrust washers (17), (one back of each pinion). Remove differential side gears (18) and thrust washers (19), (one back of each gear).

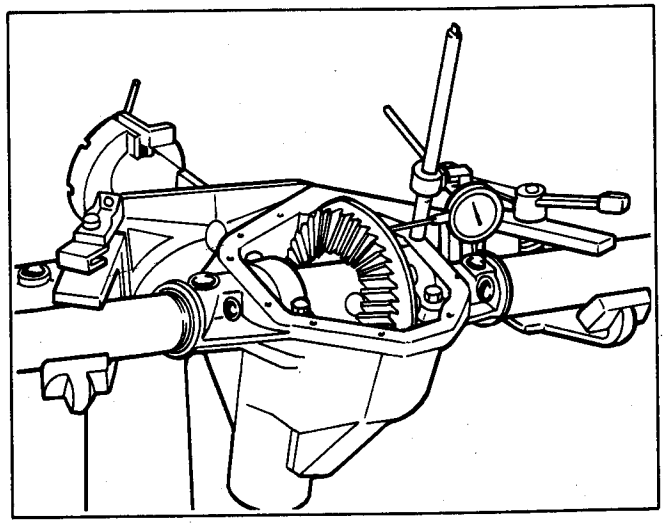
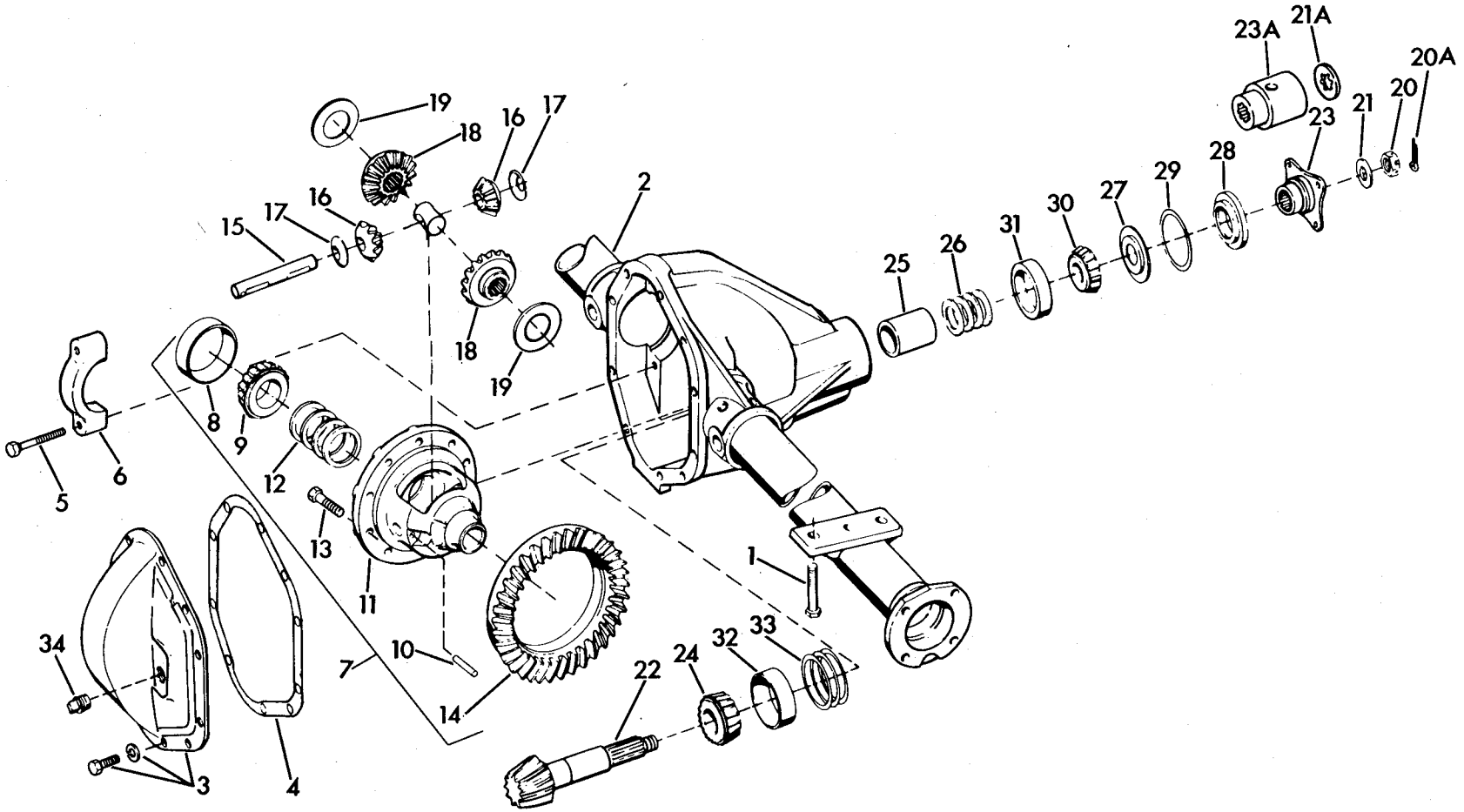


Figure 2-3. Check Drive Gear for Runout



1. Bolt (4)
2. Rear axle and differential assembly
3. Cover bolts and cover
4. Gasket
5. Bolts (4)
6. Cap (2)
7. Case assembly
8. Cup (2)
9. Bearing cone (2)
10. Lock pin
11. Case
12. Shims
13. Screw (10)
14. Drive gear
15. Shaft
16. Pinion (2)
17. Thrust washer (2)
18. Gear (2)
19. Thrust washer (2)
20. Nut*
20A. Cotter pin
21. Washer*
21A. Retainer**
22. Pinion shaft*
23. End yoke*
23A. Differential coupling**
24. Bearing cone*
25. Sleeve*
26. Shims*
27. Oil slinger**
28. Oil seal*
29. Gasket*
30. Bearing cone*
31. Bearing cup*
32. Bearing cup*
33. Shims*

(* items used on 1963-65 and 1972 and later DE, DEC, DE-4)
(** items used on 1972 to early 1977 DE and DE-4)

Figure 2-4. Dana Differential Assembly - Exploded View - 1963-1975 Models DE, DE-4, DEF and DEC

NOTE

Following steps 12 to 17 inclusive do not apply to direct drive electric cars.

12. Turn housing assembly in vise or holding fixture so that drive pinion shaft is vertical.

13. If used, bend tab on retainer (21A) flat. Remove nut (20) and washer (21) or retainer (21A) from drive pinion shaft (22) and remove end yoke (23) or coupling (23A) with claw puller.

14. Place housing assembly on arbor press similar to one shown in Figure 2-8. Press out shaft (22). Drive pinion shaft rear bearing cone (24) will remain on shaft. Remove bearing spacer sleeve (25) and adjusting shims (26), placing these parts with pinion shaft.

15. Place housing assembly on press (Figure 2-9). With a suitable pressing plug, press out outer pinion shaft bearing oil slinger (27) and oil seal (28). Remove oil seal gasket (29).

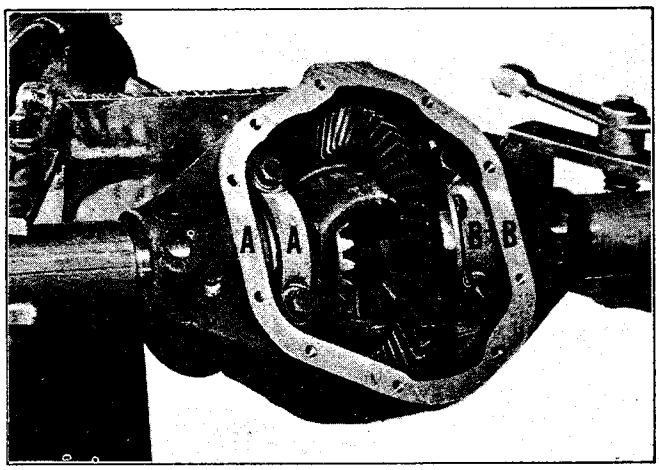


Figure 2-5. Carrier and Bearing Cap Matching Marks

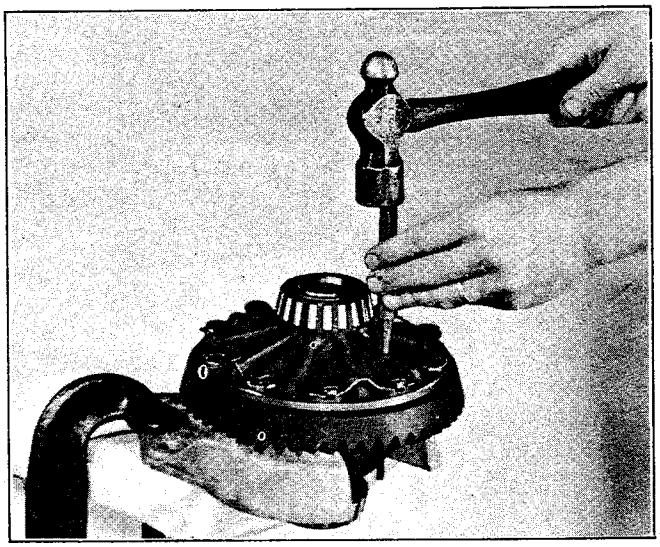


Figure 2-6. Removing Lock Pin

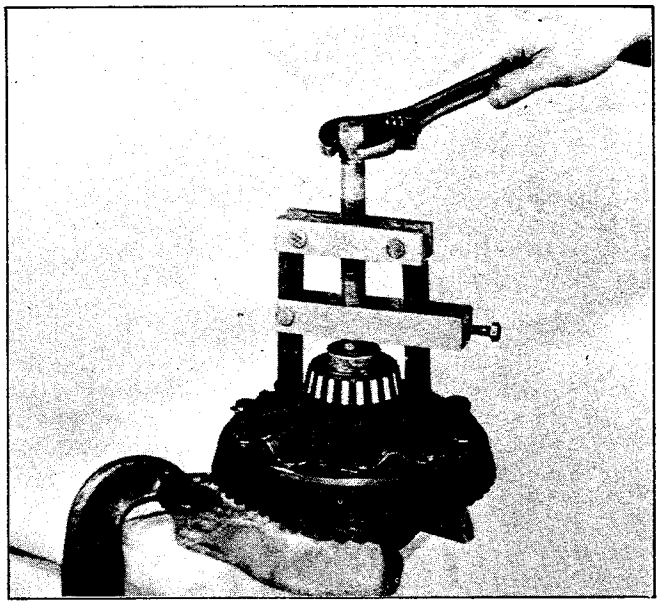


Figure 2-7. Bearing Cone Removal

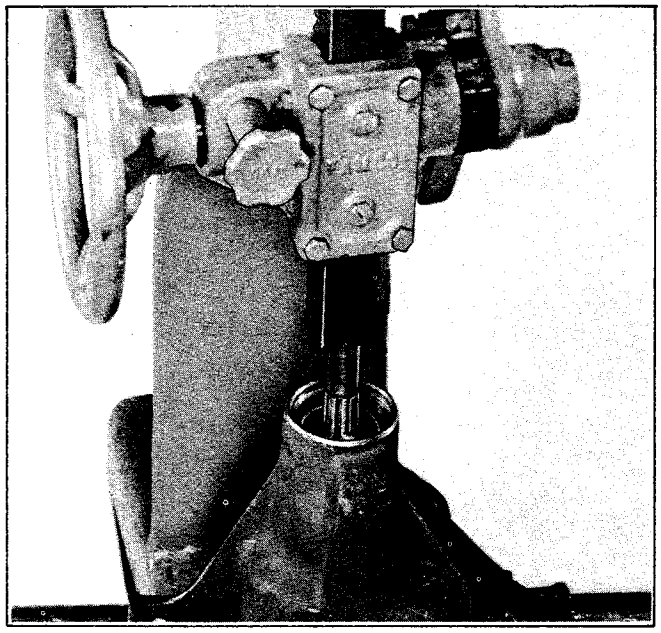


Figure 2-8. Pressing Out Shaft

NOTE

If the cups or bearings are not worn or damaged, they may be reassembled and removal is not necessary.

16. Remove drive pinion shaft rear bearing cone (30) with press tool similar to one shown in Figure 2-10.

17. Remove drive pinion shaft bearing cups (31) and (32) from housing with a drift or suitable puller. When removing bearing cup (32), remove adjusting shims (33), and record thickness of shims.

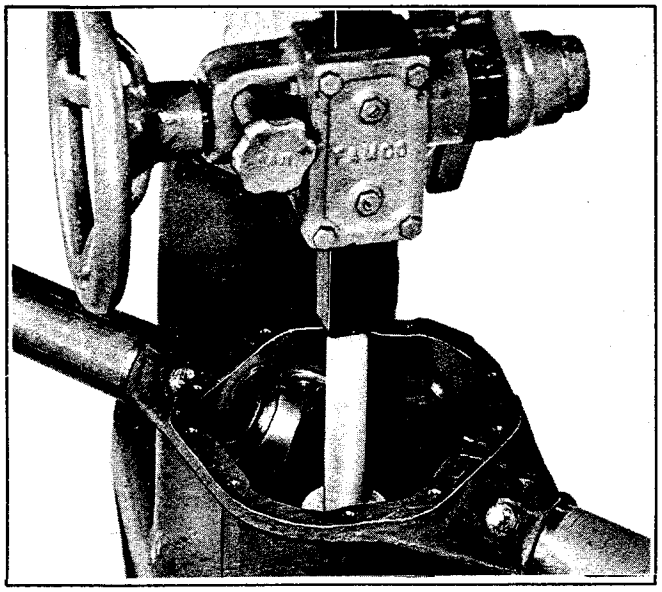


Figure 2-9. Pressing Out Oil Slinger

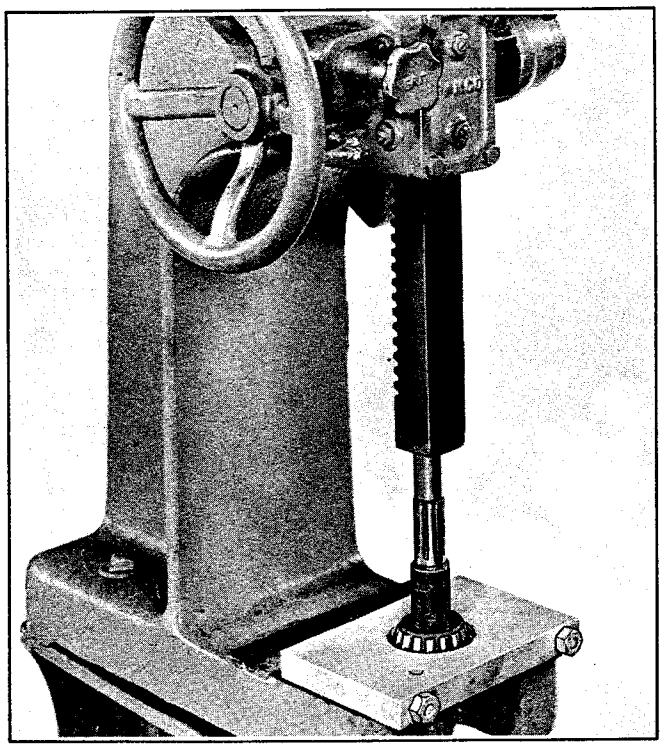


Figure 2-10. Removing Pinion Shaft Rear Bearing Cone

18. Wash all parts including carrier and tube assembly with suitable solvent. Do not steam to clean.

19. Examine all bearing surfaces and splines for burrs or scoring. Remove burrs with a hand stone.

20. Check all bearing cups and cones for nicks, roller end wear, grooves and any damage, and replace accordingly. Do not replace a worn cup or cone individually--Renew in sets only if either is worn.

21. Examine differential pinion mate and side gear thrust washers for wear.

22. All seals once removed should be replaced with new parts.

23. Replace all defective parts. Drive gears and drive pinions are available only in matched sets. Do not replace one gear or one pinion only.

ASSEMBLING DIFFERENTIAL CASE ASSEMBLY AND DRIVE PINION

1. Install differential side gears (18) thrust washers (19), differential pinion mates (16), thrust washers (17), and differential pinion mate shaft (15) in the differential case. Lubricate all parts with differential lubricant. If new gears and washers are used, it will not be necessary to check gear backlash. Correct fit is provided when using new parts.

2. Align lock pin hole in differential pinion mate shaft (15) and drive in differential pinion mate shaft lock pin (10). Peen case metal over top of pin to lock in place (See Figure 2-11).

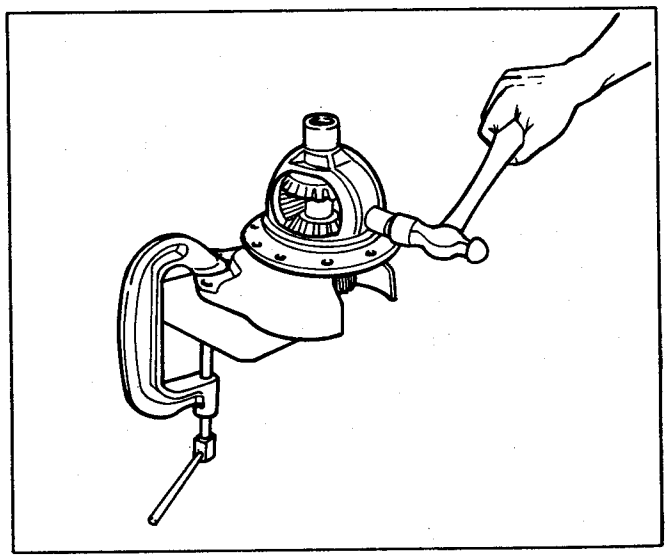


Figure 2-11. Peening Case Over Top of Pin

3. Place differential case assembly (11) in a suitable holding fixture.

4. Install drive gear (14) with screws (13). Torque screws to 45 ft.-lbs.

5. Position under arbor press. Press on differential bearing cones (9) without shims (12). Use press tool similar to one shown in Figure 2-12.

6. Place bearing cups (8) on the bearing cones (9). Make sure parts are clean and free from nubs and burrs. Cups should be clean and free from mutilations.

7. With differential cover side up, place differential case assembly (11) in housing (2).

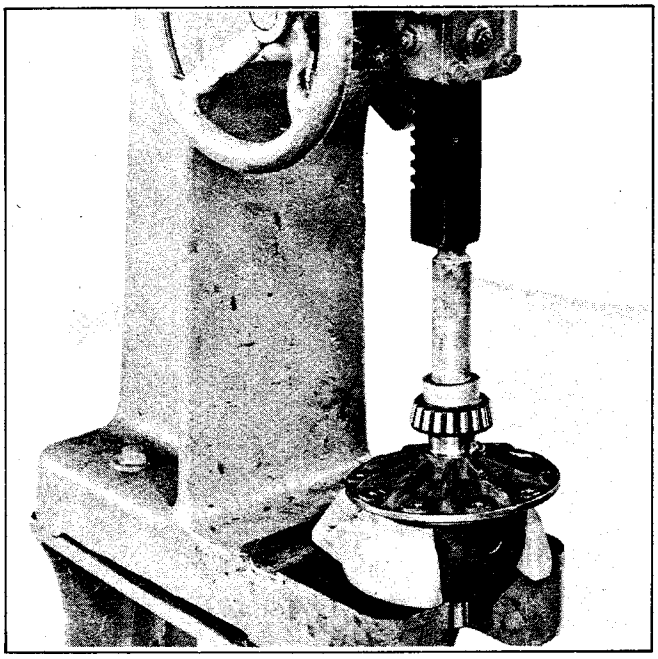


Figure 2-12. Pressing On Bearing Cone

8. Install differential bearing caps (6) in their correct positions, as noted in Step 4 of disassembly, with bearing cap screws (5) finger tight.

9. Set up dial indicator gage shown in Figure 2-13 with contact point on back of ring gear. With screwdriver blade between bearing cup and housing, pry case assembly as far as possible to one side of housing. Set dial indicator at zero. Shift case assembly to opposite side of housing and record reading. See Figure 2-14. The shim pack thickness to be placed between bearing cone assembly (9) and differential case (11) will be calculated later in the procedure.

10. Remove bolts (5), differential bearing caps (6) and place differential assembly (11) in a holding fixture or vise.

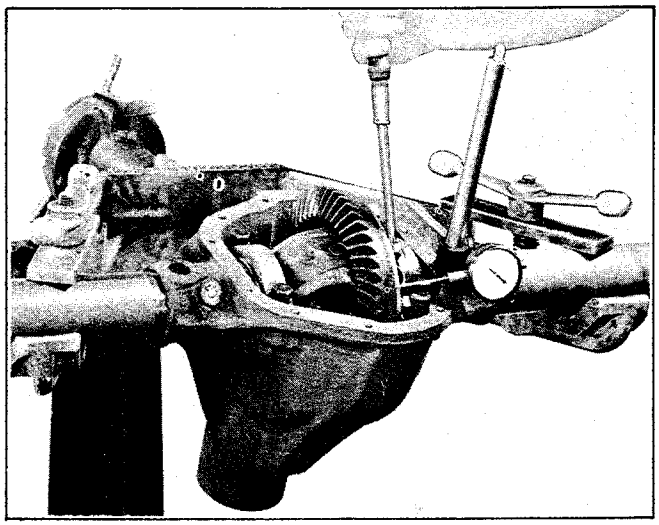


Figure 2-13. Dial Indicator Gage Set Up

11. Note figures etched on drive pinion (22) end. See Figure 2-15. Four sets of figures are etched on drive pinion. One figure is found on both the drive pinion and the drive gear and identifies a matched set. Directly opposite this figure will be one with a (+) or (-) before it, or, if not a (+) or (-), the figure will be 0. This number must be positively identified before continuing with the assembly procedure. Midway between the two sets of figures described above are numbers and letters etched for manufacturing purposes only, but as one of these numbers may be (0) and might be confused with the number needed for assembly procedure, a rule to follow would be to first examine the shaft end for a (+) or (-) number, and only if a (+) or (-) number is not etched on the shaft, will the number be (0).

NOTE

Following steps 12, 13, 14, 15, 16, 17, and 18 do not apply to direct drive electric cars.

12. Install drive pinion shaft rear bearing cone (24) and spacer (25) with press tool similar to one shown in Figure 2-16.

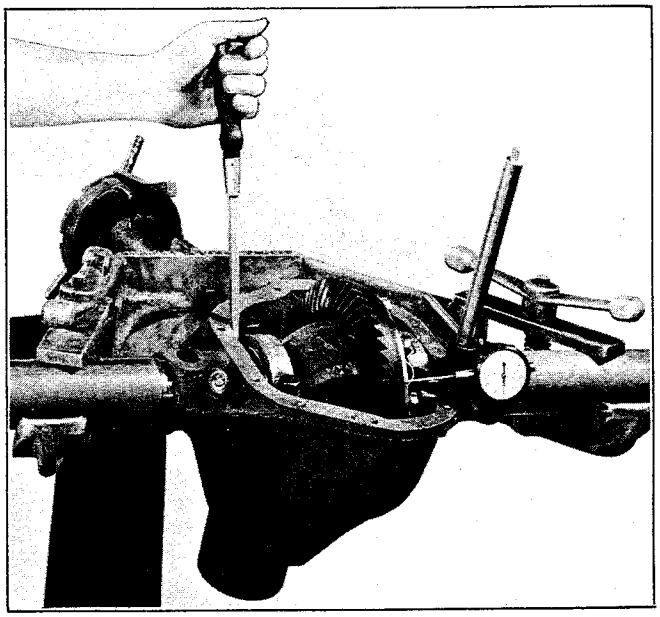


Figure 2-14. Dial Indicator Gage Reading

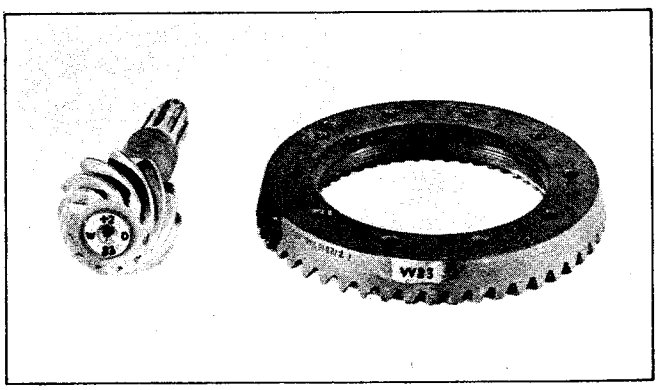


Figure 2-15. Drive Pinion and Drive Gear

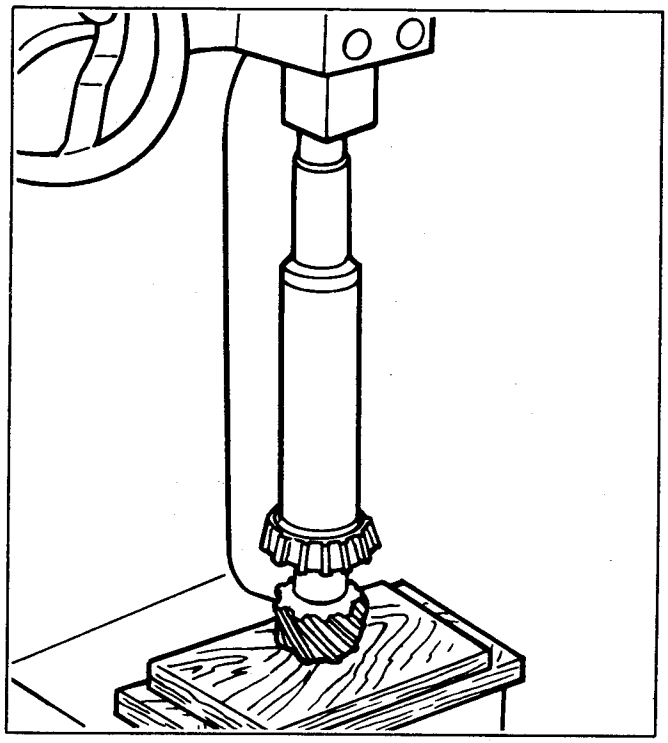


Figure 2-16. Installing Rear Bearing

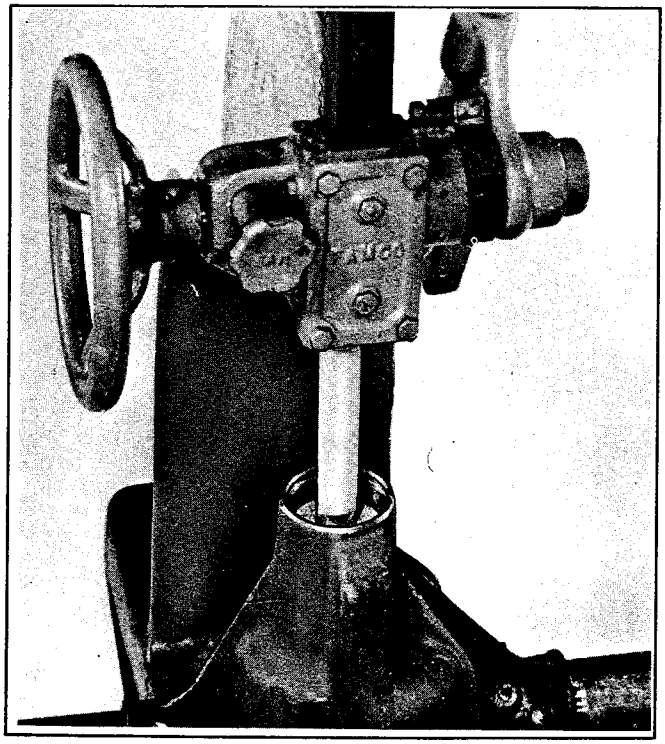


Figure 2-17. Installing Front Bearing Cup

13. Press drive pinion rear bearing cup (32) and shim pack (33) in carrier, using tool similar to one shown in Figure 2-17.

FOR A NEW PINION AND GEAR ONLY: The thickness of shims to be placed between the bearing cup and carrier can be determined from the shims removed and the etched marking on the pinion. The (+) or (-) figure indicates the variation from the nominal distance between the front of the pinion and the center line of the carrier. For example, if a pinion marked (+2) was originally installed with a shim pack of .035" and the new pinion was marked (-1), the shim pack should be increased .003" to bring the new pinion to its correct position and the new shim pack would be .038". Shims are available in .003", .005" and .010" thicknesses.

14. Press front bearing cup (31) in carrier with press tool similar to one shown in Figure 2-17. Install drive pinion shaft.

15. Press drive pinion shaft front bearing cone (30) on shaft (22) in carrier (support pinion gear end). Lubricate bearings with differential lubricant. Rotate drive pinion.

NOTE

If desired, the gage distance of pinion gear face from axle centerline can be measured with special gaging equipment to be found at rear axle repair shops. Nominal gage setting for axle is 1.938 in. (Pinion (+) or (-) number must be added or subtracted from this figure for correct micrometer reading.) If gage micrometer reads outside gage setting, add or remove shims (33) from behind rear pinion bearing cup (32) to correct reading. See Step 13.

16. Install oil slinger (27), gasket (29), and seal (28).

17. Install end yoke (23) or coupling (23A), washer (21) or retainer (21A), and nut (20). Finish tightening nut with torque wrench and socket to 50 to 70 ft-lbs. See Figure 2-18. Where applicable, bend one side of retainer (21A) against flat on nut (20), using a punch through hole in side of coupling 23A, Figure 2-4.

18. Check torque to turn drive pinion. Drive pinion shaft must be vertical for this check. Use a small torque wrench, reading in inch-pounds, and socket on shaft nut. Turning torque should be 10 to 20 in.-lbs.

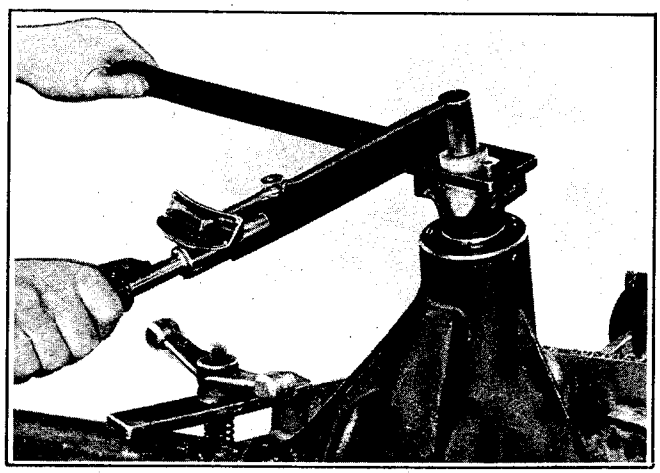


Figure 2-18. Tightening Nuts with Torque Wrench and Socket

Torque reading to start shaft turning will be disregarded. If torque is more than 20 in.-lbs, it will be necessary to add a sufficient number of shims to those previously placed on drive pinion to reduce turning torque. If torque reading is low, remove shims. Shims are available in the following thicknesses: .003", .005", .010", .010", and .030".

19. Place drive gear and differential case assembly, bearing cups included, in carrier. Place bearing caps (6) in their respective positions, align identification marks, with screws (5) finger tight.

20. Move drive gear into drive pinion and, from shim requirements as determined in Step 9, place shims (12) between cup and carrier as shown in Figure 2-19. Force them in both sides so as to use total amount and have gear rotate with no backlash.

NOTE

To decrease backlash, remove shims from left side (side on which gear teeth mesh) and transfer same amount of shims to right side. To increase backlash, reverse this procedure.

21. Place differential case in fixture and remove differential bearing cones. Install shims as indicated in Step 20 and then press on bearing cones. Lubricate bearings with differential lubricant.

22. Install differential drive gear and case assembly (7), including bearing cups (8), into housing. To insure proper seating of differential bearings in the cross-bore, the drive gear should be tapped with a rawhide hammer. Care must be taken in this operation to prevent nicking of drive pinion or drive gear as they are meshed together.

23. Install differential bearing caps (6). Bearing cap marks must match marks on carrier. Coat cap screw (5) threads with sealing compound, and torque screws to 45 ft.-lbs. Be sure all surfaces are clean and free from mutilation.

24. Set up dial indicator and with contact point on a drive gear tooth, check backlash between drive gear and drive pinion. See Figure 2-20. Check backlash at four equally spaced points around drive gear. Backlash must be held between .004" to .009" and cannot vary more than .002" between positions checked. If backlash does not fall within these specifications, change shim packs on both differential bearings. See Step 20.

25. Install gasket (4) and cover (3) using a new gasket. Torque cover screws to 20 ft.-lbs.

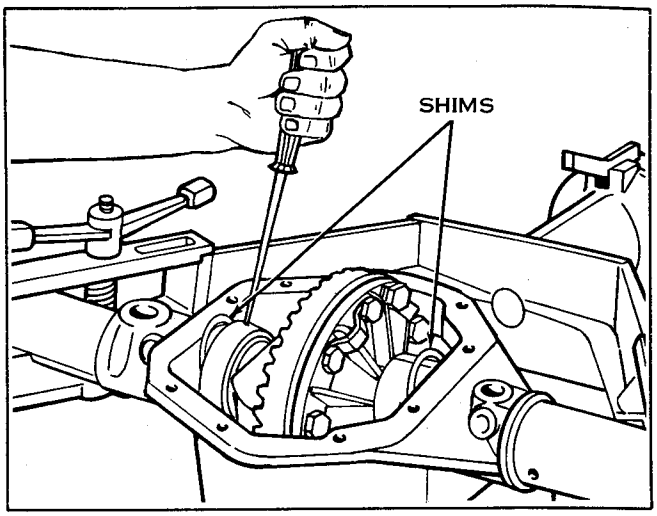


Figure 2-19. Adding Shims

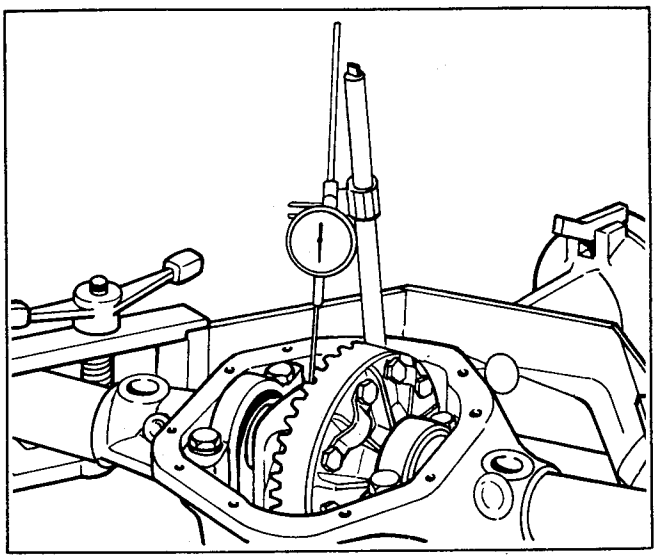


Figure 2-20. Checking Backlash

INSTALLING REAR AXLE AND DIFFERENTIAL ASSEMBLY (Fig. 2-4)

Install electric motor and shim pack (1966 and later direct drive axle) (See "Motor," Section 5).

Install axle and differential assembly in car and fasten with four mounting bolts (1).

Install "Axle Shafts," "Wheels" (Section 2), and "Drive Coupling" (Section 4) or "Transmission Rear Drive" (Section 4) and "Brake" (Section 2). Fill rear axle differential with recommended lubricant (see Specifications).

PEERLESS AXLE (1977 AND LATER MODEL DE-3)

AXLE AND DIFFERENTIAL

GENERAL

The differential lubricant level should be checked yearly and lubricant added as required to fill to level of filler plug hole. A bent wire may be used as a dipstick. See Figure 2-21. Harley-Davidson Transmission Lubricant is required per specifications in Section 1 of this manual. It is not recommended to mix various brands of hypoid lubricants. If replacing lubricant with a different brand, it is advisable to flush interior of axle housing and components with light engine oil. Never use kerosene for flushing. On 1977 and later models, differential must be removed from car and disassembled for flushing.

Wheel bearings receive their lubrication from grease packed in bearings when assembled.

Rear axle noise can be confused with other noises in the car. Considerable care should be taken in the diagnosis of noises before deciding that the trouble is in the rear axle assembly.

If the rear axle is properly maintained, little difficulty will be experienced. However, due to conditions beyond normal control, a few cases may require repair. Considering the precise nature of the differential, special tools and fixtures are required to perform some adjustments. For this reason, rear axle and differential should be taken to an automotive shop which specializes in this type of work.

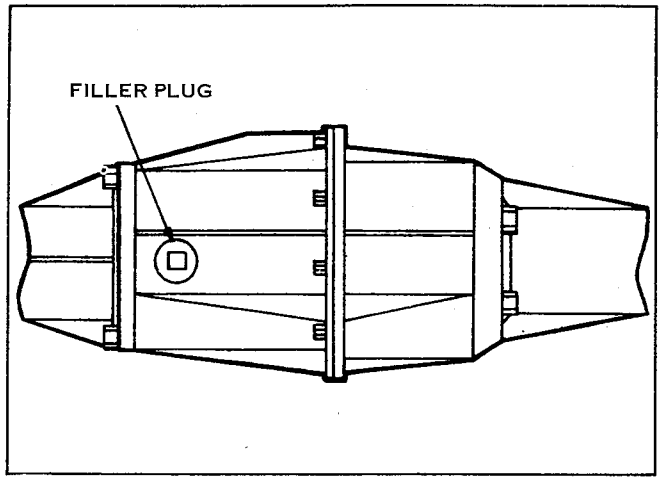


Figure 2-21. Peerless Differential Filter Plug

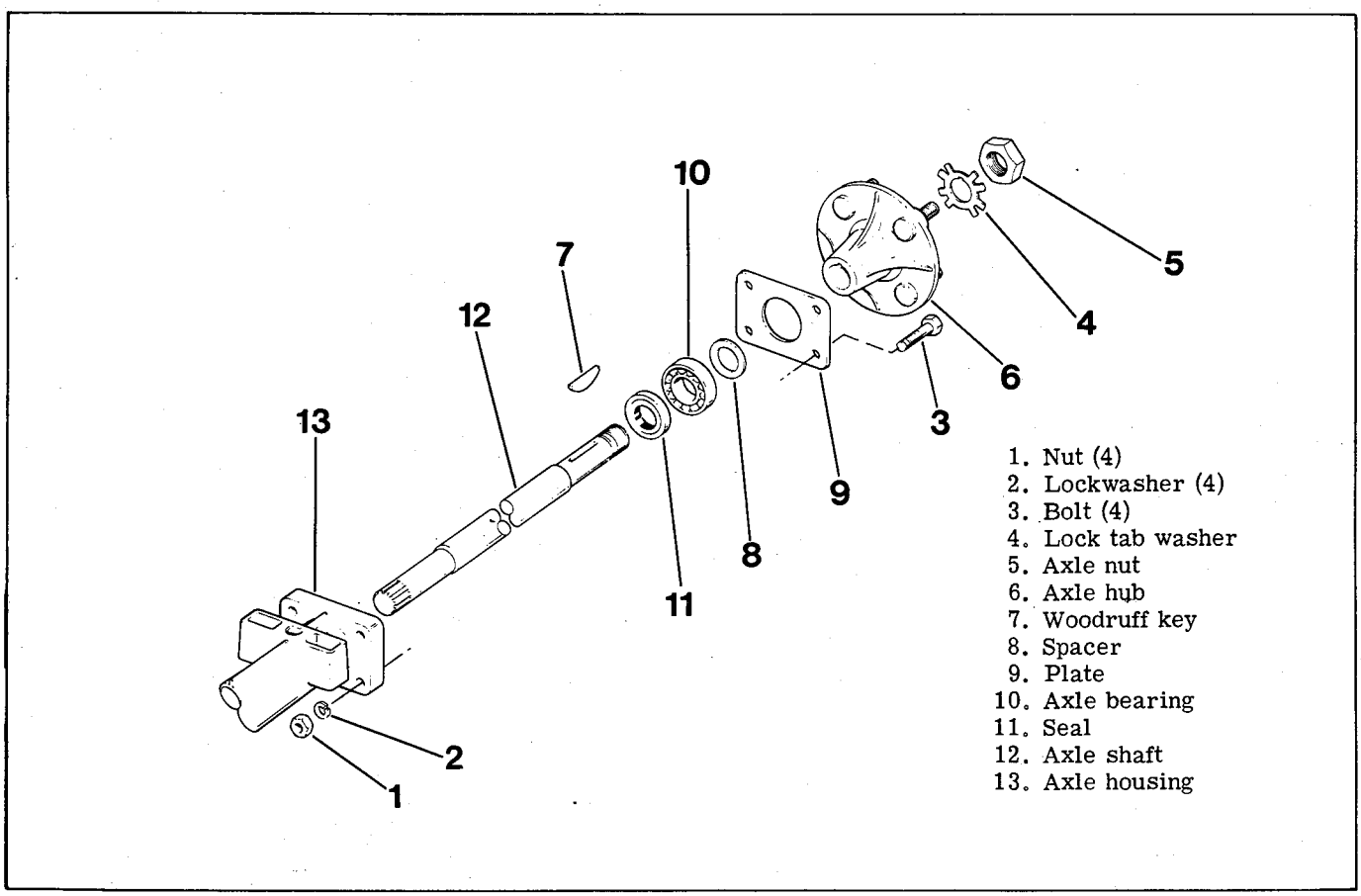


Figure 2-22. Rear Axle - Exploded View - 1977 and later Model DE-3

REMOVING AXLE SHAFT

If an axle must be removed from the housing for reasons of straightening or replacement, it can be taken out without removing entire differential and axle assembly from car. If differential is not drained prior to pulling axles, fluid will drain from axle housing. After reassembly, check level of fluid in differential and fill as required.

Block rear frame of car so that rear wheel(s) are off the ground. Remove hub caps and four wheel mounting bolts. Remove wheel assembly and wash housing free of dirt and grime.

Remove four nuts (1), lockwashers (2) and bolts (3) from axle housing. Pull axle and wheel hub assembly, which includes axle (12), wheel hub (6), axle bearing (10) and plate (9) from axle housing.

Bend tab of washer (4) away from flat of axle nut (5) and remove nut, washer, hub (6), key (7), spacer (8) and plate (9). Press ball bearing (10) from axle. Pull seal (11) from axle housing and discard.

CLEANING AND INSPECTION

Clean all parts with non-flammable cleaning solvent. Inspect bearing for excessive wear or side play. Replace all parts worn or damaged.

If axle is to be straightened, it should be done by a shop specializing in axle and differential repair.

INSTALLING AXLE SHAFT (Figure 2-22)

Press new oil seal (11) into axle housing. Press axle bearing (10) onto axle shaft (12). Pack bearing with Harley-Davidson Bearing Grease and insert axle into housing. Rotate until splines on axle shaft align with splines in differential bevel gear so that axle can be pushed in and properly seated. Bearing must seat flush with face of axle housing. Secure plate (9) to axle housing (13) with four bolts (3), lockwashers (2) and nuts (1). Torque bolts to 35-40 ft.-lbs.

Place spacer (8) on shaft up against bearing and place key (7) into shaft keyseat. Slide on hub assembly (6) and secure with tab washer (4) and axle nut (5). Torque axle nut to 100 ft.-lbs. then tighten additionally until tab on washer can be bent against flat of nut. Reinstall wheel assembly and hub caps. Check fluid level in differential and fill as required. See DIFFERENTIAL AND AXLE.

DIFFERENTIAL

REMOVING PINION AND PINION BEARING (Figure 2-23)

Should the pinion bearing need replacing, it is not necessary to remove the entire axle and differential assembly from the car. Only the traction motor need be removed, see "TRACTION MOTOR." A slight amount of differential fluid may drain from the differential when the pinion is pulled. After assembly, check fluid level in differential and fill as necessary.

NOTE

Drive gear and pinion are available in matched sets only. Do not replace one without replacing the other. Failure to replace both gears will result in excessive wear and premature breakdown.

Remove and discard oil seal (1). Remove retaining ring (2) and thrust washer (3). Pull pinion assembly (4) out of housing. Remove ball bearing (5), retaining ring (6), outer bearing race (7), thrust bearing (8) and inner bearing race (9). Needle bearing (10) may be pulled from housing if necessary for inspection or cleaning.

Clean all parts carefully and inspect for wear or damage. See "CLEANING AND INSPECTION."

ASSEMBLING PINION AND PINION BEARING (Figure 2-23)

Place inner bearing race (9), thrust bearing (8), and outer bearing race (7) on the pinion shaft (11). Secure with retaining ring (6). Slip ball bearing (5) on shaft. Press needle bearing (10) into housing, if removed. Insert pinion assembly (4) into housing, rotating slowly to mesh with ring gear (25) in differential. Insert washer (3), retaining ring (2) and press in a new oil seal (1).

REMOVING REAR DRIVE ASSEMBLY

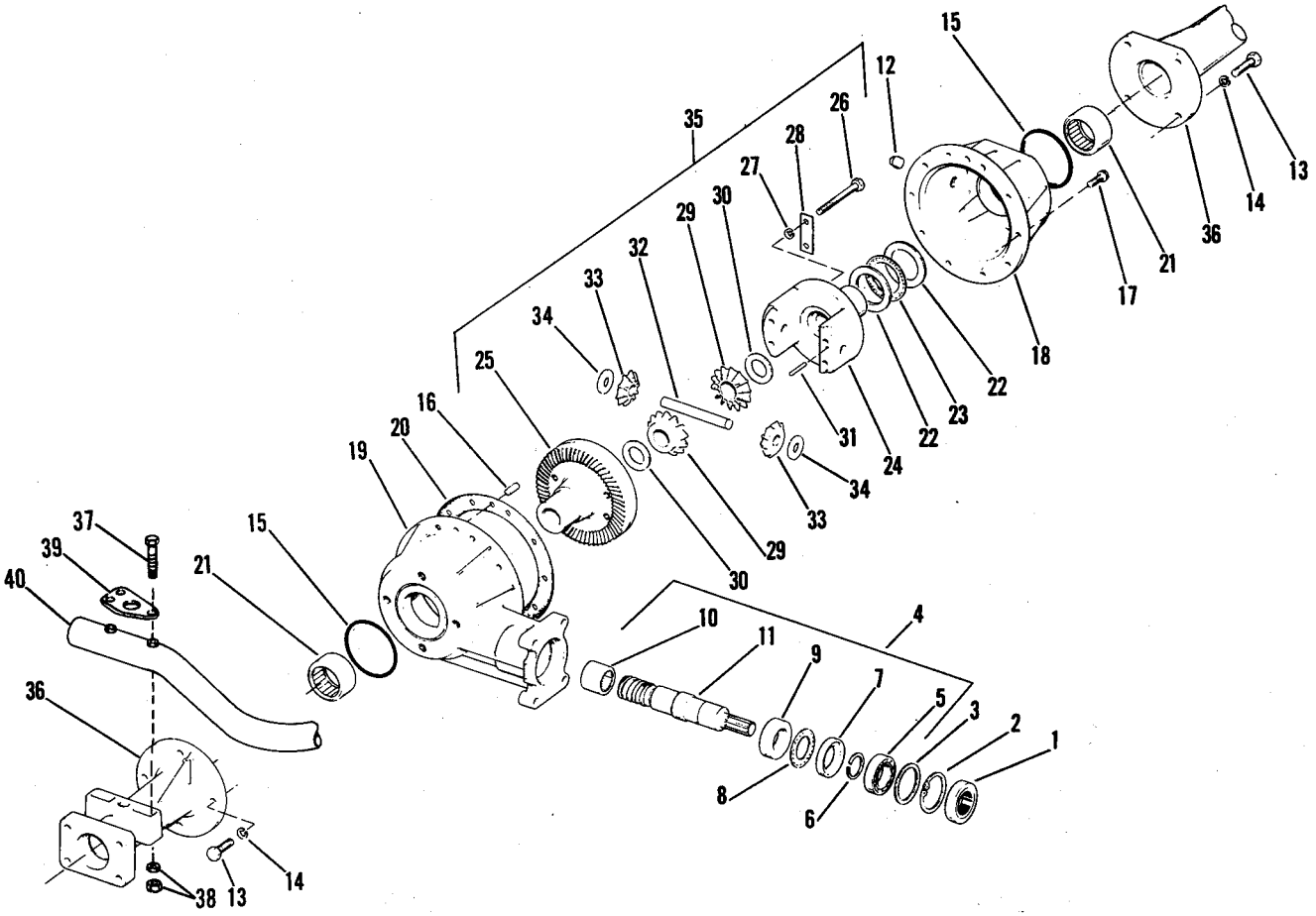
To repair the differential, it is necessary to remove the entire rear drive assembly from car. Remove wheels and motor assembly. See TRACTION MOTOR. Block rear frame of car off ground. Do not block under axle or differential. Disconnect sway bar and lockwasher from axle. Support differential assembly and remove eight locknuts, lockwashers and bolts securing axles to frame.

DISASSEMBLY OF DIFFERENTIAL CASE (Figure 2-23)

Before disassembly, clean outside of housing thoroughly with a non-flammable cleaning solvent. Remove fill plug (12) and drain fluid from unit. Place differential on a clean bench or work stand.

1. Remove axle assemblies from differential by removing four bolts (13) and lockwashers (14). Separate axle assembly from differential. Remove and discard O-ring (15).

2. Remove the ten hex head screws (17) and separate cover (18) from pinion case (19). Remove and discard cover gasket (20). Remove differential assembly (35) from case. Remove thrust washers (22) and thrust bearing (23) from differential carrier (24). If further inspection of needle bearing (21) in differential case or cover is required, pull bearings using a suitable bearing puller.



1. Seal
2. Retaining ring
3. Thrust washer
4. Pinion assembly
5. Ball bearing
6. Retaining ring
7. Outer bearing race
8. Thrust bearing
9. Inner bearing race
10. Needle bearing
11. Pinion
12. Fill Plug
13. Bolt (4)
14. Lockwasher (4)
15. O-ring
16. Dowel pin (2)
17. Screw (10)
18. Differential cover
19. Pinion case
20. Cover gasket
21. Needle bearing (2)
22. Thrust washer (2)
23. Thrust bearing
24. Gear carrier
25. Ring gear
26. Bolt (4)
27. Lockwasher (4)
28. Locktab (2)
29. Bevel gear (2)
30. Thrust washer (2)
31. Pin
32. Drive pin
33. Bevel gear (2)
34. Washer (2)
35. Differential assembly includes bracketed items plus needle bearing (2), item 21
36. Axle housing
37. Bolt (4)
38. Lock nut/washer (4)
39. Mounting pad (2)
40. Mounting pad (2)

Figure 2-23. Peerless Differential Assembly - Exploded View - 1977 Model DE and Later

3. Separate differential carrier (24) from ring gear (25) by removing the four bolts (26), lockwasher (27) and two locktabs (28). Note how parts (24) and (25) are oriented so they can be put back together exactly the same way during reassembly. Bend locktabs flat. Remove the bevel gear (29) and thrust washer (30) from the ring gear.

4. To remove the small dowel pin (31) which holds the drive pin (32) in place, tip the pin hole downward and gently tap the side of the gear carrier. Pin (31) should fall out. Remove the drive pin (32), two bevel pinions (33), two washers (34), bevel gear (29) and thrust washer (30).

5. Remove pinion as described in REMOVING PINION AND PINION BEARING.

CLEANING AND INSPECTION

Clean all metal parts with non-flammable cleaning solvent. Seals, gaskets and O-rings should be discarded and replaced. Examine all components for excessive wear and damage. Replace as necessary. Remove burrs from bearing surfaces and splines with a hand stone. Replace bearings which are nicked, grooved or damaged in any way.

NOTE

Drive gear and drive pinion are available in matched sets only. Do not replace one without replacing the other. Failure to replace both will result in excessive wear and premature breakdown.

ASSEMBLY OF DIFFERENTIAL CASE (Figure 2-23)

1. Install pinion in differential housing as described in ASSEMBLING PINION AND PINION BEARING.

2. Place one thrust washer (30) and bevel gear (29) into gear carrier (24). Assemble washers (34) and bevel pinions (33) into gear carrier while installing large drive pin (32). Insert holding pin (31). Install remaining thrust washer (30) and bevel gear (29) into drive gear housing (25). Attach drive gear to gear carrier with four lockwashers (27), bolts (26) and two locktabs (28). Reassemble gear carrier (24) and drive gear (25) so that they are oriented the same way they were before disassembly. Torque bolts to 35-40 ft.-lbs. and then bend corners of locktabs (28) against flat of bolts (26).

3. Place differential case (19) in suitable fixture and press in needle bearing (21) so that it extends out of case (toward axle housing) 7/32". Likewise, press needle bearing (21) into differential cover (18) so that it also extends out of case 7/32".

4. Place differential assembly (35) in case (19). Place thrust washers (22) and thrust bearing (23) on gear carrier. Position gasket (20) and cover (18) over dowel pins and secure with ten screws (17). Torque to 15-18 ft.-lbs.

5. Check side play of differential assembly (35) with a dial indicator placed against end of differential gear carrier (24). Side play of carrier (24) should be in the range of .004 to .018 inch for normal running.

6. Place new O-ring (15) in case (19) and cover (18) face grooves and install axle housings (36). Secure each with four bolts (13) and lockwashers (24). Reinstall axles. See AXLES.

INSTALLING REAR AXLE AND DIFFERENTIAL ASSEMBLY - LATE 1977 AND LATER (Figure 2-23)

Install traction motor (see "TRACTION MOTOR") on differential. Install motor and differential assembly in car using bolts (37), locknuts and lockwashers (38). Be sure mounting pads (39) are positioned properly on swing arms (40). Snug up locknuts (38) but do not tighten. Install sway bar and adjust length until swing arms (40) are square with car frame. Tighten locknuts (38) to 30 ft.-lbs. of torque. Install disc brake assembly to frame and traction motor as described in TRACTION MOTOR. Reconnect wiring to motor. See WIRING.

Fill differential with 24 oz. of Harley-Davidson Transmission Lubricant. Check torque of locknuts (3) after two days or 36 holes of operation.

WHEELS

GENERAL

Maximum tire life and good handling qualities are directly related to care given to the wheels and tires. At regular intervals, or if handling irregularities are experienced, see the CHECK CHART for recommended service.

REMOVING AND INSTALLING FRONT WHEELS AND HUBS

3 WHEEL MODELS (See Figure 2-24)

Raise front wheel clear of the ground with small jack or lift. 1969 & earlier: Remove cotter pin (1), nut (2) and washer (3). Loosen both axle clamp bolt nuts and lockwashers (4) and remove axle (5). Support wheel assembly (6) with hand, as axle is drawn from fork assembly. Remove spacer (7) from left side of wheel. 1970 & later: Loosen setscrew nut and setscrew (4A) at bottom of right fork slider unscrew axle (5A) using a rod through hole in end of axle. Remove spacer (7A) from left side of wheel. Pry off both hub caps (8) to expose wheel hub assembly (10). Remove nuts (9) and slide wheel hub assembly from wheel rim. To disassemble wheel hub, drift out bearings (11) from opposite sides of wheel hub (14) using 1/2" dia. brass drift. This will also remove seals (12). If bearing cups (13) are worn or pitted, drift out through opposite sides of wheel hub (14) with brass drift. Clean all parts and examine for damage or wear. Replace all damaged or worn parts. Pack wheel bearings with Harley-Davidson "Grease-All". If bearing cups (13) have been removed, press new cups into wheel hub (14). Install wheel bearings (11), wheel hub (14) and press in seals (12). Remount wheel hub assembly (10) in wheel rim with nuts (9). Install both hub caps (8), insert spacer (7) through left side hub cap axle hole and locate in bearing seal. Support wheel assembly (6) with valve stem to the left side of car and in alignment with fork sides. Install axle into fork side.

CAUTION

On 1969 & earlier models, axle nut (2) is also an adjustment for wheel bearings. Install washer (3), axle nut (2), and tighten nut until wheel drags slightly. Back off axle nut approximately 1/8 turn or until the next nut castellation lines up with the cotter pin hole in the axle. Install cotter pin (1) and tighten both axle clamp bolt nuts (4). See Figure 2-24.

On 1970 and later models axle is also an adjustment for wheel bearings. Tighten axle until wheel drags slightly, then back off 1/8 turn, install setscrew and locknut (4A).

4 WHEEL MODELS (See Figure 2-25)

Raise front wheels off the ground with a small jack or lift. Remove hub caps, wheel rim mounting nuts, and wheel, same as for 3 wheel car (See Figure 2-24.)

To remove wheel hubs, Figure 2-25, remove grease cap (1), cotter pin (2), castle nut (3), and flat washer (4). Remove hub assembly (5) from axle (6).

To disassemble wheel hub, remove bearings (7 and 8) from each side of wheel hub. If bearing cups (10 and 11) are worn or pitted, drift out from opposite sides of hub. This will also remove seal (9). Clean all parts and examine for damage or wear. Replace all damaged or worn parts.

Pack wheel bearing (7 and 8) with Harley-Davidson "Grease-All". If bearing cups (10 and 11) have been removed, press new cups into hub (12). Install wheel bearings (7 and 8). Press seal into hub with lip facing hub (9). Apply a small amount of grease to lip of seal and install hub assembly on axle. Assemble washer (4) on axle. Turn on axle nut (3) and tighten until bearing play is taken up and hub returns freely. Install cotter pin (2), and grease cap (1). NOTE: Bearing should be slightly loose rather than preloaded.

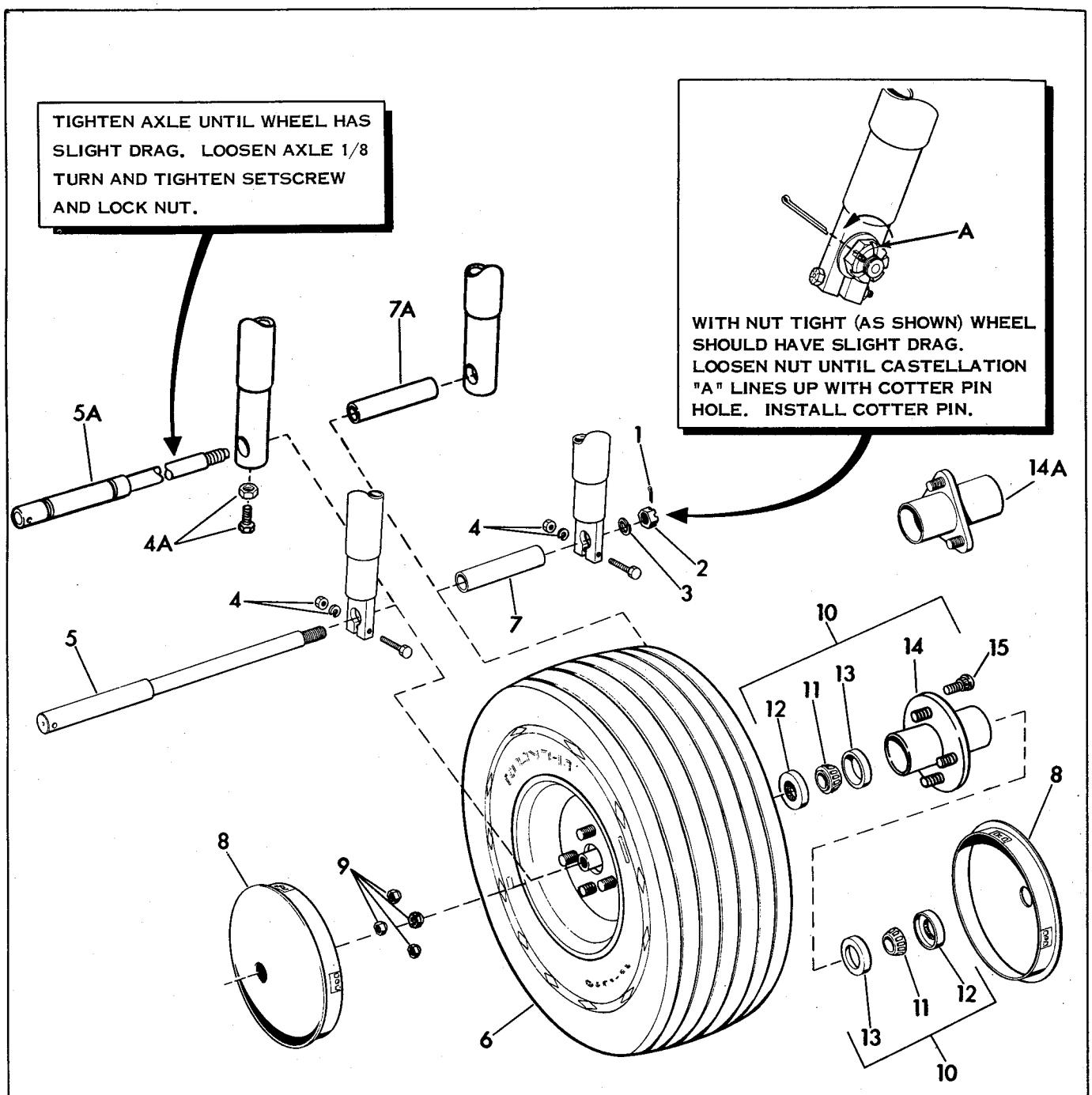
Assemble wheel to hub assembly (5) and tighten wheel rim mounting bolts. Install hub cap.

REMOVING AND INSTALLING REAR WHEELS (Figure 2-26)

Raise one or both rear wheels with small jack or lift and block in raised position. Remove hub caps (1) and the wheel rim mounting nuts (2). Pull wheel (3) assembly from axle hub (4). To reinstall, reverse order of disassembly.

CHECK CHART

CHECK FOR	REMEDY
1. Loose axle nuts and rear wheel mounting nuts.	1. Tighten loose nuts.
2. Incorrect tire inflation.	2. Inflate front and rear tires. See Specifications, Section 1.
3. Excessive freeplay in steering mechanism.	3. Adjust steering mechanism. See Section 2, "Adjusting Steering Mechanism."



1. Cotter pin
2. Nut
3. Washer
4. Nut and lockwasher (2) (1969 & earlier)

4A. Setscrew and locknut (1970)

5. Axle (1969 & earlier)

5A. Axle (1970)

6. Wheel assembly
7. Spacer (1969 & earlier)

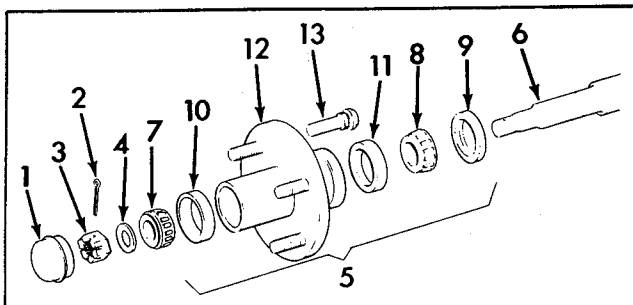
7A. Spacer (1970)

8. Hub caps (2)
9. Nut (3 or 4)
10. Hub assembly
11. Bearing (2)
12. Seal (2)
13. Bearing cup (2)
14. Wheel hub (1966 & later)

14A. Wheel hub (1963-65)

15. Wheel stud (3 or 4)

Figure 2-24. Front Wheel - 3 Wheel Car - Exploded View



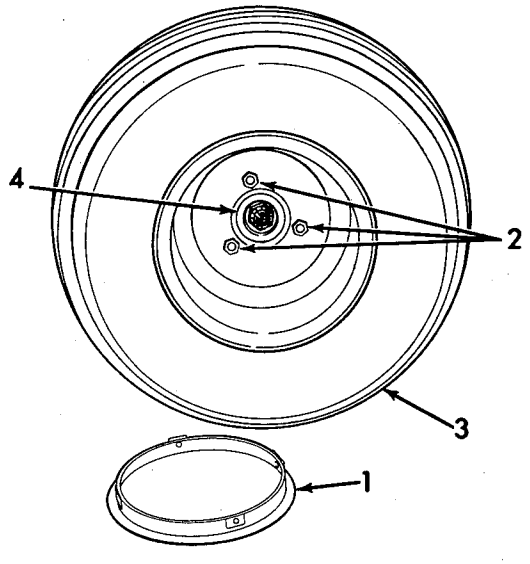
1. Grease cap
2. Cotter pin
3. Axle nut
4. Washer
5. Wheel hub assembly
6. Axle
7. Outer cone bearing
8. Inner cone bearing
9. Oil seal
10. Outer bearing cup
11. Inner bearing cup
12. Wheel hub
13. Wheel stud

Figure 2-25. Front Wheel Hub, 4 Wheel Car - Exploded View

REMOVING TIRE FROM RIM, FRONT OR REAR WHEEL (Figure 2-27)

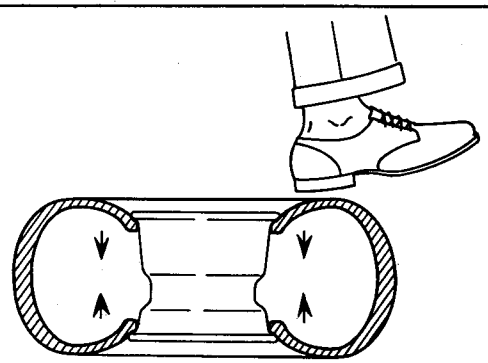
The car is fitted with low pressure tubeless tires.

In the event of a flat tire, remove wheel assembly as described in the preceding paragraphs and inflate the tire to 20 psi. Immerse tire in water to determine point of air leak. Mark point where bubbles escape. Leak could be due to any of the following: punctured casing, faulty valve core, valve stem improperly sealed in wheel rim or tire bead improperly seated on rim flange.

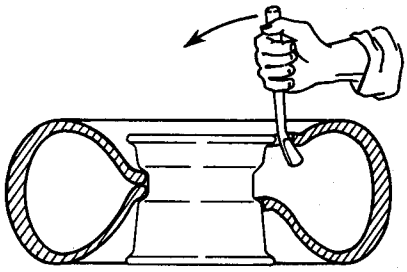


1. Hub cap
2. Mounting nuts (3 or 4)
3. Wheel and tire
4. Axle hub

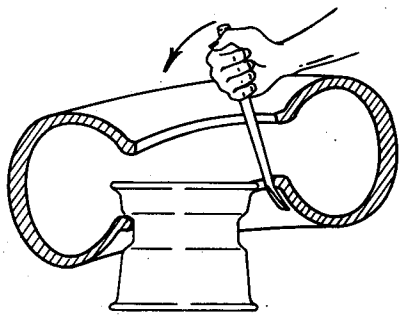
Figure 2-26. Rear Wheel



STEP I. BREAK TIRE BEADS FREE OF RIM



STEP II. REMOVING UPPER BEAD FROM RIM



STEP III. REMOVING LOWER TIRE BEAD FROM RIM

INFLATING TIRE

Figure 2-27. Tire Replacement

To remove tire from wheel rim, remove valve cap and valve core to free air from tire. Loosen both tire beads from rim flanges by stepping on tire side walls. Push tire bead off of wide rim flange into rim well. Using tire tools, carefully start upper bead over edge of wheel rim. Do not use excessive force when starting bead over edge of rim or tire bead may be damaged. When one bead is free of wheel rim, shift lower bead into rim well on one side of wheel and insert tire tool on opposite side and pry bead over rim flange. When bead has been started over rim flange, tire can be removed the rest of the way by hand.

REPAIRING TUBELESS TIRE

When the reason for loss of air has been determined and the tire has been removed, it is recommended that the standard tubeless tire repair procedure be followed depending on the nature of the air leak. (Tubeless tire repair equipment and kits are available through automotive equipment and tire suppliers.) Most service stations are equipped to repair tubeless type tires. If desired, an inner tube can be installed as an alternative to casing repair.

MOUNTING TIRE ON RIM

Clean both tire beads to remove any dirt or foreign matter. Clean wheel rim well, where tire beads seat, with a wire brush. This cleaning is very important as tubeless tires require a perfect seat between the wheel rim and tire beads to prevent loss of air. Install tire on trim using a rubber mallet or tire iron in manner opposite to removal. Apply liberal amount of tire mounting solution to the rim flange and tire beads. Remove valve core and position tire so the tire bead is seated on the rim flange narrow bead seat. Place tire upright against wall. Apply high pressure through valve stem while pushing against tire on side opposite wall and floor. This 3 point contact pressure will tend to bring beads out in contact with rim so that internal pressure is formed and beads snap into place. See Figure 2-27. 30 to 35 pounds air pressure should be used to seat tire beads on rim. Quickly remove air pressure and install valve core. Correct to specified pressure and immerse in water to recheck for air leaks.

NOTE

If tire fails to seat on rim flanges during initial inflation, it is more than likely due to a lack of sufficient air pressure. The quantity of air going into the tire must be greater than the amount escaping past the tire bead and rim flange.

FRAME

SERVICING FRAME

To rough check a frame for correct alignment, see Fig. 2-28, 1963-65 Basic Frame Dimensions. The dimensions shown will provide enough information to determine whether a frame is far enough out of alignment to require re-aligning job or replacement.

IMPORTANT

Frames, front forks or rear forks that are severely bent or damaged should be replaced. Factory repair is not available because the cost would exceed the price of new parts.

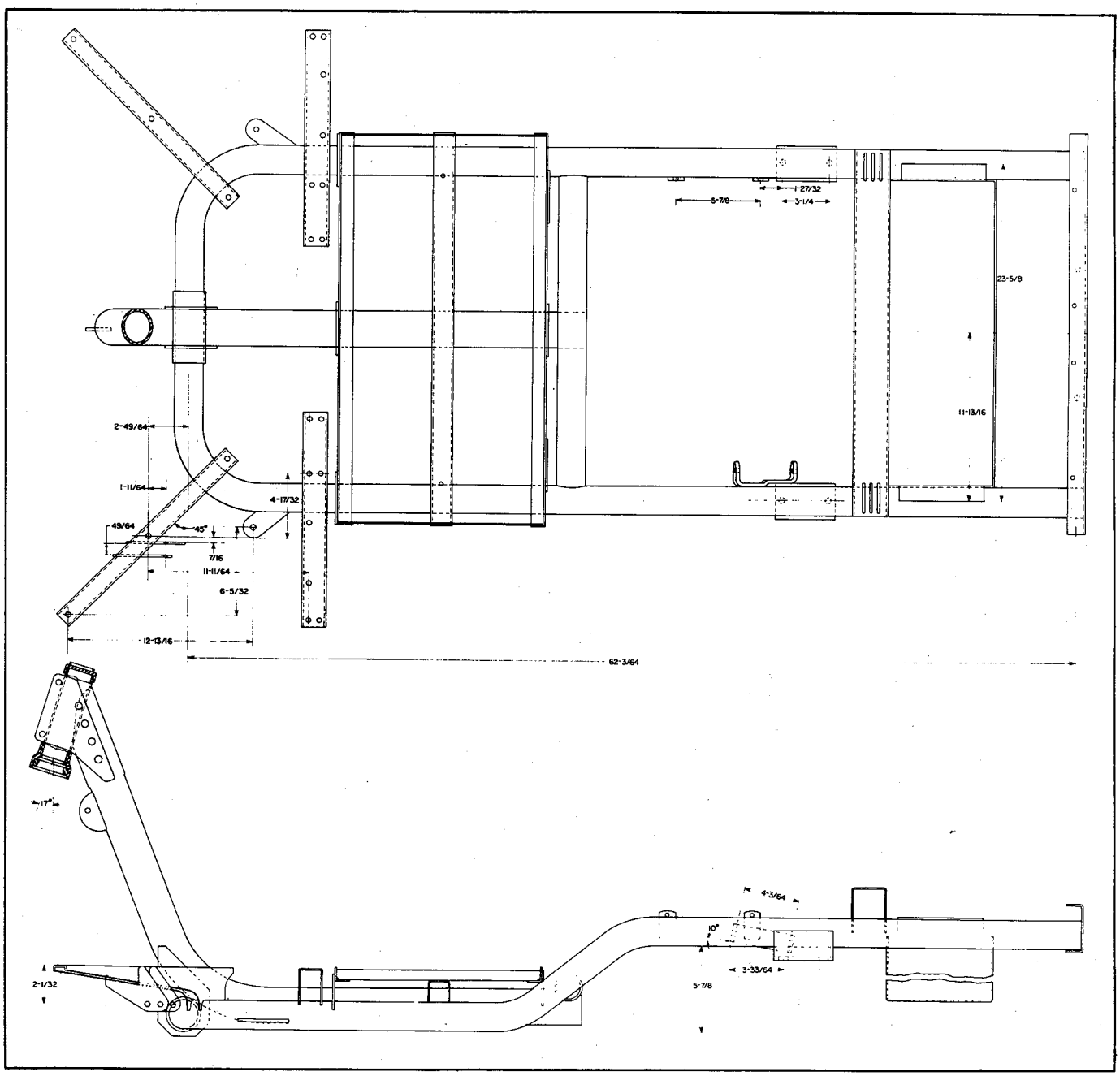


Figure 2-28. 1963-65 Basic Frame Dimensions

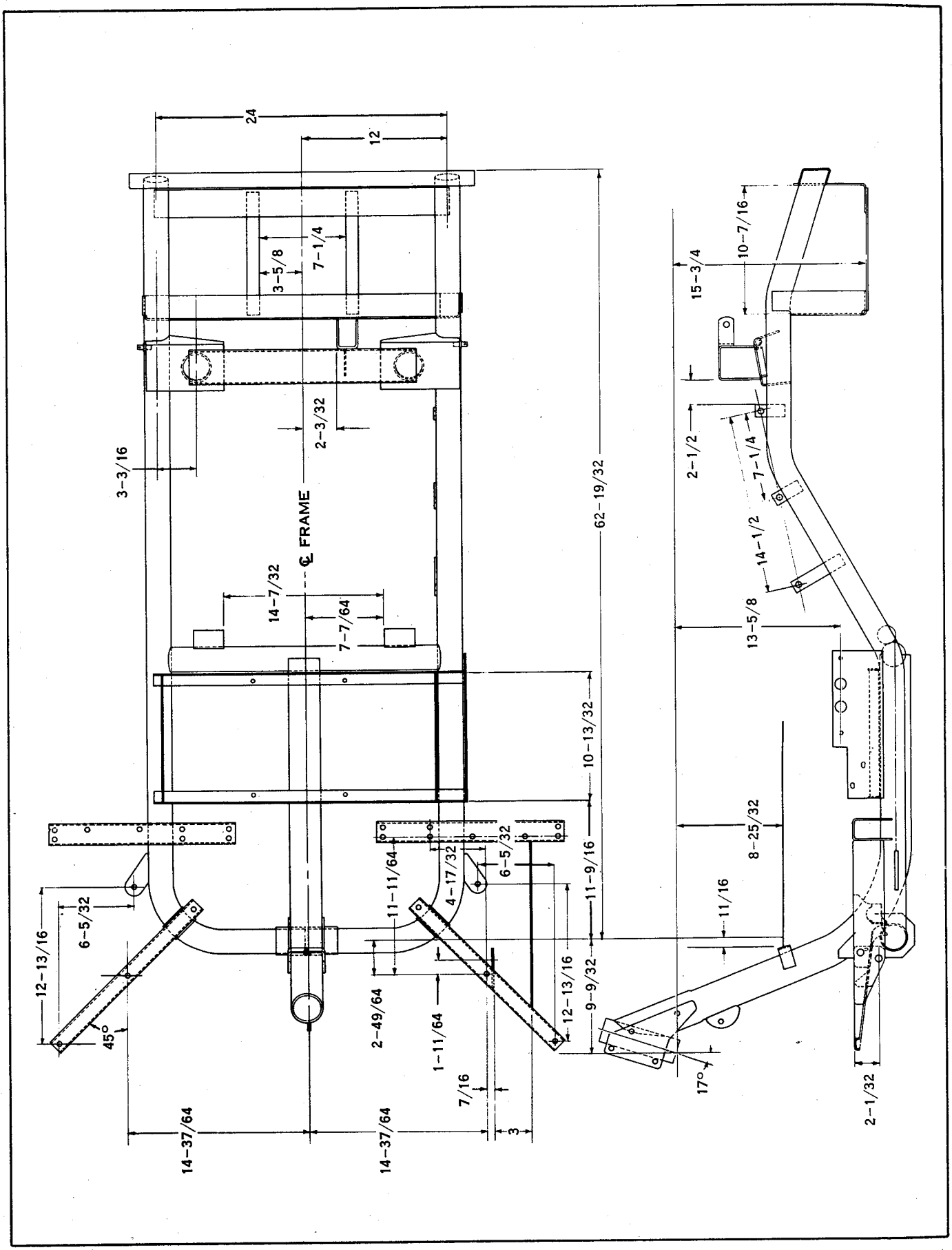


Figure 2-29. 1966-1972 Model DE, 1966-68 Model DEC Basic Frame Dimensions

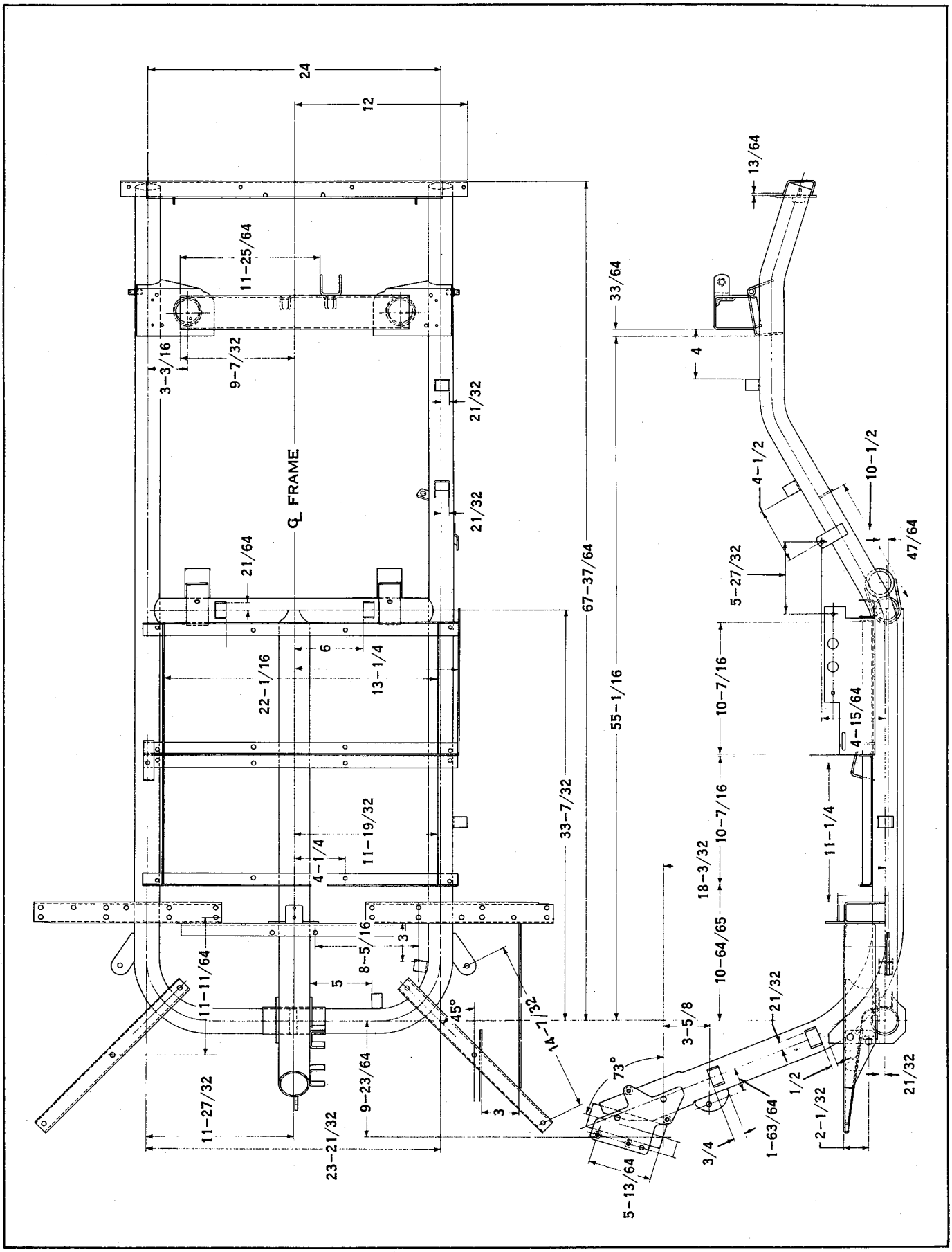


Figure 2-30. 1969 Model DEC Basic Frame Dimensions

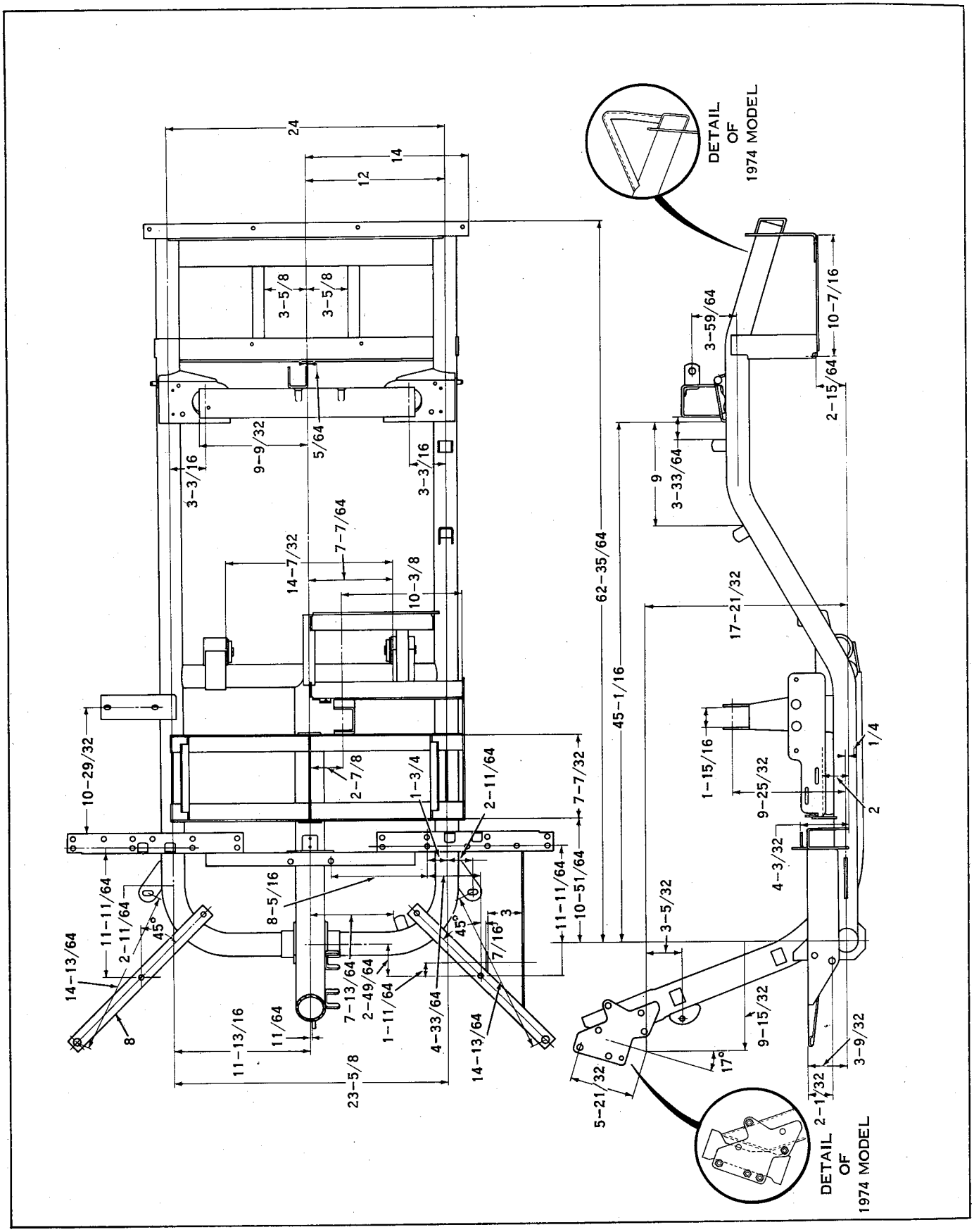


Figure 2-31. 1972-1974 Model DE Basic Frame Dimensions

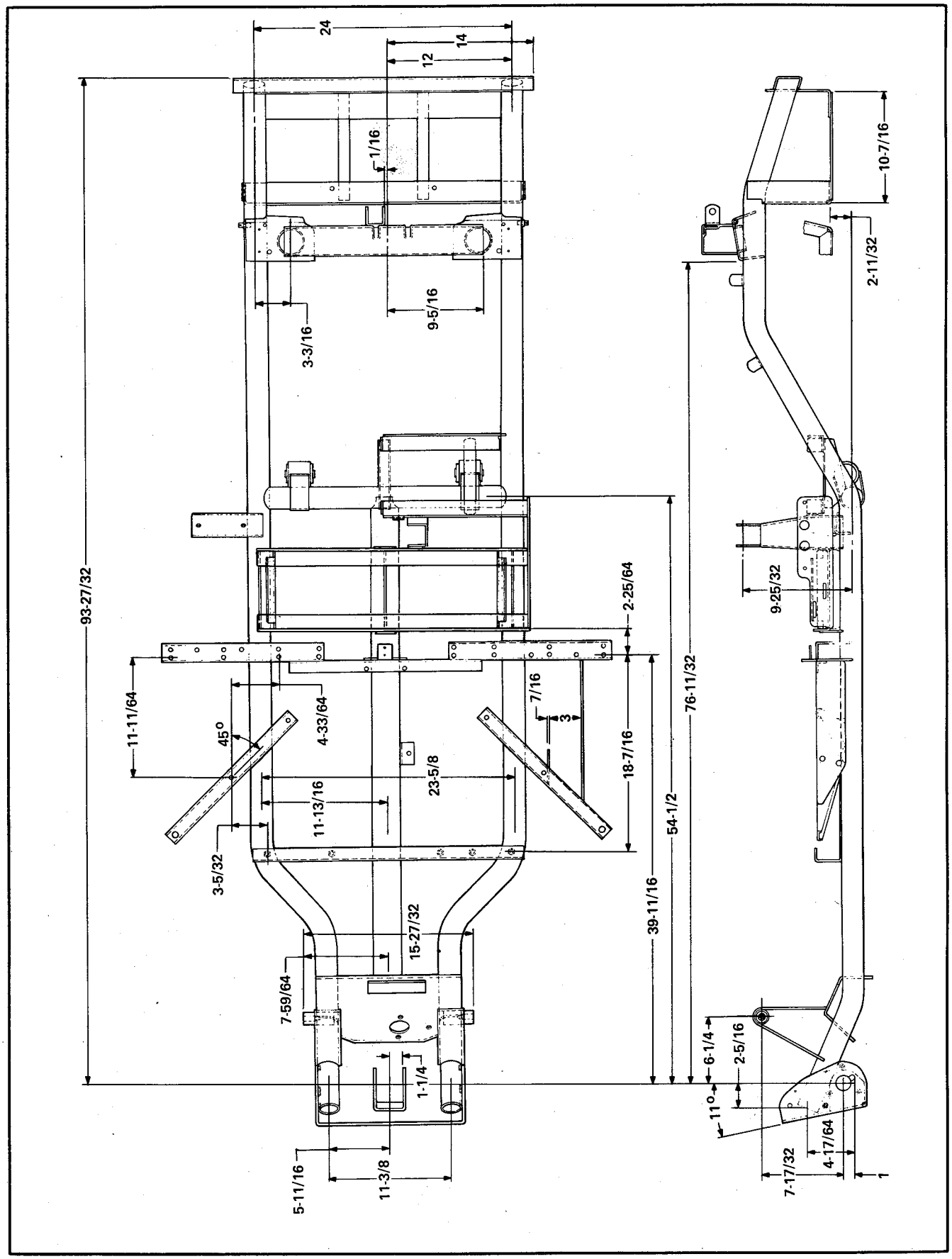
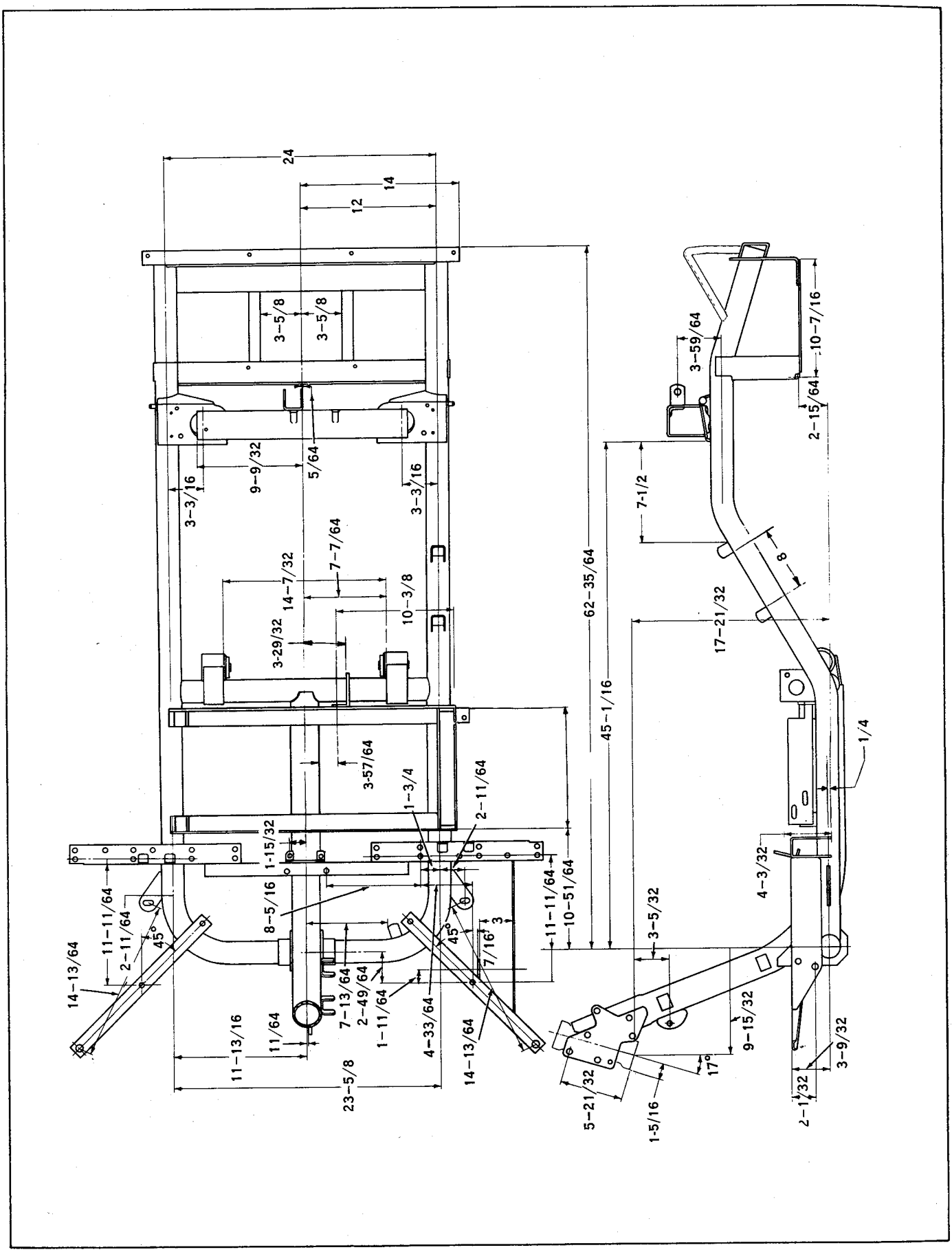


Figure 2-32. 1972-1975 Model DE4 Basic Frame Dimensions



1975 Model DE, 1977 and Later Model DE-3 Basic Frame Dimensions

STEERING

TILLER STEERING - 1973 AND EARLIER

ADJUSTING TILLER MECHANISM (Figure 2-35)

If excessive free play or slack (1/2" or more at loop in tiller bar) develops in the tiller bar, adjust steering adjustment nut (8 or 8A, Figure 2-35) by reaching up between the front fork housing section and tiller tube assembly and carefully tighten adjusting nut until free play is gone. Figure 2-34 shows adjustment of 1969 & earlier model with fork housing removed. 1970 and later models have a wing nut.

CAUTION

Do not overtighten adjusting nut or steering chain damage will result.

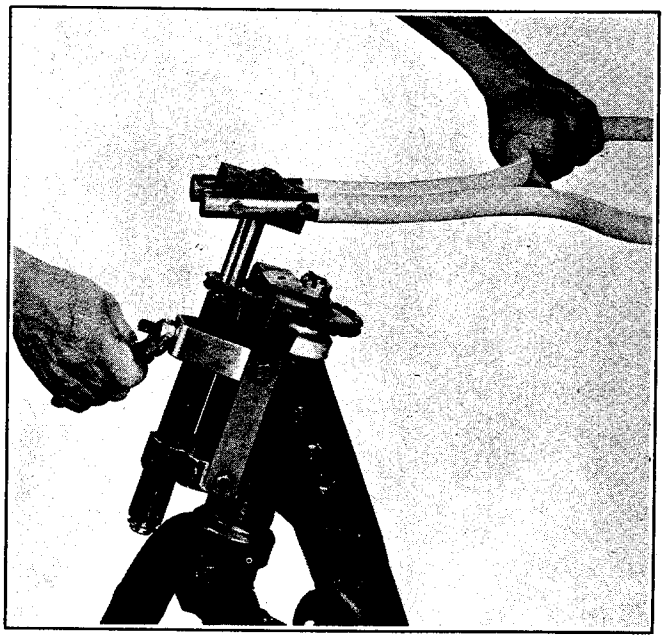


Figure 2-34. Adjusting Tiller Chain (1973 & Earlier) (Fork Housing Removed)

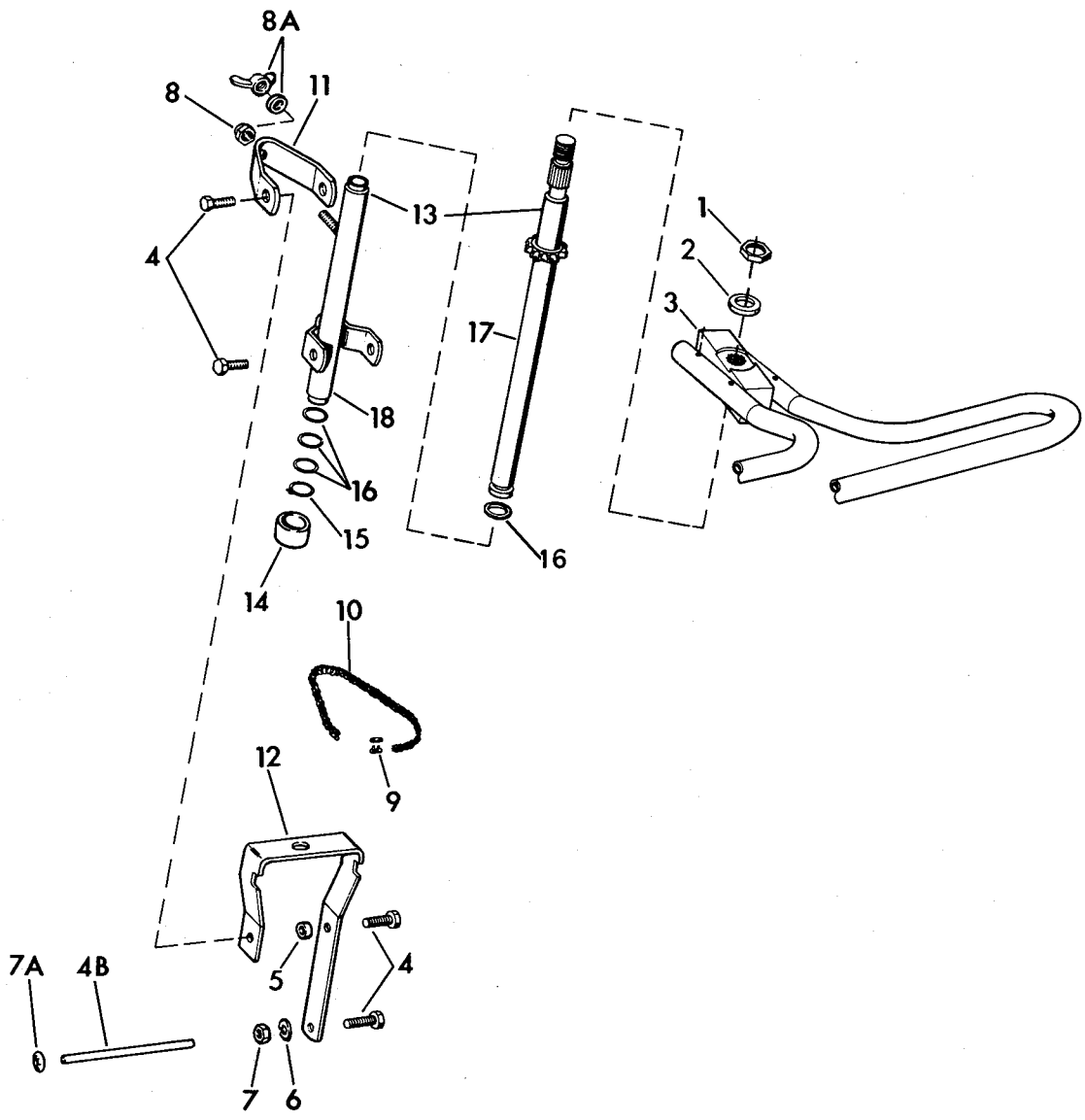
DISASSEMBLING TILLER (Figure 2-35)

Remove accessory panel. Remove tiller bar shaft nut (1), washer (2), and tap upward on tiller bar head (3) to remove assembly from shaft splines. NOTE: For further steering disassembly, it is necessary to remove the front fork housing. (See "Body," Section 2).

Remove tiller bar tube mounting bolts (4), spacers (5), lockwashers (6) and nuts (7), sprocket adjustment nut (8), tiller drive chain connecting link (9) and drive chain (10). Remove drive chain adjusting bracket (11), mounting bracket (12) and tiller tube shaft assembly (13). To further disassemble the tiller tube and shaft assembly, remove cover (14), retaining ring (15), spacer washers (16), and slide tiller shaft (17) from tiller tube (18). To remove tiller tube (18) on 1971 & later models remove one of the push nuts (7A) and shaft (4B) from bracket. Note location and arrangement of spacer washers so they can be correctly located in reassembly. Clean all parts and inspect for wear and damage. Replace worn or damaged parts.

REASSEMBLING TILLER (Figure 2-35)

Reassemble tiller tube assembly in reverse order of disassembly. Mount tiller tube assembly (13) and mounting bracket (12) in position on frame head, with the two lower mounting bolts (4). Do not tighten bolts. Install drive chain adjusting bracket (11), the two upper mounting bolts (4) and steering adjustment nut (8). Do not tighten bolts. Install drive chain (10) and connecting link (9). Position tiller tube assembly (13) so steering sprockets are in proper alignment and tighten the mounting bolts. Adjust steering adjustment nut (8) to remove "free play" in steering. Install fork housing. Set the front wheel in a straight ahead position. Install tiller bar (3) on shaft splines. Check for proper tiller bar/wheel alignment and install washer (2), nut (1), and accessory panel.



1. Nut
2. Washer
3. Bar head
4. Bolt (3 or 4)
4B. Shaft (1971 & later)
5. Spacer
6. Lockwasher
7. Nut (2)
7A. Push nut (2) (1971 & later)
8. Nut
8A. Wing nut and washer (1970 & later)
9. Link
10. Drive chain
11. Adjusting bracket
12. Mounting bracket
13. Tube shaft assembly
14. Cover
15. Retaining ring
16. Spacer washers
17. Tiller shaft
18. Tiller tube

Figure 2-35. Tiller Steering (1973 & Earlier) - Exploded View

TILLER STEERING-1974 AND LATER

ADJUSTING TILLER MECHANISM (Figure 2-36)

Too much free play in the tiller steering bar usually can be corrected by either re-positioning or replacing slider (11). Remove tiller guide (7) by removing two screws (9) and nuts (10). With guide (7) removed, sliding block (11) will be accessible for repositioning.

Rotate slider block (11) 90° so that the previously unused sides of the slider block contact guide (7). With slider (11) re-positioned in this way, remount guide (7) and check tiller for free play. If free play remains excessive, try turning slider (11) over. If free play cannot be reduced by repositioning block, it probably is because slider (11) is worn out beyond use and should be replaced. In this case, replace slider (11) with a new one.

CAUTION

SLIDER BLOCK IS SELF LUBRICATING. DO NOT use oily lubricant because it collects grit which causes wear.

DISASSEMBLING TILLER (Figure 2-36)

Remove accessory panel (not shown) attached to tiller handle. Remove tiller bar shaft nut (1) and washer (2). Tap upward on tiller bar head (3) to free from shaft splines.

NOTE

For further tiller disassembly, it will be necessary to remove front fork housing. (See "BODY", Section 2.)

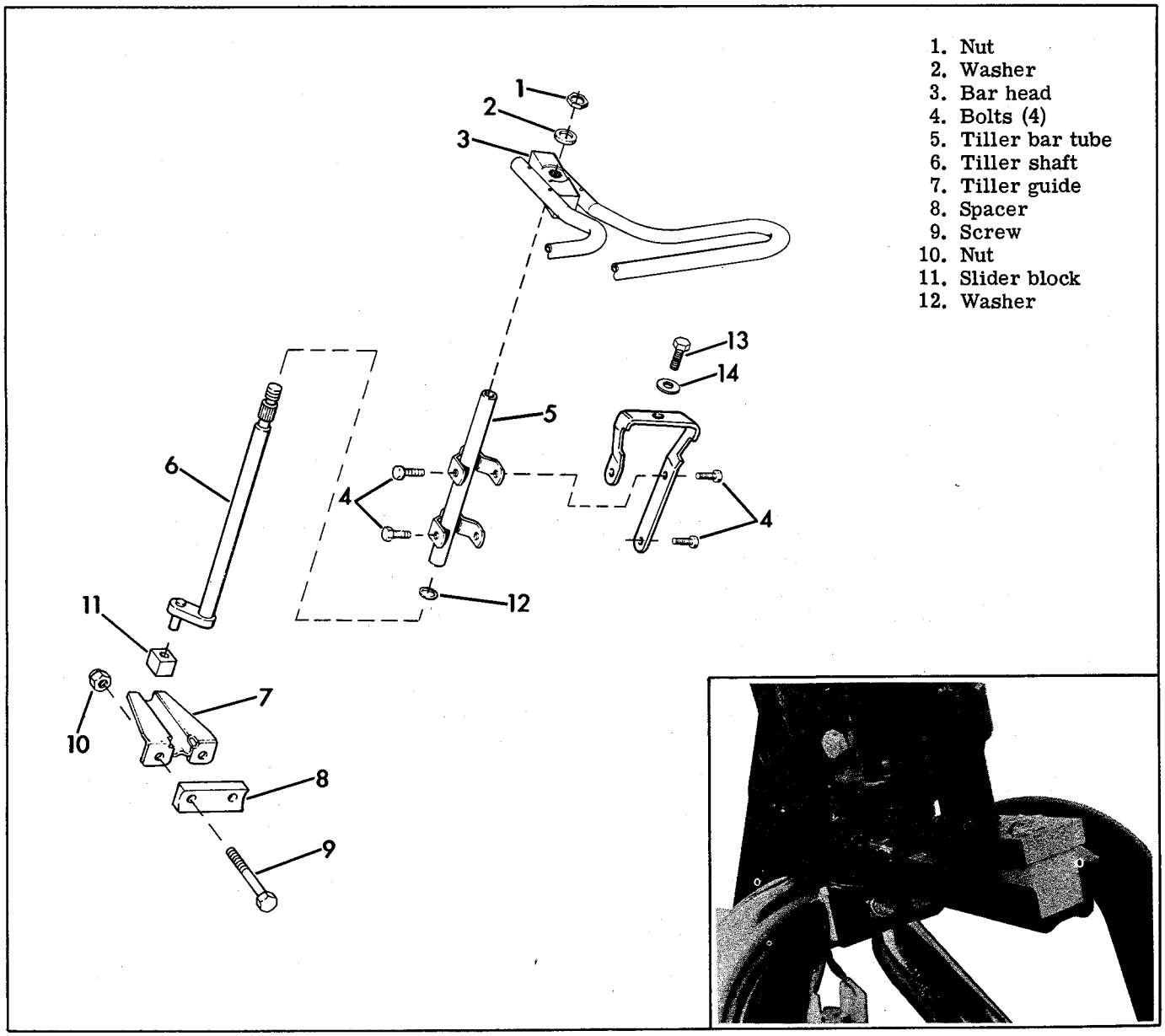


Figure 2-36. Tiller Steering (1974 & Later) - Exploded View

Remove bolts (4) which mount tiller bar tube (5) to the two plates welded to frame. Slide tiller shaft (6) out of tube (5). Remove tiller guide (7) along with spacer (8) by removing screws (9) and nuts (10) from fork. Pull slider (11) off pin of tiller shaft (6). Remove washers (12).

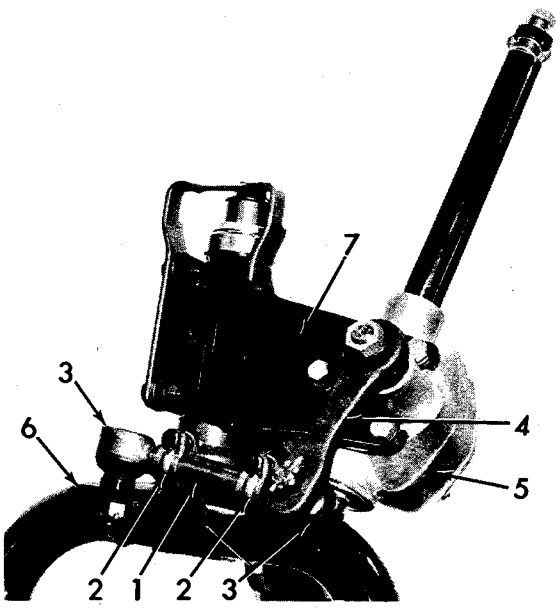
Clean all parts and inspect for wear and damage. Replace any worn or damaged parts.

REASSEMBLING TILLER (Figure 2-36)

Reassemble tiller in reverse order of disassembly, above. When completed, check axial play in tiller shaft by pulling up on tiller. Play should be no more than .04 in. and is adjusted by either adding or removing washers (12).

WHEEL STEERING

Steering linkage, Figure 2-37, does not require periodic lubrication because the gear housing and tie rod ball joints are lubricated and sealed at time of manufacture. If loss of seal occurs in gear unit, it must be disassembled for repair. Tie rod is serviced as an assembly.



1. Tie rod
2. Tie rod clamp (2)
3. Tie rod ball joint (2)
4. Steering arm
5. Steering gear unit
6. Fork bracket
7. Head bracket

Figure 2-37. Steering Linkage (3 Wheel Models)

ADJUSTING STEERING GEAR UNIT

There are three adjustments on the steering gear unit.

1. Worm bearing preload adjustment.
2. Over-center adjustment.

3A. Tie rod adjustment - 3 wheel car.

3B. Tie rod adjustment - 4 wheel car.

IMPORTANT: The worm bearing adjustment must be checked and corrected if necessary before the over-center adjustment is made. These adjustments can be made with unit remaining mounted in the car or with unit removed from the car. If the unit is in the car it will be necessary to disconnect steering arm from shaft splines. (See "disassembling steering arm and tie rod assembly".)

1. Worm Bearing Preload Adjustment (Figure 2-38).

Note that lockwasher (14) or locking cup (14A) is bent down to fit into a notch in housing flange at one point. This is the original factory adjustment. If the adjustment is correct, there should be a very slight amount of drag on bearings when turning steering shaft. Check for excessive looseness by pulling up and pushing down on steering wheel - there should be no play. To adjust out any looseness, remove nut (13) and lockwasher (14), or locking cup (14A). Turn cap (15 or 15A) inward to produce a slight amount of bearing drag and take out any up and down play in steering wheel shaft (See Figure 2-39). When the adjustment is finished, install washer (14), nut (13), or locking cup (14A), and use a punch to bend washer (14) or cup (14A) into housing notch to hold nut in position. If cup (14A) is used, also stake edge of cup over end of nut to keep nut from turning.

2. Over-Center Adjustment.

After making the worm bearing adjustment the worm finger adjustment screw should be tightened to take up free play when the steering wheel is in the center position (turned half way (2 turns) between extreme clockwise and counterclockwise positions). At this position, the two worm fingers on the steering arm are tightest in the worm grooves, therefore the adjustment should be made to eliminate free steering wheel play in this position only.

Loosen locknut (16) and turn screw (17) in or out to eliminate play and while holding screw in desired position retighten locknut (see Figure 2-40).

NOTE

Play can be felt by holding arm shaft and turning steering wheel shaft back and forth.

1. Steering wheel hub cap
2. Steering wheel nut
3. Steering wheel
4. Cup
5. Spring (1967 and earlier)
5A. Spacer (1968 and later)
6. Bushing
7. Steering column and gear unit
8. Steering arm nut and lockwasher
9. Steering arm - 3 wheel car
9A. Steering arm - 4 wheel car
10. Tie rod - 3 wheel car
10A. Tie rod - 4 wheel car
11. Ball joint nut and cotter pin (2)
12. Bracket bolt and lockwasher (3)
13. Locknut (1967 and earlier)
14. Lockwasher (1967 and earlier)
14A. Locking cup (1968 and later)
15. Cap (1967 and earlier)
15A. Cap (1968 and later)
15B. O-ring
16. Adjusting screw locknut
17. Adjusting screw
18. Side cover bolt and lockwasher (4)
19. Side cover
20. Side cover gasket
21. Steering arm shaft
22. Steering arm shaft seal
23. Bearing race, lower
24. Bearing ball cage, lower
25. Worm shaft
26. Ball bearing cage, upper
27. Bearing race, upper
28. Plug
29. Stop bolt (1 on left side only - 1969 and earlier D, all DC, DEC - adjust to 1 in. from boss) (2 on right and left sides - 1970 and later D, DE - adjust to 1-1/2 in. from bosses)

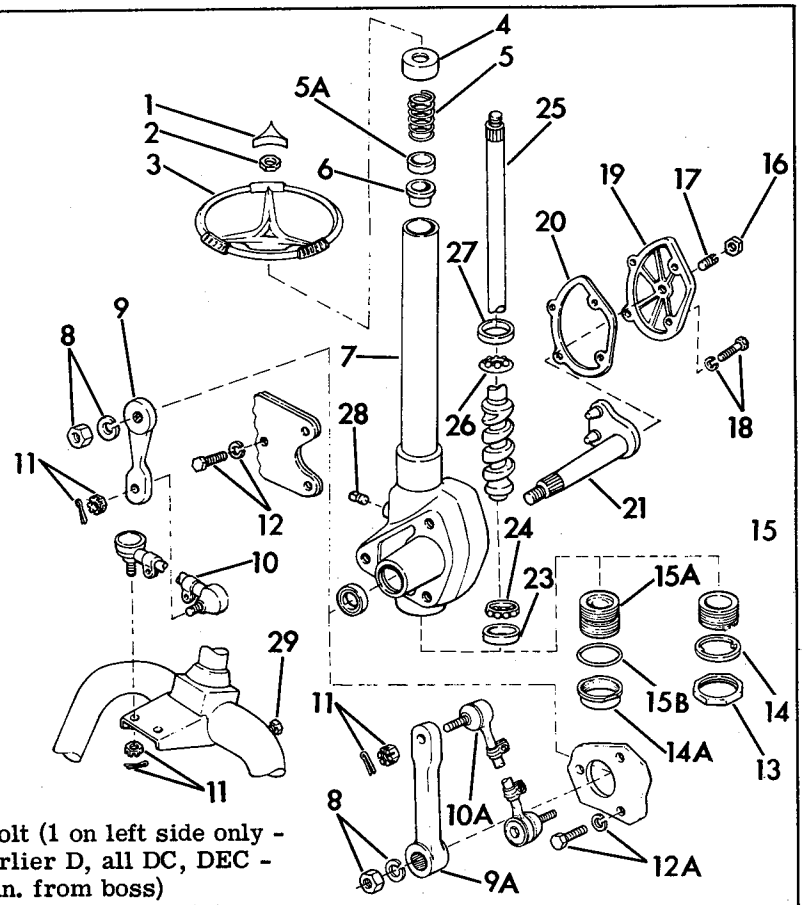


Figure 2-38. Wheel Steering - Exploded View

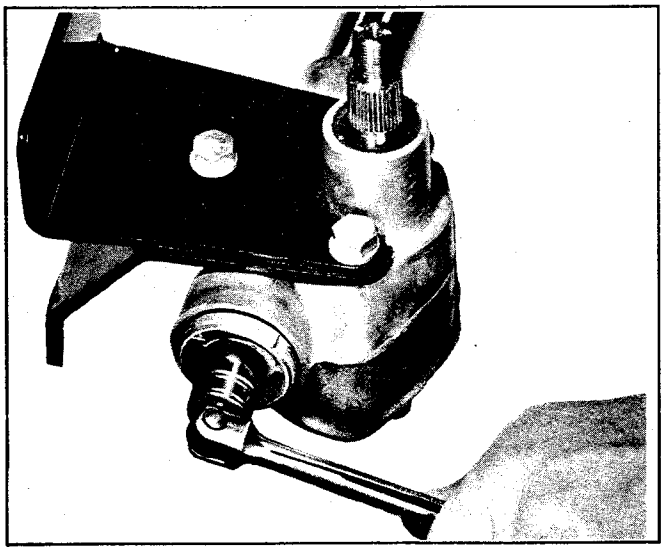


Figure 2-39. Adjusting Worm Bearings

3A. Tie Rod Adjustment - 3 Wheel Car

Tie rod (10) has a thread on both ball ends which is adjustable in a threaded sleeve. Both ends should be adjusted in the sleeve an equal number of threads to a length of 5-7/8 inches to centers of ball studs as shown in Figure 2-41.

To adjust, remove tie rod from car (see "disassembling steering arm and tie rod assembly"). Loosen clamp nuts and turn ball joint end in or out of sleeve

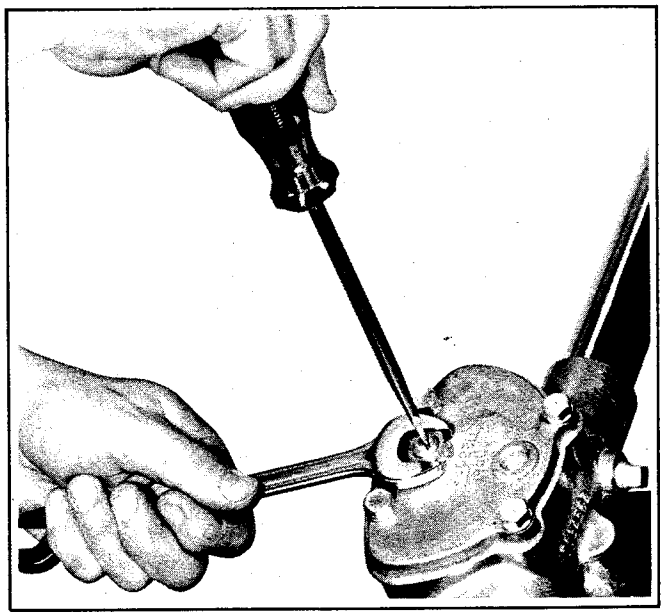


Figure 2-40. Making Over-Center Adjustment

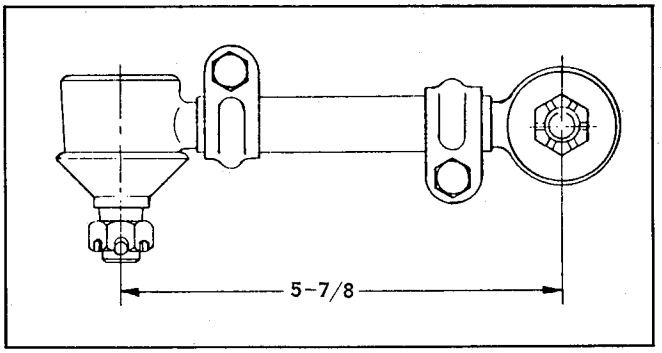


Figure 2-41. Tie Rod Adjustment - 3 Wheel Models

to adjust length. Position clamps so they will not strike fork bracket or gear unit when fork is turned.

Overall Linkage Adjustment on Car.

Adjust steering linkage in the following manner if any parts have been disconnected.

1. Adjust and install tie rod ends in fork bracket and steering arm.

2. Turn steering wheel shaft to center position (least play in worm gear).

3. Put front wheel in straight ahead position.

4. Install steering arm on shaft splines without moving position of steering wheel or front wheel.

5. Adjust left side fork stop to limit fork travel short of hitting fiber glass housing. Right side will stop in correct location if tie rod length has been adjusted correctly.

On 1968 and earlier models, it is necessary to remove steering wheel and fork housing to work on gear unit. On 1969 model, gear unit with bracket can be removed from car without removing fork housing.

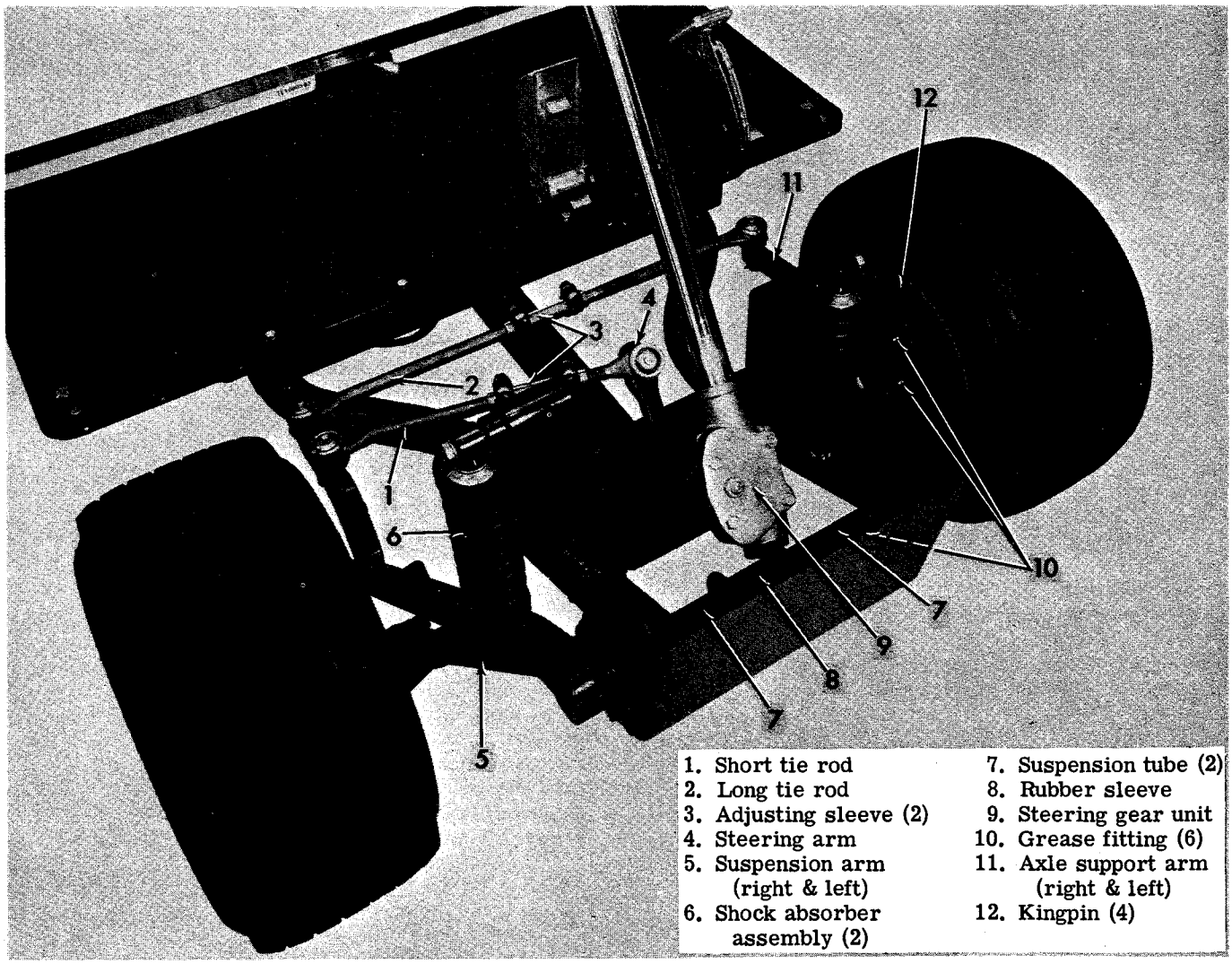


Figure 2-42. Front Suspension - 4 Wheel Car

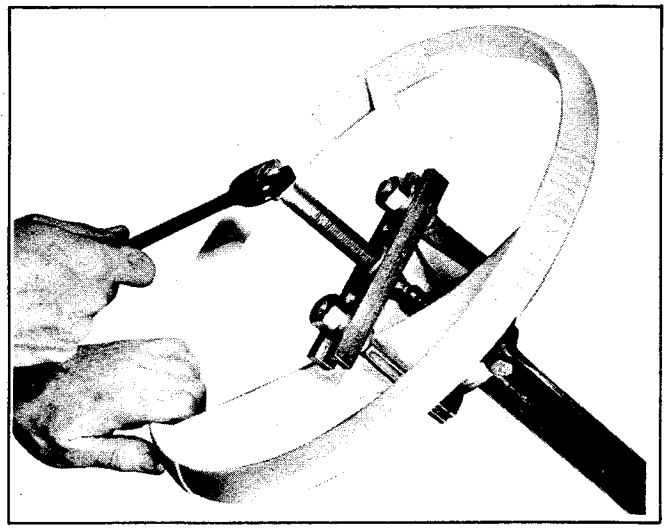


Figure 2-43. Pulling Steering Wheel

3B. Tie Rod Adjustment - 4 Wheel Car (Figure 2-42)

Both tie rods (1, 2) are threaded on both ends which are adjustable in threaded sleeves (3). Both ends should be adjusted in the sleeve an equal number of threads. Short tie rod (1) should be a length of 13-1/4 in. between centers of ball studs. Long tie rod (2) should be a length of 24 in. between centers of ball studs.

Overall Linkage Adjustment on Car

Adjust steering linkage in the following manner.

1. Set steering wheel shaft at the midpoint of its travel (approximately two turns from either extreme). Install steering arm (4) at approximate midpoint of the frame slot.

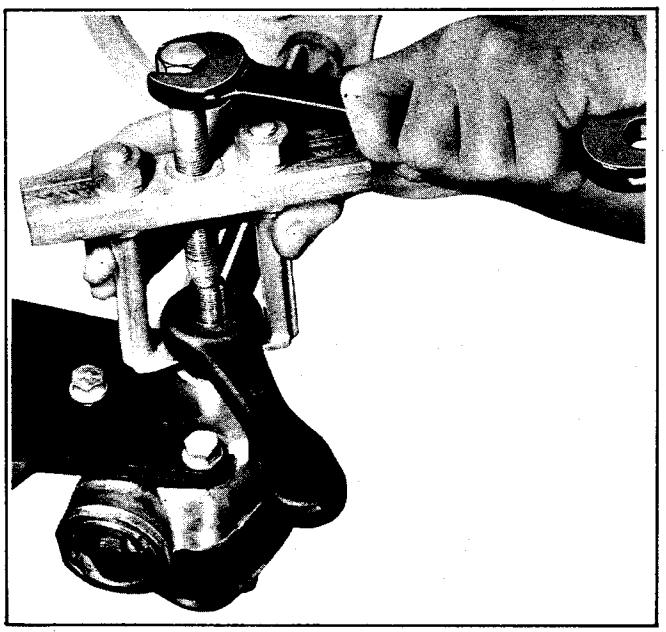


Figure 2-44. Pulling Steering Arm

2. Install short tie rod assembly (1). Check alignment of right front wheel with a long straight edge which extends across the right rear wheel and right front wheel. If necessary adjust threaded sleeve on tie rod so that right front wheel points straight ahead.

3. Install long tie rod (2) and check alignment of left front wheel with a straight edge extending across the front and left rear wheels. Left front wheel should point straight ahead. Adjust the threaded sleeve on long tie rod if necessary.

4. Tighten clamping bolts and nuts on both tie rod sleeves.

REMOVING STEERING WHEEL AND STEERING GEAR UNIT (Figure 2-38)

Pry cap (1) from steering wheel and loosen nut (2) until flush with end of threads on shaft. Use claw puller, Part No. 97292-61 and wedge attachment, Part No. 95637-46 with a cap, Part No. 95652-43A (or equivalent) to protect threads as follows. Install wedge underneath steering wheel (3) hub - cup (4) can be depressed to gain elearance. Install jaws of puller behind wedge and turn screw against protective cap on shaft to pull wheel from splines (see Figure 2-43). Disassemble nut (2), steering wheel (3), cup (4), spring (5) or spacer (5A) and bushing (6) from steering column (7).

On 1968 and earlier models, remove fork housing (fiber glass front center section). See "Body" Section 2.

On 1969 model, remove 4 bolts holding steering unit bracket to frame and disconnect tie rod from fork. Ball joints on tie rod (10) ends are a taper fit in steering arm and fork bracket sockets. Remove cotter pins and nuts (11) and use claw puller Part No. 97292-61 to pull joint from socket. See Figure 2-45. Remove entire steering unit from car.

On 1972 and later DE-4, the front fiberglass body section must be removed. See "Body" Section, 2. After removing steering shaft nut and lockwasher (8, Figure 2-38) use claw puller part No. 97292-61 to remove steering arm (9A, Figure 2-38). Steering gear is secured to frame with three bolts and lockwashers (12A, Figure 2-38).

DISASSEMBLING AND ASSEMBLING STEERING ARM AND TIE ROD ASSEMBLY (Figure 2-38)

Remove steering wheel and fork housing (if necessary) as described previsouly. To disconnect steering arm from lever shaft, remove nut and lockwasher (8) and use claw puller, Part No. 97292-61 to pull arm (9) from shaft (21) splines (See Figure 2F-76).

IMPORTANT: When disconnecting a ball joint, no attempt should be made to drive a wedge between the joint and the attached part.

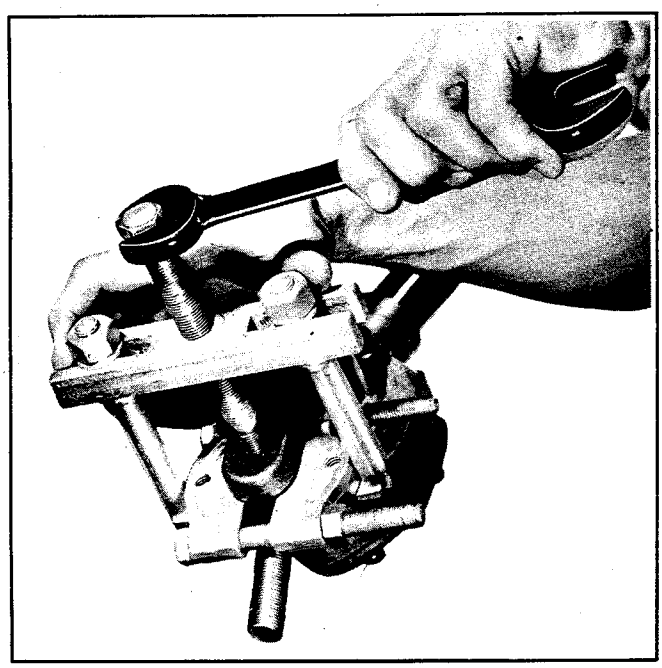


Figure 2-45. Pulling Ball Joint

On frozen sockets, moderate heat applied to socket with torch will aid in removal with claw puller. (In this case ball joints must be replaced.) Care should be taken so as not to damage rubber boots since they are not replaceable.

Before reassembling tie rod, check ball joints for fit in sockets. Replace tie rod if play is excessive. Apply a liberal quantity of grease to ball underneath each rubber boot.

NOTE

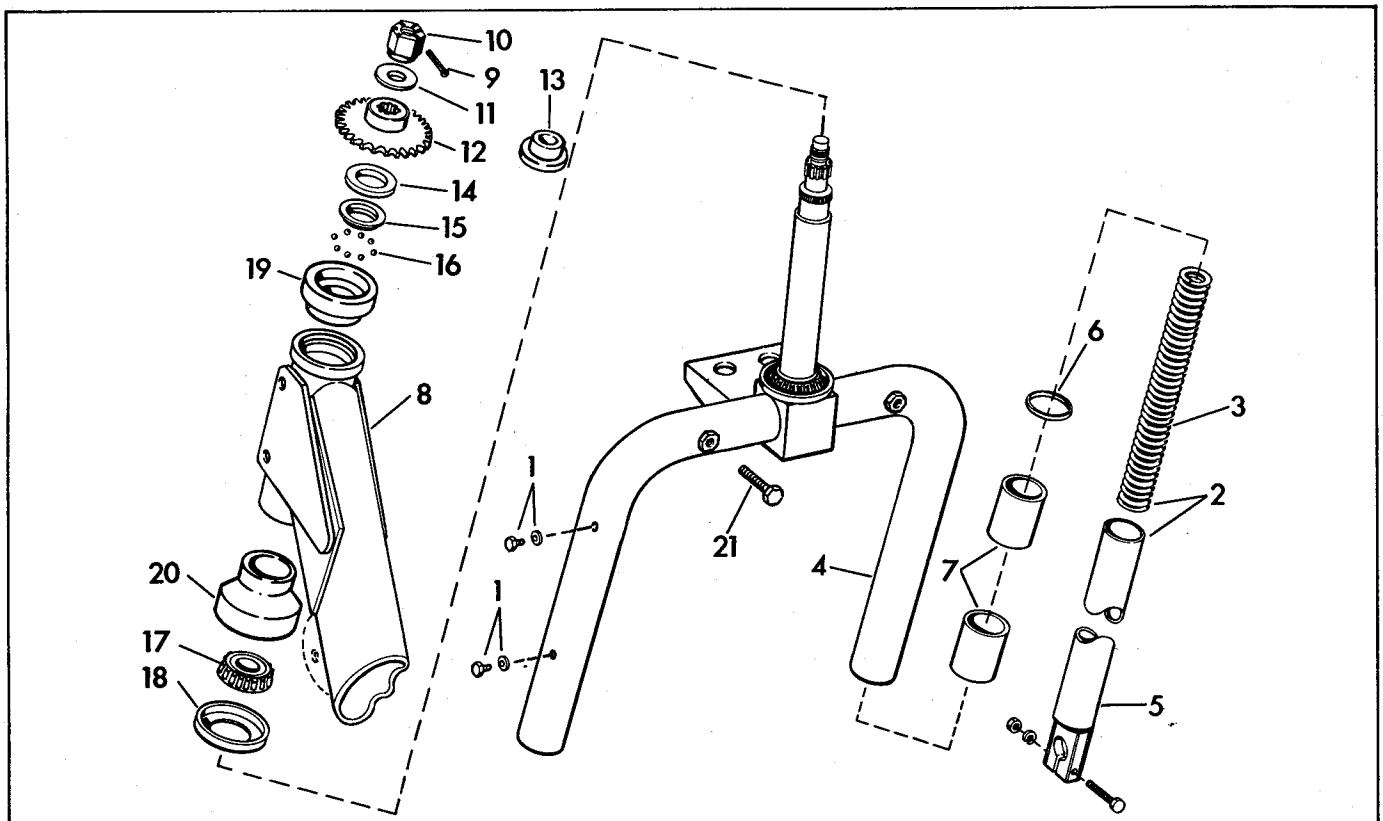
When connecting ball joint stud to steering arm, torque the attaching castle nut 25 to 28 ft-lbs before backing off to insert cotter pin.

Install tie rod and steering arm on car in reverse order of disassembly and in correct relation as described in "Overall Linkage Adjustment".

DISASSEMBLING AND ASSEMBLING STEERING GEAR UNIT (Figure 2-38)

Remove steering gear from car as described previously.

Remove bolts and lockwashers (18), side cover (19), gasket (20) and withdraw steering shaft (21). Inspect seal (22) lip surface and replace if damaged.



1. Screw and washer (4)
2. Slider assembly
3. Fork spring
4. Fork assembly
5. Fork slider
6. Seals (2)
7. Bushing (4)
8. Frame
9. Cotter pin
10. Nut
11. Washer
12. Sprocket (tiller)
13. Spacer (steering wheel)
14. Bearing guard
15. Cone
16. Bearing (23)
17. Bearing cone
18. Cover
19. Upper head cup
20. Lower head cup
21. Fork stop bolt

Figure 2-46. Front Fork 1969 and Earlier - Exploded View

Remove locknut (13) and lockwasher (14) (if used) or locking cup (14A). Remove cap (15 or 15A), lower bearing race (23), and lower ball cage (24), worm shaft (25), upper ball cage (26) and upper bearing race (27). Replace balls and races if worn or damaged.

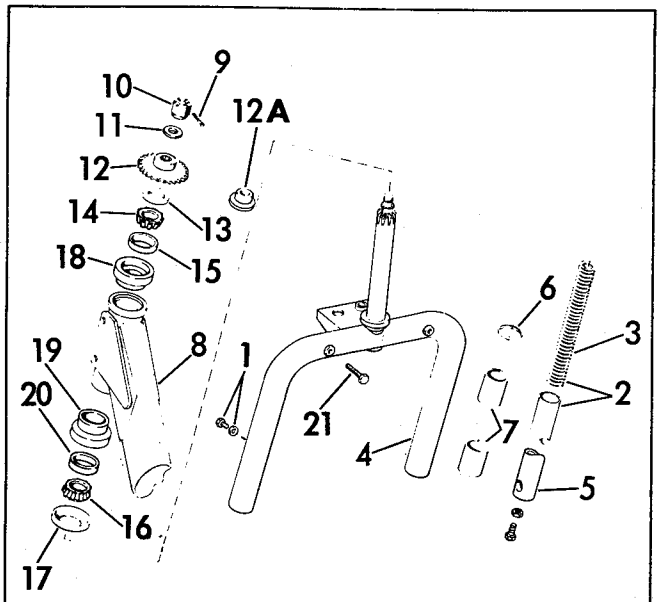
Reassemble steering gear unit in reverse order of disassembly using new gasket (20) underneath side cover.

Remove plug (28) and fill unit with Harley-Davidson transmission lubricant and hold unit in approximately the same position as it will be in car to allow excess fluid to drain from filler hole. Reinstall plug.

Before installing unit on car make adjustments as described under "Adjusting Steering Gear Unit."

DISASSEMBLING FRONT FORK TUBES 1969 & EARLIER (Figure 2-46)

Remove front wheel assembly. See Section 2C, "Removing and Installing Front Wheel."



1. Plug and washer (2)
2. Slider assembly
3. Fork spring
4. Fork assembly
5. Fork slider
6. Seals (2)
7. Bushing (4)
8. Frame
9. Cotter pin
10. Nut
11. Washer
12. Sprocket (tiller)
12A. Spacer (steering wheel)
13. Upper cover
14. Bearing cone
15. Upper bearing cup
16. Bearing cone
17. Lower cover
18. Upper head cup
19. Lower head cup
20. Lower bearing cup
21. Fork stop bolt

Figure 2-47. Front Fork, 1970 and Later - Exploded View

After front wheel has been removed, the fork slider assemblies can be removed by removing upper cap screw and washer (1) and unscrewing the slider assembly (2) to disengage the fork spring (3) from the fork assembly (4). To remove fork spring (3) from slider (5), simply unscrew fork spring. (Turn counterclockwise.) If seals (6) are leaking or worn, replace them by prying out old seals and press in new seals with seal lip facing inward. Replace fork tube bushings (7) if worn, using claw type bushing puller.

REASSEMBLING FRONT FORK TUBES 1969 & EARLIER (Figure 2-46)

Clean old grease and dirt from all parts, inspect for damage or wear. Replace any damaged or worn parts. Pack fork spring coils with Harley-Davidson "Grease-All" and screw springs (3) tight into slider (5). Insert right side slider assembly (large diameter axle hole) into right fork leg and screw in until tight. Back off by unscrewing just enough to allow correct axle hole alignment. Install left side slider assembly (small diameter axle hole), in left fork leg in same manner. Install cap screws and washers (1). Install front wheel.

Grease both fork sides once a year as follows: Remove lower cap screw and washer (1) and install a 45° grease fitting having a 1/4-28 thread (obtainable at hardware stores). Using a hand grease gun, pump two shots of grease into fork side and reinstall cap screw and washer. Caution: If excessive amount of grease is pumped into fork side, slider seal (6) may be blown out.

DISASSEMBLING AND ASSEMBLING 1969 & EARLIER FRONT FORK (Figure 2-46)

To remove fork (4) from frame (8), remove cotter pin (9), fork shaft nut (10), washer (11). NOTE: Mark sprocket (12, if used) as to its position on fork shaft. Restart fork shaft nut on threads and tap firmly on shaft nut with heavy rawhide mallet, until fork drops free. Support fork and remove fork shaft nut, steering sprocket (12) or spacer (13), bearing guard (14) and fork stem cone (15). Slide fork down out of frame head and remove the twenty-three ball bearings (16). Remove bearing cone (17) and cover (18) from fork stem. Clean all parts and inspect for wear or damage. Replace all worn or damaged parts. Replace upper and lower head cups (19 & 20) if worn excessively.

Pack bearings with Harley-Davidson "Grease-All." Slide fork (4) (with lower bearing guard (18) and bearing (17) in position on fork stem) into frame head with fork stops facing toward the rear of the car. Support fork and install ball bearings (16) into greased upper bearing race. Install upper fork stem cone (15) and upper bearing guard (14). Install steering sprocket (12, if used) on fork shaft according to marks made before assembly, or install spacer (13). Install washer (11), nut (10), and tighten nut until there is no noticeable free play or bind when front fork is turned from side to side. Install cotter pin (9).

DISASSEMBLING AND ASSEMBLING FRONT FORK TUBES 1970 & LATER (Figure 2-47)

Remove front wheel assembly. See Section 2, "Removing and Installing Front Wheel."

After front wheel has been removed, remove both fork slider assemblies by first removing cap screws and washers (1) and then unscrewing slider assemblies to disengage fork springs (3) from fork assembly (4).

Unscrew fork springs (3) from slider assemblies in a counterclockwise direction and remove.

If seals (6) are leaking or worn, pry out old seals and replace. Press in new seals with seal lips facing inward. Replace fork tube bushings (7) if worn, using claw type bushing puller.

Reassemble as follows. Insert left side slider assembly (smaller diameter axle hole) into left fork leg and screw spring into leg until dimension between bottom edge of leg and center line of axle hole in fork measures 4" (with spring unloaded). When this dimension is achieved, reposition fork slider with larger hole opening for axle sleeve (countersunk side) toward wheel.

Insert right side slider assembly (larger diameter axle hole) into right fork leg and screw spring into leg until axle hole aligns with left side slider axle hole. These two holes must align for axle to mount correctly.

Install cap screws and washers (1). Install front wheel.

Grease both fork sides once a year as follows: Remove lower cap screw and washer (1) and install a 45° grease fitting having a 1/4-28 thread (obtainable at hardware stores). Using a hand grease gun, pump two shots of grease into fork side and reinstall cap screw and washer. Caution: If excessive amount of grease is pumped into fork side, slider seal (6) may be blown out.

DISASSEMBLING AND ASSEMBLING 1970 & LATER FRONT FORK (Figure 2-47)

To remove fork (4) from frame (8), remove cotter pin (9) fork shaft nut (10), washer (11).

NOTE

Mark sprocket (12, if used) as to its position on fork shaft.

Restart fork shaft nut on threads and tap firmly on shaft nut with a heavy rawhide mallet until fork drops free. Support fork and remove nut, steering sprocket (12) or spacer (12A), and upper bearing cover (13). Slide fork down out of frame head and remove bearing cones (14 and 16) and lower cover (17). Bearing cups (15 and 20) are pressed into head cups (18 and 19), and head cups also are a press fit in steering head (8). If necessary to replace bearing races, drive head cups from steering head with a hammer and drift from opposite side of hole. Clean all parts and inspect for wear or damage. Replace all worn or damaged parts particularly bushings (7), seals (6) and bearing parts (14, 15, 16 and 20). Pack bearings with Harley-Davidson "Grease-All." Slide fork (4) with lower bearing cone (16) and cover (17) in position on fork stem into frame head with fork stops facing toward the rear of the car. Install upper bearing cone (14), cover (13), and sprocket (12) or spacer (12A). Install washer (11), nut (10) and tighten nut until there is no noticeable free play or bind when fork is turned from side to side. Install cotter pin (9).

FRONT SUSPENSION - 4 WHEEL CAR (Figure 2-48)

DISASSEMBLY

Raise front end of car and support underneath frame. Remove front wheels and hubs as described in Section 2, "Wheels."

Pull steering arm (1) from steering shaft with puller as described under "Removing Steering Wheel and Steering Gear."

Remove ball joint nuts and cotter pins (2). Remove short tie rod assembly (3) from right axle support arm (4) as shown in Figure 2-45, using claw puller, Part No. 97292-61, and wedge attachment 95637-46. See "Disassembling and Assembling Steering Arm and Tie Rod Assembly" for additional information. In a similar manner remove long tie rod assembly (5) from right and left axle support arms (4 and 6).

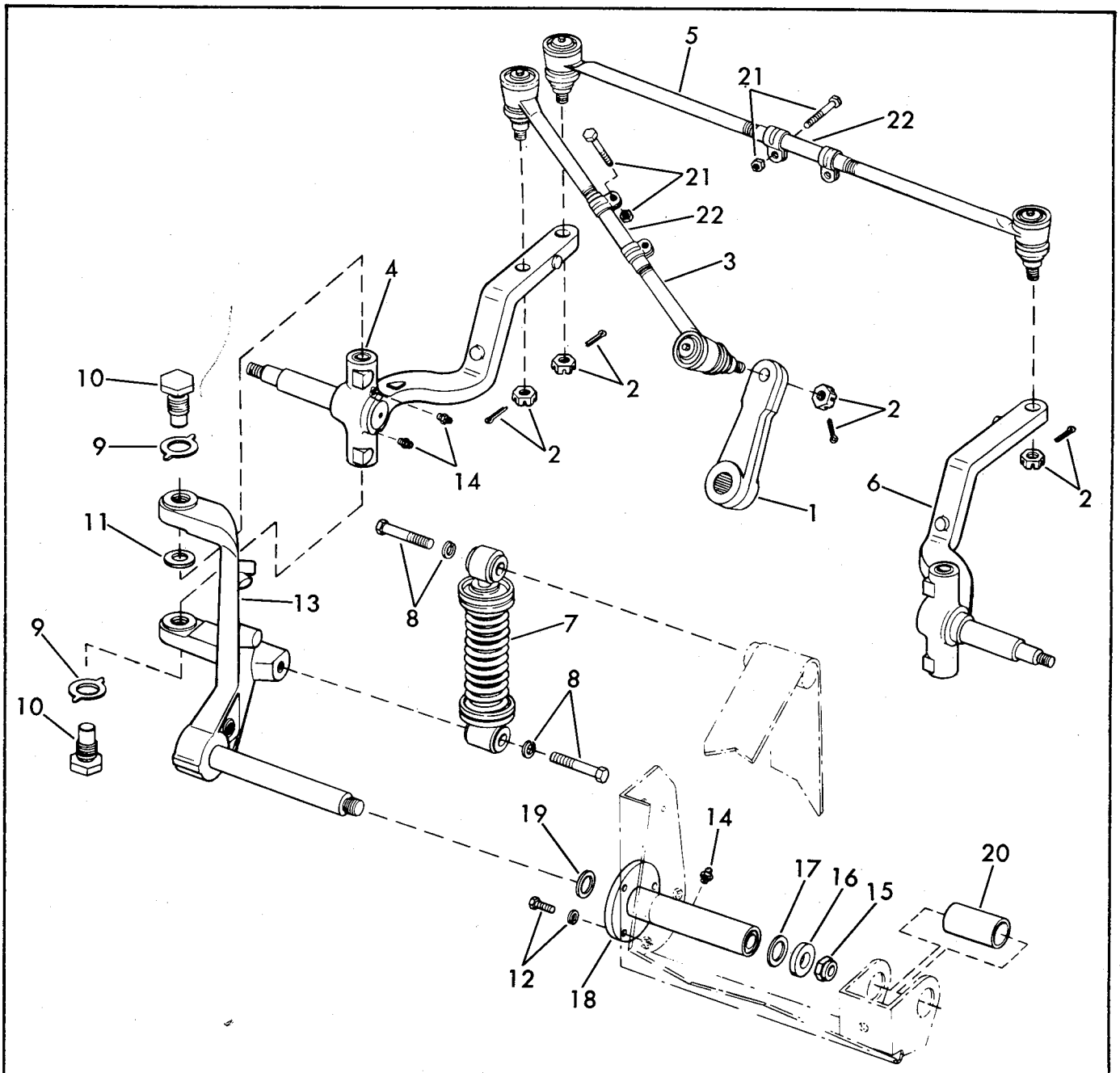
Either side of suspension system is removed in an identical manner.

Remove shock absorber assembly (7) by disassembling shock absorber mounting bolts and lockwashers (8).

Bend tabs and side flat on tab lockwashers (9). Remove kingpins (10). Axle support arm may now be removed. Note position of bronze thrust washer (11). Remove suspension tube mounting bolts and lockwashers (12). Pull outward on suspension arm (13) making sure that grease fitting (14) passes through slot in frame. Remove nut (15), spacer (16), and shim (17) noting number and thicknesses of shims. Suspension tube (18) may now be removed from suspension arm (13). Some early 1972 cars have an additional spacer (19). Remove rubber sleeve (20) from frame bracket. To disassemble shock absorber unit (7) see "Disassembling and Assembling Front Shock Absorbers."

CLEANING AND INSPECTION

Clean all parts and inspect for damage or wear. Check ball joints for fit in sockets. Replace tie rod if play is excessive or if rubber boot is damaged. Before reassembly apply a liberal quantity of grease to ball underneath each rubber boot. Examine bushings in suspension tubes (18) and axle support arms (4 and 6), if they are worn or damaged they must be replaced.



1. Steering arm
2. Castle nut and cotter pin (4)
3. Short tie rod assembly
4. Right axle support arm
5. Long tie rod assembly
6. Left axle support arm
7. Shock absorber (2)
8. Bolt and lockwasher (4)
9. Tab lockwasher (4)
10. Kingpin (4)
11. Thrust washer (2)
12. Bolt and lockwasher (6)
13. Suspension arm (2) (right and left)
14. Grease fitting (6)
15. Nut
16. Spacer
17. Shim (2) (as required)
18. Suspension tube (2)
19. Spacer (early 1972 models)
20. Rubber sleeve
21. Clamping bolt and nut (4)
22. Adjusting sleeve (2)

Figure 2-48. Front Suspension, 4 Wheel Car - Exploded View

REASSEMBLING FRONT SUSPENSION

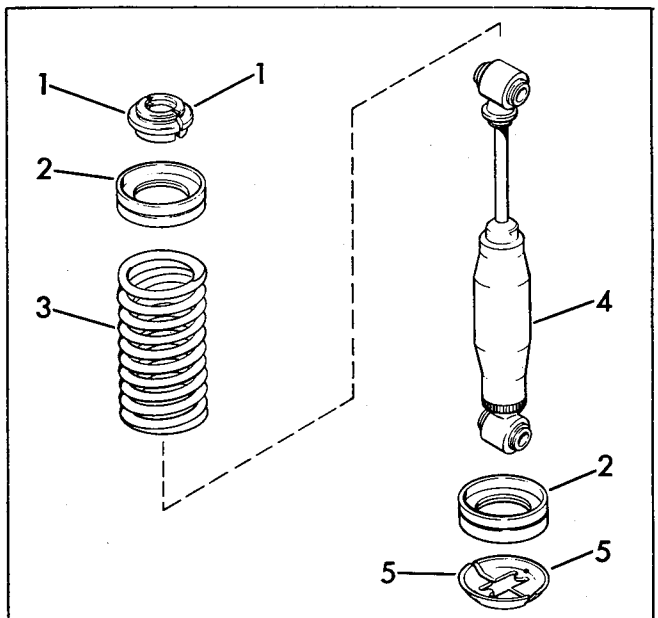
Reassembly is basically the reverse of disassembly with the following exceptions. When assembling suspension tube (18) to suspension arm (13), use variable thickness shims (17) to obtain .005 in. to .025 in. end play. (Note that some early 1972 cars require additional spacer washer (19). Make sure rubber sleeve (20) is in position in frame bracket before suspension tube (18) and suspension arm (13) assembly is assembled to frame bracket. When assembling suspension tube to frame, point grease fittings (14) downward so they are accessible for greasing. After assembling axle support arm (4 and 6) to suspension arm (13), bend both tabs on tab lockwasher down, and bend one side up against flat of kingpin hex. Pack suspension tubes (18) and axle support arms (4 and 6) with Harley-Davidson Grease-All grease. Use a hand gun and pack until grease comes from seams.

To install and adjust steering arm (1) and tie rods (3, 5) see "Tie Rod Adjustment - 4 Wheel Car," in this section.

DISASSEMBLING AND ASSEMBLING FRONT SHOCK ABSORBER (Figure 2-50)

Raise front end of car so that wheels are supported. Remove shock absorber from car by removing two mounting bolts and lockwashers (8, Figure 2-48).

Place shock absorber assembly in shock absorber tool, Part No. 97010-52A, in same position as when mounted in car. See Figure 2-49. Compress absorber spring enough to remove each half of upper spring retainer (1). Release spring compression and remove absorber assembly from tool. Remaining items can then be removed in order shown in Figure 2-50.



1. Upper spring retainer
2. Spring guide (2)
3. Spring
4. Shock absorber unit
5. Lower spring retainer

Figure 2-50. Front Shock Absorber, 4 Wheel Car - Exploded View

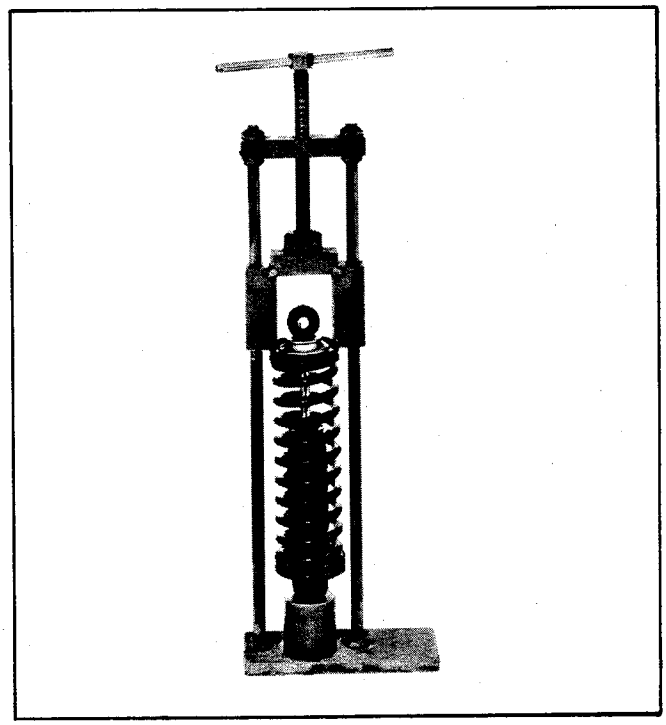
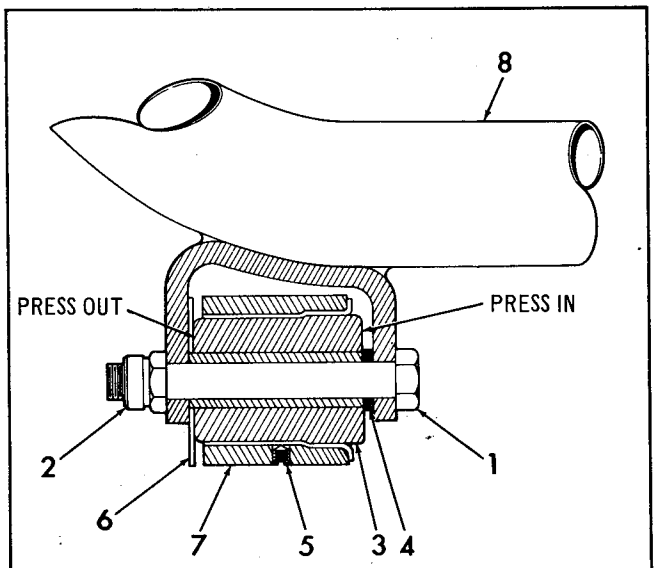


Figure 2-49. Using Shock Absorber Tool



1. Bolt
2. Nut
3. Bushing assembly
4. Spacer
5. Set screw
6. Nylon washer
7. Frame eye
8. Fork

Figure 2-51. Rear Fork Suspension

Clean and inspect all parts for wear and damage. Examine absorber unit for traces of fluid leaking, especially at upper end. Unit should compress slightly easier than it extends. If possible, compare action with a new unit. Shock absorber cannot be repaired. Faulty units must be replaced.

Assembly is the reverse of disassembly.

REAR FORK SUSPENSION (1966 and Later Models)

To disassemble rear fork suspension, support rear end of car main frame with suitable blocking. Remove shock absorber upper and lower mounting bolts from frame and differential. Remove handbrake clevis at pull-lever end. Disconnect hydraulic brake line. See Figure 2-51. Remove bolts and nuts (1 and 2) to release rear fork from car.

NOTE

Rubber bushing assembly (3) is held in frame eye (7) with set screw (5) and also Loctite Stud N' Bearing Mount (H-D Part No. 99626-77). Set screw (5) must first be removed and eye heated to loosen "Loctite." Bushing Assembly (3) must be driven inward to remove and outward to install. Use Loctite Stud N' Bearing Mount (H-D Part No. 99626-77) when reinstalling.

If fork tube or brackets are bent, and straightening is practicable, realign according to dimensions shown in Section 2 of this manual.

DISC BRAKE (DE, DE-3, DE-4, DEF, DEC)

DESCRIPTION

When the brake foot lever is depressed, it transmits a clamping action to the caliper type brake shoes through the brake cable. The brake shoes apply this pressure to the brake disc attached to the drive shaft on the differential unit, thus stopping the car.

When the brake pedal is tilted forward while held in a depressed position, it will lock the brake, holding the car until the brake is released by tilting the brake pedal rearward or until the accelerator pedal is depressed, automatically releasing the brake. This feature provides a parking brake by simply tilting the brake pedal and also prevents any possible damage by automatically releasing the brake when the accelerator is depressed.

On hydraulic brake equipped utilicars, the disc brake is used as a parking brake, and a separate hand lever is used to apply the brake.

ADJUSTING DISC BRAKE (Figure 2-52)

When brake pedal free travel becomes excessive, indicating that brake adjustment is necessary, raise rear body section to perform brake adjustment.

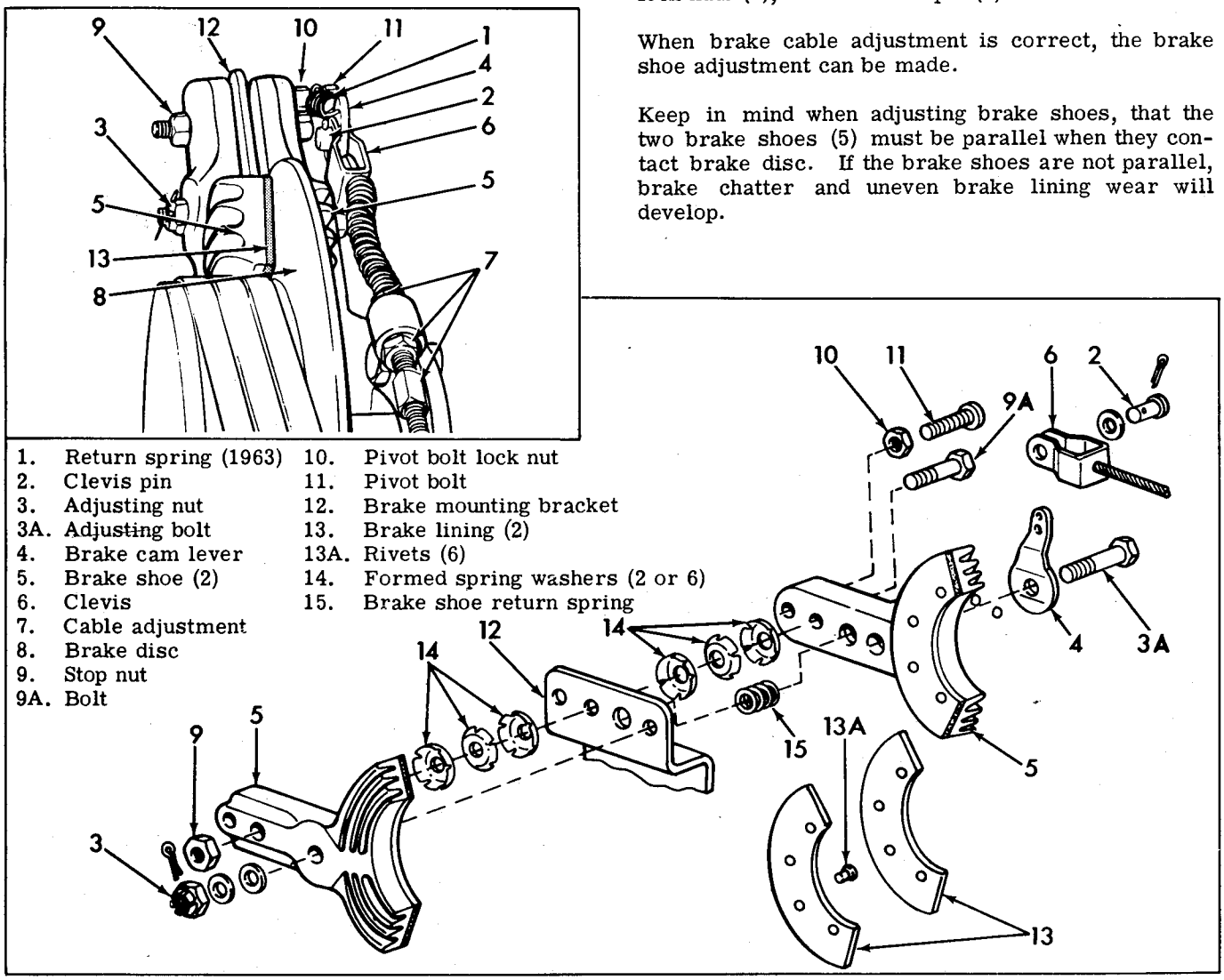
NOTE

On the 1972 and later Electric cars equipped with an automatic seat brake, a foot operated body latch is provided. It is located at the left front corner of the rear body section, under the floor board. On these models the seat brake clevis pin must be removed before adjusting the disc brake, "See Automatic Seat Brake."

Remove brake arm spring (1, if used), cotter pin washer and clevis pin (2). Remove cotter pin and tighten adjusting nut (3) until brake cam lever (4) is fully seated on cam surface of brake shoe (5). With cam lever centered in this position, attempt to reinstall clevis pin (2). If hole in clevis (6) does not line up with brake cam lever hole, correct alignment with cable adjustment (7). Tighten cable adjustment lock nuts (7), install clevis pin (2).

When brake cable adjustment is correct, the brake shoe adjustment can be made.

Keep in mind when adjusting brake shoes, that the two brake shoes (5) must be parallel when they contact brake disc. If the brake shoes are not parallel, brake chatter and uneven brake lining wear will develop.



1. Return spring (1963)
2. Clevis pin
3. Adjusting nut
3A. Adjusting bolt
4. Brake cam lever
5. Brake shoe (2)
6. Clevis
7. Cable adjustment
8. Brake disc
9. Stop nut
9A. Bolt
10. Pivot bolt lock nut
11. Pivot bolt
12. Brake mounting bracket
13. Brake lining (2)
13A. Rivets (6)
14. Formed spring washers (2 or 6)
15. Brake shoe return spring

Figure 2-52. Disc Brake

To adjust brake shoes, tighten adjusting nut (3) until brake linings (13) bear lightly on brake disc (8). Back off stop nut (9), pivot bolt lock nut (10) and adjust pivot bolt (11) until brake shoes are parallel. Loosen adjusting nut (3) until approximately 1/32 in. (.030) clearance is obtained between each brake lining (13) and the brake disc (8). Tighten pivot bolt lock nut (10) and stop nut (9).

IMPORTANT: Reinstall cotter pin securing adjusting nut (3) in correct position and hook up return spring (1). Operate car to make sure there is no brake drag or chatter.

On 1972 and later models equipped with an automatic seat brake reattach seat brake release rod assembly using clevis pin washer and cotter pin.

Brake disc (8) must run true. If brake disc is warped, it will drag on shoes, making a noise each revolution. Replace any disc which is over 1/32 in. warped. This can be checked with a steel straightedge against disc surface.

NOTE

Lubricate brake cam lever (4) and rear brake shoe cam surface with grease to prevent wear and brake drag. Also oil pedal and linkage parts periodically. Noise caused by a slight drag of shoes on disc can be relieved by applying light oil to shoe linings.

On Utilicars, equipped with a parking brake handlever, adjust handlever tension by turning adjusting screw at end of handlever clockwise to increase tension as necessary to lock brake when handlever is moved over center to outward position.

REMOVING AND INSTALLING DISC BRAKE SHOES (figure 2-52)

If brake shoe linings (13) become worn thin or damaged, the brake can be disassembled for lining replacement and other repairs as follows: Remove brake arm spring (1, if used) and clevis pin (2).

On 1972 models equipped with automatic seat brake first remove seat brake release rod clevis pin.

NOTE

1967 Model D brake can be removed as an assembly at this point by removing 2 bolts securing bracket (12) to differential housing bracket.

Remove adjusting nut (3), adjusting bolt (3A), and stop nut (9). Remove bolt (9A) and separate brake shoes (5) from brake mounting bracket (12). When removing brake shoes from mounting bracket, be sure to note the position of the formed spring washers (14) and the brake shoe return spring (15) and cam lever bearing balls. Clean all parts and inspect for wear or damage. Replace worn or damaged parts.

NOTE

On models with automatic seat brake also note position and condition of seat brake cam and balls.

To replace worn or damaged brake linings (13) press out rivets (13A) and rivet new linings to brake shoes.

Chamfer leading and trailing edges of both linings slightly, to prevent brake chatter or squeal. If brake disc is scored, or damaged, it must be removed for replacement.

REPLACING DISC BRAKE CABLE ASSEMBLY (Figure 2-56)

Raise body. Remove clevis pin (7) from brake lever (5 or 5A) and pull cable assembly (11) towards rear of car, through hole in frame cross-member. Remove clevis pin (12) from brake shoe operating cam lever. Remove locking nut (13) from end of cable adjusting screw (14) and pull cable assembly toward the left side of car and downward to release assembly from brake mounting bracket (15).

Install a new cable assembly in reverse order.

NOTE: The wire is not replaceable because the ends are swaged on - the entire assembly must be replaced.

Brake adjustment is necessary after the new cable assembly is installed, see "Adjusting Brake."

REMOVING AND INSTALLING DISC BRAKE ASSEMBLY

Remove brake cable assembly as described in preceding paragraph. Remove 4 bolts, nuts and lockwashers which attach brake disc to rear axle drive shaft yoke. Remove bolts and lockwashers which attach brake assembly to car. See "Transmission Rear Drive," Section 4. On 1972 and later models equipped with an automatic seat brake, first remove seat brake release rod clevis assembly.

AUTOMATIC SEAT BRAKE (OPTIONAL EQUIPMENT)

The automatic seat brake option provides an additional control mechanism which applies the disc brake independently of the foot brake. See figure 2-53. Driver's weight on seat releases the brake allowing car to be driven. Driver's weight removed from seat automatically applies parking brake through the lever and spring arrangement.

A lockout mechanism (Figure 2-55) is provided to hold the brake in the released position for moving or towing the car. To lockout brake, apply downward pressure to seat so that button on left side of body next to seat can be depressed and rod (22, figure 2-54) can enter slotted hole in plunger (26, Fig. 2-54). Hold button in this position and allow seat to come up against lockout rod to hold the brake in disengaged position. To release, apply downward pressure to seat. Spring pressure on lockout rod will release lockout rod from plunger hole and release lockout mechanism.

ADJUSTING THE AUTOMATIC SEAT BRAKE (Figure 2-53)

Before adjusting the automatic seat brake, adjust the foot disc brake as described previously under ADJUSTING DISC BRAKE.

Check the length of the compressed spring (1). Adjust the length to 6-3/8 in. (dimension A) by tightening or loosening self-locking nut (2).

Check the distance between the heel of the clevis (3) and the face of the spacer on the operating rod (4). This distance should be approximately 1-1/4 in. (dimension B).

Attach clevis (3) to seat brake cam lever (5) using clevis pin (6), washer, and cotter pin. Depress seat brake lever (7) to line up clevis with brake cam lever when inserting clevis pin.

This arrangement should lock brake securely. If brake does not hold tightly enough, detach the clevis (3) and tighten clevis nut (8) by turning the clevis while retaining the rod (4). Reattach clevis to seat brake cam lever (5).

Lower the body. With the body down there should be a slight amount of play (1/16 to 1/8 in.) between the seat brake lever and the contact button. If there is no play, loosen clevis assembly to obtain specified play.

Lubricate the seat brake cam surface with grease. Lightly oil plunger operating rod, and lockout rod.

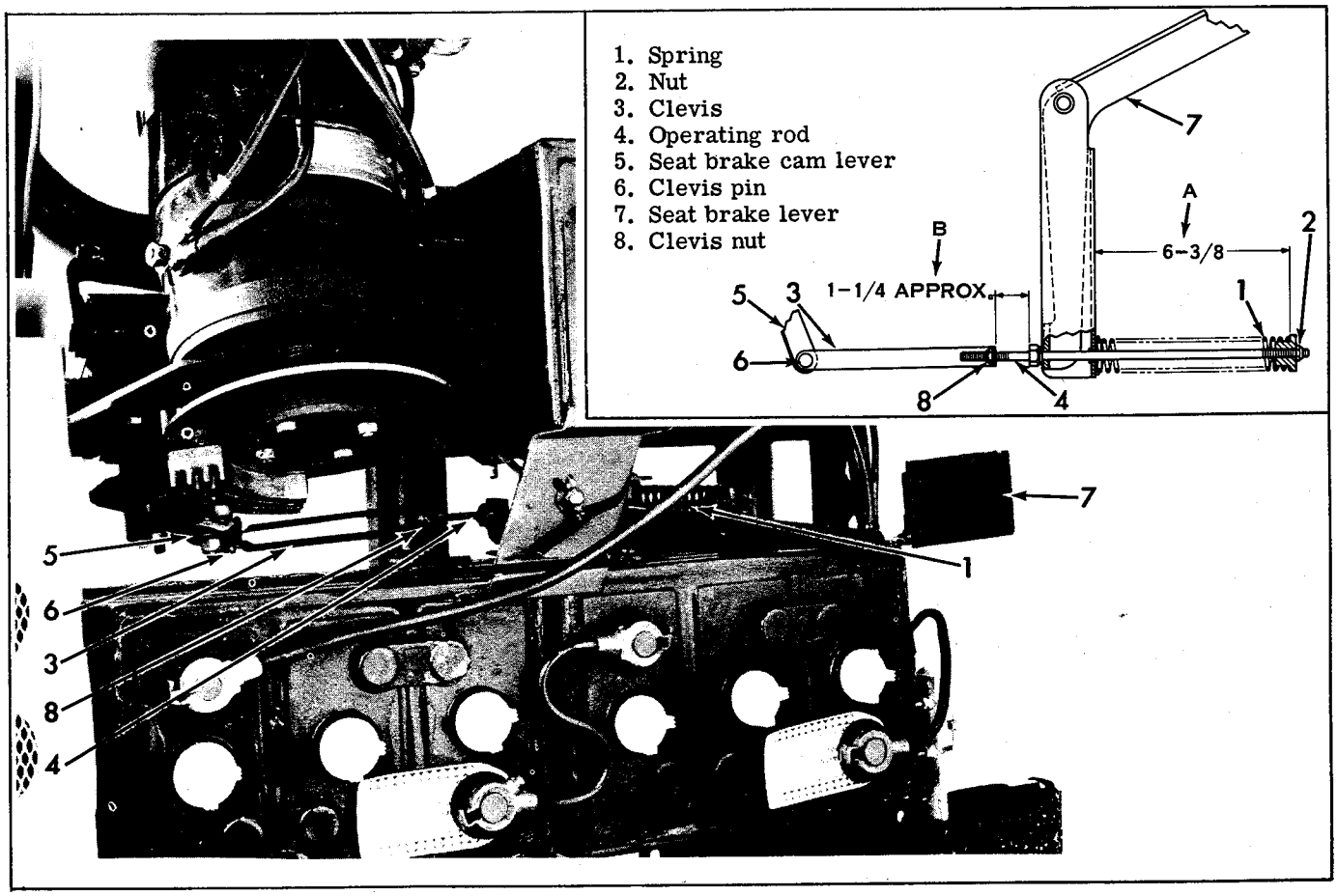


Figure 2-53. Adjusting Automatic Seat Brake

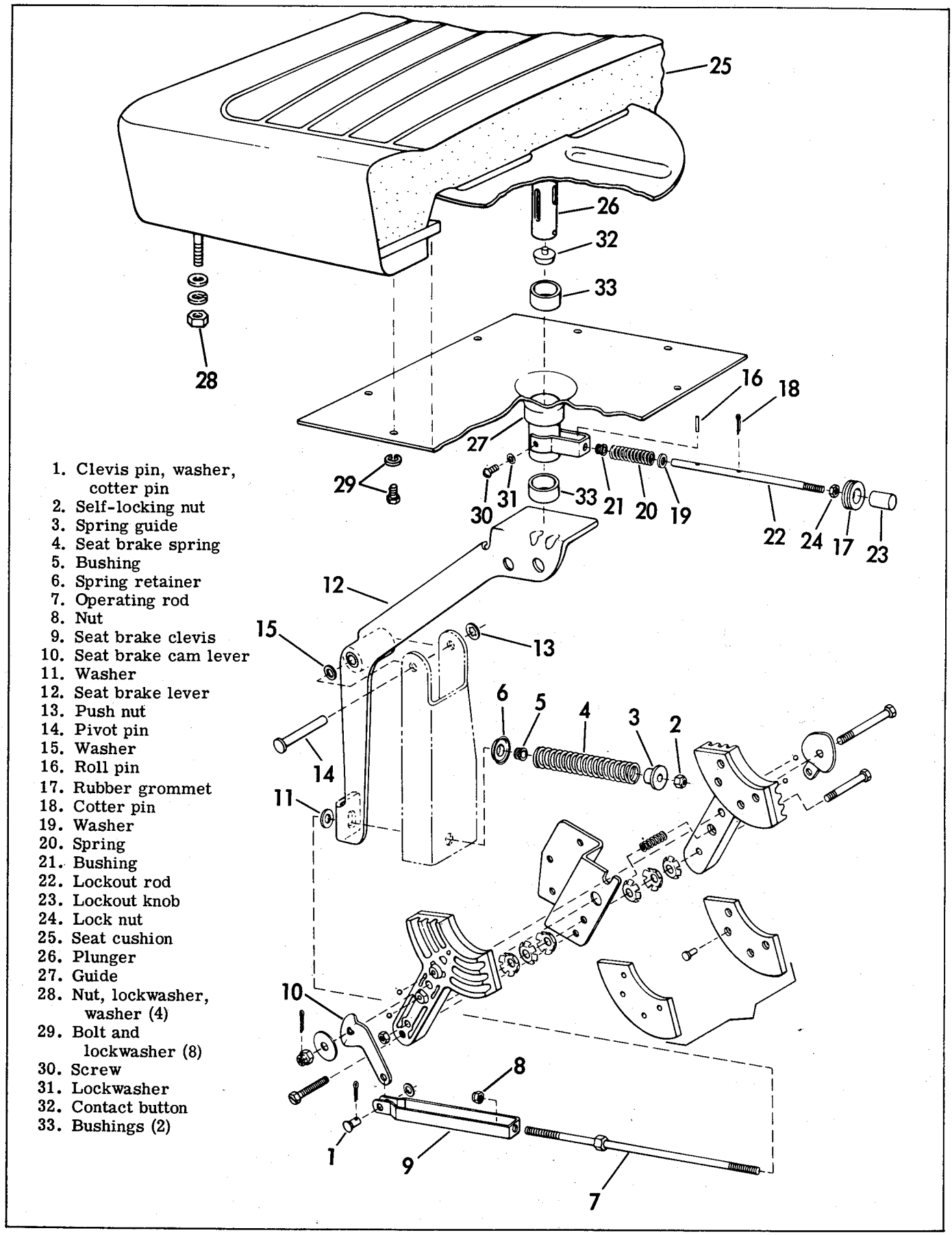


Figure 2-54. Automatic Seat Brake

DISASSEMBLING AND ASSEMBLING AUTOMATIC SEAT BRAKE (Fig. 2-54)

Disconnect seat brake clevis assembly from disc brake assembly by removing cotter pin, washer and clevis pin (1).

Remove self-locking nut (2), spring guide (3), seat brake spring (4), and spring retainer (6). Remove clevis assembly (7, 8, 9) and washer (11). To detach seat brake lever (12) from golf car frame assembly, remove push nut (13), pivot pin (14) and washer (15).

Remove lockout rod assembly by pulling out roll pin (16). Pull rod assembly out through rubber grommet (17) in body. Remove cotter pin (18), washer (19), spring (20) from rod (22). The lockout knob (23) can then be removed from the lockout rod (22) by loosening the lock nut (24).

The seat cushion (25), plunger (26) and guide (27) assembled may now be removed from the car body by removing 4 nuts, lockwashers and washers (28). Remove 8 bolts and lockwashers (29) to release the seat cushion (25).

Remove screw (30) and lockwasher (31), then pull apart the plunger (26) and guide (27). If the contact button (32) on the plunger is damaged, replace it. Use Harley-Davidson Part No. 99618-60, EC-847 adhesive to fasten it in place.

Examine bushings (33). If they are damaged or badly worn, drift or press out the old bushings and press in new ones. The bushing surfaces are lined with a plastic bearing material. Do not score or remove bushing lining. NOTE: Bushings must be flush with the ends of the sleeve.

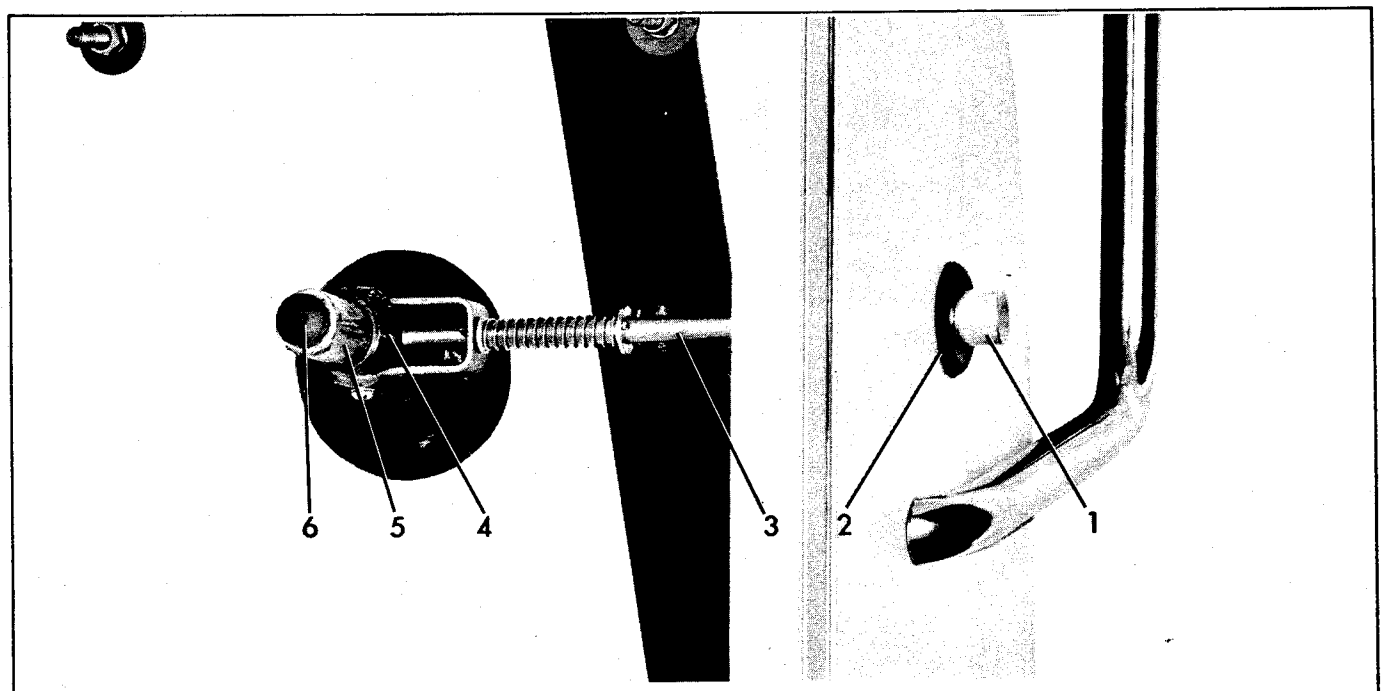
Reassemble in reverse of disassembly. Lockout knob (23) should project 5/8 in. beyond rubber grommet (17).

Adjust seat brake. See "Adjusting Automatic Seat Brake."

MECHANICAL SHOE BRAKES (DEF, 1965 DEC)

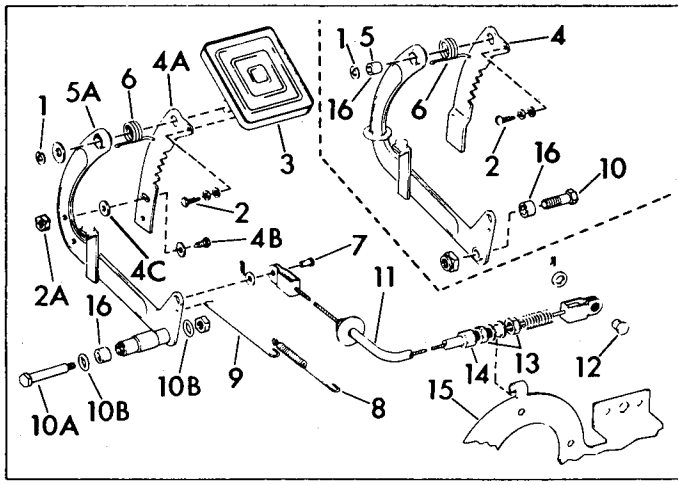
DESCRIPTION

Drum type expanding shoe brakes are located on rear wheels and are connected to foot pedal by rod and cross-shaft linkage as shown in Figure 2-57. When the brake pedal is tilted forward while held in a depressed position, it will lock the brakes, holding the car until the brake is released by tilting the brake pedal rearward.



1. Lockout knob
2. Rubber grommet
3. Lockout rod
4. Guide
5. Plunger
6. Contact button

Figure 2-55. Automatic Seat Brake Lockout Mechanism



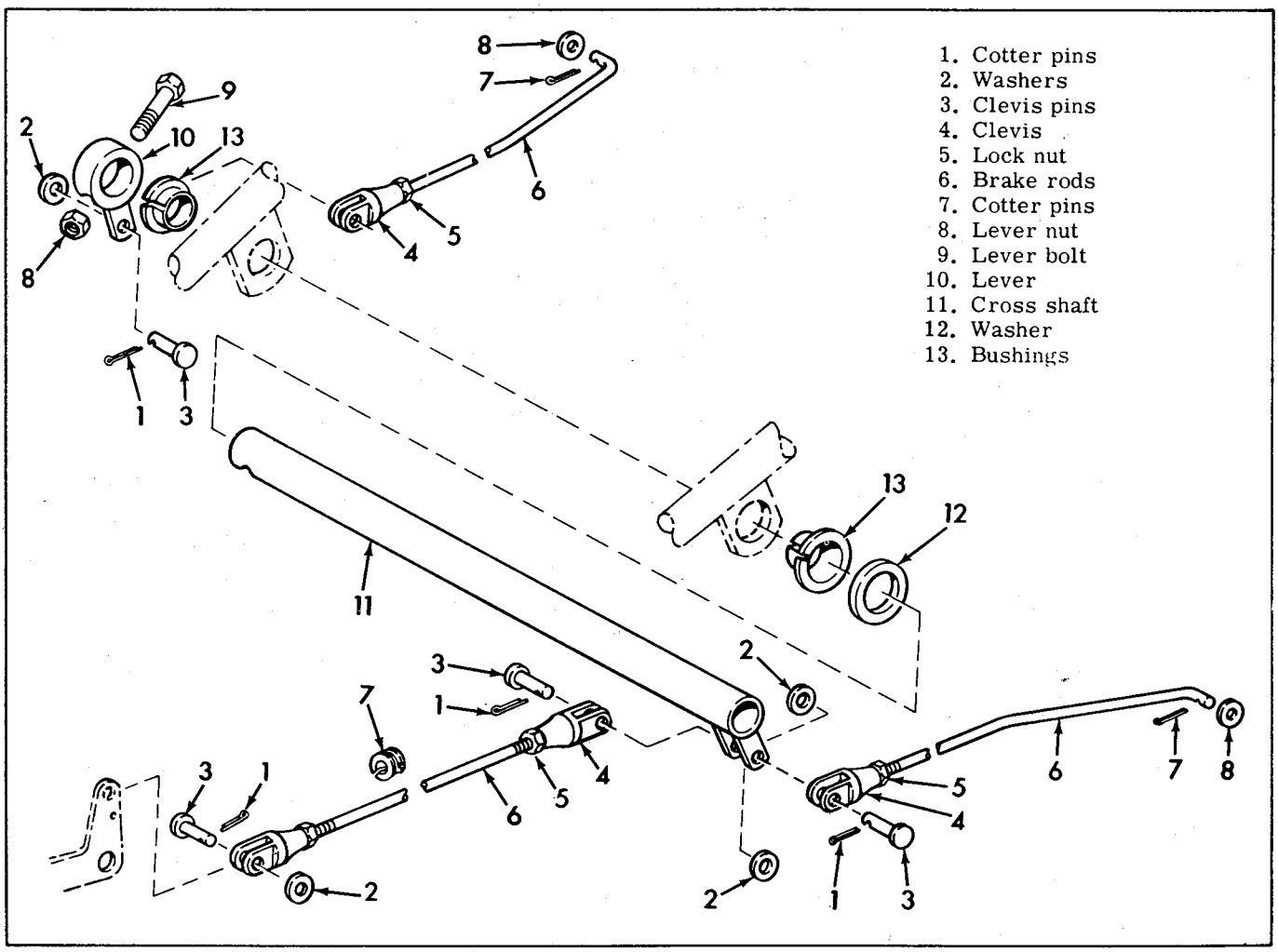
1. Retaining ring
2. Pedal screw
2A. Pedal screw nut
3. Brake pedal
4. Locking ratchet (1963-65)
4A. Locking ratchet (1966 & later)
4B. Ratchet stop screw (1966 & later)
4C. Spacer
5. Brake lever (1963-65)
5A. Brake lever (1966 & later)
6. Ratchet spring
7. Clevis pin
8. Return spring
9. Pull wire
10. Pivot bolt
10A. Pivot bolt (1966 & later)
10B. Pivot O-ring (2) (1966 & later)
11. Cable assembly
12. Clevis pin
13. Locking nut (2)
14. Adjusting screw
15. Mounting bracket
16. Brake lever bushing (2)

Figure 2-56. Brake Pedal and Cable - Exploded View (Mechanical Brake)

ADJUSTING MECHANICAL BRAKE SHOES (Figure 2-57)

When brake pedal free travel becomes excessive, indicating that brake adjustment is necessary, raise rear body section to perform brake adjustment. Adjustment for brake lining wear is made by reducing length of rear brake rods (6) as follows:

Support rear end of car with both wheels off the



1. Cotter pins
2. Washers
3. Clevis pins
4. Clevis
5. Lock nut
6. Brake rods
7. Cotter pins
8. Lever nut
9. Lever bolt
10. Lever
11. Cross shaft
12. Washer
13. Bushings

Figure 2-57. DEF, 1965 DEC Brake Linkage

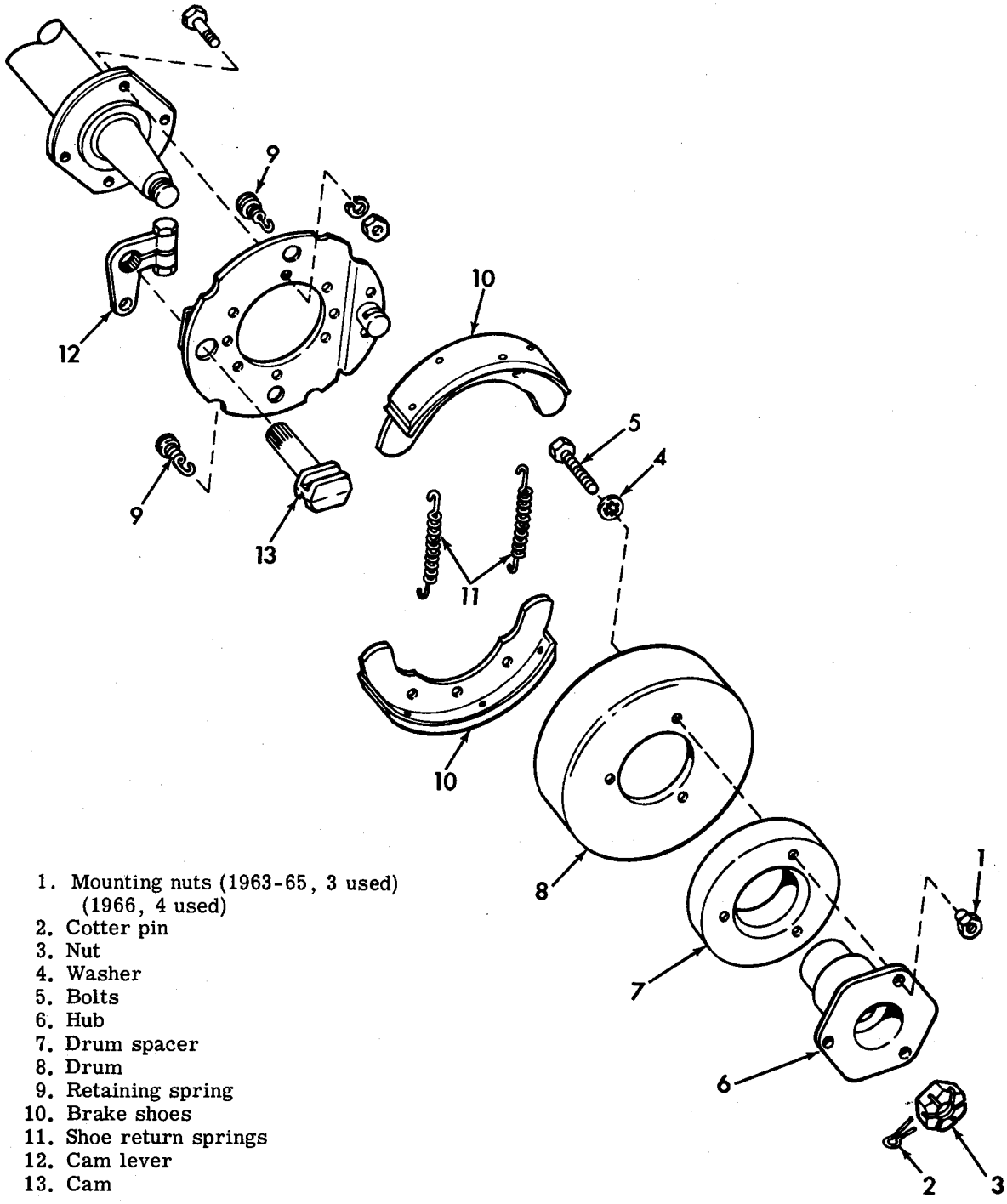


Figure 2-58. Mechanical Drum Type Brake - Exploded View

ground. Remove cotter pin and celvis pin from front ends of ends of left and right brake rods.

Shorten each rod (turn clevis (4) onto rod until each brake drags when clevis and pin are reinstalled on cross shaft lever.) Check by turning wheels. Turn each clevis the same number of turns to keep brakes equalized. When new brake linings have been installed, the left and right rear brake rods may have to be adjusted an unequal number of turns to equalize brakes.

After several minor adjustments of front brake rod it will be necessary to readjust brake shoe cam lever on brake sideplate (12, Figure 2-58) to keep lever in approximately vertical position. To adjust position loosen clamping bolts, remove levers from camshaft splines and reposition both levers the same amount on splines.

IMPORTANT: All brake linkage adjustments must be made so that operating levers on cross shaft and brake operating levers are in a nearly vertical position with foot pedal in depressed position (brakes applied).

REMOVING AND INSTALLING MECHANICAL BRAKE SHOES AND PARTS (Figure 2-58)

If brake shoe linings become worn thin or damaged, the brake shoes (10) can be inspected and removed, if necessary for lining replacement as follows: Remove wheel mounting nuts (1) and remove wheel (not shown). Remove wheel axle hub nut cotter pin (2) and nut (3). Attach suitable puller to ends of 3 bolts (5) and pull hub (6), drum spacer (7) with drum (8) from axle as an assembly. Linings are exposed to view at this point. To remove shoes unhook shoe retainer springs (9) from holes in shoes and unfold shoes (10) from slots in cam (13) and pivot stud by swinging shoes away from backing plate. Remove shoe return springs (11). If linings are worn, shoes can be replaced as an assembly, or linings only can be replaced by drilling out old rivets and riveting on new linings which are supplied in sets with rivets. Grease cam and pivot stud slots and reassemble parts in reverse order. If cam lever (12) has been removed from cam (13), reassemble on splines so cam lever is perpendicular to cam slot as shown.

NOTE

Oil pedal and rod linkage parts including brake operating camshaft (13, Figure 2-58) cross shaft bearings (13, Figure 2-57) and clevises (4, Figure 2-57) periodically.

DISASSEMBLING AND REASSEMBLING MECHANICAL BRAKE CROSS-SHAFT (Figure 2-57)

Remove front and rear brake rod clevises from cross-shaft levers by removing cotter pins (1) washers (2) and clevis pins (3). Remove right side lever nut (8), lever bolt (9) and lever (10). Withdraw cross shaft (11) from left side. Replace bushing (13) if worn or damaged.

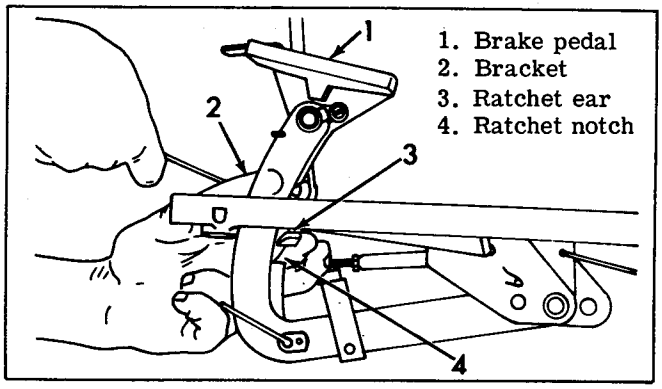


Figure 2-59. Adjusting Mechanical Brake Release

MECHANICAL BRAKE LOCKING RATCHET (Figure 2-59)

If brake locking ratchet (4) fails to engage or release from the accelerator interlocking ear (3) when the brake pedal (1) is tilted, the accelerator bracket (2) must be readjusted for proper brake locking and releasing.

See Figure 2-59. Loosen, but do not remove pedal bracket-to-floor panel nuts with wrench. Depress brake pedal and tilt foot pedal (1) forward. Shift bracket (2) so that ear (3) engages one of notches (4). Fully tighten nuts while holding in this position.

DISASSEMBLING BRAKE PEDAL (Figure 2-56)

To replace or repair worn or damaged brake pedal parts, proceed as follows: Remove retaining ring (1) and pedal screw (2). Slide brake pedal (3) out of brake ratchet (4) and brake lever (5). Remove ratchet spring (6), clevis pin (7), and unhook brake return spring (8) from brake spring pull wire (9). Remove brake pivot bolt (10) and brake lever (5). Clean all parts and inspect for wear or damage. Replace any worn or damaged parts and assemble brake in the reverse order of disassembly.

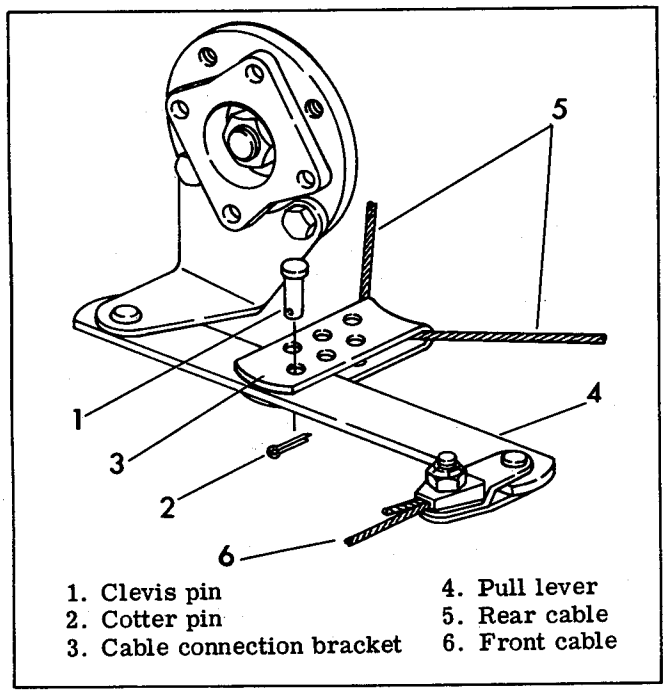
HYDRAULIC SHOE BRAKES (1966-1970 DEC)

DESCRIPTION

Hydraulically operated drum type expanding shoe brakes are located at rear wheels. Foot pedal operates master cylinder piston creating hydraulic pressure in lines to wheel cylinder pistons which expand brake shoes. Brake shoes require periodic adjustment to compensate for lining wear. Master cylinder fluid level should be checked once a month to restore level - USE ONLY HYDRAULIC BRAKE FLUID. A separate hand operated parking brake is cable-connected to the rear brake shoe actuating lever. Adjustment is provided at cable bracket connection.

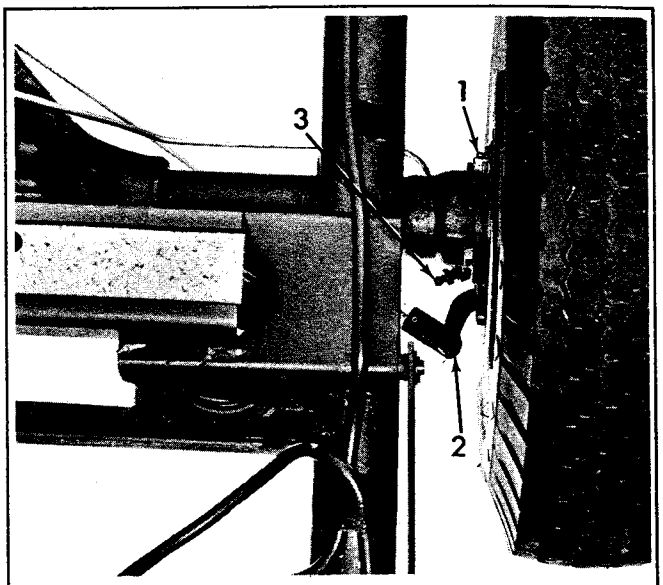
ADJUSTING HYDRAULIC BRAKE SHOES

Adjust brake shoes if pedal moves more than 3/4 way to floor. Adjustment for brake lining wear is made by expanding brake shoe pivot as follows:



1. Clevis pin
2. Cotter pin
3. Cable connection bracket
4. Pull lever
5. Rear cable
6. Front cable

Figure 2-60. Parking Brake Adjustment



1. Adjusting screw
2. Parking brake actuating lever
3. Bleed fitting

Figure 2-61.

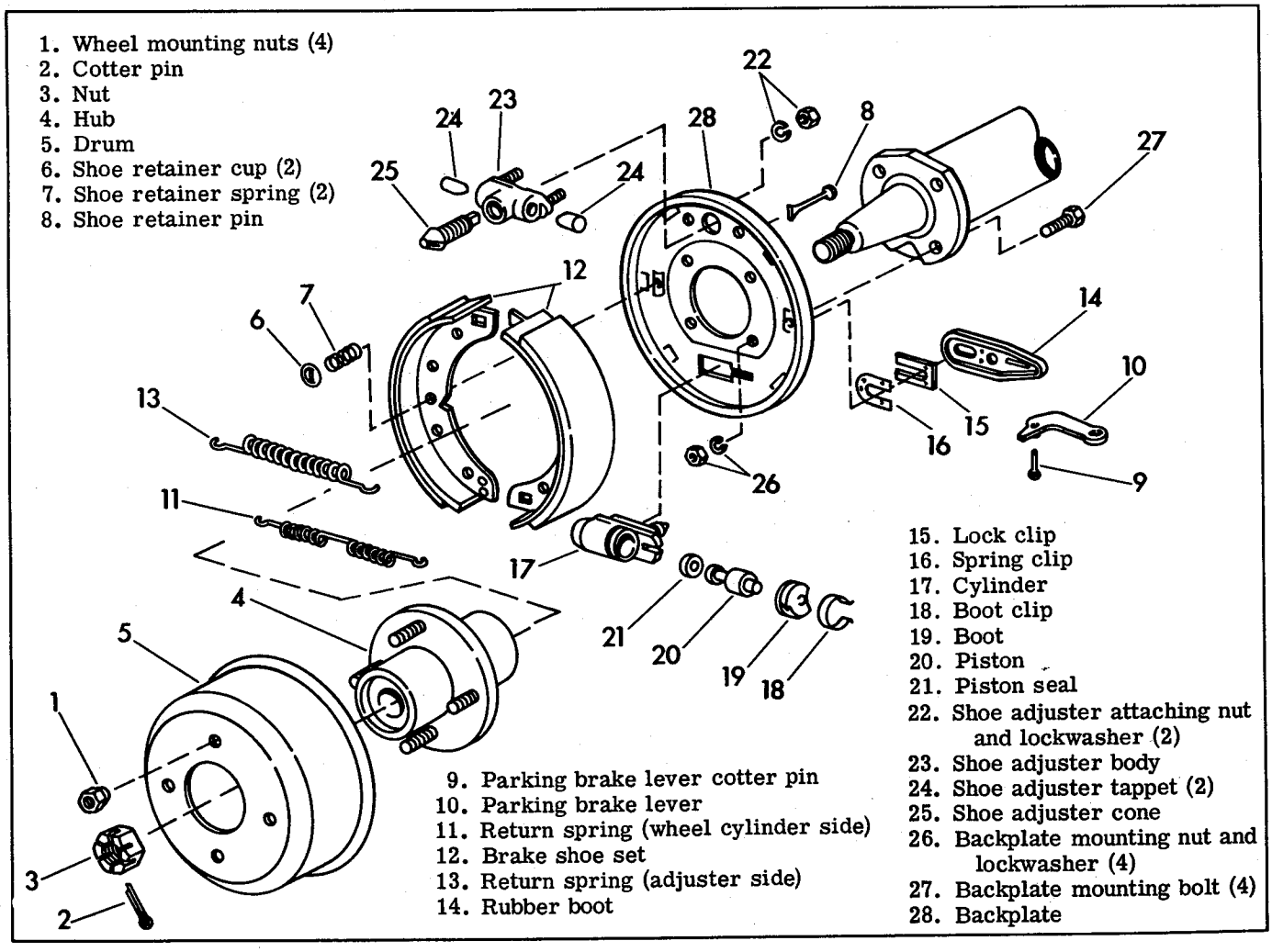


Figure 2-62. Hydraulic-Brake - Exploded View

Support rear end of car with both wheels off the ground. Remove cotter pin and clevis pin (1 and 2, Fig. 2-60) from adjusting bracket at front end of parking brake pull cable.

Turn square head screw (1, Fig. 2-61) at top of brake sideplate inward (clockwise) until each brake drags slightly. Check by turning wheels. Reinstall cable adjusting bracket on lever using clevis pin hole giving slight cable slack with brake handle released.

REMOVING HYDRAULIC BRAKE SHOES AND PARTS (Fig. 2-62)

If brake shoe linings become worn thin or damaged, the brake shoes (12) can be inspected and removed, if necessary for lining replacement as follows: Remove wheel mounting nuts (1) and remove wheel (not shown). Remove wheel axle hub nut cotter pin (2) and nut (3). Attach suitable puller to ends of bolts and pull hub (4), with drum (5) from axle as an assembly. Linings are exposed to view at this point. To remove shoes, disengage shoe retainer spring cups (6) from pins (8) and remove springs (7). Remove cotter pin (9) from parking brake lever (10). Remove cylinder side (red) shoe return spring (11). Pull shoes (12) from slots in adjuster assembly and swing shoes away from backing plate. Remove adjuster side shoe return spring (13). Note how spring ends are positioned in holes.

NOTE

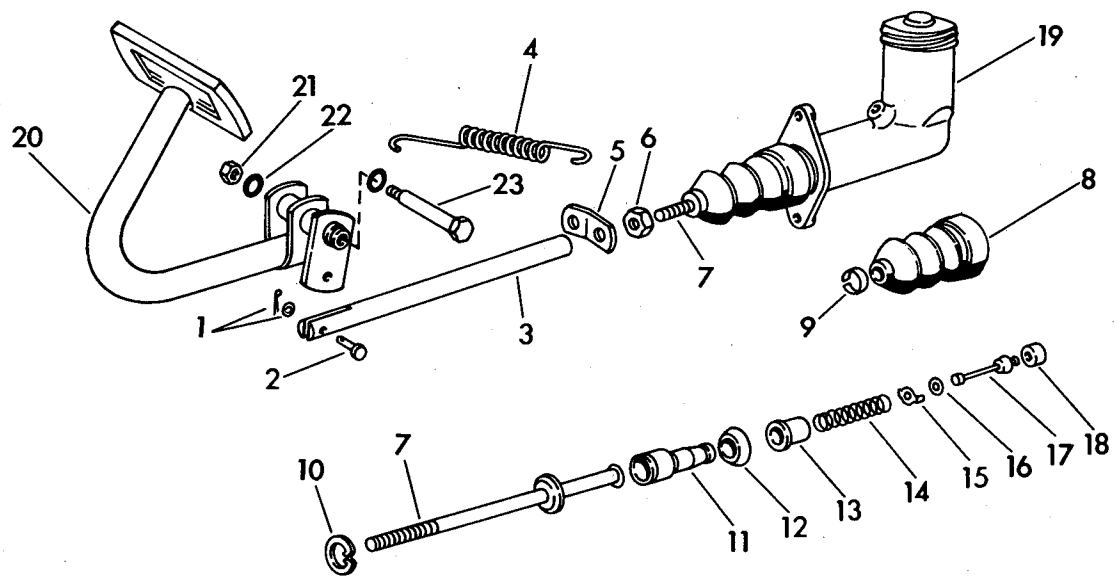
Do not depress rear wheel brake pedal with shoe assemblies disassembled.

If wheel cylinder repair is necessary, remove rubber boot (14) and 2 clips (15 and 16) at rear of brake sideplate with a pointed tool.

INSPECTION AND SERVICING BRAKE SHOES AND PARTS (Fig. 2-62)

Examine brake linings for wear and signs of being oil soaked. Linings are bonded to shoes which are available as a set to service 2 wheels. Examine wheel cylinder also for signs of leaking fluid.

If faulty unit is found, disconnect hydraulic line, remove wheel cylinder from back plate and disassemble for inspection. Remove rubber boot (14), lock plate (15) and spring plate (16) to release cylinder (17) and lever (10). Examine seal (21), piston (20) and cylinder (17) for wear and pits or scratches and



1. Cotter pin and washer
2. Clevis pin
3. Clevis rod
4. Return spring
5. Return spring bracket
6. Clevis rod lock nut
7. Push rod
8. Boot
9. Boot retainer clip
10. Push rod retainer clip
11. Piston
12. Piston seal
13. Valve spring collar
14. Valve spring
15. Valve spacer
16. Valve washer
17. Valve stem
18. Valve seal
19. Master cylinder
20. Brake pedal
21. Pivot bolt nut
22. Pivot bolt washer (2)
23. Pivot bolt

Figure 2-63. Master Cylinder - Exploded View

replace parts as necessary. Note: Use brake fluid or alcohol only to clean wheel cylinder parts. Wheel cylinder piston kits or seal kits are available to service 2 wheels.

Disassemble shoe adjuster tappets (24) from body (23) and clean parts in solvent.

Severely scored or grooved brake drums should be replaced. Assemble brake shoes and parts in reverse order of disassembly. Apply a slight amount of grease to shoe adjuster cone (25) and tappets (24). Also apply a slight amount of grease to shoe contact points on brake sideplate. Install adjuster side spring first and position shoe ends on adjuster tappets. Install cylinder side spring and position shoe ends on cylinder - one side has square hole for parking brake lever. Assemble remaining parts, adjust brake shoes and bleed hydraulic system as described in this section.

DISASSEMBLING MASTER CYLINDER AND PARTS (Fig. 2-63)

Disconnect hydraulic line and remove two master cylinder attaching bolts, nuts and spacers. Remove cotter pin and washer (1) which attaches clevis rod (3) to brake pedal. Disconnect return spring (4). Withdraw master cylinder assembly (19) from car frame hole.

Loosen clevis rod lock nut (6) and unscrew rod (3) from push rod (7). Remove spring bracket (5) and nut (6). Remove boot (8) from master cylinder (19). Remove clip (9) and boot from push rod (7). Remove push rod retainer (10) from groove in master cylinder bore. Withdraw push rod (7), and piston (11) with seal (12). Remove spring collar (13), valve spring (14), valve spacer (15), valve washer (16), valve stem (17) and valve seal (18). Clean all parts in hydraulic brake fluid or alcohol ONLY.

Examine piston (11) and cylinder (19) bore for wear, scratches or pitting. Examine seals (18 and 12) for wear or distortion. Repair Kits are available to service the master cylinder.

Assemble parts in reverse order of disassembly and obtain correct adjustment of push rod (7) by screwing clevis rod onto push rod until there is 1/16 inch play between push rod and piston in cylinder when clevis hole lines up with hole in pedal. This free play is important for correct operation of hydraulic system.

Bleed brakes as described in following paragraph.

BLEEDING HYDRAULIC SYSTEM

If any line or cylinder has been opened when servicing brake system or when satisfactory brake adjustment is unobtainable or pedal is spongy, bleed air from hydraulic system as follows:

Strip the end of a length of appropriate size plastic tubing over wheel cylinder bleeder nipple, located next to wheel cylinder line connection (3, Fig. 2-61).

Place the other end in any clear glass jar containing about 1 in. of brake fluid.

Bleed right wheel first. Open bleeder nipple by rotating it counterclockwise about 1/2 turn. With master cylinder full of fluid at all times, slowly depress foot pedal repeatedly until fluid flows from bleeder nipple free of air bubbles. Add fluid to master cylinder to bring to 1/4 in. from cover. Close bleeder nipple. Repeat above procedure on left wheel.

Do not re-use bled fluid unless it is clear and free of sediment. If it is impossible to bleed all air from system, master cylinder check valve is faulty and a master cylinder repair kit should be installed.

BODY

The golf car body, body tail gate, fork housing, left shield and right shield are of fiberglass construction. Fiberglass will not discolor, rot or deteriorate. Utilicar bodies are steel construction.

The seats and tail gate are bolted to the main body section but do not have to be removed to take body off car frame.

Body assembly is hinged at the rear and has two check straps or metal braces to hold body when raised to upright position.

NOTE

1973 and later cars have a body hold-down latch underneath left floorboard. Latch must be moved toward rear of car to raise body.

Hinges should be cleaned and oiled every 6 months (oftener if required to counteract corrosion caused by acidic fertilizer, grass and moisture).

WARNING

On models with flat support braces, insert bolt or rod through matching holes near brace hinge when body is raised to prevent body from coming down accidently.

REMOVING AND INSTALLING BODY

To support body in vertical position, make a platform from wood or use suitable blocking which is 10 in. high, the top surface about 18 in. wide and 39 in. long. Cover top surface with carpet or cloth.

Raise body and position platform under tail gate.

On 1965 and later models, unfasten body support at either end. On earlier models, unlace straps from brackets on body. Lacing pattern is shown in Figure 2-64.

With body resting on platform, remove bolts, washers and nuts securing hinge to frame.

To reinstall body, reverse this procedure. After hinge is attached, support body at about a 45° angle with a suitable prop to lace check straps to body brackets or attach metal braces.

Body can be adjusted forward or backward as may be necessary for clearance of forward-reverse lever by loosening both rear bumper bolts on side of car.

REMOVING AND INSTALLING FORK HOUSING AND SHIELDS - 3 WHEEL CAR

Shields:

Remove 8 Phillips-head screws which fasten each shield to sides of fork housing and 5 Phillips-head screws which fasten bottom of each shield to floor panel. On 1972 and later models the Phillips-head screws are replaced by 3/16 in. aluminum pop rivets.

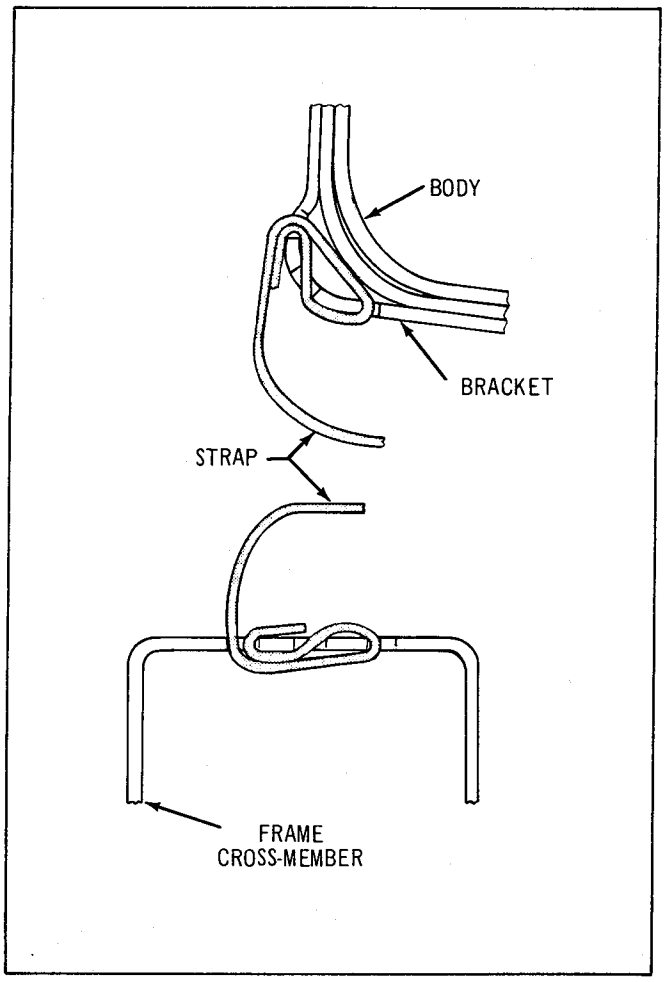


Figure 2-64. Lacing Body Straps (1965 & Earlier)

To remove pop rivets drill them out with a 3/16 in. drill. When replacing pop rivets be sure to use washers to prevent damage to fiberglass.

Fork housing:

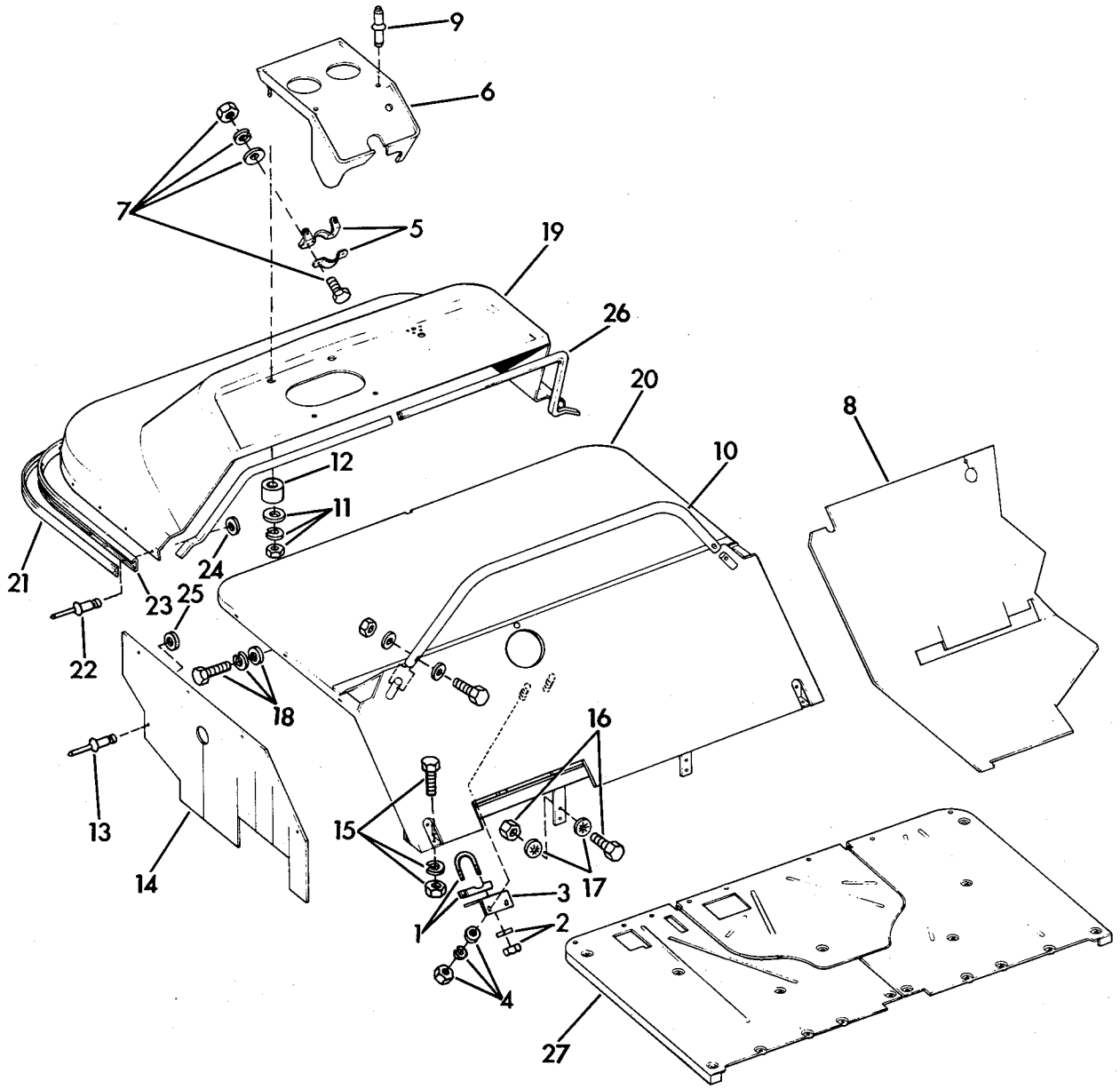
Remove accessory panel (See "Fork," Section 2). Remove tiller bar assembly held by shaft nut and lock washer, or remove steering wheel (See "Fork" Section 2).

Disconnect switch, wiring, etc. from fork housing. On tiller bar models remove screw and cup washer holding top of fork housing to steering head bracket. Remove 8 Phillips-head screws holding bottom of fork housing to floor panels. Lift housing from frame, being careful not to lose 3 rubber spacer washers underneath fork housing.

NOTE

If desired, shields need not be detached from fork housing and entire assembly can be removed and replaced as a unit.

Install parts in reverse order of removal.



1. Steering column U bolt clamp
2. Nut and lockwasher (2)
3. U bolt clamp bracket
4. Nut, lockwasher, washer (2)
5. Steering column clamp
6. Instrument panel
7. Bolt, nut, washer, lockwasher (2)
8. Floormat
9. Countersunk pop rivet (2)
10. Support tube
11. Washer, lockwasher, nut (2)
12. Spacer (2)
13. Pop rivet (2)
14. Splash shield (2)
15. Bolt, lockwasher, nut (2)
16. Bolt and nut (4)
17. Internal tooth lockwasher (8)
18. Bumper mounting bolt, washer, lockwasher (4)
19. Fiberglass body section
20. Subframe
21. Plastic bumper strip
22. Pop rivet (17)
23. Channel
24. Pop rivet washer (17)
25. Pop rivet washer (2)
26. Plastic trim (2)
27. Floor panel

Figure 2-65. Front Body Section, 4 Wheel Car - Exploded View

REMOVING AND INSTALLING FRONT BODY SECTION - 4 WHEEL CAR (Figure 2-65)

Remove steering wheel. See "Removing Steering Wheel" in Section 2.

Remove steering column U bolt clamp (1) by removing 2 nuts and lockwashers (2). Remove U bolt clamp bracket (3) from subframe by removing 2 nuts, lockwashers, and washers (4).

Remove steering column clamp (5) from beneath instrument panel (6) by removing 2 nuts, lockwashers, washers, and bolts (7).

Disconnect wiring from ignition switch and fuel gage. Disconnect choke cable from carburetor. Remove straps securing wiring harness and choke cable to steering column. Pull choke cable up through floorboard.

Remove chrome steering column housing.

Remove floormat (8).

Using a 3/16 in. drill, drill out countersunk pop rivets (9), securing instrument panel (6) to support tube (10). Remove nut, lockwashers, and washers (11) and spacer (12). Lift off instrument panel (6). Drill out the lower front 3/16 in. pop rivet (13) securing splash shield (14) to car frame.

Remove 2 bolts, lockwashers and nuts (15). Remove 4 bolts and nuts (16), and 8 internal tooth lockwashers (17) which secure subframe to floor panel.

Note that there are lockwashers under the bolt heads and under the nuts.

Remove bumper by removing 4 bumper mounting bolts, lockwashers and washers (18).

The body section, fiberglass and subframe, may now be lifted free of car.

If it is necessary to remove the fiberglass (19) from the subframe (20), remove the black vinyl bumper strip (21) and use a 3/16 drill to drill out the 17 pop rivets (22), holding channel (23) and fiberglass to subframe.

Reassembly is basically the reverse of disassembly with the following exceptions.

Make sure to use washers (24, 25) on backside of pop rivets (13, 22), using a pop rivet gun to install new rivets (see parts catalog).

Before replacing the black vinyl bumper strip, lubricate it with tire soap or a small amount of grease. Start the strip at one end of channel and pull it all the way through.

When replacing floor mat, use contact adhesive Harley-Davidson Part No. 99625-69.

NOTE

If it is only necessary to remove the fiberglass body section (19), the subframe (20) need not be removed. Remove items 5, 6, 7, 9, 11, 12, 21, 22, 23 of figure 2-65.

FIBERGLASS BODY CARE AND REPAIR

Parts are made of molded fiberglass. There are 3 types of fiberglass material finishes:

1. Gel Coat finish: This finish is made of a special pigment and blended polyester resin several thousandths of an inch thick.

2. Molded-in-Color finish: This finish is molded into the fiberglass material which is the same color throughout its thickness.

3. Painted finish: This finish is painted on the natural color fiberglass material using standard painting procedure.

The Gel Coat and molded-in-color finishes require minimum care and can be kept new looking by following these easy maintenance rules:

Clean, buff and wax the exterior periodically to renew finish.

An automotive wax type cleaner containing fine rubbing compound is suitable for removing minor scratches and scuffs. Scratches which are not removed by the rubbing compound can be removed by wet sanding with 400 grit sandpaper. Then wet sand with 600 grit sandpaper, rebuff and apply wax polish.

Care should be taken not to cut through the gel coat surface when buffing. A power buffer may be used with care or the surface may be buffed by hand, using a rubbing compound.

Patch and fill in deep scratches, scars and small breaks.

Repair any major breaks as soon as possible, to avoid any additional damage.

For damage to the gel coat finish, you will need a can of Gel Coat of the same color and a small amount of catalyst. For damage to the molded-in-color surface, you will need a can of Filler Coat of the same color and a small amount of catalyst. For deeper holes, breaks, or gouges, you will also need some fiberglass mat and pre-accelerated polyester resin. Gel coat and Filler Coat with catalyst are available in kit form from the Harley-Davidson Motor Co. The other materials including fiberglass mat, and pre-accelerated polyester resin are supplied in fiberglass repair kits which are available at most marine or automotive supply stores.

Damage to the painted type finish can be repaired by sanding, priming and painting using regular painting procedure.

SURFACE FINISHING

A. GEL COAT TOUCH-UP AND SURFACE REPAIRS

This type of damage may be classified as damage to the gel coat only, or a hole or gouge that is deep enough to slightly penetrate fiberglass material. Repair as follows:

1. To be sure that the area to be patched is dry, clean and free of any wax or oil, wash with lacquer thinner.

2. Roughen the bottom and sides of the damaged area, using a power drill with a burr attachment. Feather the edge surrounding the scratch or gouge, being careful not to undercut this edge. See Figure 2-66.

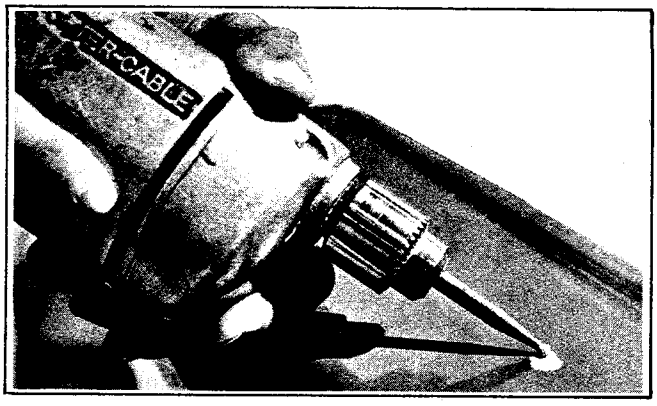


Figure 2-66. Roughing Damaged Area

3. A small amount of gel coat, the same color as the finish should be placed in a small can lid or on a piece of cardboard. Use just enough to fill the damaged area. If damage has penetrated through to fiberglass material, an equal amount of fibers, which can be taken from glass mat and shredded into small fibers, should be mixed with the gel coat - using a putty knife or flat stick. Add three drops of catalyst per teaspoon of gel coat using an eye dropper. Be sure to mix the catalyst thoroughly for maximum working time. Maximum working time (pot life) will be about 15 to 20 minutes at which time it begins to "gel." See Figure 2-67.

4. Fill the scratch or hole above the surrounding undamaged area about 1/16", working the material into the damaged area with the sharp point of a knife. Be careful to puncture and eliminate any air bubbles which may occur. See Figure 2-68.

NOTE

If fiberglass fibers have not been used in mixture, skip steps 5 thru 7 and proceed with step 8.

5. When the patch feels rubbery to touch (10 - 15 minutes), trim the patch flush with the surface, and then allow to cure complete (30 - 60 minutes). Patch will shrink slightly as it cures, making a depression. See Figure 2-69.

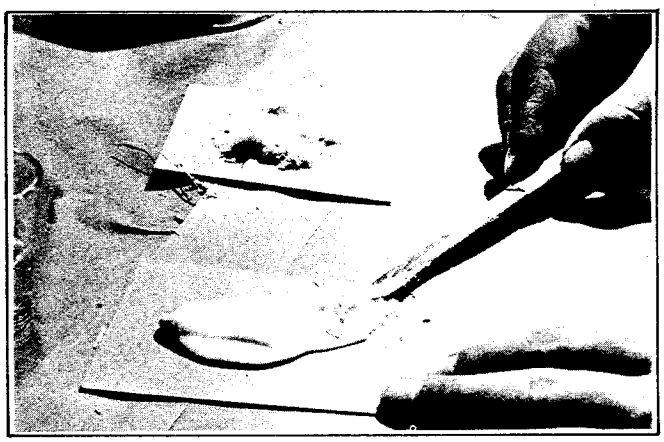


Figure 2-67. Mixing Gel Coat and Glass Fibers

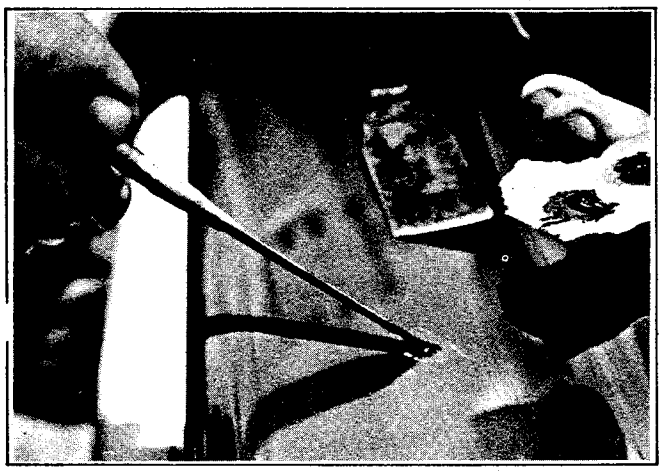


Figure 2-68. Filling Hole or Scratch

Figure 2-69. Trimming Patch

6. Carefully rough up the bottom and edges of the depression, using the electric drill with burr attachment, as in Step 2. Feather into surrounding gel coat; do not under cut.

7. Again mix a small amount of gel coat with catalyst - do not use glass fibers. Using your finger or putty knife, fill the depression with gel coat 1/16" above the surrounding surface.

8. Spread the gel coat level with the surrounding area and allow to cure (30 - 60 minutes). See Figure 2-70. Gel coat can be covered with cellophane, if desired, to aid in spreading evenly. Remove cellophane after gel coat has cured.

9. Sand the patched area, using a sanding block with 600-grit wet sandpaper. Finish by buffing with fine rubbing compound such as DuPont #606 and waxing. Weathering will aid to blend touch-up if a slight color difference can be observed. See Figure 2-71.

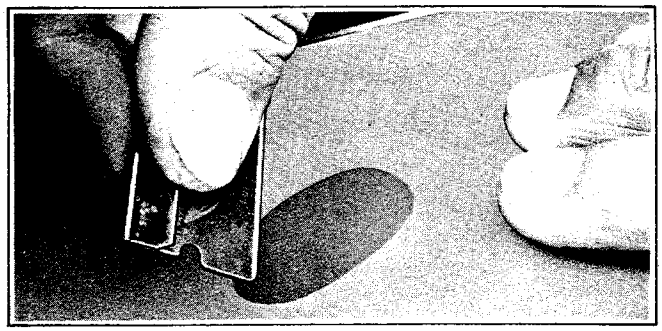


Figure 2-70. Spreading Coat Evenly

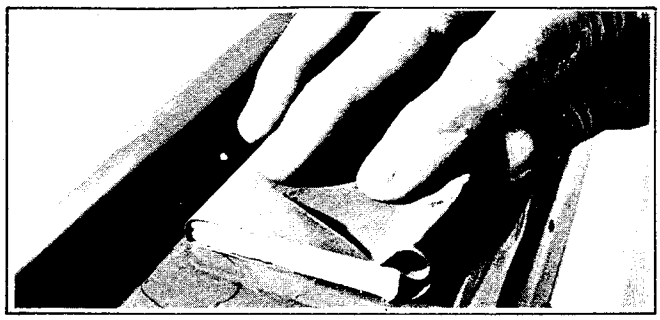


Figure 2-71. Sanding Patch

NOTE

Where surface color of part has changed due to weathering, color match of patch may not be satisfactory. In this case, entire panel must be sprayed.

Thin Gel coat with acetone (1 to 1 ratio) and spray panel, blending sprayed area into a radius or corner on the part. Use a touch-up spray gun such as the Binks Model 15. After Gel coat is hard, buff and polish-sprayed area.

B. MOLDED-IN-COLOR SURFACE REPAIRS

This type of damage consists of a scratch, hole or gouge that is deep enough to slightly penetrate fiberglass material.

Repair as follows:

1. To be sure that the area to be patched is dry, clean and free of any wax or oil, wash with lacquer thinner.

2. Roughen the bottom and sides of the damaged area, using a power drill with a burr attachment. Feather the edge surrounding the scratch or gouge, being careful not to undercut this edge. See Figure 2-66.

3. A small amount of Filler coat, the same color as the finish should be placed in a small can lid or on a piece of cardboard. Use just enough to fill the damaged area. Add three drops of catalyst per teaspoon of Filler coat using an eye dropper. Be sure to mix the catalyst thoroughly for maximum working time. Maximum working time (pot life) will be about 15 to 20 minutes at which time it begins to "gel."

4. Fill the scratch or hole slightly above the surrounding undamaged area, working the Filler coat into the damaged area with a putty knife. Be careful to puncture and eliminate any air bubbles which may occur. Patch can be covered with cellophane to aid in spreading evenly (see Figure 2-70). Allow to cure completely before removing cellophane.

5. Sand smooth with 220-grit sandpaper; then use 600-grit for finish sanding. Blend into surrounding area using 600-grit sandpaper. Buff with polishing compound such as DuPont #600 and finish with paste wax.

NOTE

Where surface color of part has changed due to weathering, color match of patch may not be satisfactory. In this case, entire panel must be sprayed.

Thin Gel coat with acetone (1 to 1 ratio) and spray panel, blending sprayed area into a radius or corner on the part. Use a touch-up spray gun such as the Binks Model 15. After Gel coat is hard, buff and polish sprayed area.

C. PATCHING OF HOLES, PUNCTURES AND BREAKS

If possible, work in shaded spot or in a building where the temperature is between 70° and 80° F.

1. Be sure surface is clean and dry where repair is to be made. Remove all wax and dirt from the damaged area.

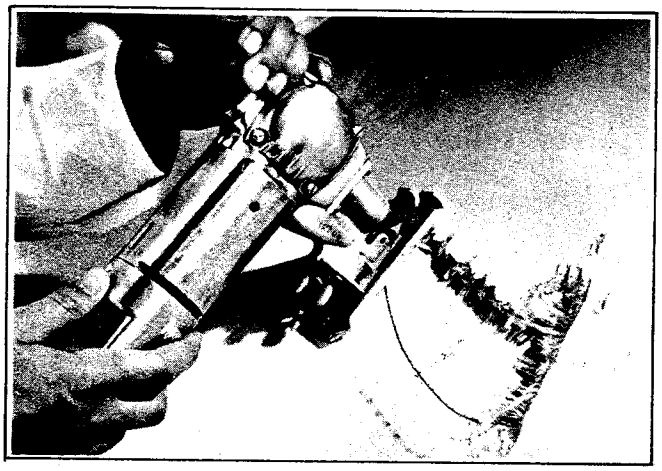


Figure 2-72. Sawing Out Damaged Area

2. Prepare injured area by cutting back fractured material to the sound part of the material. A keyhole or electric saber saw can be used to cut out the ragged edges. See Figure 2-72.

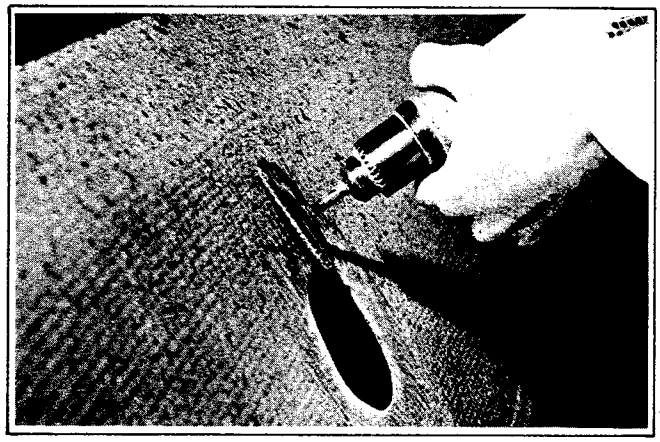


Figure 2-73. Rough Sanding Inside Surface

3. Rough sand the inside surface, using 80-grit dry sandpaper, feathering back about two inches all around the hole in the area the patch will touch. See Figure 2-73.

4. Cover a piece of cardboard or aluminum with cellophane and tape it to the outside surface with the cellophane facing toward the hole. Aluminum is used as backing where contour is present. The aluminum should be shaped the same as the contour. See Figure 2-74.

Figure 2-74. Taping on Backing

5. Cut glass mat to shape of hole, about 2" larger than hole.

6. Mix a small amount of pre-accelerated resin and catalyst and daub resin on mat, thoroughly wetting it out. This may be done on a piece of cellophane or wax paper. See Figure 2-75.

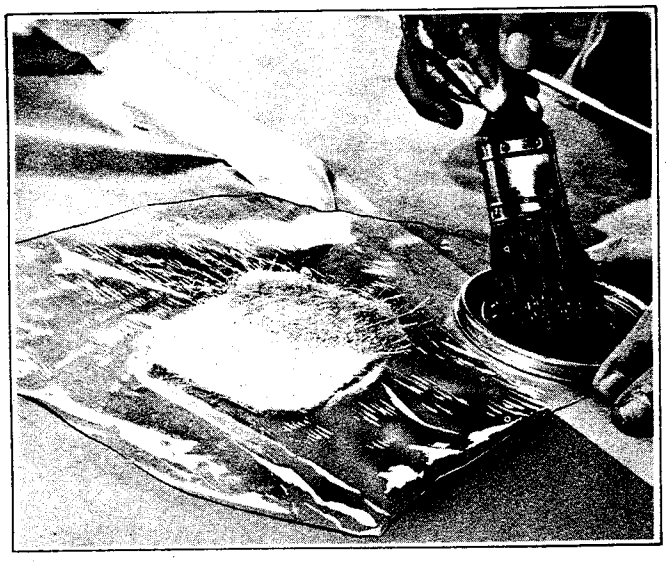


Figure 2-75. Applying Resin to Mat

NOTE

Mix resin 100 parts to 1 part catalyst for an approximate 30 minutes working time. Only mix enough resin for a given patch.

7. Lay patch over hole, cover with cellophane and squeegee out air bubbles. Allow one to two hours to cure, then remove cellophane. See Figure 2-76.

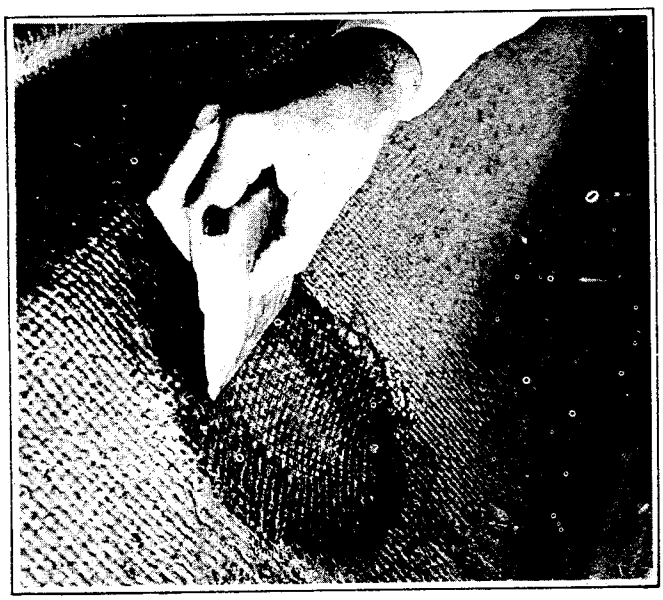


Figure 2-76. Squeegeeing Patch

8. After the patch is cured, remove the cardboard from the outside of the hole and rough sand outside surface, feathering the edge of the hole. See Figure 2-77.

9. Mask area with tape and paper to protect the surrounding surface; then repeat B Steps 5, 6, 7, and

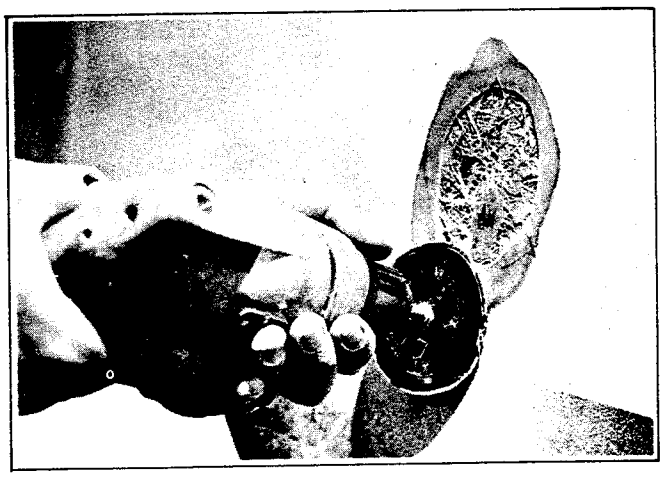


Figure 2-77. Rough Sanding Outside Surface

8, applying patches to outside surface until enough material has been laminated to re-establish the original thickness of the section.

10. Allow the patch to cure overnight; then sand with dry 80-grit paper on power sander. Smooth the patch and blend it with surrounding surface. If air pockets are present, puncture and fill with catalyzed resin. Let cure and re-sand. See Figure 2-78.

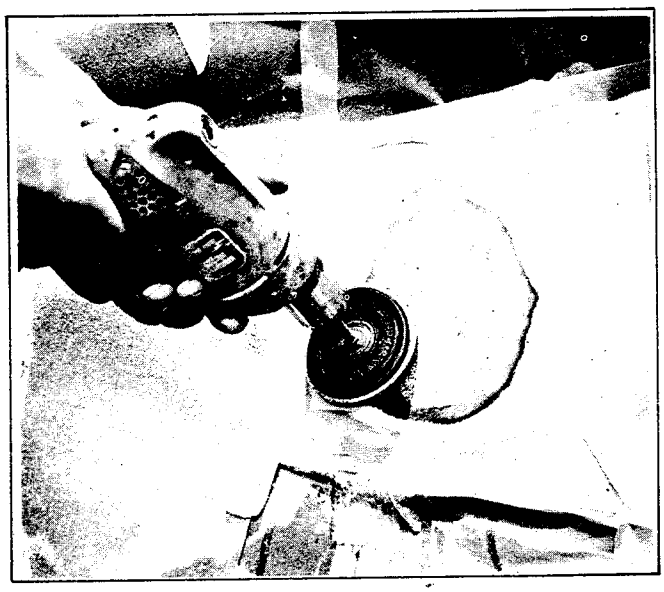


Figure 2-78. Blending Patch with Sander

11. Mix gel coat or filler coat with catalyst. Work Gel Coat into patch with fingers. See Figure 2-79. Filler Coat should be filled into patch with a putty knife.

12. Patch can be covered with cellophane to aid in spreading evenly (see Figure 2-70). Allow to cure completely before removing cellophane.

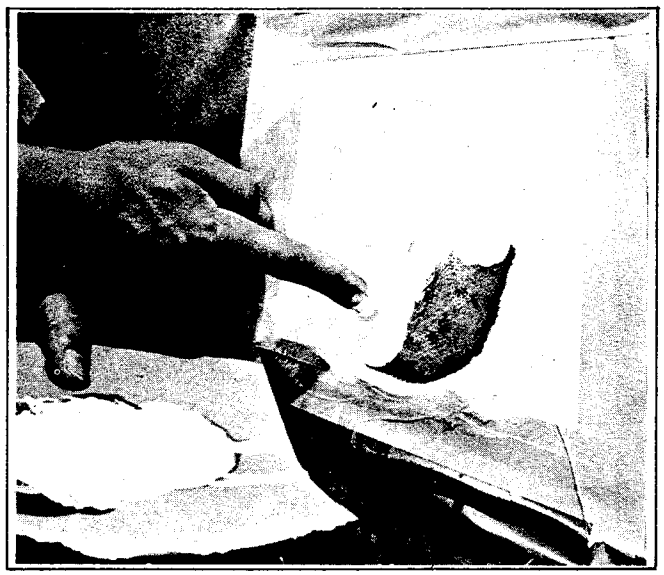


Figure 2-79. Working Gel Coat into Patch

13. Sand the patch with 220-grit wet sandpaper; then use 600-grit for finish sanding. On painted type surface, paint can be applied at this point. Buff with polishing compound and wax.

NOTE

On Gel Coat finish, it may be necessary to repeat Steps 12 and 13 to insure a smooth, even gel coat surface. See Figure 2-80.

For large areas the gel coat can also be sprayed.

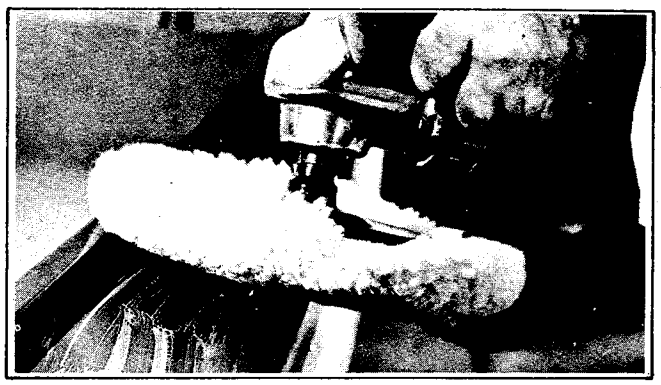
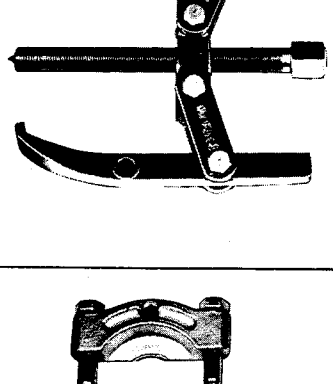


Figure 2-80. Buffing Finish

Where surface color of part has changed due to weathering, color match of patch may not be satisfactory. In this case, entire panel must be sprayed.

Thin Gel coat with acetone (1 to 1 ratio) and spray panel, blending sprayed area into a radius or corner on the part. Use a touch-up spray gun such as the Binks Model 15. After Gel coat is hard, buff and polish sprayed area.

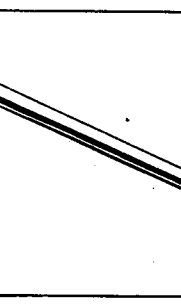
Heat lamps may be used if working conditions are cold. CAUTION: Do not place lamp bulb closer than 14 inches to surface or the resin may blister.



95635-46

ALL PURPOSE CLAW PULLER

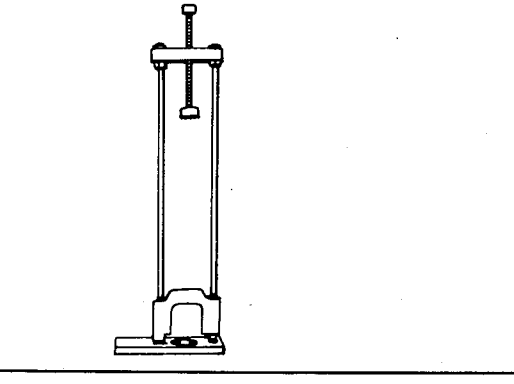
For variety of applications such as pulling transmission drive flange, gears, etc. Has center adapter for pulling objects from a small diameter shaft.



95637-46

WEDGE ATTACHMENT FOR CLAW PULLER

Used in combination with claw puller for pulling steering wheel, etc.



96806-40

BENDING BAR

Used for straightening bumpers. Hooks on bumpers for applying bending leverage.

97010-52A

SHOCK ABSORBER TOOL

Compresses shock absorber for disassembly or assembly. Holds shock absorber spring in compression while parts are disassembled.

97292-61

TWO JAW PULLER

Used to pull steering gear parts, bearings, etc.
95652-43A - Center Cap only.

ELECTRICAL 5

TABLE OF CONTENTS

GENERAL

ELECTRIC CAR OPERATION AND CIRCUITS
1963 to 1966 DE and 1965 to 1968 DEC Models

There are two basic circuits involved in the operation of the electric car:

1. Solenoid Control Circuit (12 or 18 volt) (light gage wires); includes key switch, speed switch and solenoid coils.

2. Motor Circuit (36 volt also 18 volt on DC) (heavy gage wires); includes solenoid contacts, resistor and motor.

The electric car operates in the following manner:

Current to traction motor from batteries is controlled by solenoids, which are electro-magnetic switches. To reduce motor speed, the solenoids cut in resistance which reduces motor current. Solenoids are also used to reverse motor by reversing direction of current through the motor field coils. On 1966 Model DEC either 36 or 18 volt current is made available to the motor by means of a selector switch and 2 switching solenoids.

The solenoid coils receive current from 12 or 18 volt tap on batteries through the key switch and the speed switch, which is operated through connecting linkage from the foot pedal.

NOTE

A 12 volt tap was provided as original equipment on 1963-66 electric cars for operation of solenoids. An 18 volt tap is now recommended for more reliable operation (18 volt tap is shown by dotted line in diagrams).

A micro-switch is used in conjunction with the speed switch to control first speed only. The speed switch contactors control second and third speeds.

The following schematic diagrams show the electrical circuits for car operation:

CIRCUIT DESCRIPTION

NOTE

The following description applies to 1963 to 1965 belt drive models. 1966 is the same except that key switch connections are changed so that FWD. becomes REV. for solenoids A and B, and REV. becomes FWD. for solenoids C and D. This makes motor shaft rotation correct for direct drive axle.

See Figure 5-1.
Key switch in off position - no current flow with speed switch in off position. NOTE: If speed switch is operated, 2nd and 3rd speed solenoid coils will be energized, but motor current will not flow because forward and reverse solenoid contacts remain open.

See Figure 5-2.
Key switch in forward position - speed switch between stop bar and 2nd speed contactor. Micro-switch closes allowing current to flow through forward solenoid coils A and B. This closes solenoid switch contacts A and B allowing current to flow from batteries through resistance (.3 ohm), motor field and armature. Resistance reduces current flow through motor field and armature windings resulting in low torque and speed.

See Figure 5-3.
Key switch in forward position - speed switch on 2nd speed contactor. Micro-switch remains closed keeping switch contacts closed on solenoids A and B. When speed switch arm makes contact with the second speed contactor, current flows through solenoid coil E, closing solenoid switch contacts E, causing the current to by-pass the .2 ohm section of the resistor. This allows a higher current to flow through the field and armature, causing motor speed to increase.

See Figure 5-4.
Key switch in forward position - speed switch on 3rd speed contactor. Micro-switch remains closed keeping switch contacts closed on solenoids A and B. When speed switch arm moves off 2nd speed contactor, current flow through solenoid E stops and solenoid switch contacts E open. When switch arm now contacts the third speed contactor, current flows

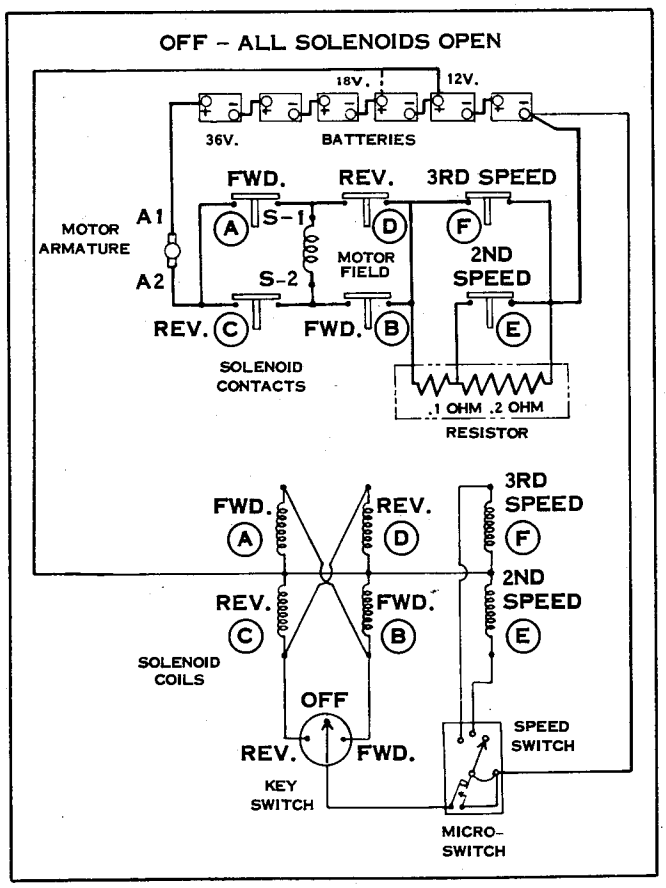


Figure 5-1. Key Switch in Off Position

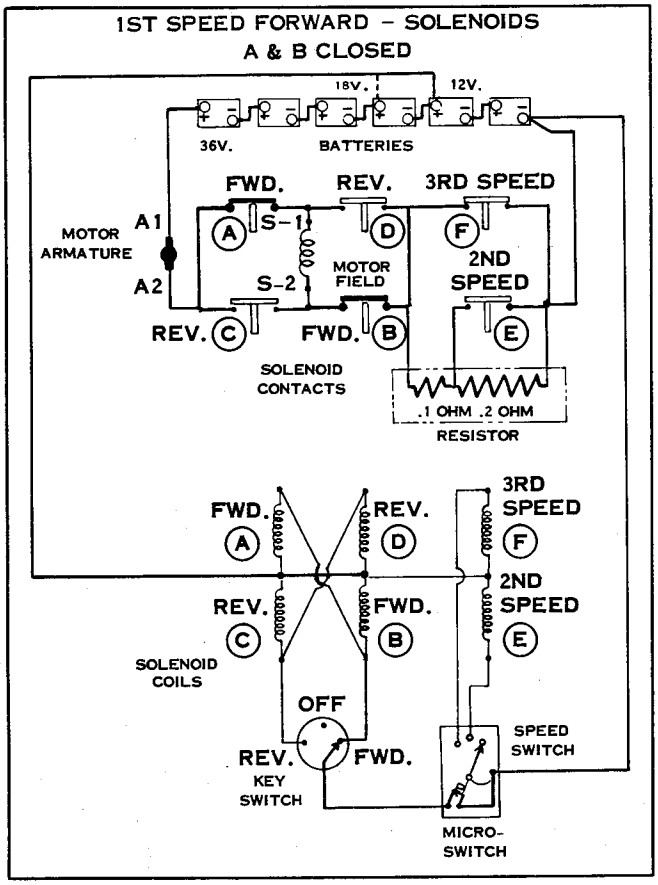


Figure 5-2. 1st Speed Forward

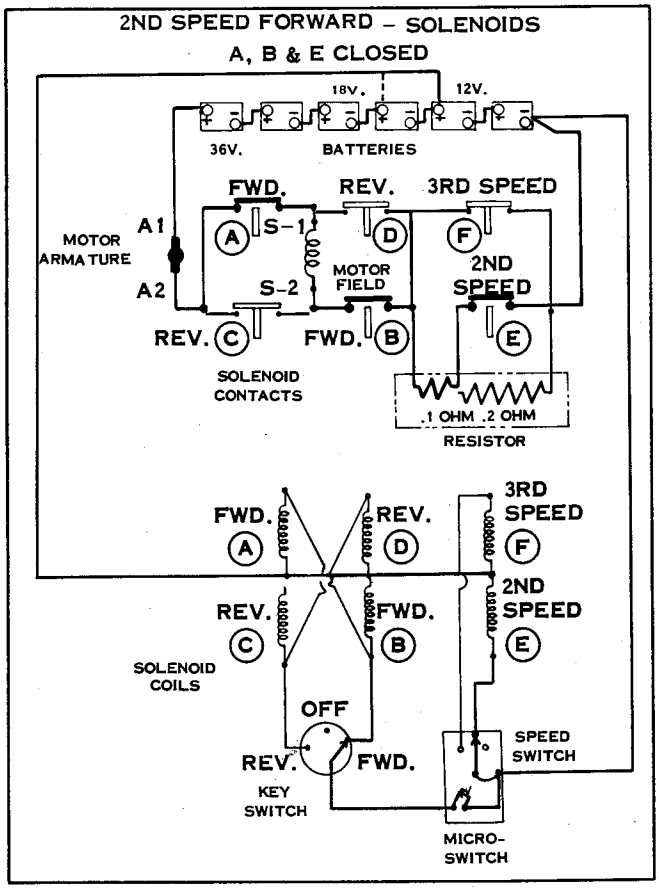


Figure 5-3. 2nd Speed Forward

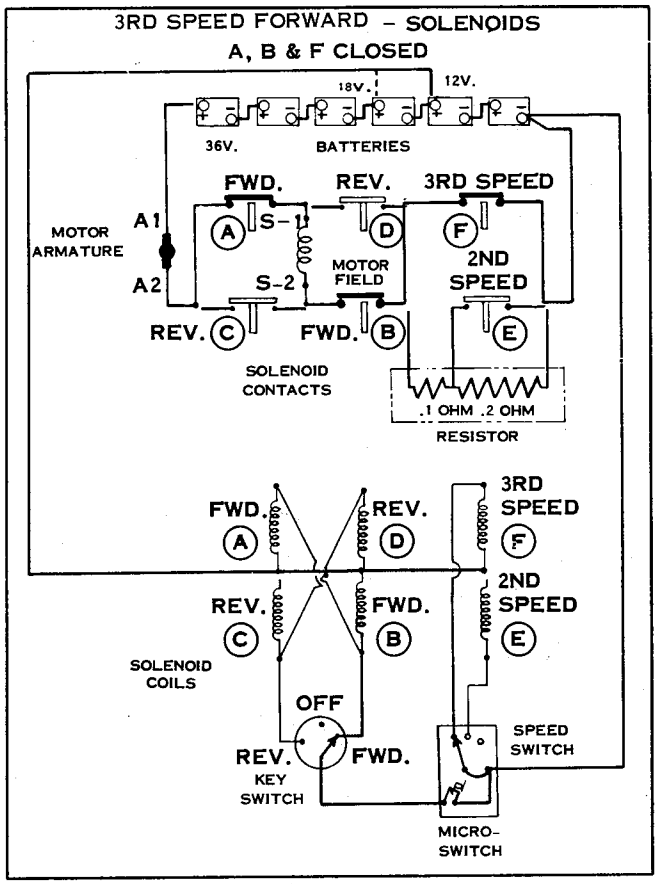


Figure 5-4. 3rd Speed Forward

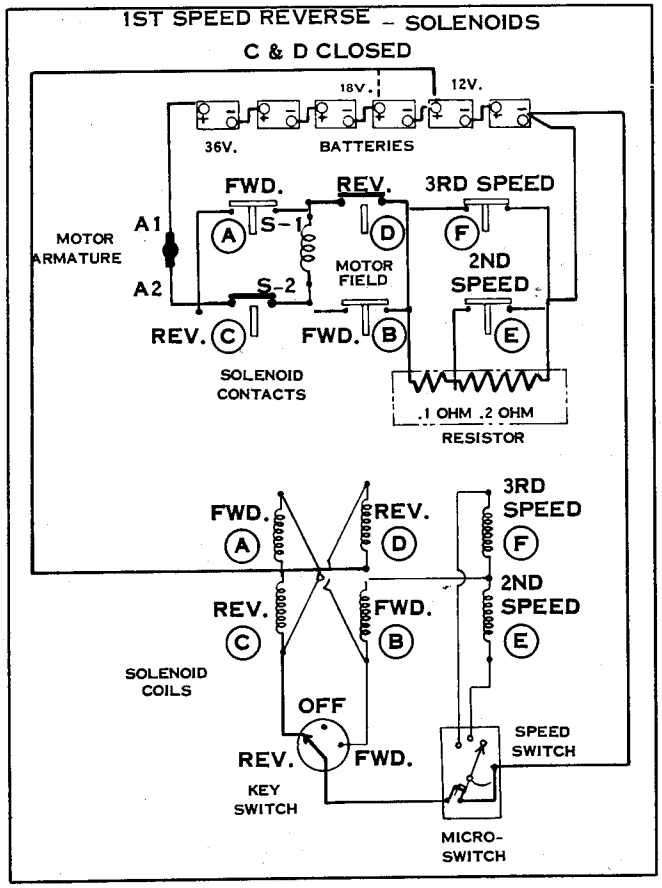


Figure 5-5. 1st Speed Reverse

through solenoid coil F, closing solenoid switch contacts F. Current in the motor circuit now by-passes both the .2 and .1 ohm resistors, allowing full current to flow through the motor field and armature causing motor to run at top speed.

See Figure 5-5.
Key switch held in reverse position. When the speed switch arm is moved to a position between the stop block and 2nd speed contactor, the micro-switch closes allowing current to flow through the reversing solenoid coils C and D. This closes solenoid switch contacts C and D allowing current to flow from batteries through the full resistance (.3 ohm). Current flows through the armature in the same direction as when key switch is in forward position but the reversing solenoids C and D reverse this current flow through the motor field circuit, causing reverse rotation.

Circuits controlling second and third speed in reverse are the same as for forward operation, except that current through motor field is reversed by operation of solenoids C and D as explained.

The previous circuits also apply to the Dual Range system except that two switching solenoids are added to provide a choice of 18V. or 36V. battery connections. Each solenoid has two sets of contacts.

CIRCUIT DESCRIPTION - DUAL RANGE DEC

The previous circuits also apply to the dual range system except that the switching solenoids are added to provide 18V. or 36V. battery connections.

Since the car is equipped with a 3-speed resistance speed control circuit, the 18 and 36 volt connections result in 6 usable speeds in forward and reverse. The low speed (18V.) connection provides a greater operating distance between battery re-charge. High range should be used when more speed and power are required.

See Figure 5-6.
With the speed range switch closed (low range), voltage is applied to the coils of solenoids G and H when the accelerator micro-switch is actuated. Batteries are parallel-connected (18 volts) with solenoids G and H energized through one contact set.

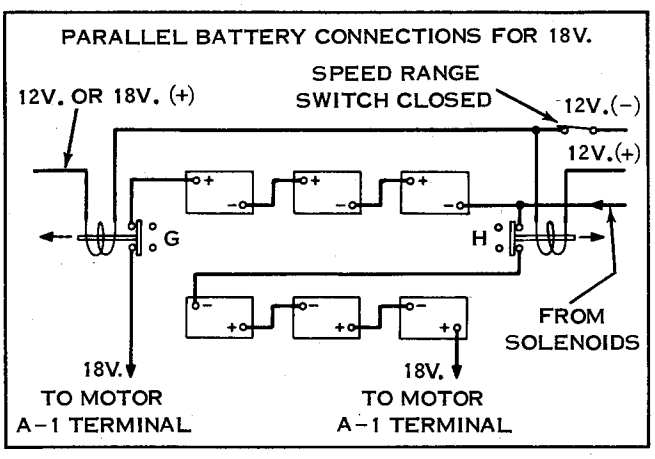


Figure 5-6. Model DEC Low Range

See Figure 5-7.

The control circuit to solenoids G and H is broken when the speed range switch is open (high range). This disables solenoids G and H and allows plunger spring to close other set of contacts resulting in a series (36 volt) battery connection.

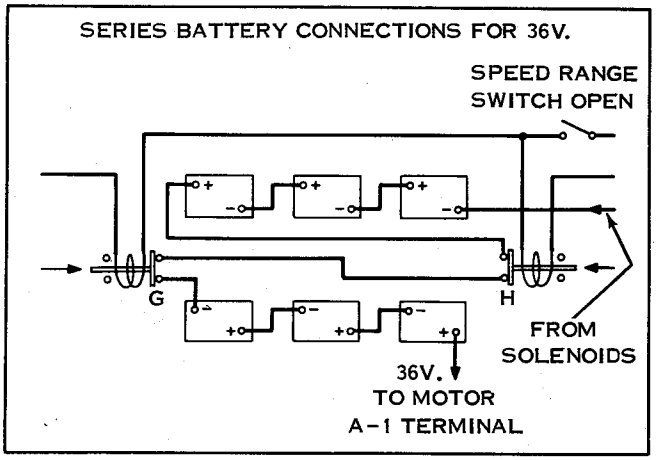


Figure 5-7. Model DEC High Range

ELECTRIC CAR OPERATION AND CIRCUITS
1967 AND LATER DE, DE-3
1969-1970 MODEL DEC

This circuitry employs a battery switching system and resistor to control current flow to the traction motor. In this system, both 18 and 36 volts are made available to power the motor in the various speed stages. This results in efficient operation at low speeds, extending the range of the car and prolonging battery life.

There are two basic circuits involved:

1. Solenoid control circuit (18 volt) includes key switch, speed switch and associated diodes, time delay components and solenoid coils.

2. Motor circuit (36 volt and 18 volt) includes solenoid contacts, circuit breaker, (1970-71 only) large motor diodes, resistor and the traction motor.

CHARGING BATTERIES

See Figure 5-8.
Speed switch is fully released with the movable contact touching contact #1. Control system is in "charge" position. Batteries are in series with charger output.

FIRST SPEED STAGE

See Figure 5-9.
As the speed switch is operated, it opens the circuit at contact #1. This removes the series (36 volt) battery connection. The parallel (18 volt) connec-

tions are now provided through diodes 1 and 2. Contact #2 is a buffer bar; no connections are made to this contact. As the movable contact touches contact #3 with the key switch in the forward position, solenoids F and B are energized, passing current through motor resistor to start the car in first speed. (Diode 3 prevents energizing solenoid C when movable contact touches contact #3.)

SECOND SPEED STAGE

See Figure 5-10.

As the speed switch movable contact moves farther, it touches contact #4, energizing solenoid C through micro-switch. Solenoid C allows current to by-pass the motor resistor, resulting in 18 volts being directly applied to the motor. Solenoids F and B remain energized through diode 3.

THIRD SPEED STAGE

See Figure 5-11.

As movable contact advances farther, it maintains contact with contact #4 and closes the normally open contacts of micro-switch. This de-energizes solenoid C, placing the motor resistor back in the circuit. Simultaneously, solenoid A is energized, completing the 36-volt battery connection. The heater of the time delay tube is also energized in this speed stage. Heater resistor provides voltage drop to operate heater filament at 18 volts. (Diode 4 prevents continued operation of coil A (36-volt circuit) during the 5 to 10-second interval time delay contacts remains closed after micro-switch button is released when going from fourth speed to second speed.)

FOURTH SPEED STAGE

See Figure 5-12.

After approximately two seconds in the third speed stage, the bi-metal in the time delay tube heats sufficiently to close the normally open delay tube contacts, thereby energizing solenoid C which allows current to by-pass motor resistor. This results in 36 volts being directly applied to the golf car motor.

REVERSE

See Figure 5-13.

The above circuit descriptions also apply in the reverse position of the key switch, except that in reverse, solenoid R is energized instead of solenoid F. This reverses the polarity of the motor field in relation to the armature, resulting in reversed armature rotation in all speeds. Fourth speed stage is shown. Note that solenoids F and R are double acting.

NOTE

Connections to motor fields S1 and S2 are shown for 1972 and later models. Earlier models have connections to these terminals reversed because the motor armature rotation is in opposite direction. Circuit breaker is eliminated from 1972 and later models.

WIRING

TESTING CIRCUITS

Electrical tests of the electric car wiring, switches and resistor can be made with a continuity tester consisting of a lamp and battery arranged as shown in diagram Figure 5-14.

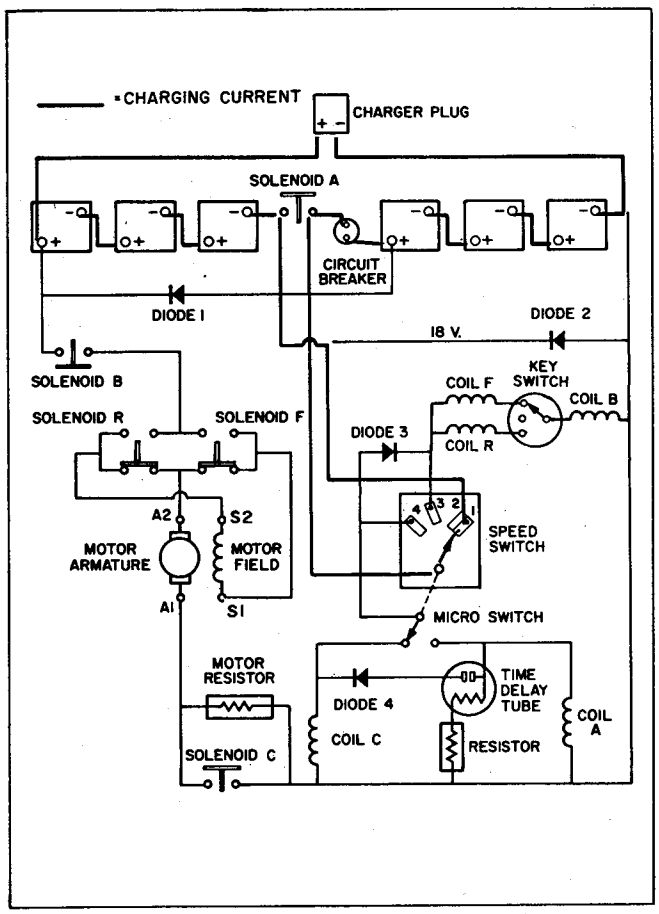


Figure 5-8. Charging Batteries

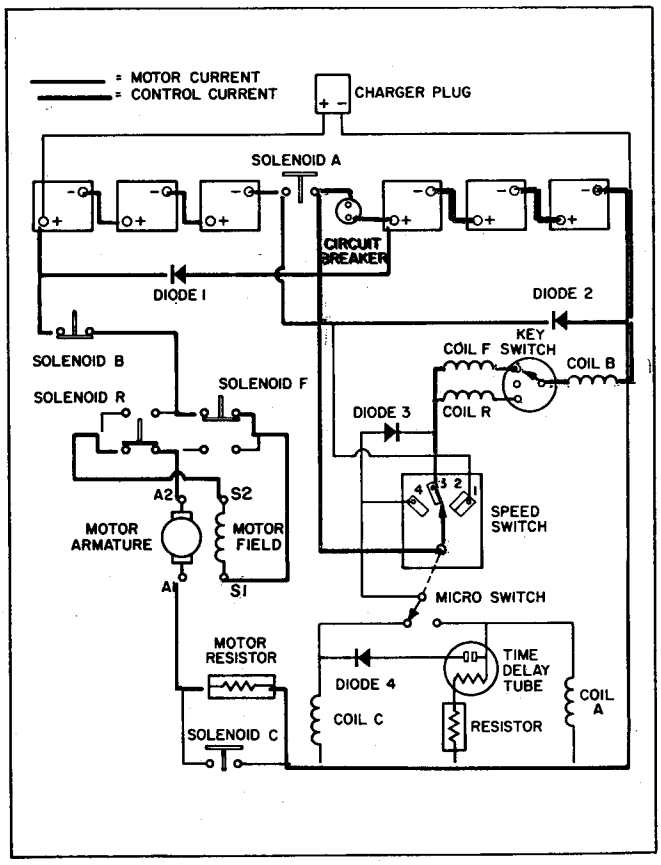


Figure 5-9. First Speed Stage

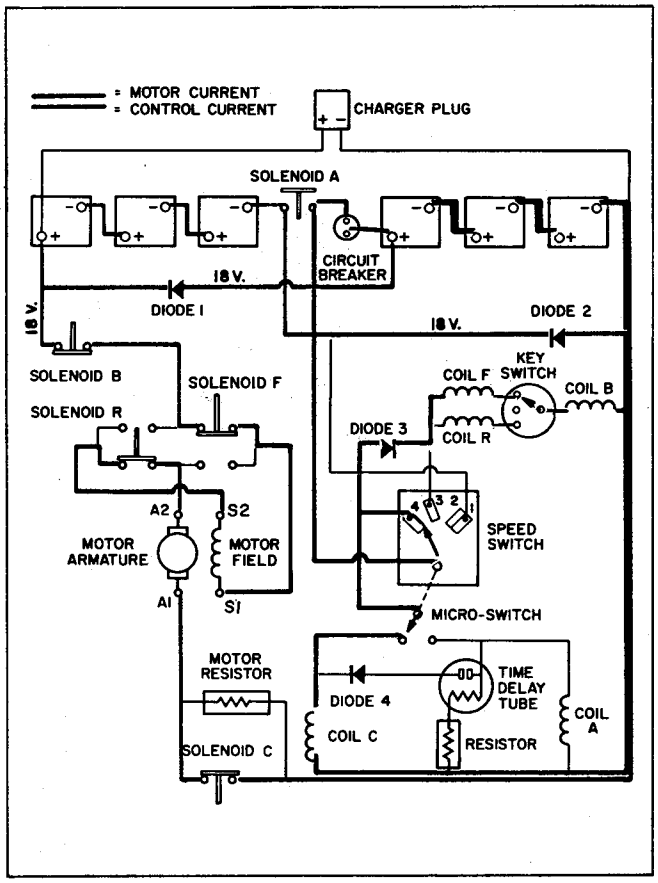


Figure 5-10. Second Speed Stage

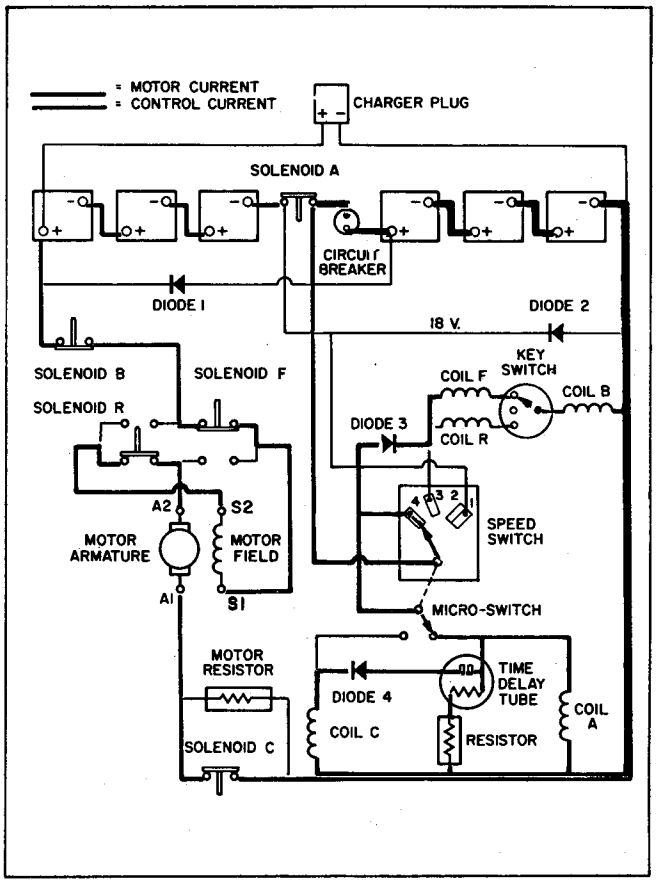


Figure 5-12. Fourth Speed Stage

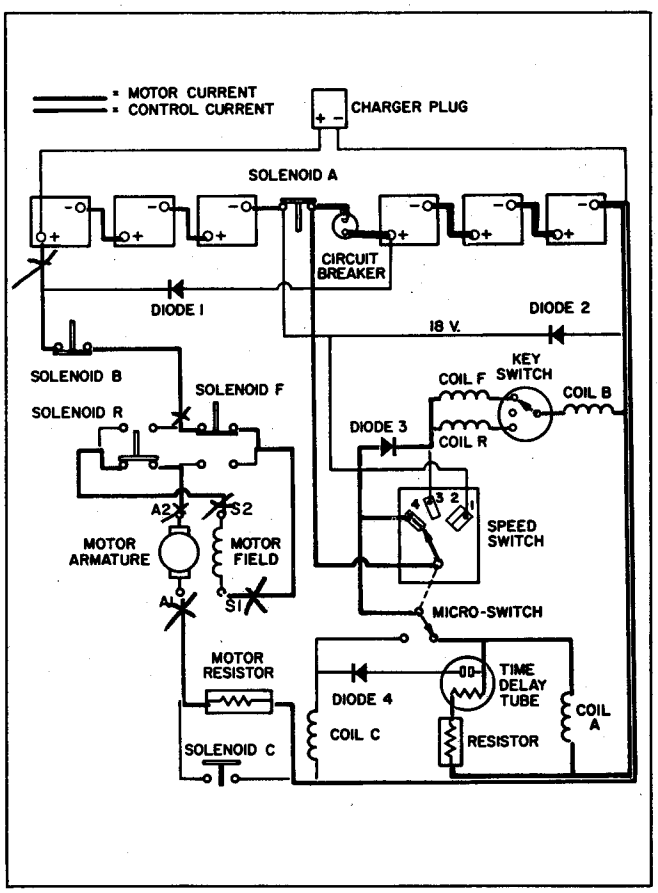


Figure 5-11. Third Speed Stage

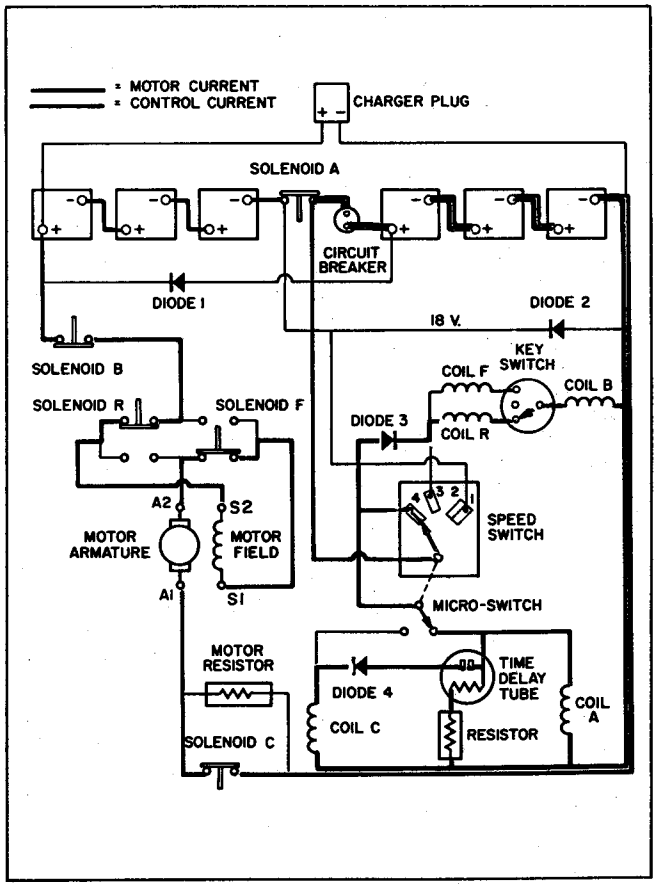


Figure 5-13. Reverse

Parts used are a six-volt battery and turn signal lamp or equivalent bulb (21 CP) in series using jumper wires of adequate length.

CAUTION

Before making any test of individual components, disconnect power supply cables at battery posts.

The control circuits and components can be tested as described in section 5C Switches.

A complete electrical trouble shooting guide is located in Section 1C near the beginning of this manual. Also, a convenient check chart is located underneath body of each car.

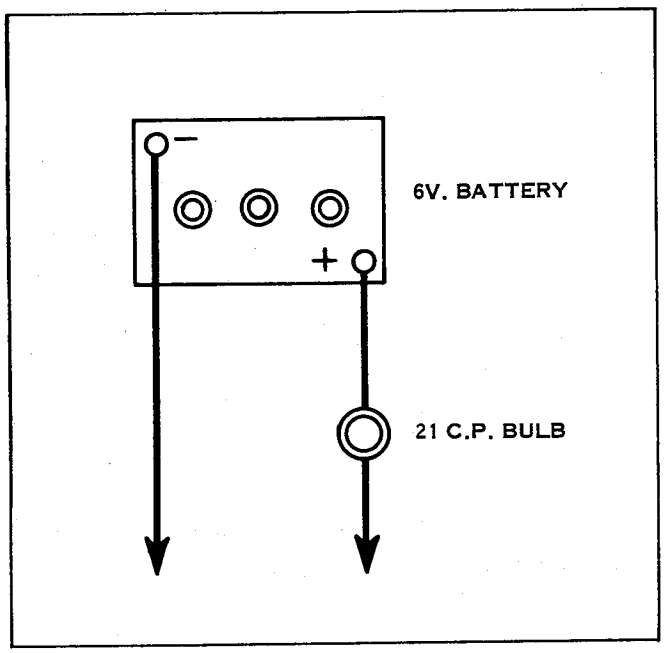


Figure 5-14. Test Circuit

TROUBLESHOOTING ELECTRICAL SYSTEM - 1972 and Later DE, DE-3, DE-4

If the 1972 and later electric golf car is not operating properly or does not operate at all, the following tests can be made to find most problems without disconnecting any wiring. Only two "tools" are needed. A voltmeter reading 0 to 36 volts, and a jumper wire consisting of a two foot length of 12 gage wire with an alligator clip on each end.

Figure 5-38 shows the location of the solenoids. Figure 5-16 shows the wiring diagram for the control circuit and Figure 5-15 shows the motor circuit.

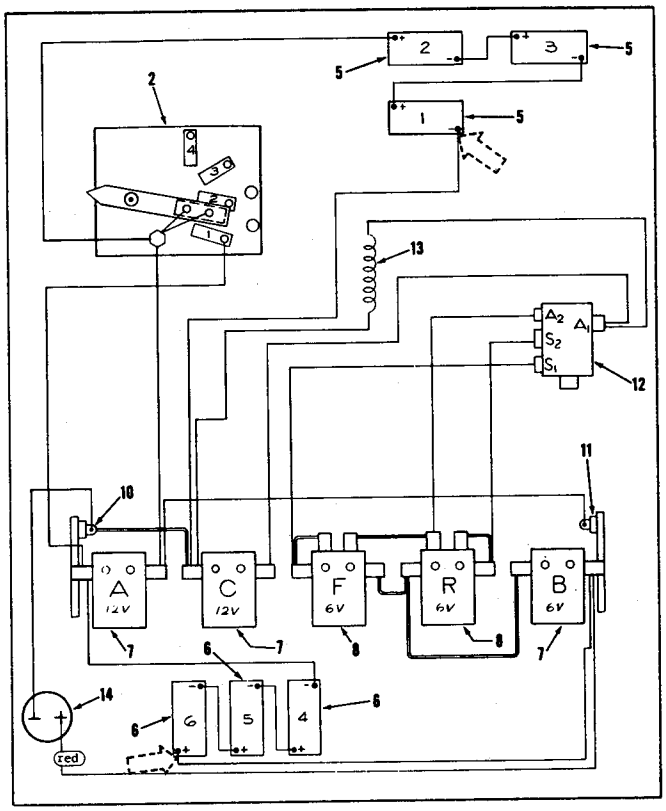


Figure 5-15. 1972 and Later Model DE, DE-3, DE-4 Wiring Diagram - Heavy Cable Motor Circuit

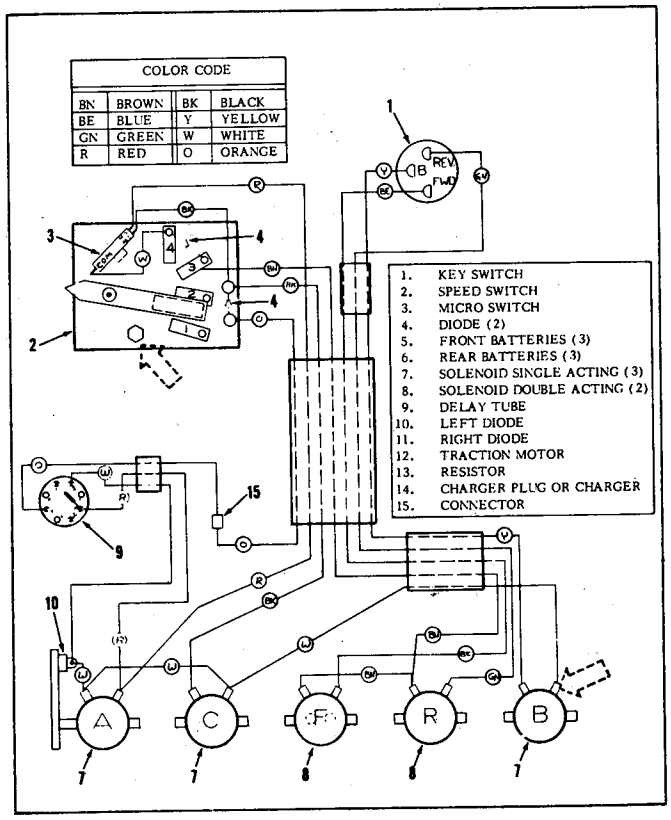


Figure 5-16. 1972 and Later Model DE, DE-3, DE-4 Wiring Diagram - 16 Gage Wire Control Circuit

To troubleshoot the car proceed as follows: Block up rear end of car so that one wheel is off the ground. With key switch off and speed switch on contact number 1, check battery voltage at points indicated by arrows in Figure 5-15. Voltmeter reading should be 36-37 volts. Check the control circuit voltage at points indicated by arrows in Figure 5-16. Voltmeter reading should be 18-19 volts. If these voltages are not within these limits, check the speed switch, batteries, and battery connections. If no voltage is indicated in the second voltage test check the continuity of the white wires in Figure 5-16.

If the batteries check out, turn key switch on and slowly depress accellerator pedal. Note the number of speed changes. There should be four speed changes. If not, determine which speed is missing and refer to appropriate chart in the following guide. The jumper cable is indicated by a red line. When repairing control circuit refer to Figure 5-16.

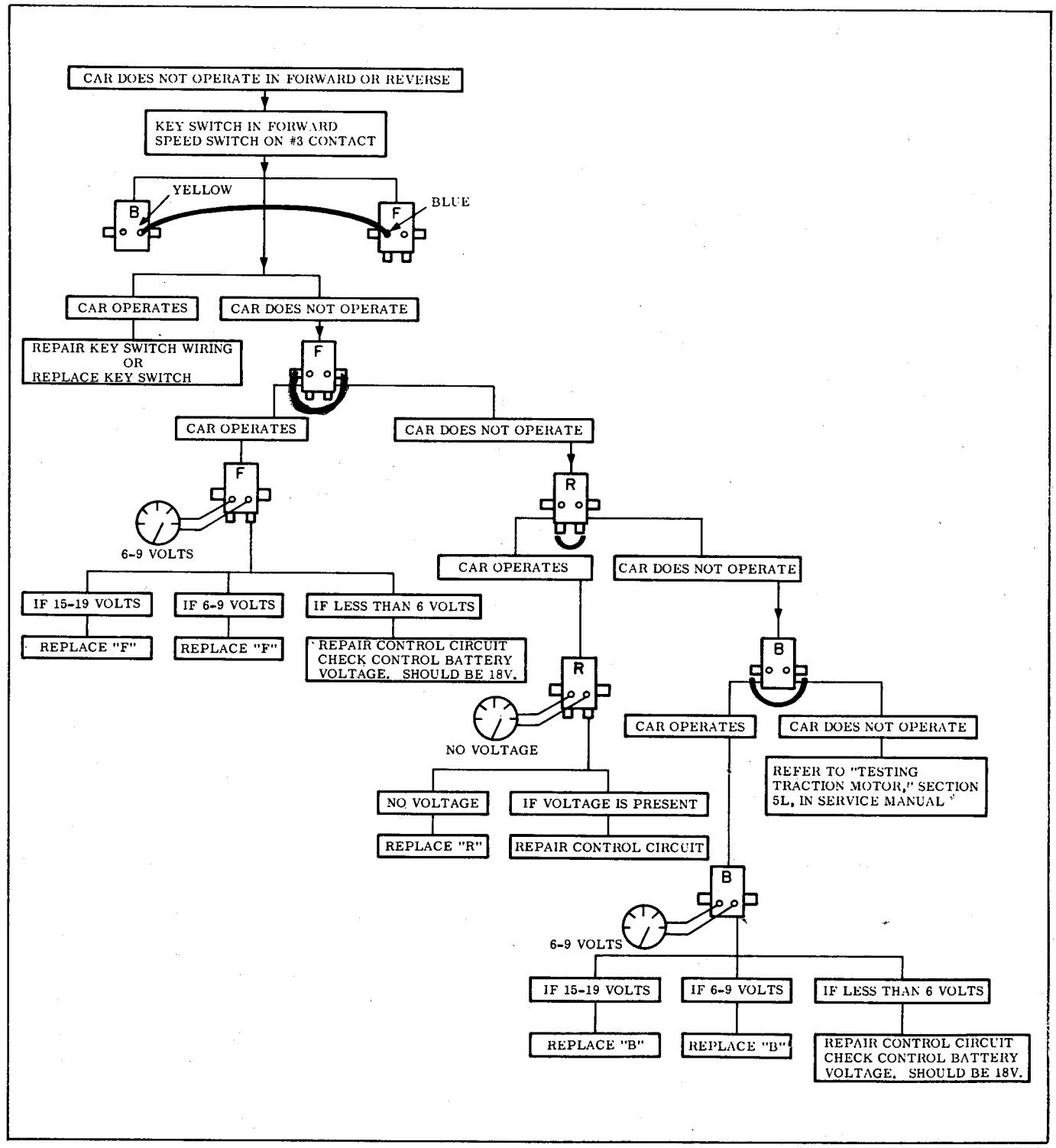


Figure 5-17. Car Does Not Operate in Forward or Reverse

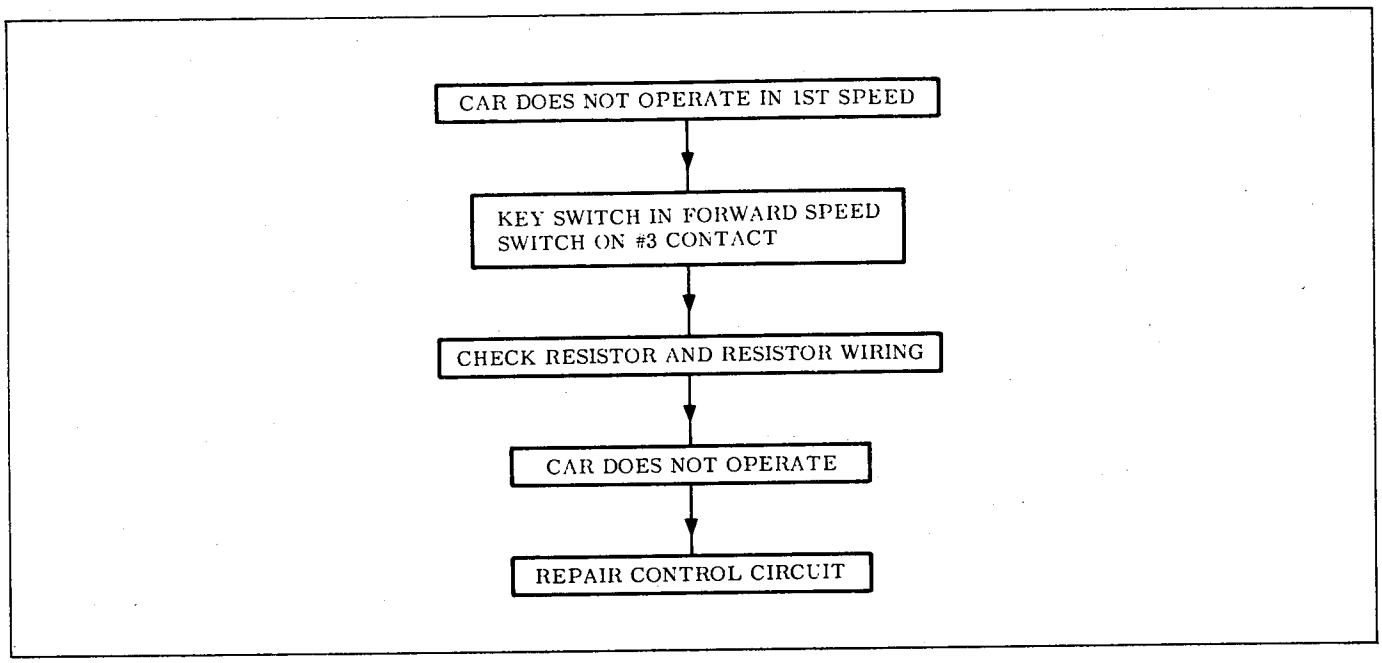


Figure 5-18. Car Does Not Operate in First Speed

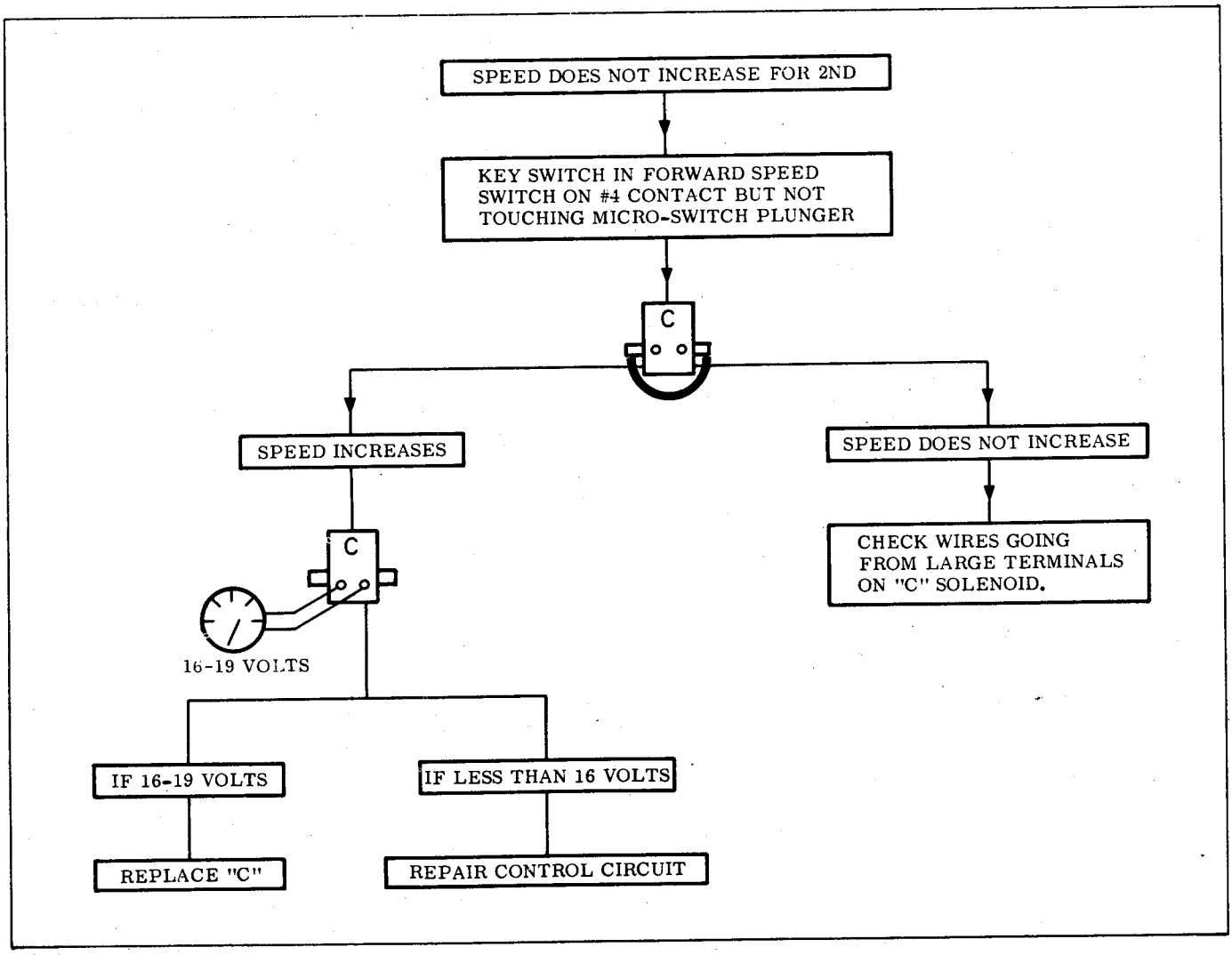


Figure 5-19. Speed Does Not Increase for Second Speed

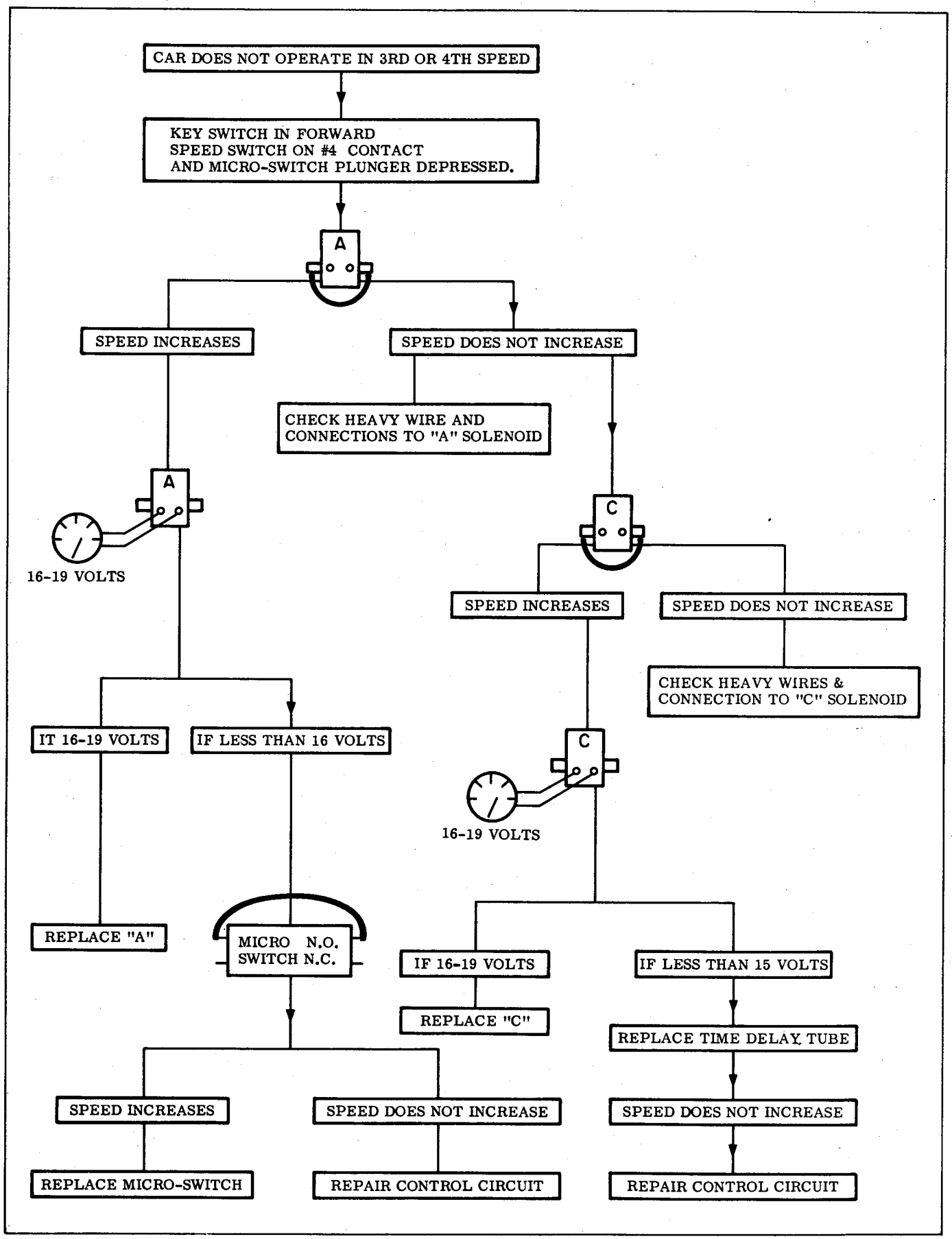


Figure 5-20. Car Does Not Operate in Third or Fourth Speed

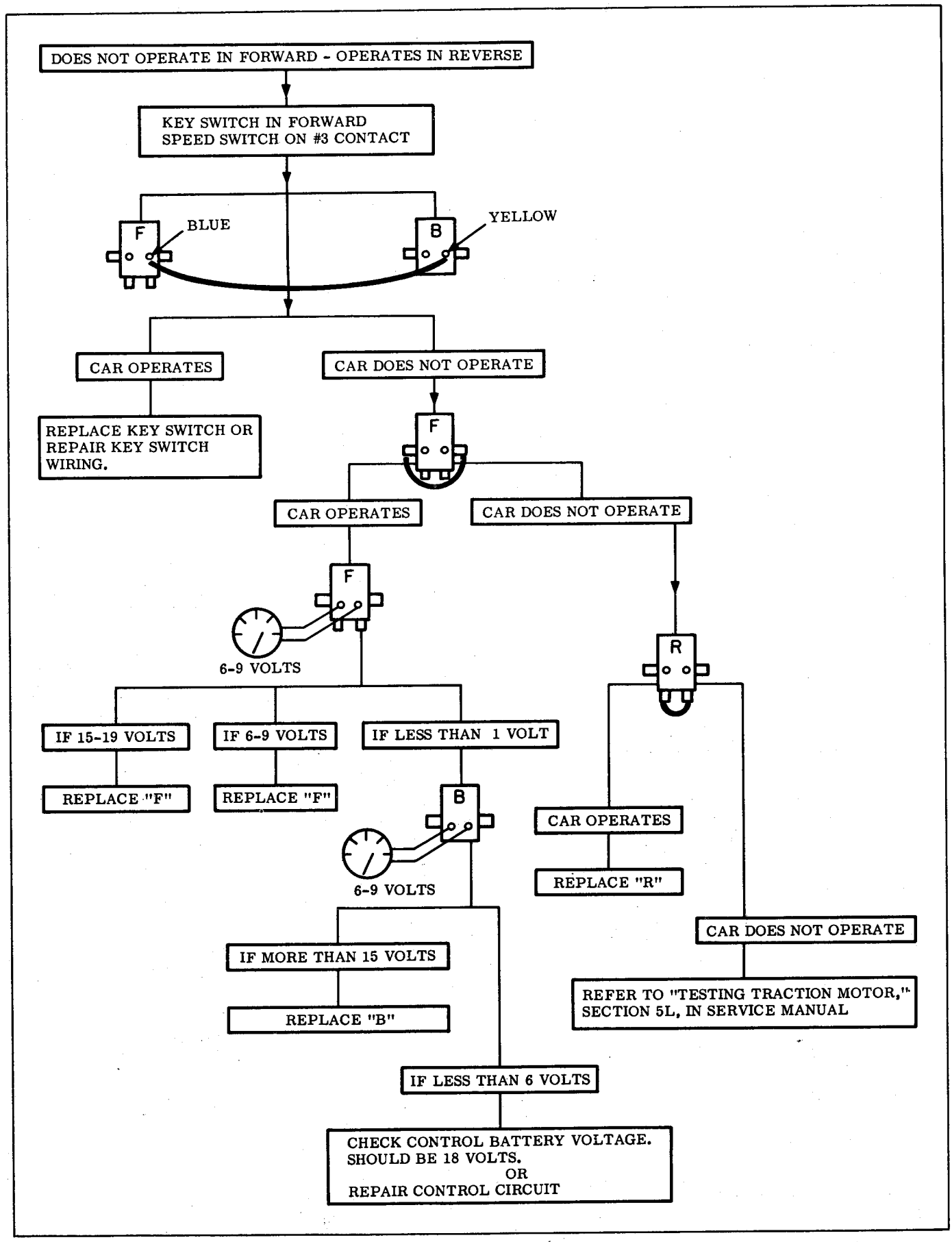


Figure 5-21. Car Does Not Operate in Forward - Operates in Reverse

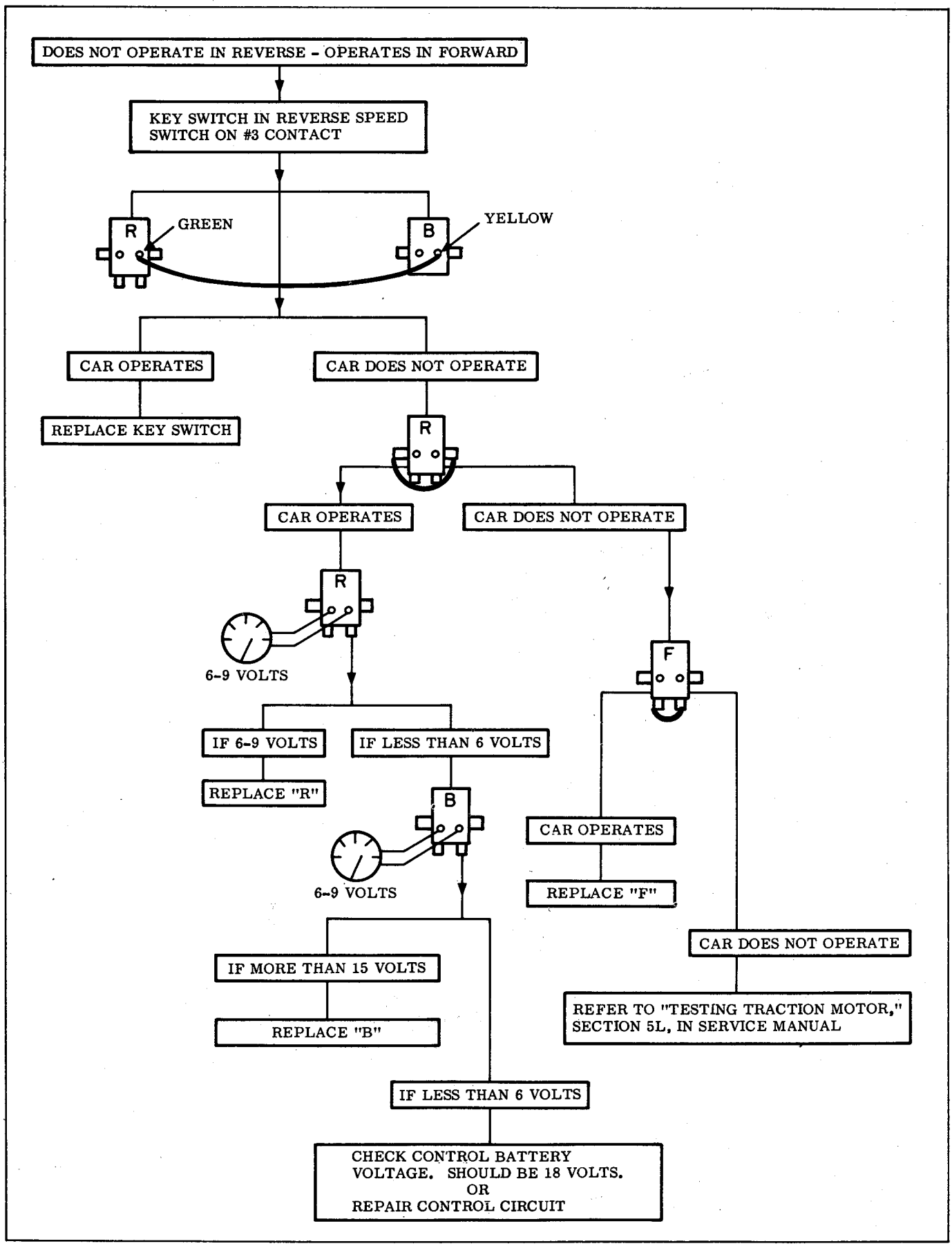


Figure 5-22. Car Does Not Operate in Reverse - Operates in Forward

WIRING

1963-65 MODEL DE WIRING DIAGRAM KEY (FIGURE 5-23)

1. Key Switch (bottom view) - 3 wires. See terminals 2, 3 and 4.

2. Key Switch terminal - Green wire to speed switch terminal 9.

3. Key Switch terminal - Blue wire to speed switch terminal 10.

4. Key Switch terminal - Yellow wire to micro-switch.

5. Speed Switch. See terminals 6 through 12.

6. Speed Switch terminal (4 wires) - White to speed switch arm terminal 12, Red to micro-switch terminal 2, Black to charger plug and Black to battery negative terminal (-).

7. Speed Switch terminal (2 wires) - White to 12 volt tap 20 on battery, White to solenoid terminal C2.

8. Speed Switch terminal - Yellow wire to solenoid terminal E3.

9. Speed Switch terminal (2 wires) - Green to solenoid terminal A3, Green to key switch terminal 2.

10. Speed Switch terminal (2 wires) - Blue to solenoid terminal C3, Blue to key switch terminal 3.

11. Speed Switch terminal - Red wire to solenoid terminal F3.

12. Speed Switch arm terminal - White wire to speed switch terminal 6.

13. Micro-switch (2 wires) - Yellow to key switch terminal 4, Red to speed switch terminal 6.

14. Charger plug (2 wires) - See terminals 1 and 2.
    1 - Negative wire (Black) to speed switch terminal 6.
    2 - Positive wire (Red) to motor terminal A-1.

15. Motor (5 wires) - See terminals A-1, A-2, S-1, S-2.
    A-1 - Red wire to charger plug terminal 2, Black to left rear battery positive terminal (+) 21.
    A-2 - Black wire to solenoid terminal C1.
    S-1 - Black wire to solenoid terminal D1.
    S-2 - Black wire to solenoid terminal B1.

16. Resistor (3 wires)
    Terminal marked .1 - Black to solenoid terminal E1.
    Terminal marked .3 - Black to solenoid terminal E4.
    Terminal unmarked - Black to solenoid terminal B4.

17. Solenoids A, B, C, D, E, and F
    (See insert on diagram for solenoid terminal arrangement)

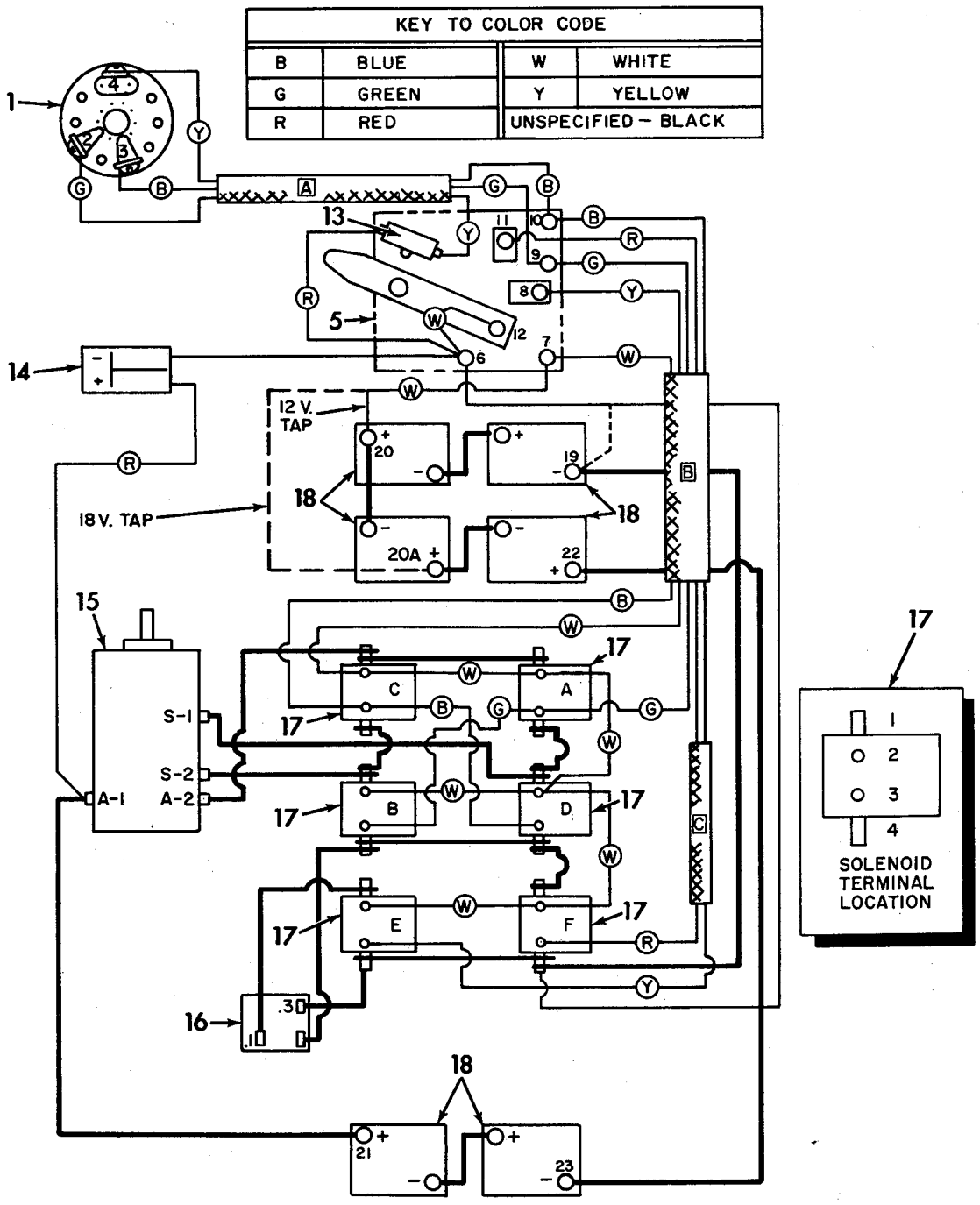
    Solenoid A - top left (front)
    A1 - Copper strap to solenoid terminal C1.
    A2 (2 wires) - White to solenoid terminal C2, White to solenoid terminal D2.
    A3 (2 wires) - Green to speed switch terminal 9, Green to solenoid terminal B3.
    A4 - Copper strap to solenoid terminal D1.

    Solenoid D - top center
    D1 Copper strap to solenoid terminal A4.
    Black wire to motor terminal S1.
    D2 (2 wires) - White to solenoid terminal B2, White to solenoid terminal F2.
    D3 - Blue to solenoid terminal C3.
    D4 (2 straps) - Copper strap to solenoid terminal F1,
    Copper strap to solenoid terminal B4.

    Solenoid F - top right (rear)
    F1 - Copper strap to solenoid terminal D4
    F2 (2 wires) - White to solenoid terminal D2, White to solenoid terminal E2.
    F3 - Red wire to speed switch terminal 11.
    F4 (1 strap) - Copper strap to solenoid terminal E4,
    (2 wires) - Black wire to negative terminal 19 on right front battery. Black wire to speed switch terminal 6 (late 1964).

    Solenoid C - Bottom left (front)
    C1 (1 strap) - Copper strap to solenoid terminal A1,
    (1 wire) - Black wire to motor terminal A2.
    C2 (2 wires) - White to solenoid terminal A2, White to speed switch terminal 7.
    C3 (2 wires) - Blue to solenoid terminal D3, Blue to speed switch terminal 10.
    C4 - Copper strap to solenoid terminal B1.

    Solenoid B - Bottom center
    B1 (1 strap) - Copper strap to solenoid terminal C4,
    (1 wire) - Black wire to motor terminal S2.
    B2 - White wire to solenoid terminal D2.



NOTE: Dotted lines show optional connections. The 18 V. tap is recommended in place of 12 V. tap for solenoid operation.

Figure 5-23. 1963-65 Model DE Electric Car and 1965 DEC Utilicar Wiring Diagram

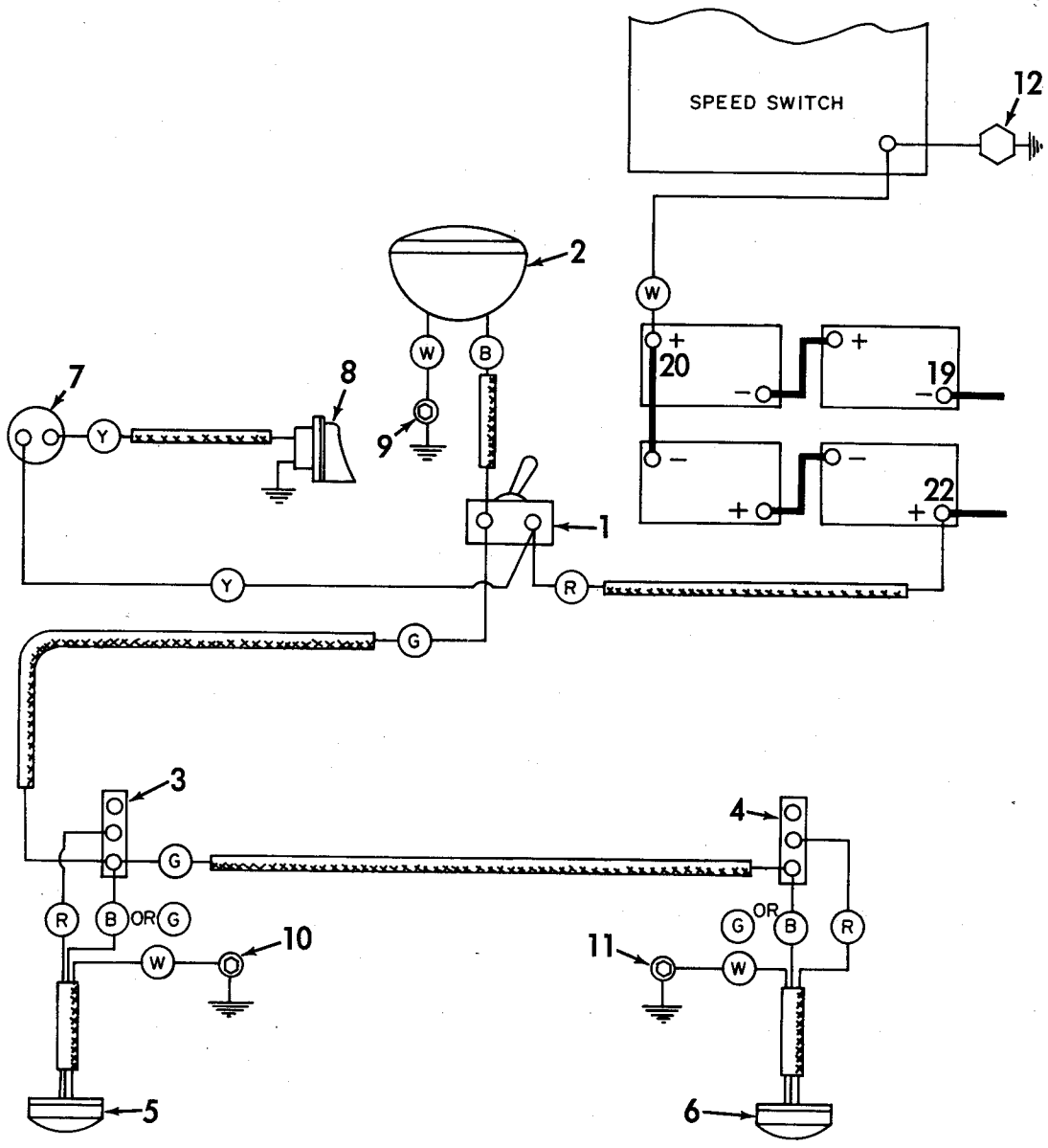


Figure 5-24. 1965 Model DEF Lighting System Wiring Diagram

Solenoid B - Bottom center (Cont)
B3 - White wire to solenoid terminal A3.
B4 (1 strap) - Copper strap to solenoid terminal D4,
(1 wire) - Black wire to unmarked terminal of resistor.

Solenoid E - Bottom right (rear)
E1 - Black wire to resistor terminal (.1).
E2 - White wire to solenoid terminal F2.
E3 - Yellow wire to speed switch terminal 8.
E4 - (1 strap) - Copper strap to solenoid terminal F4,
(1 wire) - Black wire to resistor terminal (.3).

18. Battery - Six 6-volt batteries series connected to give 36 volts for motor circuit with 12 or 18 volt tap for solenoid control circuit.

19. Right front battery negative terminal (2 wires) - Black to solenoid terminal F4, black to speed switch terminal 6 (early 1964).

20. Left front battery tap at + 12 volts - White wire to speed switch terminal 7.

20A. Left second from front, battery tap at +18 volts (recommended modification).

21. Left rear battery terminal + 36 volts - Black wire to motor terminal A1.

Conduit (A) 3 wires (yellow, blue and green)

Conduit (B) 5 wires (white, yellow, green, red and blue)

Conduit (C) 2 wires (red and yellow)

22. Right, second from front, battery positive terminal - black wire to right rear battery negative terminal 23.

23. Right rear battery negative terminal - black wire to terminal 22.

MODEL DEF, DEC LIGHTING SYSTEM WIRING DIAGRAM KEY (FIGURE 5-24)

1. Light Switch (4 wires) - Black to headlamp (2), green to terminal plate (3), yellow to horn button (7), red to battery 12 volt tap (22).

2. Headlamp (2 wires) - Black to headlamp switch (1), white to frame bolt (9) (ground).

3. Left rear terminal plate (4 wires).
Center terminal - Red to tail lamp
Rear terminal - Green to light switch, green to terminal plate (4), black (or green) to left tail lamp (5).

4. Right rear terminal plate (3 wires).
Center terminal - Red to tail lamp
Rear terminal - Green to terminal plate (3), black (or green) to right tail lamp (6).

5. Left tail lamp (3 wires) - Red and black (or green) to terminal plate (3), white to left rear frame bolt (10) (DEF).

6. Right tail lamp (3 wires) - Red and black (or green) to terminal plate (3), white to right rear frame bolt (11) (DEF).

7. Horn button (2 wires) - Yellow to light switch (1), Yellow to Horn (8).

8. Horn - Yellow wire to horn button (7).

9. Ground bolt to frame.

10. Ground bolt to frame (DEF only).

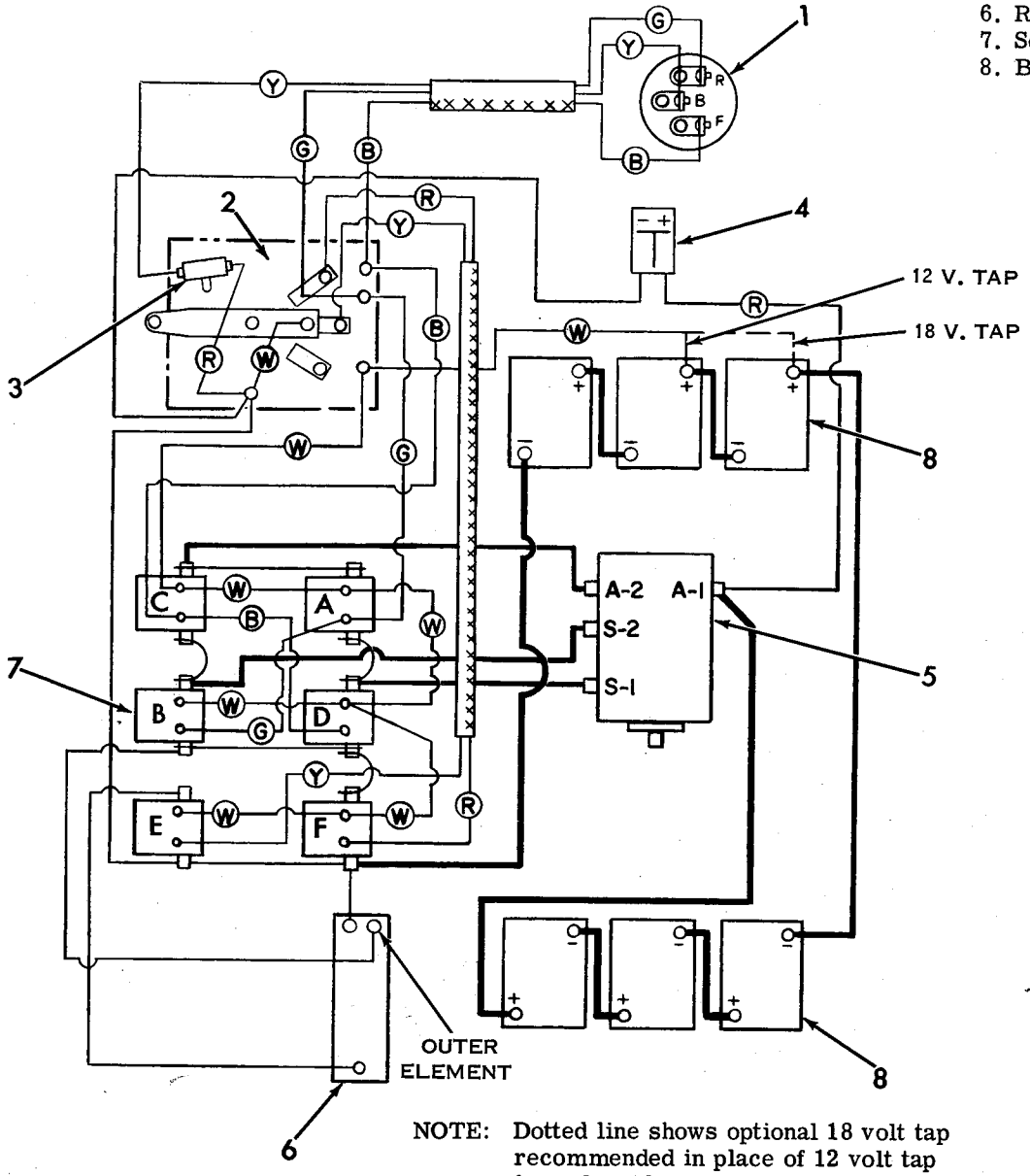
11. Ground bolt to frame (DEF only).

12. Ground strap to floorboard bolt.

22. DEF - Right center battery terminal post (22) (12 volt tap) Red wire to light switch (1).
DEC - (Six batteries forward) Rear center battery terminal post (22) (12 volt tap) Red wire to light switch (1).

KEY TO COLOR CODE			
B	BLUE	W	WHITE
G	GREEN	Y	YELLOW
R	RED	Unspecified	BLACK

1. Key switch
2. Speed switch
3. Micro-switch
4. Charger plug
5. Motor
6. Resistor
7. Solenoid
8. Battery



NOTE: Dotted line shows optional 18 volt tap recommended in place of 12 volt tap for solenoid operation.

Figure 5-25. 1966 Model DE Wiring Diagram

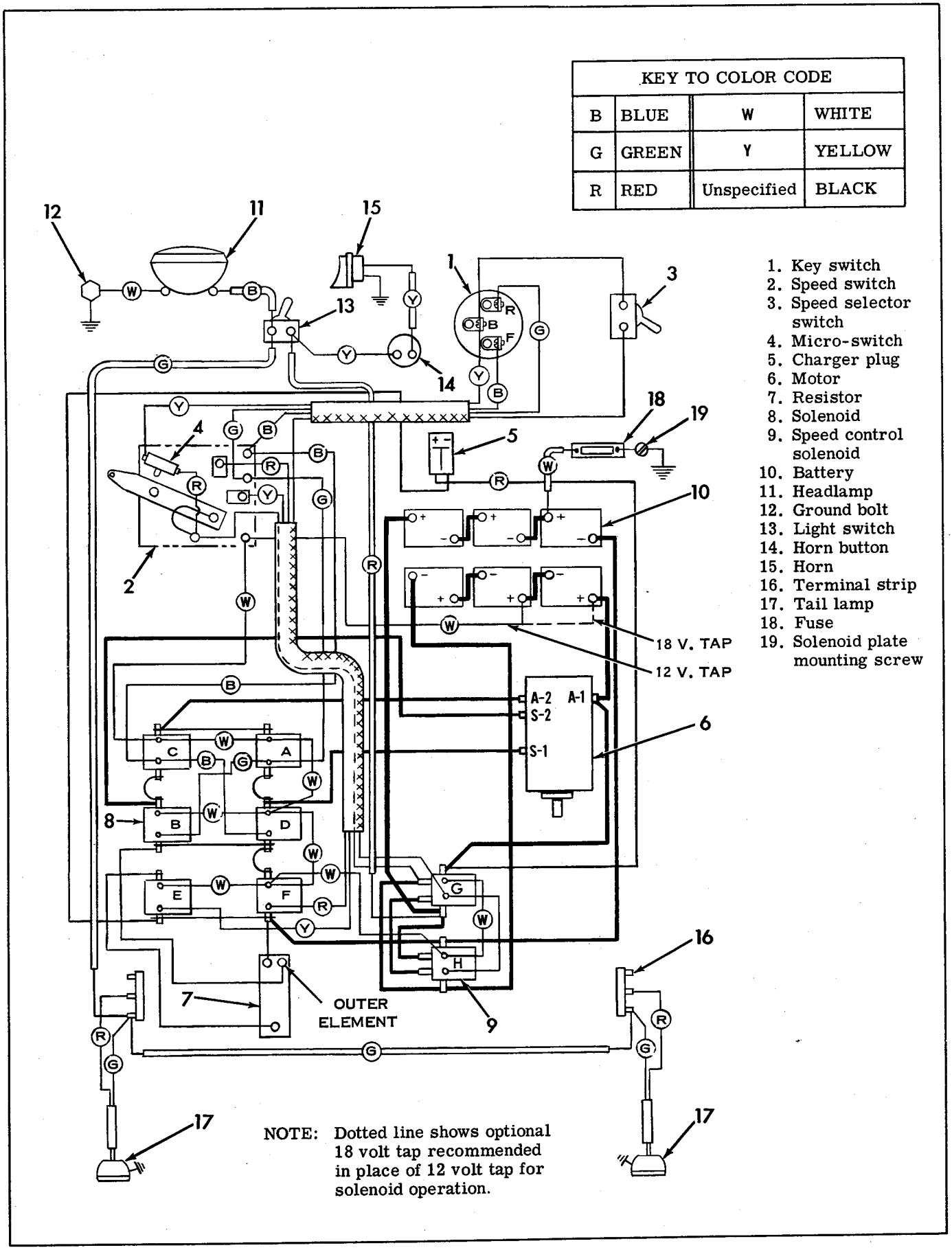
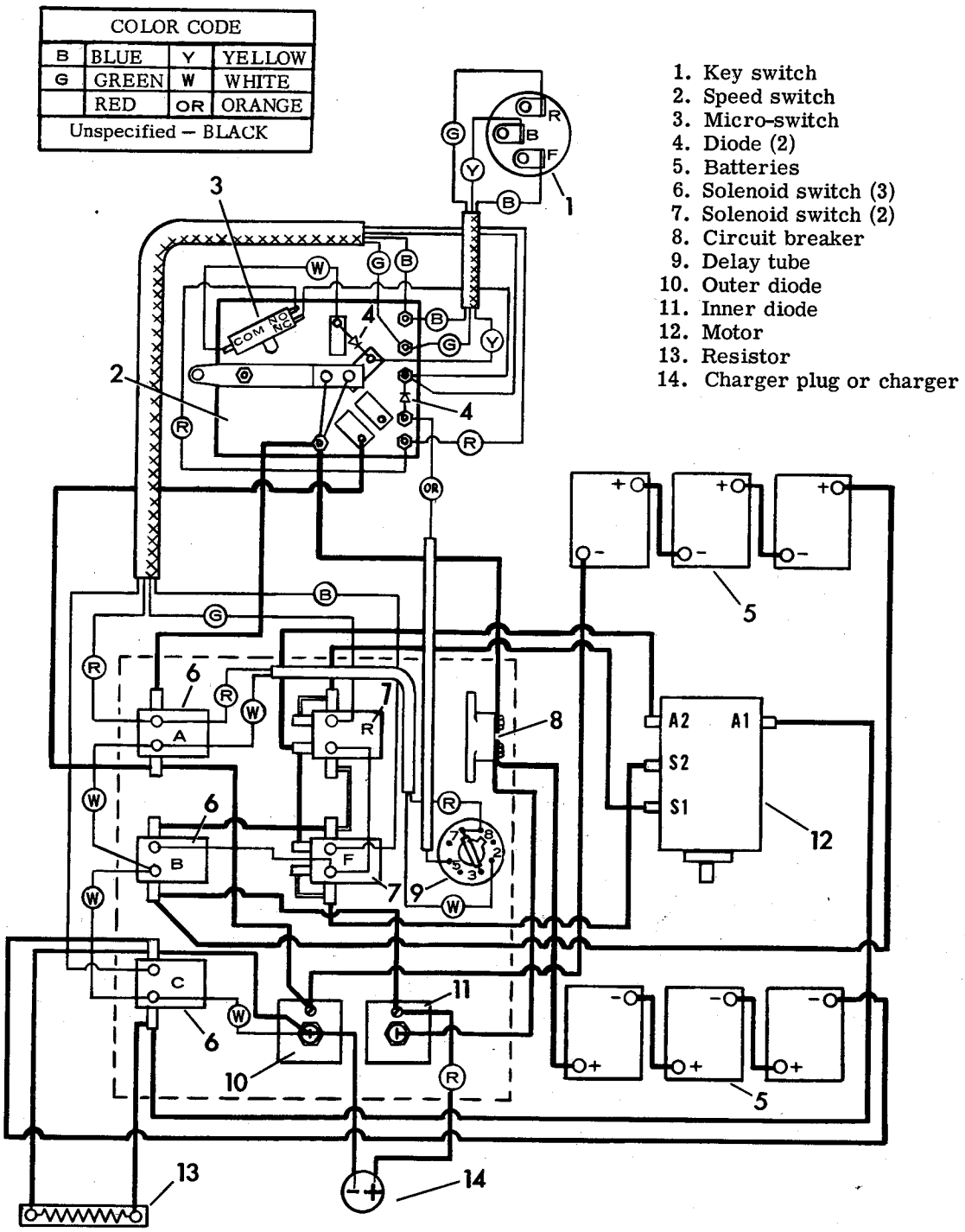


Figure 5-26. 1966-67 Model DEC Wiring Diagram



NOTE: On 1967 Model, S1 and S2 motor cable connections are reversed from positions shown.

Figure 5-27. 1967-70 Model DE Wiring Diagram

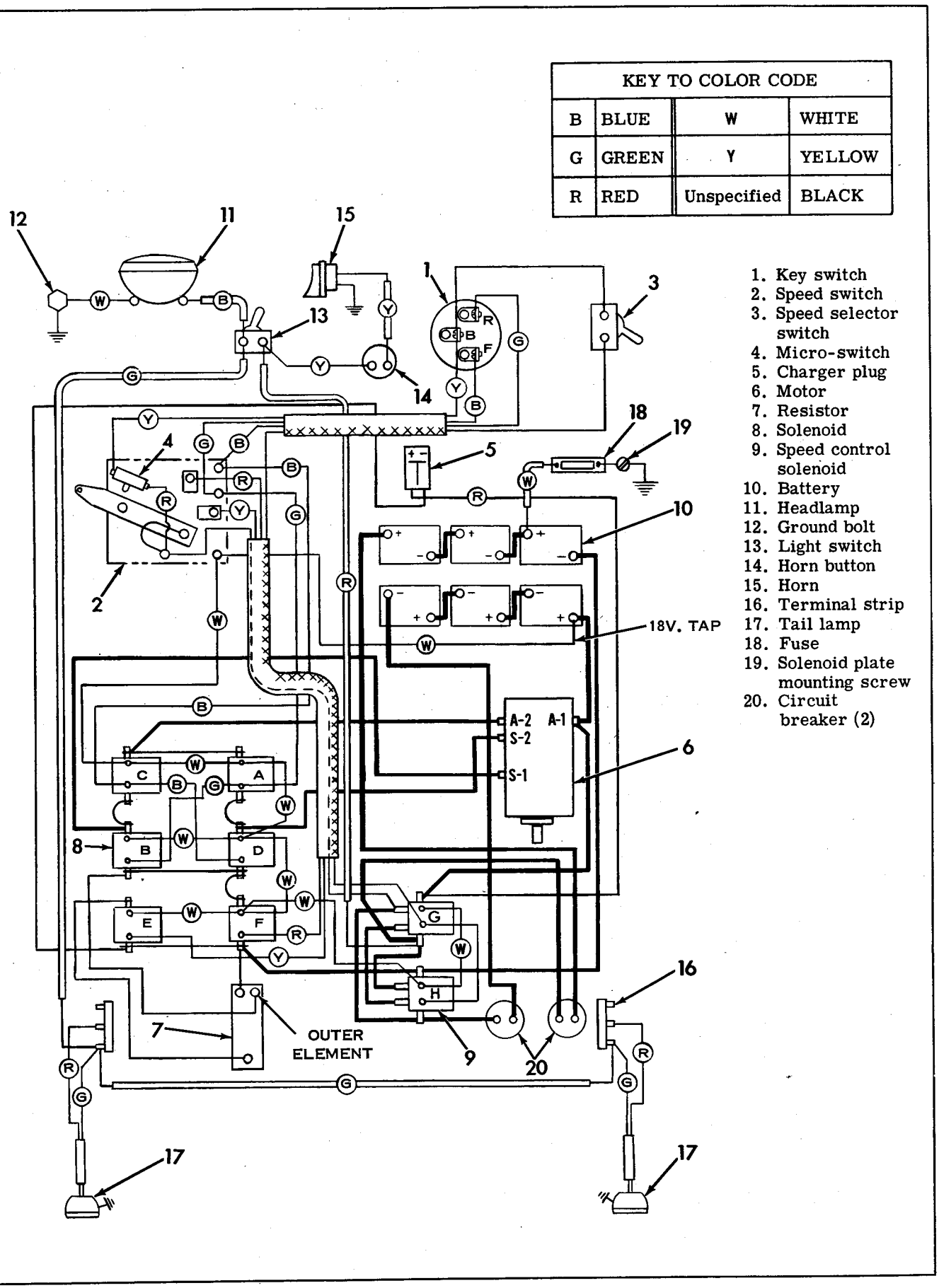


Figure 5-28. 1968 Model DEC Wiring Diagram

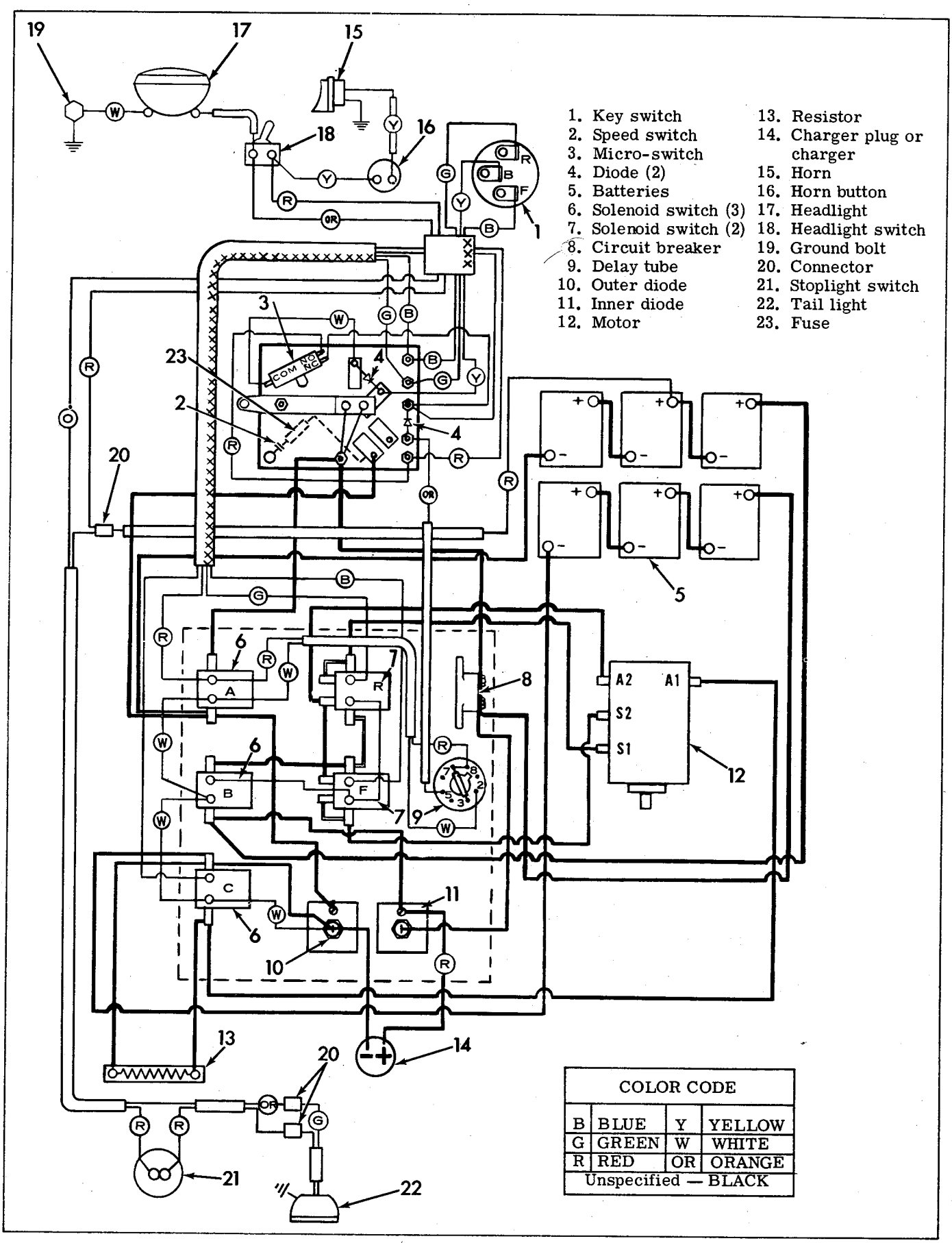


Figure 5-29. 1969-70 Model DEC Wiring Diagram

KEY

1. KEY SWITCH
2. SPEED SWITCH
3. MICRO SWITCH
4. DIODE (2)
5. BATTERIES
6. SOLENOID SWITCH (3)
7. SOLENOID SWITCH (2)
8. CIRCUIT BREAKER
9. DELAY TUBE
10. OUTER DIODE
11. INNER DIODE
12. MOTOR
13. RESISTOR
14. PORTABLE CHARGER PLUG or IN-CAR CHARGER

COLOR CODE			
B	BLUE	Y	YELLOW
G	GREEN	W	WHITE
R	RED	OR	ORANGE
Unspecified — BLACK			

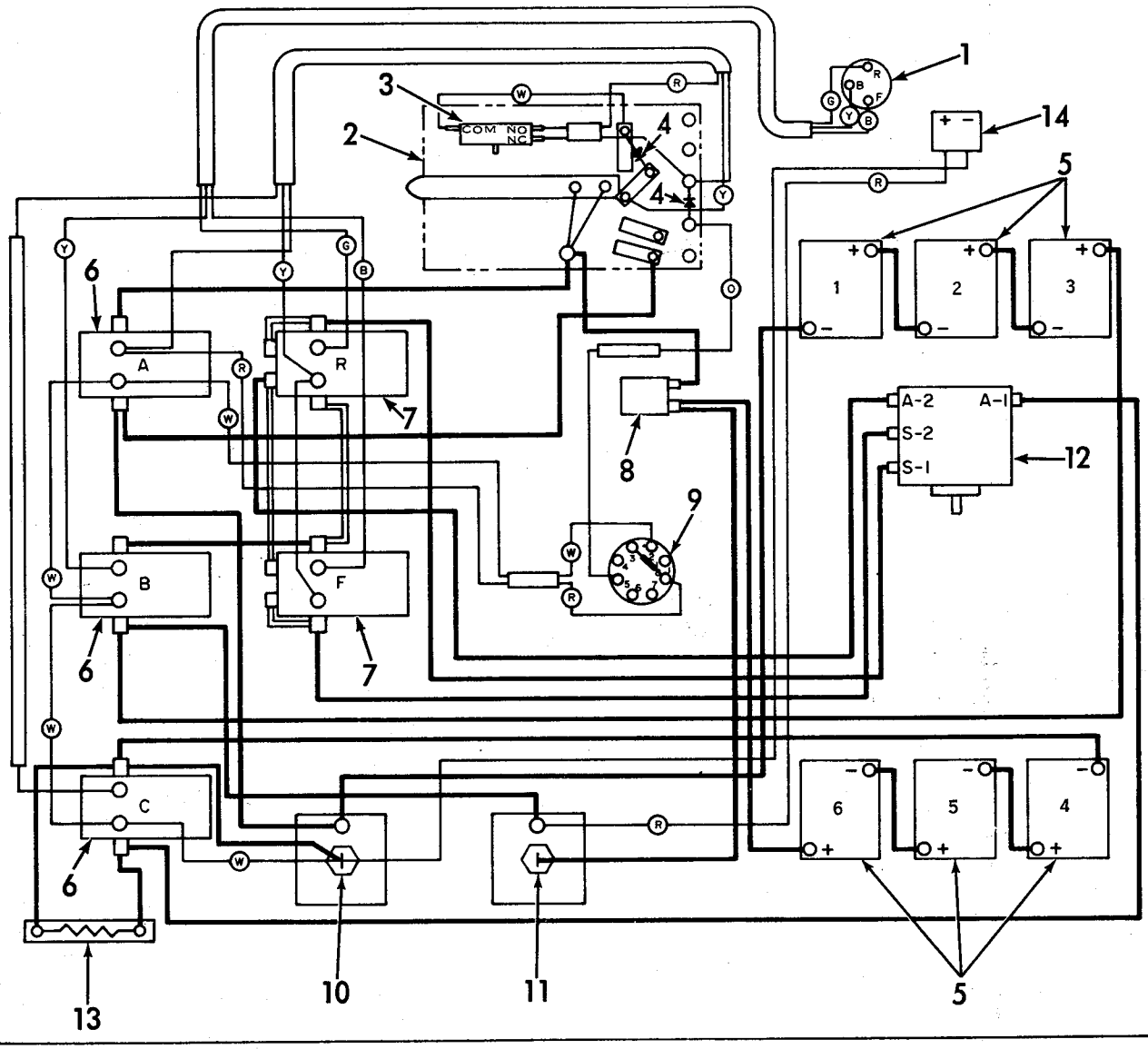


Figure 5-30. 1971 Model DE Wiring Diagram

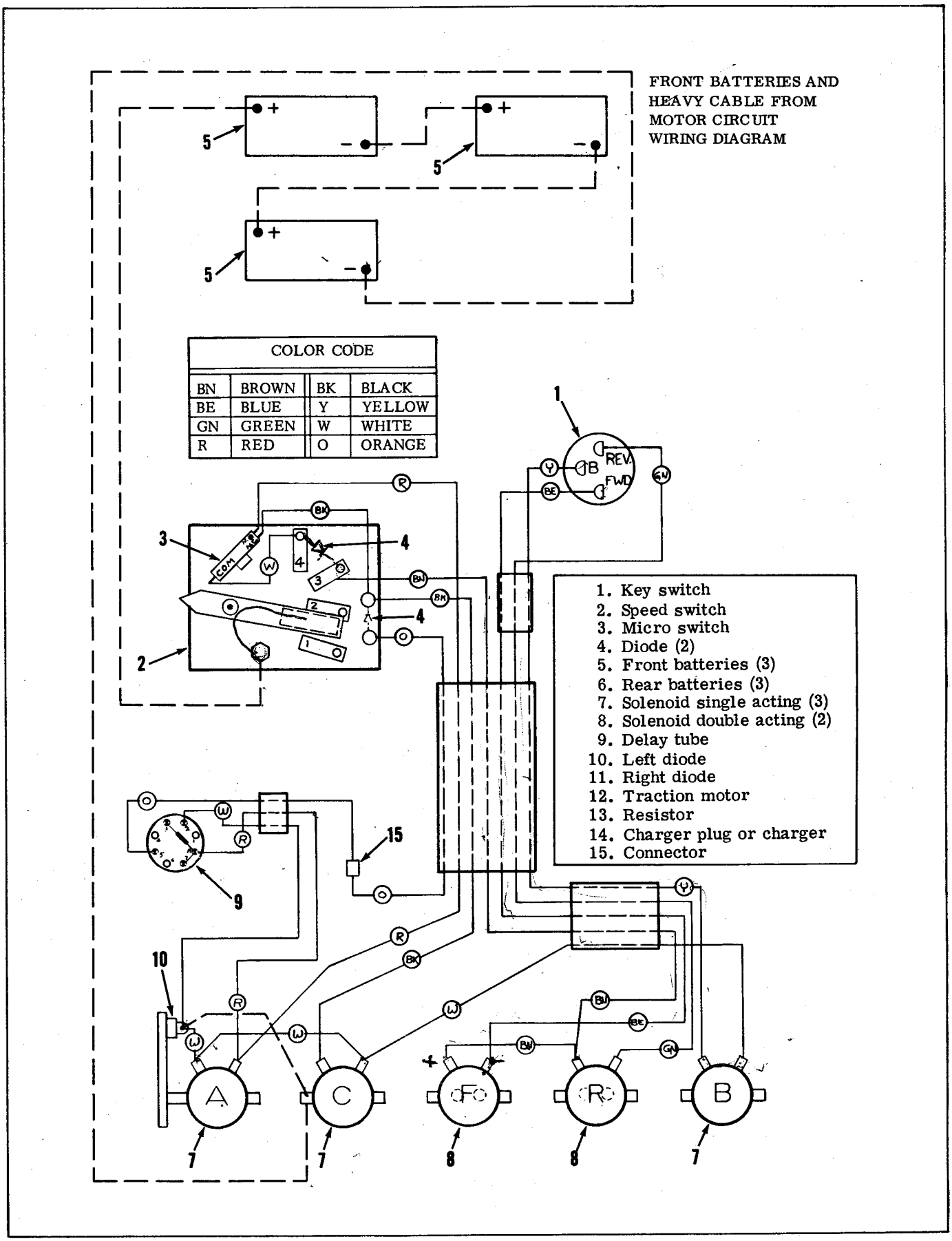
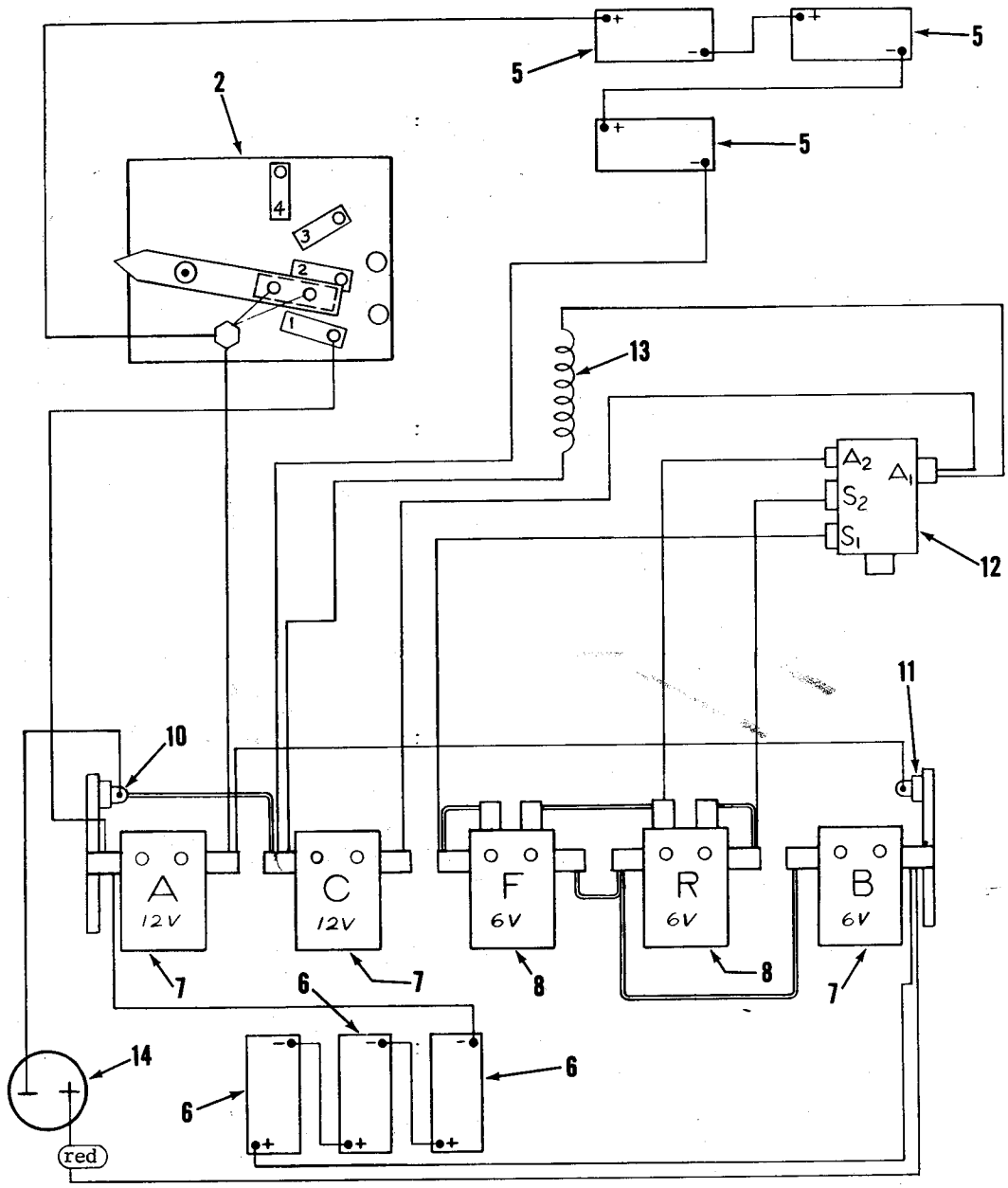


Figure 5-31. 1972-1975 Model DE and DE-4 Wiring Diagram - 16 Gage Wire Control Circuit



1. Key switch
2. Speed switch
3. Micro switch
4. Diode (2)
5. Front batteries (3)
6. Rear batteries (3)
7. Solenoid single acting (3)
8. Solenoid double acting (2)
9. Delay tube
10. Left diode
11. Right diode
12. Traction motor
13. Resistor
14. Charger plug or charger
15. Connector

Figure 5-32. 1972-1975 Model DE and DE-4 Wiring Diagram - Heavy Cable Motor Circuit

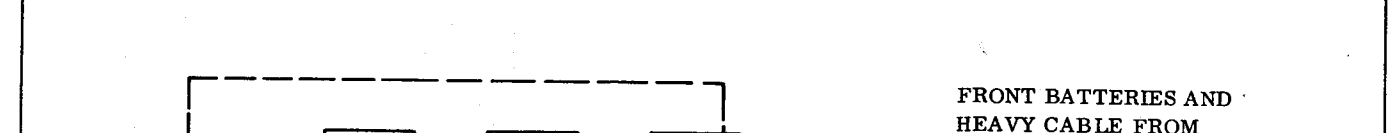
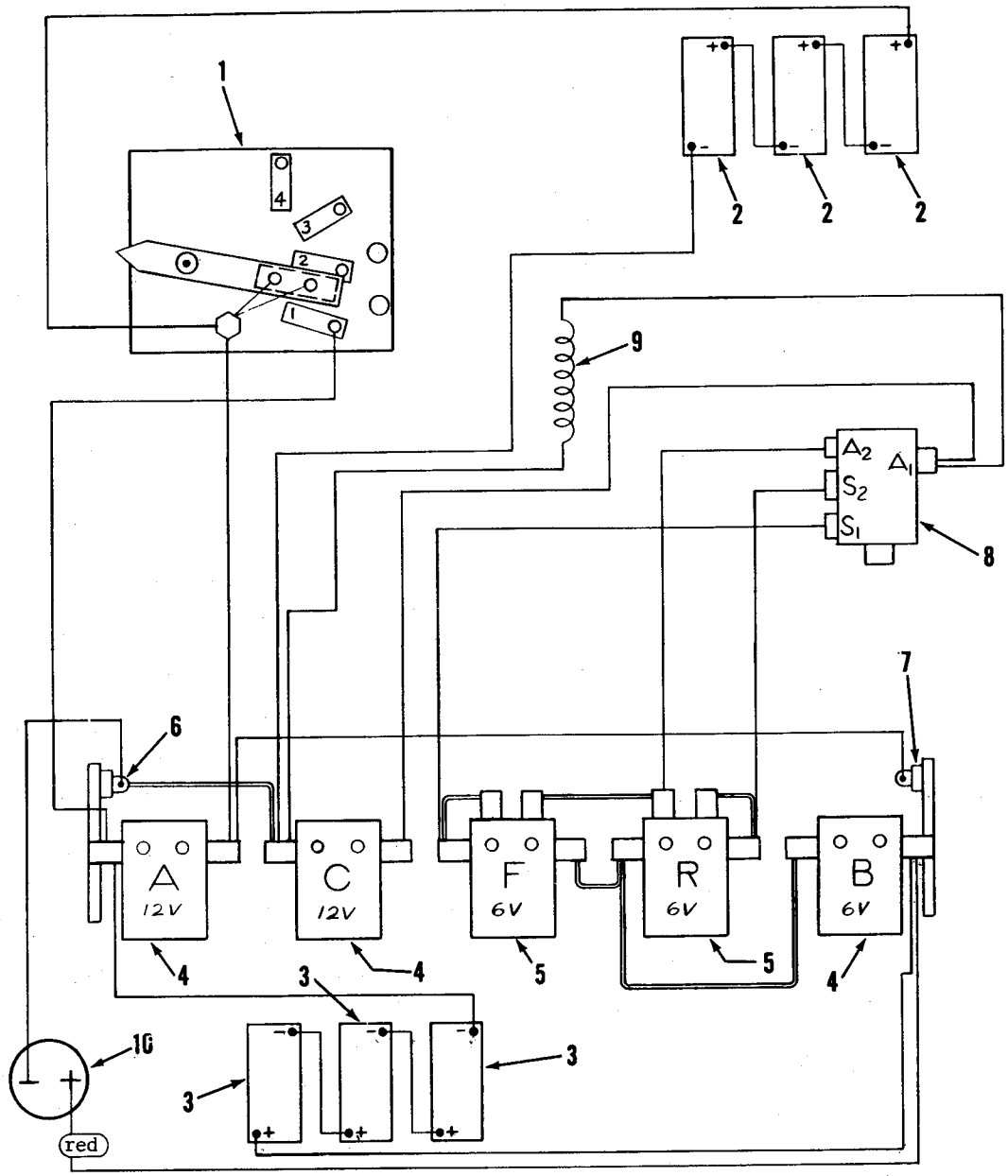


Figure 5-32A. 1977 and Later Model DE-3 Wiring Diagram - 16 Gage Wire Control Circuit



1. Speed switch
2. Front batteries (3)
3. Rear batteries (3)
4. Solenoid single acting (3)
5. Solenoid double acting (2)
6. Left diode
7. Right diode
8. Traction motor
9. Resistor
10. Charger plug or charger

Figure 5-32B. 1977 and Later Model DE-3 Wiring Diagram - Heavy Cable Motor Circuit

SWITCHES

SPEED SWITCH

The function of the speed switch in car operation is described under "Electric Car Operation and Circuits," Section 5.

Speed switch contacts should be kept clean, and surfaces should be in smooth condition. Contacts are replaceable. All contacts must be of equal height to provide smooth operation of lever.

ADJUSTING BRAKE RELEASE

See Figure 5-33. Loosen, but do not remove pedal bracket-to-floor panel nuts with wrench. Depress brake pedal and tilt foot pedal (1) forward. Shift bracket (2) so that ear (3) engages one of notches (4). Fully tighten nuts while holding in this position.

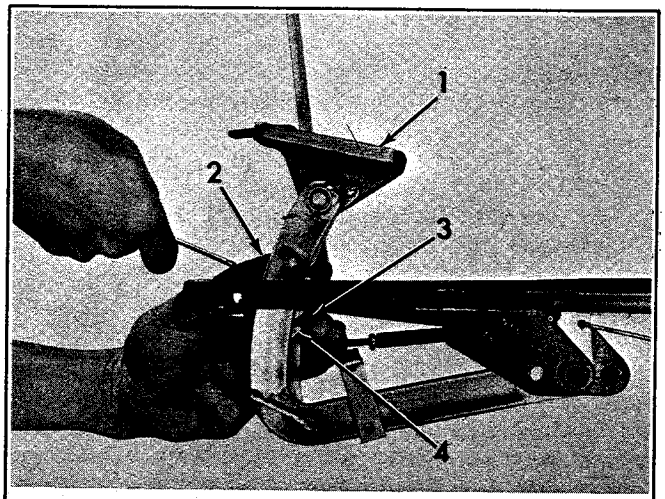
ADJUSTING SPEED SWITCH (1963-65 MODELS)

Disconnect cable leads from battery. Remove speed switch cover (See Figure 5-34). Unhook spring (1) from speed switch rod on switch arm (2).

See Figure 5-35. Remove cotter pin and washers from front end of speed switch rod to disconnect rod (1) from speed switch pedal lever. With pedal in released (up) position, loosen lock nuts (4), and adjust length of rod (1) so that bent end will enter pedal lever hole (2) freely. Rod ends screw into hex coupling (3) to shorten rod - out to lengthen rod.

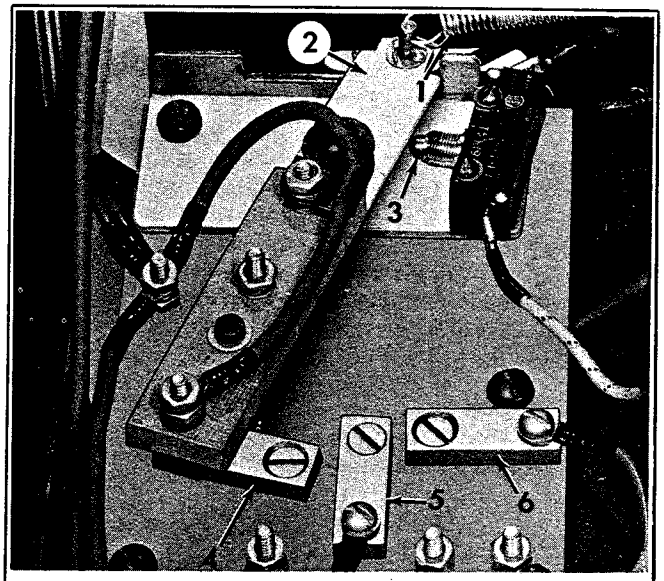
Check Operation:

Depress brake pedal and tilt forward to lock brake pedal in depressed position.



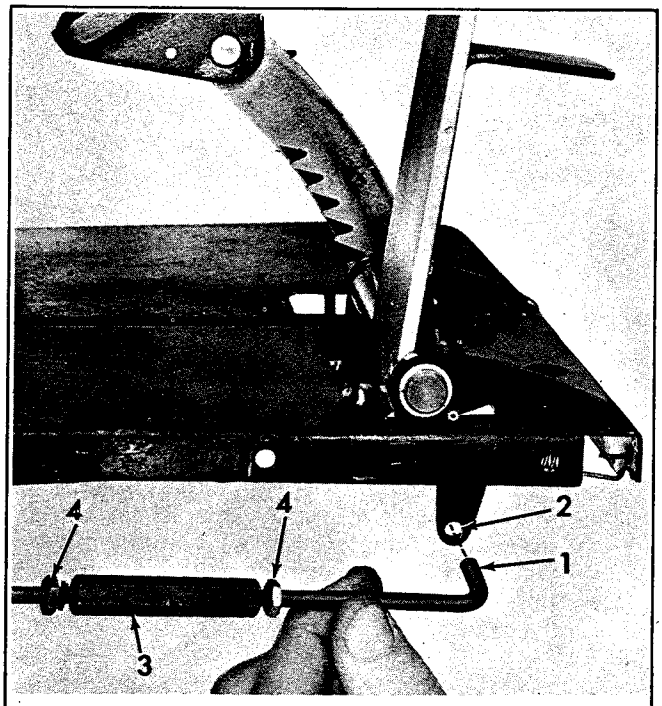
1. Brake pedal
2. Bracket
3. Ratchet ear
4. Ratchet notch

Figure 5-33. Adjusting Brake Release



1. Return spring
2. Switch arm
3. Button
4. 1st speed contact
5. 2nd speed contact
6. 3rd speed contact

Figure 5-34. Speed Switch with Cover Removed (1963-65 DE, 1967-68 DEC)



1. Rod (front section)
2. Lever hole
3. Coupling
4. Lock nut (2)

Figure 5-35. Adjusting Speed Switch Rod (1963-65 DE, 1967-68 DEC)

Depress speed pedal slowly, observing movement of micro-switch button (3, Figure 5-34) located on base of speed switch. Micro-switch should click (completing first speed circuit) shortly AFTER brake pedal releases.

If micro-switch closes (clicks) too soon, shorten speed switch rod (1, Figure 5-35) as necessary to delay click until shortly after brake pedal releases.

Contact end of switch lever should be entirely on the first contact block (4, Figure 5-34) (no circuit stage) when micro-switch clicks (closes). Under no circumstances should micro-switch close when contact end of lever is on second speed contact block (5) (2nd speed stage). This would cause a severe jerk when starting up car. Lengthen speed switch rod as necessary to correct. Reinstall washers and cotter pin and tighten speed switch rod nuts (4, Figure 5-35) securely.

Reinstall speed switch arm spring, switch cover, battery cables, and check operation of car.

ADJUSTING SPEED SWITCH (1966 AND LATER DE, DE-3, DE-4; 1969 AND LATER DEC MODELS)

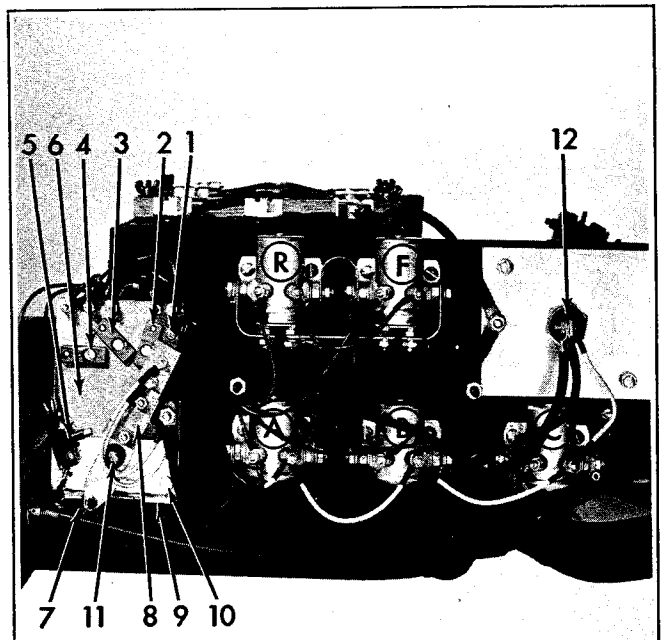
Speed switch for late models is adjusted by position of insulator base (6) fastened to car mounting bracket. The speed switch rod (7) length is not adjustable. The speed switch is correctly adjusted when speed switch arm (8) contacts rear arm stop (9) with accelerator pedal depressed all the way. This should also actuate microswitch (5). With accelerator pedal released, speed switch arm contact should be centered on contact (1). To correct adjustment, loosen bolt (10) and screw (11); shift base (6) forward or backward in slotted holes in mounting bracket. Retighten screw and bolt nuts and check operation.

SOLENOID SWITCH

Solenoid switches are designed to close and open electrical circuits electro-magnetically. Switches of this type consist basically of contacts and a winding around a hollow cylinder containing a movable plunger. When the winding is energized by the battery through an external control circuit, the magnetism produced pulls the plunger into the coil. The contact disc attached to the plunger moves against switch contacts closing the circuit. Double contact solenoids have an extra set of contacts which are closed when coil is not energized.

The function of solenoids in car operation is explained under "Electric Car Operation and Circuits," Section 5.

The solenoid switch is permanently assembled. Repair parts are not sold. If this switch becomes defective, it must be replaced.



1. Contact for charging circuit
2. Buffer bar (inactive)
3. Contact for first speed
4. Contact for second speed and micro-switch (3rd and 4th speed)
5. Micro-switch for third and fourth speed
6. Speed switch base
7. Speed switch control rod
8. Control arm
9. Arm stop
10. Rear mounting bolt
11. Mounting screw
12. Diode

Figure 5-36. Speed Switch Solenoid Panel and Wiring (1967-71 DE Model)

The correct wiring arrangement and terminal connections at solenoids for DE models are shown in Figures 5-36, 5-37, and 5-38. The control circuit wires are connected to small terminals. The motor circuit wires are connected to heavy terminals.

CAUTION

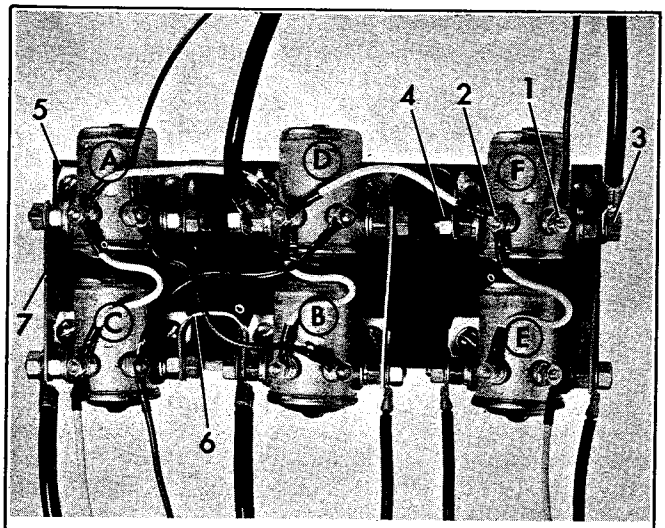
To prevent damage to solenoid, hold inner terminal nut with wrench when tightening outer terminal nut to keep stud from twisting.

TESTING SOLENOID SWITCHES

When it is suspected that a solenoid switch is defective, tests should be made of the solenoid coil winding and continuity through the main (heavy) contacts when contacts are in closed position. Using the test circuit described, these two tests can be made simultaneously.

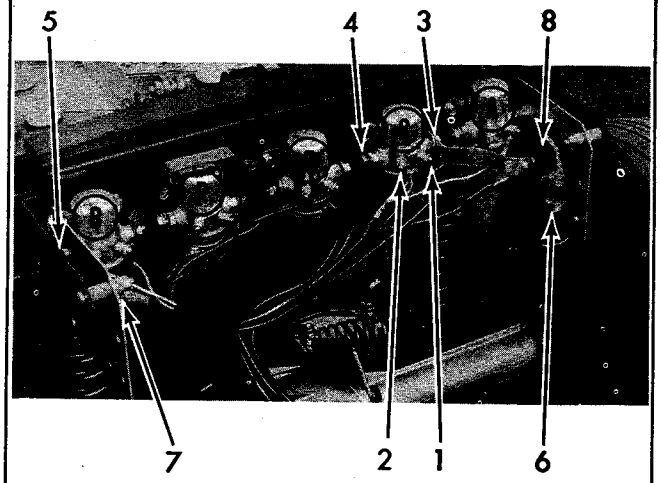
CAUTION

Before making any tests, disconnect battery cables leading to car from battery posts.



1. Control coil terminal
2. Control coil terminal
3. Switch contact terminal
4. Switch contact terminal
5. Mounting panel
6. Connection bar (curved) (3)
7. Connection bar (straight) (3)

Figure 5-37. Solenoid Panel and Wiring Arrangement (1963-66 DE)



1. Control coil terminal
2. Control coil terminal
3. Switch contact terminal
4. Switch contact terminal
5. Mounting panel
6. Time delay tube
7. Right diode
8. Left diode

Figure 5-38. Solenoid Panel and Wiring Arrangement (1972 and Later DE, DE-3 and DE-4)

IMPORTANT

There are two types of solenoids used having 6- or 12-volt coils and correct test voltage must be used. All solenoids are stamped "6V." or "12V." on case. If in doubt, check coil resistance with ohmmeter - 6V. coil 3.5 ohms, 12V. coil 13.5 ohms at room temperature.

Using correct battery voltage, make circuit connections as shown in Figure 5-39.

Leads A (+) and B (6V.) or C (12V.) are connected to terminals 1 and 2 (coil terminals) to actuate solenoid. A sharp click should be heard from the solenoid switch when making this connection. No click or a heavy spark at the terminals when connecting wires would indicate either an open or short in the solenoid winding and solenoid switch must be replaced. If the solenoid winding checks good and plunger does close main switch contacts, there is still a possibility contacts are badly burned or eroded and will not pass heavy current.

To test continuity on the main contacts, leave leads connected to terminals 1 and 2, connect a jumper wire between terminals 2 and 4 and a test bulb of at least 21 CP to terminals 1 and 3. A bright glow of the test bulb indicates main switch contacts 3 and 4 are passing current.

On double contact solenoids, contacts 5 and 6 should be open when coil is energized and closed when coil is de-energized.

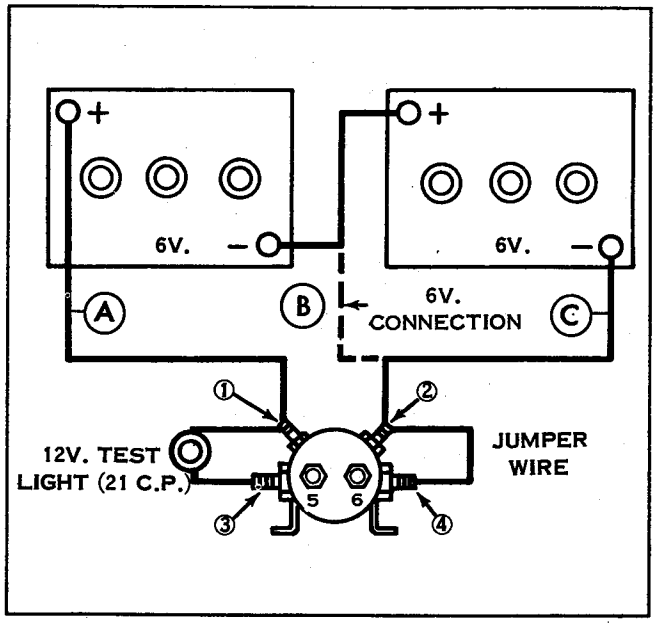


Figure 5-39. Test Circuit for Single or Double Contact Solenoid

TESTING SOLENOIDS IN CAR

CAUTION

Before making any tests, disconnect battery cables leading to car from battery posts. Key and Speed switches should be in OFF position.

Disconnect the wire or wires connected to the coil terminal of the solenoid being tested and use same test circuit and procedure outlined in preceding paragraph.

MICRO-SWITCH

This switch is permanently assembled. If this switch becomes defective, it must be replaced.

TESTING MICRO-SWITCH

CAUTION

Place Key Switch in OFF position and disconnect battery cables leading to car from battery posts.

Using continuity tester described in "Testing Circuits", Section 5A, connect test leads to switch terminals and press speed switch pedal to close micro-switch contacts. If test lamp glows, switch is operating correctly.

RESISTOR

The resistor box was not designed for disassembly and should be replaced when it becomes defective. The resistor (ribbon or grid type) for 1963 to 1966 models, has a total resistance of .3 ohm. It is tapped at a point dividing it into sections of .1 ohm and .2 ohm. These resistance sections are introduced into the motor circuit automatically by the action of the control solenoids, giving the motor a range of three speeds. The resistor for the 1967 D model has one resistance of .12 ohm which is in the motor circuit in first speed stage (18V.) and third speed stage (36V.).

TESTING RESISTOR

CAUTION

Before making any tests, disconnect battery cables leading to car from battery posts.

When testing for continuity in the two sections of the resistor, the Key and Speed switch must be in OFF position. Disconnect the wires from resistor terminals. Use a continuity tester as described under "Testing Circuits," Section 5 and make the following tests:

1963-65 Resistor.
Touch the test battery lead to the unmarked terminal and the test lamp lead to .1 ohm terminal. If bulb lights, .1 ohm section is continuous (second speed). If bulb fails to light, resistor has an open and car will not operate in second or first speeds. To test .2 ohm section of resistor, move test battery lead to .3 ohm terminal holding test bulb lead to .1 ohm terminal. If bulb glows, resistor can be considered good. Failure of bulb to light indicates open in .2 ohm section and car will not operate in first speed.

1966 Resistor.
Test between outside element end terminals. If bulb lights, .1 ohm section is continuous (second speed). Test between inside element terminal and outside element terminal having jumper block between inside and outside elements. If bulb lights, .2 ohm section is continuous.

1967 Resistor.
Test between end terminals. Failure of bulb to light indicates an open resistor and car will not operate in first and third speed stages. If tests indicate defective resistor circuit, remove resistance box from car and examine resistor ribbons or grids for breaks or faulty spot welds at terminal connections at ends.

KEY SWITCH

CAUTION

Before making any tests, disconnect battery cables leading to car from battery posts.

This switch is permanently assembled. If this switch becomes defective, it must be replaced.

TESTING KEY SWITCH

Using continuity tester described under "Testing Circuits," Section 5, disconnect wire from terminal 4 (or "B") (see "Wiring Diagram," Section 5) and connect one lead of continuity tester. Touch other test lead to switch terminal 3 (or "F"). When turning and holding switch to reverse position, bulb should glow to indicate completed circuit. Make similar test with switch in forward position by switching test lead from terminal 3 (or "F") to terminal 2 (or "R").

DIODES

Solid state diodes are used in the golf car electrical circuit as one way "valves" to control the direction of current flow. Their function in the circuit is described in Section 5 of this manual.

TESTING DIODES

A simple check to determine if diode is functioning correctly is with the use of a battery and test lamp

in series with the diode as shown in Figure 5-40. Lamp should light with current flow in one direction only as shown. If lamp lights with battery connections reversed for current flow in opposite direction, diode is shorted. If lamp does not light for current flow in both directions, diode is open.

IMPORTANT

When replacing defective stud mounted diodes, do not over-tighten the diode stud mounting nut. Maximum tightening torque is 25 inch-lbs. (4 lbs. pressure at the end of a 6-inch wrench). Excessive tightening may damage the diode internally.

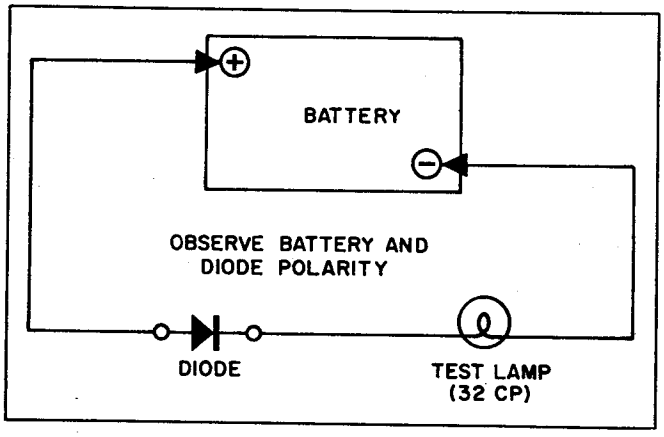


Figure 5-40. Test Circuit for Diodes

TIME DELAY SWITCH

The time delay switch (tube) consists of a heater element and switching contacts in a conventional electronic vacuum tube. When accelerator pedal is depressed all the way, accelerator micro-switch contacts close and current flows from pin 7 through voltage dropping resistor (R) (18V. to 12V.) to pin 3, through heater element to pin 2. Temperature sensitive contacts close after 1 to 2 seconds allowing current to flow from pin 7 to pin 5 which are connected to motor resistor control solenoid C. A description of the operation of the time delay tube in the complete golf car circuit is described in Section 5 of this manual.

TESTING TIME DELAY SWITCH (TUBE)

Remove tube from socket. See tube base diagram. Connect circuit tester (12V. battery and 12V. low wattage bulb) (instrument panel bulb) in series to pins 7 and 5. Connect 12-volt battery to pins 2 and 3. Tube element contacts should close and light test bulb in from 1/2 to 2 seconds. If bulb lights immediately, contacts are welded closed. Replace tube. If test bulb does not light up within 2 seconds, replace tube. If tube checks O.K. but does not function correctly when installed in base, check tube base connections and resistor. Check resistor with an ohmmeter. Resistance should be approximately 30 ohms.

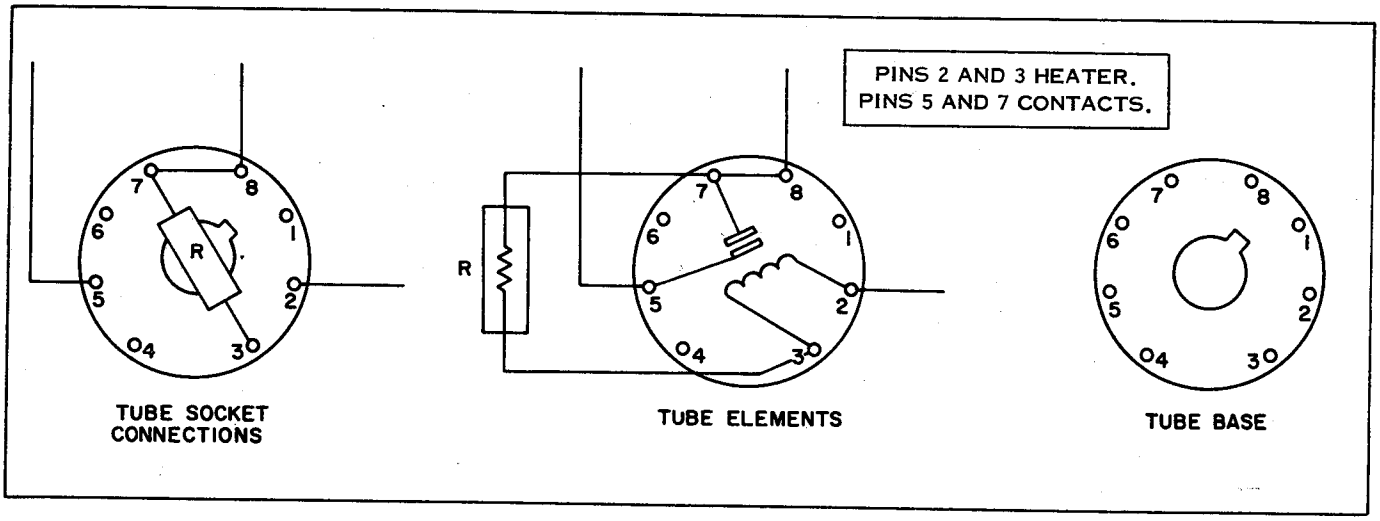


Figure 5-41. Time Delay Switch (Tube)

BATTERY AND CHARGER

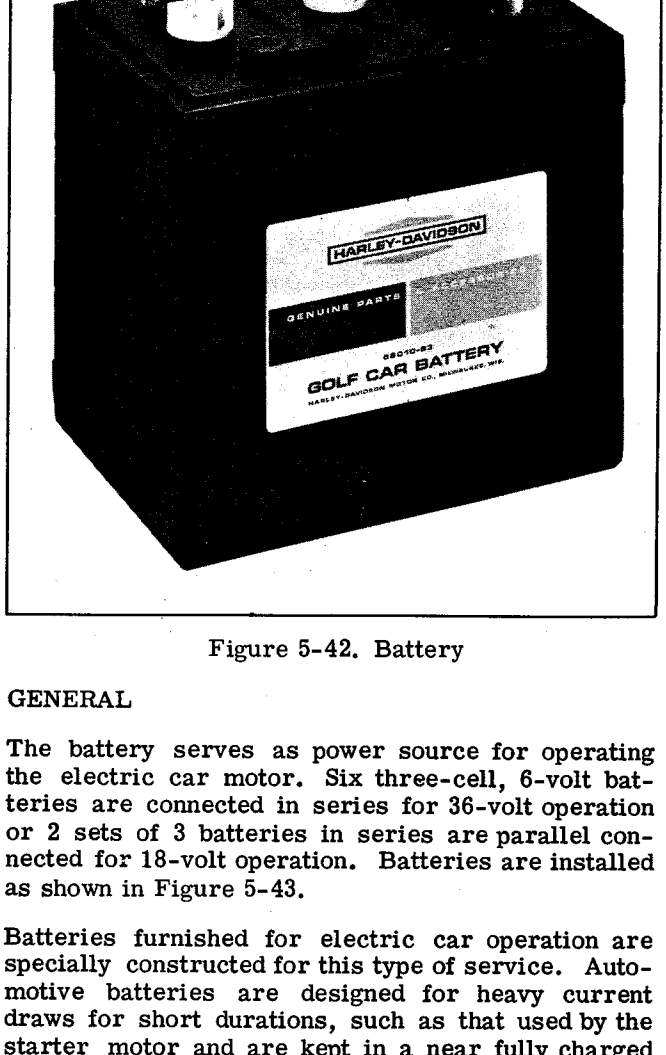


Figure 5-42. Battery

GENERAL

The battery serves as power source for operating the electric car motor. Six three-cell, 6-volt batteries are connected in series for 36-volt operation or 2 sets of 3 batteries in series are parallel connected for 18-volt operation. Batteries are installed as shown in Figure 5-43.

Batteries furnished for electric car operation are specially constructed for this type of service. Automotive batteries are designed for heavy current draws for short durations, such as that used by the starter motor and are kept in a near fully charged condition by the generator charging circuit. In contrast, a battery designed for electric car service must meet the requirements of being capable of furnishing currents up to 50 amperes for long durations, also being able to supply this current when in a partially discharged state. This type of service demands that a battery be durable enough to withstand repeated complete cycling.

For this reason, these batteries are constructed with heavier plates and cells having greater capacity of electrolyte to get more reliable service. Only Harley-Davidson batteries, which are designed for this type of service, should be used.

BATTERY CARE

Regular and correct battery care determines the life span and efficiency of the unit. Therefore, for the longest possible useful life, the following must be observed.

1. Keep battery solution (electrolyte) level up in cells by adding approved water (do not overfill).

2. Keep batteries charged but do not over-charge.

3. Keep battery and connections clean and felts lubricated.

These items are covered in detail in this section.

1. Battery solution level should be checked once a week. See paragraph "Charging." The battery solution should be maintained within the bottom section of filler opening. When not up to correct level, fill to triangle or split ring with distilled or approved water after charging batteries. Be careful not to overfill. Overfilling will result in some of the electrolyte being forced out through cap vent holes, diluting or weakening the solution strength. An overflow of battery solution will cause cables to corrode and parts near the battery to be damaged. Solution level should be checked once a week in normal service and more often in hot weather and when car is in continuous use. Older batteries will require more water than newer ones.

If a battery is operated with plates exposed, the acid will reach a dangerously high concentration that may char and disintegrate the separators and may permanently sulphate and impair the performance of the plates. Plates cannot take full part in battery action and cannot be properly charged unless they are completely covered by solution. Therefore, sufficient water should be added to cover plates BEFORE charging, then after charging the remaining water can be added to bring to correct level.

2. To protect your warranty 36-Volt Automatic Chargers supplied by Harley-Davidson must be used for charging batteries. The charger provides a maximum charge rate of approximately 20 to 30 amperes with gradual reduction to the finish rate of approximately 3 amperes. This protects the batteries against overheating and resulting damage.

3. Clean top of battery, battery hold-downs and terminals when necessary with a baking soda-water solution of 5 teaspoons (sodium bicarbonate) per quart of water. Be careful to avoid getting any of the solution into the cap vent holes. When solution stops bubbling, flush off battery with clean water. Dirty batteries will self-drain and will cause the charger to finish at a higher rate than normal, resulting in shortened battery life. Battery posts are provided with felt washers. Keep felts saturated with lubricating oil to prevent corrosion.

CHARGING

The lead-acid battery produces electricity through chemical action. This action is reversible which means the storage battery may be connected to a

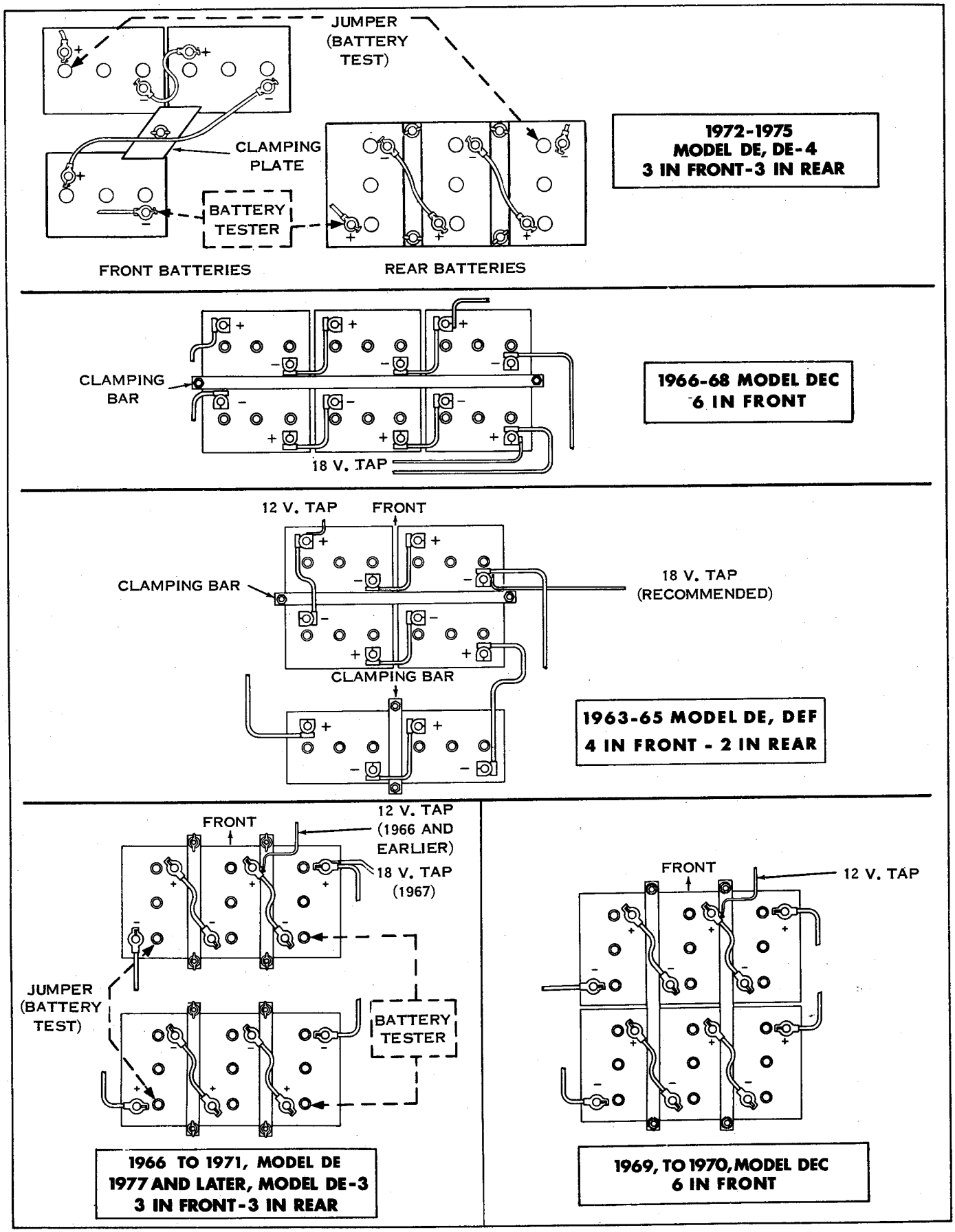


Figure 5-43. Battery Installation Diagrams

charger to have an electric current passed through it in the direction opposite to the direction of discharge and restore the battery's active chemicals to "good as new" state.

Batteries should be charged just enough to bring them up to full charge because overcharging is harmful. The state of charge can be tested accurately in each cell with a hydrometer or cell tester (voltmeter), but to simplify maintaining a fleet of cars, which normally require charging at least once a day, the following "CHARGING TIME CHARTS" can be used for daily charging.

CHARGING TIME CHART	
GOLF CAR USE	CHARGING TIME
9 Holes or Less 18 Holes or More	7 Hours 12 Hours
COMMERCIAL USE	
Less than 1 Hour More than 1 Hour	7 Hours 12 Hours

If a golf car is used only occasionally, it is recommended that a several hour refresher charge be given prior to using the car. Cars should be rotated so that all are used the same amount.

Commercial cars, not used in golf course operation, should be charged after use each day, or as charge becomes low as indicated by hydrometer or voltmeter test. Battery efficiency is affected by temperature.

COMPARISON OF POWER AVAILABLE FROM FULLY CHARGED BATTERY

80°F - 100% 32°F - 65% 0°F - 40%

If the temperature of the outside air and batteries is below 60°F, battery capacity will be reduced. They will require more frequent and longer charge periods such as in early spring, fall and winter. It will also help to put batteries on charge while still warm after use.

As batteries age, they finish charge at progressively higher charge rates and resulting higher water use rates. At this point in battery life, the battery life can be extended by reducing the hours of charge. For example, the 12 hour/18 hole charge may be reduced to 10 hours after one year of battery service.

If batteries are unusually hot at the end of normal charge with a heavy deposition of moisture around the filler caps and/or water use rate is high, this may indicate one or more defective batteries or that the batteries are nearing the end of their useful life.

(See "TESTING BATTERY" and "BATTERY CHARGER" following.)

WARNING

Hydrogen gas, formed when charging, is explosive. Avoid open flame or electrical spark near batteries. To avoid accumulation of gas under car body, lift body while charging.

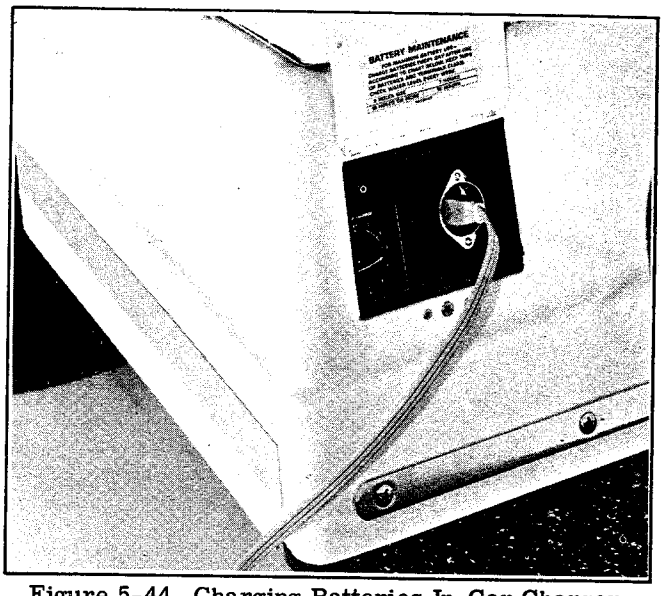


Figure 5-44. Charging Batteries In-Car Charger

CAUTION

Under no circumstances should charging be prolonged at the finish rate after the batteries are fully charged. Practical charging time maximum limit is 12 hours.

If car batteries do not respond to normal charging, one or more cells may be defective and all should be tested following procedure in next paragraph "Testing Battery". Batteries found defective must be replaced. If balance of batteries are over 6 months old, it is recommended that all be replaced with new batteries. All batteries in a car should be matched (approximately the same age, capacity and brand).

TESTING BATTERY

Use the following instructions for testing battery condition. As a guide for determining when to start or stop charging, check charge state in at least two cells (center cell of one of front and one of rear batteries). For cars in normal daily service, check condition of all cells once a month.

HOW TO TEST

Discharged, or less than 1/2 charged batteries (1.210 gravity or 2.04 open circuit cell voltage) must be recharged in order to have charge sufficient for testing. Use hydrometer (A), cell tester (B), or load tester (C), as follows:

A. Use of Hydrometer: (Refer to chart below)

BATTERY CONDITION

State of Charge	Specific Gravity (A)	Open Circuit Volts/Cell (B)
100%	1.250 - 1.270	2.10 - 2.12
75%	1.220 - 1.240	2.07 - 2.09
50%	1.190 - 1.210	2.04 - 2.06
25%	1.160 - 1.180	

1. Be sure to correct reading for temperature extremes. For each 10° above 80°F. add 4 points, or deduct 4 points for each 10° below 80°F.

2. Read gravity of each cell and record.

3. If any 2 cells in a battery vary more than 50 points, battery is defective.

4. If cells are even or vary only slightly, battery is generally not "suspect."

5. Batteries with satisfactory specific gravity (1.220 or better) but very low or no open circuit voltage are probably not serviceable.

NOTE

Hydrometer must be clean to read accurately. Flush with clean water after use, and if dirty should be taken apart and cleaned.

B. Use of Cell Tester (Voltmeter): (Refer to chart)

Follow Manufacturer's instructions.

1. Read open circuit voltage of each cell and record.

2. If any 2 cells vary more than .05 volt (25% or 5 scale divisions), battery can be considered defective.

3. If the voltage of any battery in the car reads more than .15 volts lower than the highest battery, it can be considered defective. If there is only slight voltage variation, the battery is generally not "suspect."

C. Use of Shunt Type Prod Tester:

1. Never use on discharged batteries or batteries under 3/4 charged (1.240 sp. gr.).

2. Follow manufacturer's instructions after recharging battery.

D. Use of Load Tester:

The use of a load tester, such as the Fox model 450, in conjunction with a voltmeter is the recommended method for determining battery condition. If car service between charges is poor, or the finish charge rate is above 8 amperes, conduct battery discharge test as follows:

NOTE

Batteries must have received a full 12-hour charge before conducting this test. Test must be run within 18 hours after coming off charge. Car cannot be used, even for short runs, prior to the discharge test. Electrolyte level must be satisfactory in all cells.

1. Car batteries must be placed in series to use tester on 1967 and later cars as follows:

1967 to 1971. Connect heavy jumper wire between left front battery (-) terminal and left rear battery (+) terminal. Connect Fox tester to right front battery (-) terminal and right rear battery (+) terminal.

1971 and later. Connect heavy jumper wire between left front battery (+) terminal and right rear battery (-) terminal. Connect Fox tester to second battery from front (-) terminal and left rear battery (+) terminal.

Connections are shown in Figure 5-43.

2. Check electrolyte temperature of a center cell of the front battery bank with a thermometer.

3. Connect discharge box to 110V AC, turn tester on.

4. After 20-30 minutes, with the discharge tester "on," check and record individual battery voltages or cell voltages on all six batteries. This must be done as rapidly as possible.

5. Allow the tester to shut off automatically and note time. (Note: Shutoff should occur at a battery voltage of 31.5V. ± 0.2 volts. Check tester shutoff voltage periodically. This setting must be accurate for a valid test.)

6. Check battery voltages recorded in step 6 above and discard any battery more than 0.15 volts lower than the highest battery in the bank or any battery with more than .05 volts variation between individual cells. (Note: If a defective battery is found, recharge the entire bank for 12 hours, then replace the defective battery with a good, fully-charged battery of the same brand and date code, if possible. Equalize the bank by placing on charge for an additional 3 hours, then re-test.)

If all battery voltages check within 0.15 volts or cell voltages within .05 volts, discharge times must meet the minimums specified below:

Electrolyte Temperature (Step 4)	Minimum Discharge Time (Step 7)
40 to 49°F.	40 minutes
50 to 59	45
60 to 64	50
65 to 69	54
70 to 74	57
75 to 79	60
80 to 84	62
85 to 89	64
90 to 99	66
100 to 109	68
110 to 119	70
120 to 129	72
130 to 150	74

Even though battery voltages or cell voltages check o.k., but discharge times fail to meet the minimums indicated above, the entire bank should be replaced.

Normally, the full bank should not require replacement until batteries age to the point where charger finish rates reach at least 10 amperes. Finish rate should be checked at the end of a full 12 hour charge. If charger is off, turn it on and allow ampere charge rate to taper off for 15 minutes to finish rate.

STORAGE

When the car is being stored, the batteries should be kept in a fully charged condition with electrolyte level up to level in all cells. Store at temperatures between 20°F. to 50°F. Check state of charge every 8 to 10 weeks and charge as necessary to 1.250 to 1.270 specific gravity. New batteries in stock should be stored in same manner, however, when individual batteries are found to need charging, they must be connected to a conventional 6-volt battery charger and given a boosting charge. Do not use Harley-Davidson Electric Car battery charger for less than six 6-volt batteries in series. See paragraph "Battery Charger."

If a battery is allowed to stand or is operated in a discharged condition for a long period of time, lead sulphate may develop on the plates, which is dense, hard and crystalline, and which cannot be electrochemically converted to normal active material again.

Lead sulphate formed on the plates during discharge is relatively insoluble as long as the specific gravity of electrolyte is kept above 1.125 specific gravity, but if allowed to drop below this value, the lead sulphate becomes increasingly soluble and may migrate into the pores of the separators and deposit as a white crystalline mass. Subsequent charging may convert these deposits into filamentous metallic lead which may "short" the positive and negative plates through the areas affected. These small shorts may cause a condition of low cell voltage when battery is allowed to stand idle in a more than 75% discharged condition.

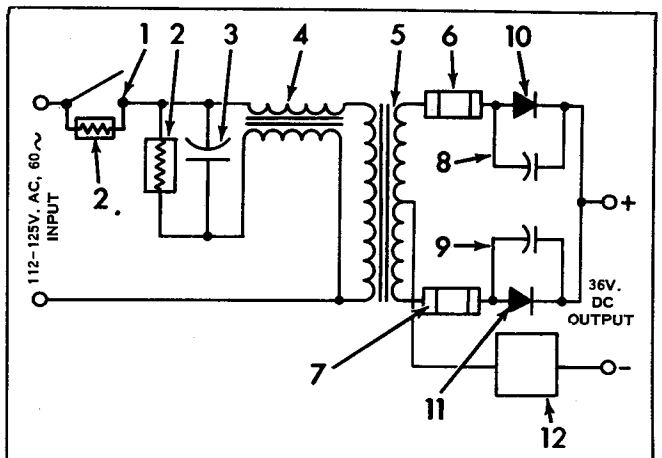
Batteries allowed to stand in a discharged condition (1.100 specific gravity) will freeze at 19°F. and ice may crack the container and damage the positive plates.

BATTERY CHARGER

Battery chargers supplied by Harley-Davidson are designed expressly for the Harley-Davidson electric car battery bank.

The charger power cord is equipped with a three-prong UL approved grounded type plug. For permanent locations, a three-prong receptacle that matches the plug should be installed, as this arrangement will automatically ground the car and charger and eliminate any electrical hazard.

The portable charger charging cord is equipped with a polarized connector which fits into a receptacle on the car. The IN-CAR charger does not have a charging cord, since it is connected directly to the battery bank.



1. Switch
2. Resistor
3. Capacitor
4. Reactor
5. Transformer
6. Fuse
7. Fuse
8. Capacitor
9. Capacitor
10. Diode (rectifier)
11. Diode (rectifier)
12. Ammeter

Figure 5-45. Battery Charger Schematic Diagram Part No. 66492-63 and 66492-63A

After the power cord has been connected to a 115 volt A.C. electric outlet, and the charging plug has been connected to the car receptacle charging is started by turning power switch or timer switch on.

Late type chargers having an automatic timer will shut off after the selected time has elapsed. An indicating ammeter is located on the front panel to indicate the charging rate (See Circuit diagram). On fully discharged batteries, the meter normally will read 20 to 30 amperes. As the charge progresses, the charge rate will gradually decrease until, at the end of the charge, the ammeter should read approximately 3 amperes (finish rate) of batteries in good condition. A higher finish rate indicates ageing or a defective battery or batteries. If finish rate approaches 8 amperes, batteries should be checked, see "TESTING BATTERY."

CAUTION

Never set the portable charger on the ground, dirt, or in the grass; or on anything that may prevent sufficient air from entering underneath the feet of the charger, as overheating will result which may cause serious damage to the charger. It is recommended, for outdoor charging, that rain protection be provided, and the charger be located at least 12" above the ground on a flat platform, or permanently mounted in such a manner as to permit the maximum air flow underneath the charger. NEVER locate the charger, while in service, in the hot sunshine since reflections from nearby objects could increase the intensity of the sun rays to such a degree that it may be injurious to the unit. Provide some type of shield against the sun.

Charger is automatic, and there are no movable adjustments required. Any normal line voltage (as indicated on the front panel) will provide satisfactory operation. However, excessive line voltage will cause the charger to overcharge at the finish rate, and cause excessive gassing of the batteries. If this condition should arise, it is recommended that you notify your power company and, in most cases, they will correct this condition.

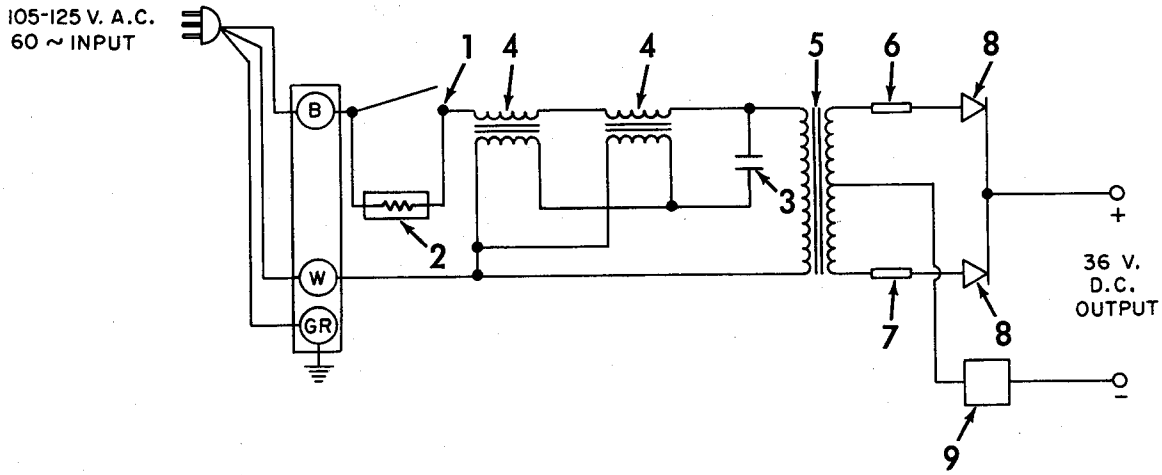
Some chargers have a circuit breaker in the output circuit. If the charging rate is above normal, the circuit breaker will interrupt the circuit, and the ammeter will read 0 for a very short period of time (approximately 30 seconds). The breaker will automatically reset and the charging will continue. If this charging interruption recurs continuously for 1/2 hour, the batteries should be checked for shorted cells.

When connecting or disconnecting the charger to the car, always make sure that the power switch is in the OFF position, as sparking will occur and may be the cause of an explosion or fire if the car is in an explosive area.

WARNING

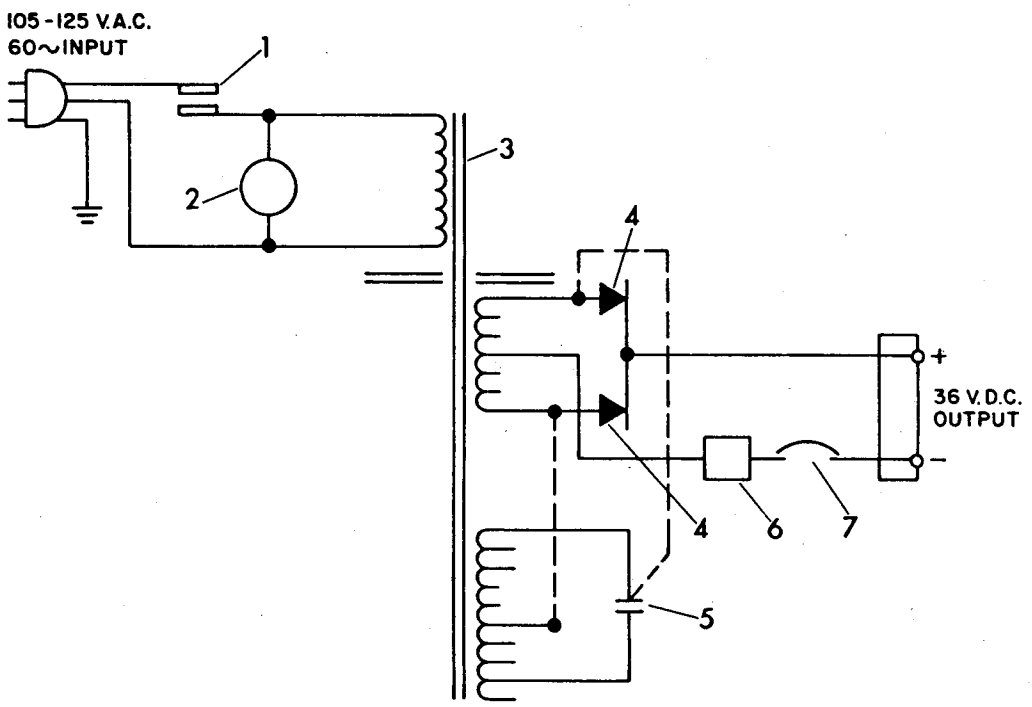
A power cord adaptor plug should be used only temporarily, as the charger should be adequately grounded. Charger power cord is provided with the necessary UL approved grounded standard plug for this purpose. For permanent locations, it is recommended that a receptacle that matches the plug be installed as soon as possible, as an ungrounded electrical device becomes a physical hazard.

Repair parts for this unit are listed in the Electric Car Parts Catalog. Parts may be obtained from your Harley-Davidson Dealer, or by contacting the Parts and Accessories Department. A trouble-shooting guide is included with each charger.



1. Switch
2. Resistor
3. Capactor
4. Reactor (2)
5. Transformer
6. Fuse
7. Fuse
8. Diode (rectifier) (2)
9. Ammeter

Figure 5-46. Battery Charger Schematic Diagram Part No. 66492-63B



1. Timer switch
2. Timer motor
3. Transformer
4. Diode (rectifier) (2)
5. Capacitor
6. Ammeter
7. Circuit breaker

NOTE

Broken lines indicate (early 1966) connections at transformer secondary taps and capacitor.

Figure 5-47. Battery Charger Schematic Diagram Part No. 66492-63C

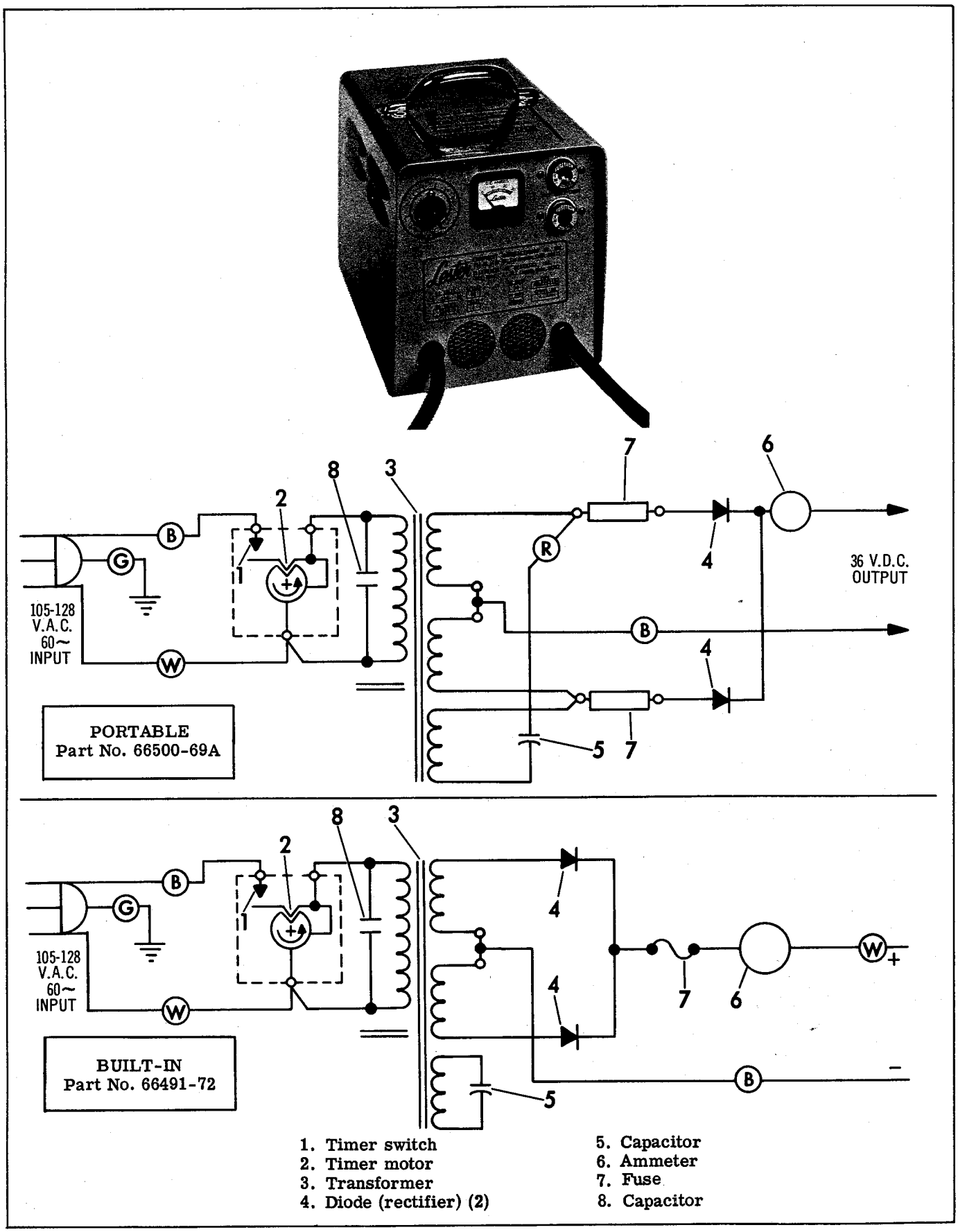


Figure 5-48. Battery Charger Schematic Diagram

TRACTION MOTOR

GENERAL

The traction motor is lubricated for life and under normal use, requires no internal attention except for inspection of brushes and commutator and cleaning once a year.

The 1963 to 1965 electric cars used a triple V-belt drive from motor to differential pinion shaft. The 1966 and later electric cars have the motor mounted on the differential housing and the differential pinion gear is mounted directly on motor armature shaft.

ADJUSTING AND REPLACING V-BELTS (1963 to 1965 Models)

At regular service intervals or if car fails to give normal performance on hills, indicating possible belt slip, V-belt tension should be checked and adjusted. Raise rear body section. To check V-belt tension, apply pressure (approximately 10 to 14 lbs.) on each belt separately at a point midway between the motor sheave (2) and rear axle sheave (3) as shown in Figure 5L-1. Deflection should be 1/4 in. To tighten V-belts, turn front adjusting screw (4) down until belt tension is correct, then turn rear adjusting screw (5) down until it seats on the differential housing.

Check sheave alignment to be sure that V-belts are running true on sheaves. If sheaves are out of alignment, loosen motor sheave set screw located at keyway position in center V-belt groove, using 1/8" Allen wrench and shift position on motor shaft until alignment is correct and V-belts run true on sheaves. Retighten motor sheave set screw very tightly.

To replace worn or damaged V-belts, unscrew both adjusting screws (4) and (5) until V-belts can be rolled off of both sheaves. Generally, it is good practice to install all three new V-belts to assure equal belt length and tension. Readjust new belts as previously described.

TOWING ELECTRIC CAR

CAUTION

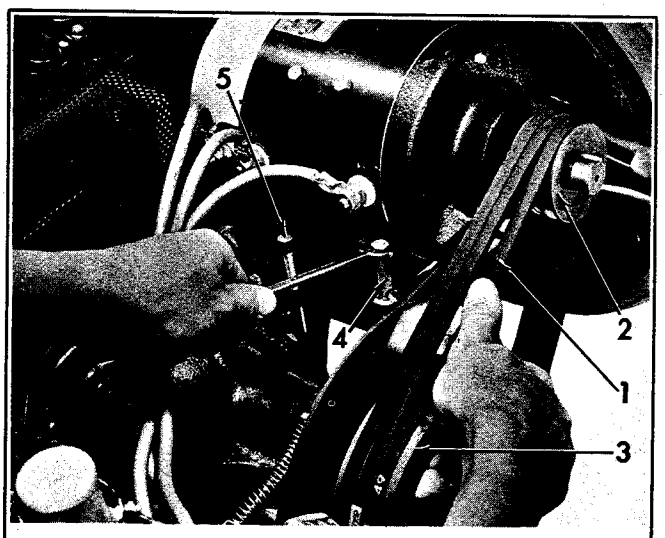
Car should not be towed above 15 M.P.H. on ground because the motor armature will be driven at excessive speed and damage to motor may result.

TRACTION MOTOR

BRUSHES AND COMMUTATOR

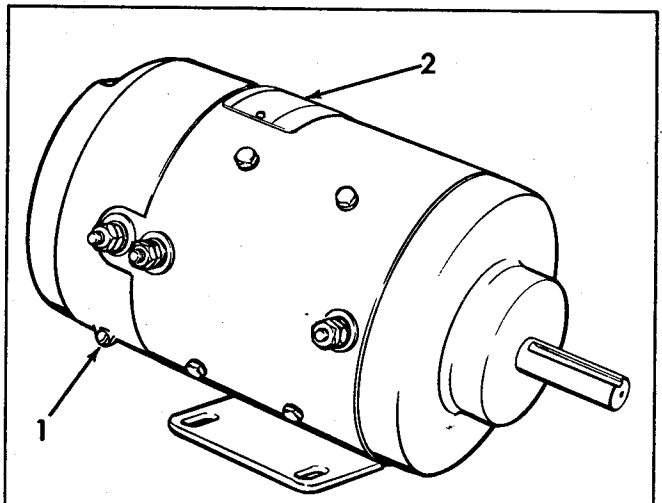
Inspect brushes and commutator once a year.

To inspect motor brushes in the Westinghouse or AMF motor, disconnect cables from the motor. Remove



1. Belt (3)
2. Motor sheave
3. Rear axle sheave
4. Front adjusting screw
5. Rear adjusting screw

Figure 5-49. Adjusting V-Belts (1963 to 1965)



1. Commutator and brush cover band screw
2. Identification plate

Figure 5-50. Traction Motor (1963 to 1965 Model Shown)

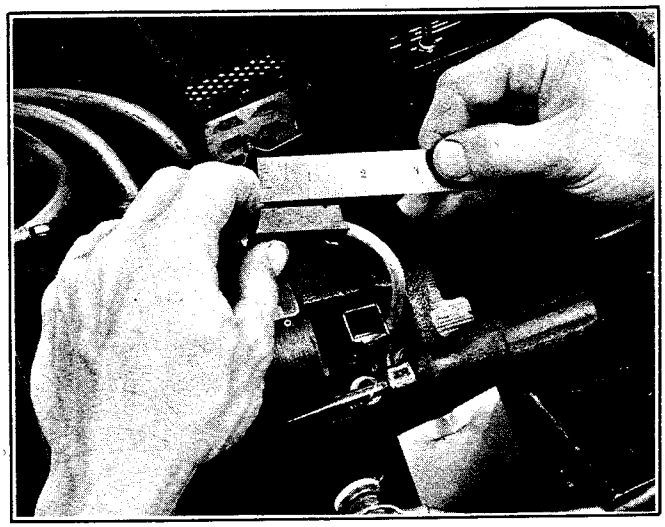


Figure 5L-3. Measuring Brush Length
(1963 to 1965 Model Shown)

commutator cover band screw and pull cover back to expose opening. For the Westinghouse motor, unhook each of 4 brush springs and pull brushes out of brush holders. To inspect motor brushes in the GE motor, pull off the four rubber brush covers. See Figure 5-51. If any of brushes are worn to less than 3/4 inches from top to heel, new brushes are needed. Replace brushes in sets only. Detach pigtail terminal held by screw to brush holder, release spring from brush with a wire hook and lift out brush. During replacement of brushes, check the condition of the brush springs. Springs should apply a force of 1 to 2 lbs. to the brush. If not, the springs are damaged and should be replaced. Slight roughness of the commutator can be polished away with grade 4/0 sandpaper (do not use emery cloth - also, do not use oil or other lubricants on the commutator). If commutator appeared oily, oil seal should be replaced. If commutator is worn to a grooved or pitted condition, it requires refinishing. See "SERVICING MOTOR." Blow carbon and copper dust from brush and commutator area before reassembly. When replacing cover band, position cover connection so gap is at the bottom of the motor as shown in Figure 5-50.

TESTING TRACTION MOTOR

If prior tests to other components of electrical system show no defective parts or difficulty in the wiring circuit, the motor can be suspected as faulty. The following tests can be made to determine if motor is defective without disassembling motor.

Disconnect heavy wires from motor terminals, identifying them so they can be replaced on same terminals after tests.

WARNING

Disconnect all cables from motor terminals before making the following tests.

Use 6-volt continuity test circuit as described under "Testing Circuits," Section 5A.

1. To test motor terminals for grounding to frame, hold one test lead to motor frame and touch other lead to motor terminals A-1, A-2, S-1, and S-2 in turn (see Wiring Diagram, Section 5A). If test lamp glows when contacting any of these, terminal is grounded.

2. If prior test shows no ground, connect one test lead to terminal S-1 and other to terminal S-2. Test lamp should now glow to show a continuous circuit in motor field winding. If lamp fails to glow, field is open.

3. To test for continuity in the armature circuit, attach test leads to terminals A-1 and A-2. If lamp fails to glow indicating an open circuit, brushes should be inspected for length, brush leads tested for continuity with respective armature terminals on frame, and brush spring tension tested to insure good brush contact with commutator. If these parts test good, armature may have open circuit.

If motor tests reveal no difficulty, but motor is still suspected faulty, there is a possibility the field or armature windings are shorted internally (see "Field Coils").

REMOVING AND INSTALLING MOTOR (1963 to 1965 Models) (Figure 5-52)

Remove drive motor and base from car frame as follows:

Relax V-belt tension by unscrewing adjusting screws (1) and (2) and roll V-belts (3) from motor sheave (4). Remove V-belts. Disconnect cables attached to motor terminals (5). Remove retaining ring (6) from front end of motor pivot shaft and drive shaft (7) out of base with suitable drift. Motor and base (8) are now free to be removed from frame. To remove sheave (4), unscrew set screw (9) and tap sheave from shaft. Remove key (10) from motor shaft.

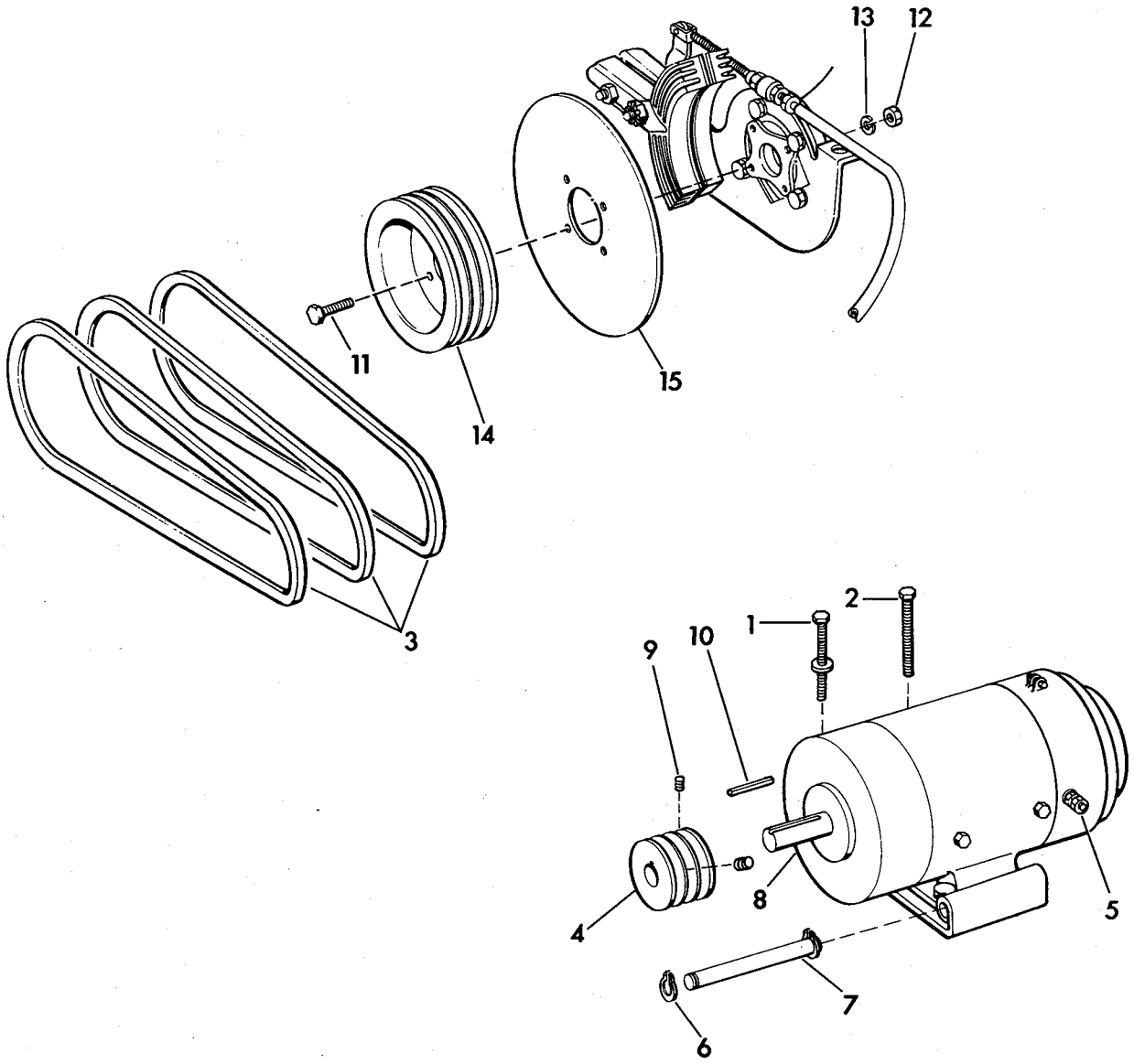
Rear axle drive sheave is attached to drive shaft end yoke through brake disc. Remove 4 bolts (11), nuts and lockwashers (12) and (13) to free drive sheave (14) and brake disc (15).

REMOVING AND INSTALLING MOTOR (1966 to 1971 Models) (Figure 5-53)

Remove drive motor from differential housing as follows:

Disconnect brake cable clevis from brake shoe lever by removing cotter pin (1) and clevis pin (2). Remove brake shoe bracket bolts (3) and locknuts (4) securing bracket (5) to motor end bracket (6). Move brake shoe assembly aside. Remove 3 bolts (7) and single bolt (8), nut, washers, and lockwashers (9) to remove motor end bracket (6).

Remove 4 locknuts (10) and bolts (11) securing brake disc (12) to hub (13). Remove setscrews (14), hub key (15) and remove hub (13) from motor shaft with a claw puller.



1. Adjusting screw
2. Adjusting screw
3. V-belt (3)
4. Sheave
5. Motor terminal (4)
6. Retaining ring
7. Pivot shaft
8. Base
9. Set screw (2)
10. Key
11. Bolt (4)
12. Nut (4)
13. Lockwasher (4)
14. Drive sheave
15. Brake disc

Figure 5-52. Motor, Drive Belts and Brake Assembly (1963-1965 Models) - Exploded View

Remove 4 motor flange bolts and lockwashers (16) and (17) and carefully withdraw motor from differential housing to prevent damage to shims (18) and (19). Remove shaft rubber seal (20).

CAUTION

DO NOT DROP FOREIGN MATERIAL INTO AXLE HOUSING.

Shim pack thickness controls the pinion to differential gear center distance and the number of steel shims should not be changed when reinstalling the motor. If a replacement motor is being installed, a shim pack is included with the new motor. The shim pack consists of two gaskets with a variable number of .003, .005 and .010 thickness steel shims. Shims should be placed between two new gaskets (19) when installing motor.

Before reinstalling motor, clean faces of motor flange and axle housing flange and check for nicks which could cause oil leaks or misalignment. Use care when engaging pinion gear with ring gear to prevent nicks on gear teeth. Grease shaft seal (20) and position so outside edge lightly contacts motor end cover.

Reinstall motor with 4 bolts and lockwashers (16) and (17) and torque evenly to 35-50 ft.-lbs.

Assemble brake end parts in reverse order of disassembly. Check oil level in differential housing and add transmission lubricant if necessary.

REMOVING AND INSTALLING MOTOR (1972-1974 Models) (Figure 5-53)

Remove traction motor from differential housing as follows:

Disconnect motor wiring, making sure wires are identified.

Disconnect brake cable clevis from brake shoe lever by removing cotter pin (1) and clevis pin (2). On models equipped with an automatic seat brake, disconnect the seat brake clevis assembly by removing cotter pin and clevis pin.

Remove brake shoe bracket bolts (3) and lock nuts (4) securing brake shoe assembly bracket (5) to brake assembly mounting bracket (6). Remove 3 bolts (7) and single bolt (8), nut, washers, lockwashers (9) to remove brake assembly mounting bracket (6).

Remove setscrews (14). Remove hub (13) and disc (12) assembly from motor shaft with a pinch bar. Apply leverage between motor end and hub (13). Remove key (15).

Remove two motor mounting bolts (24) and spacers (25) which attach resistor mounting bracket to motor end. Swing resistor assembly out of the way. Remove 2 motor strap bolts (16A), nuts (22), and washers (17A). Slide motor strap (23) back over axle housing.

Remove the two remaining motor mounting bolts (24). Carefully withdraw motor from coupling housing to prevent damage to splines. Remove shaft rubber seal (20) and nylon washer (21). Remove motor coupling (26) by loosening 2 setscrews (27). Remove key (28).

To remove the differential coupling (34), remove 4 bolts (30) and coupling housing (29). Remove cotter pin (31), castle nut (32), and retainer (33). Pull differential coupling (34) off shaft.

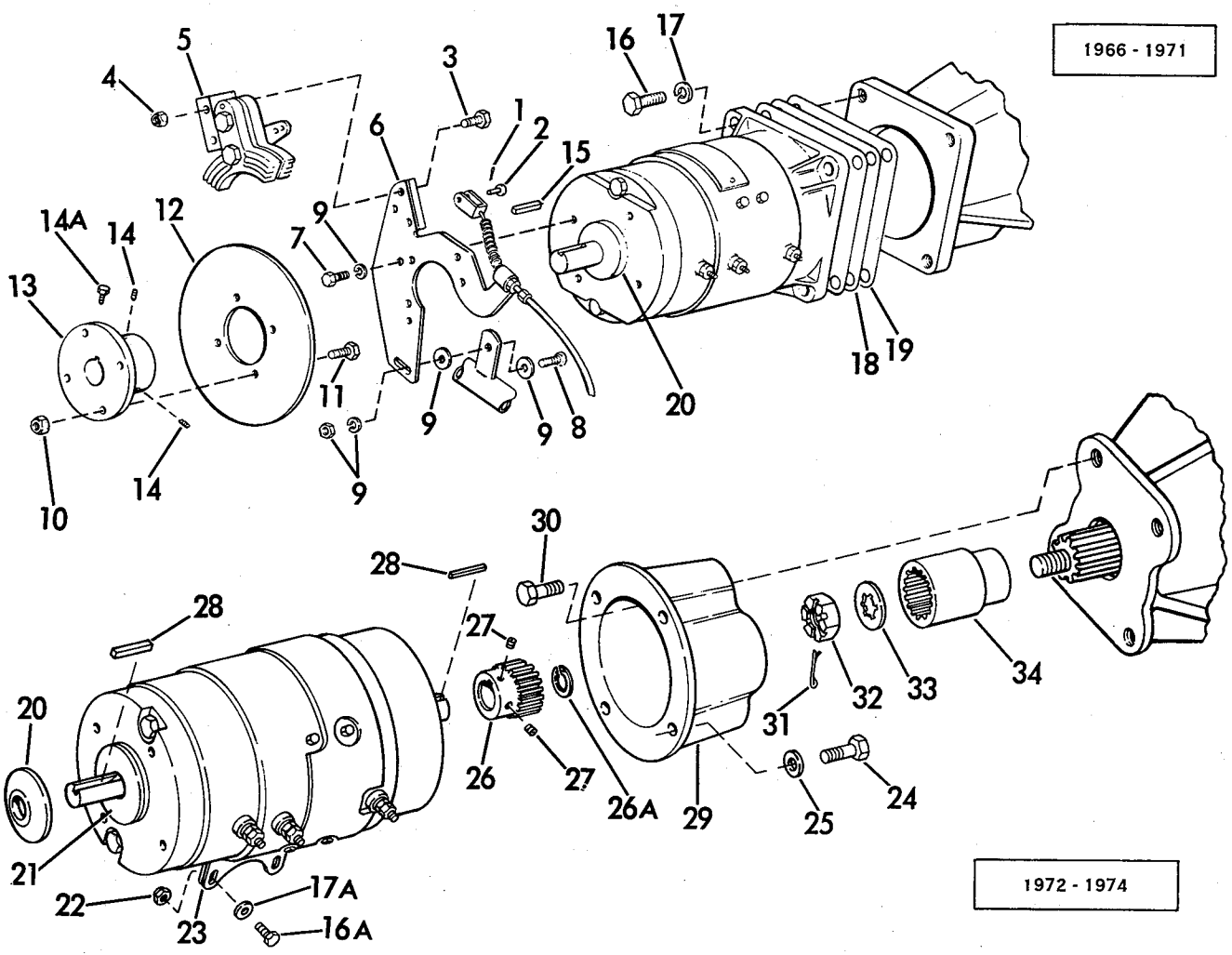
CAUTION

Do Not Drop Foreign Material Into Axle Housing:

Reassemble in reverse order of disassembly, observing the following: Before reassembling grease shaft seal (20), position nylon washer (21) and shaft seal so that outside edge of the shaft seal lightly contacts nylon washer. Coat coupling housing bolts (30) and motor mounting bolts (24) with Loctite, grade A. Apply Loctite sealant, grade A to the bore and keyway of the disc brake hub. Grease splines on the motor coupling (26) and the differential coupling (34) before reassembling. On 1973 and later models make sure retaining ring 26A is in place.

When reassembling torque castle nut (32) to 50-70 ft.lbs.

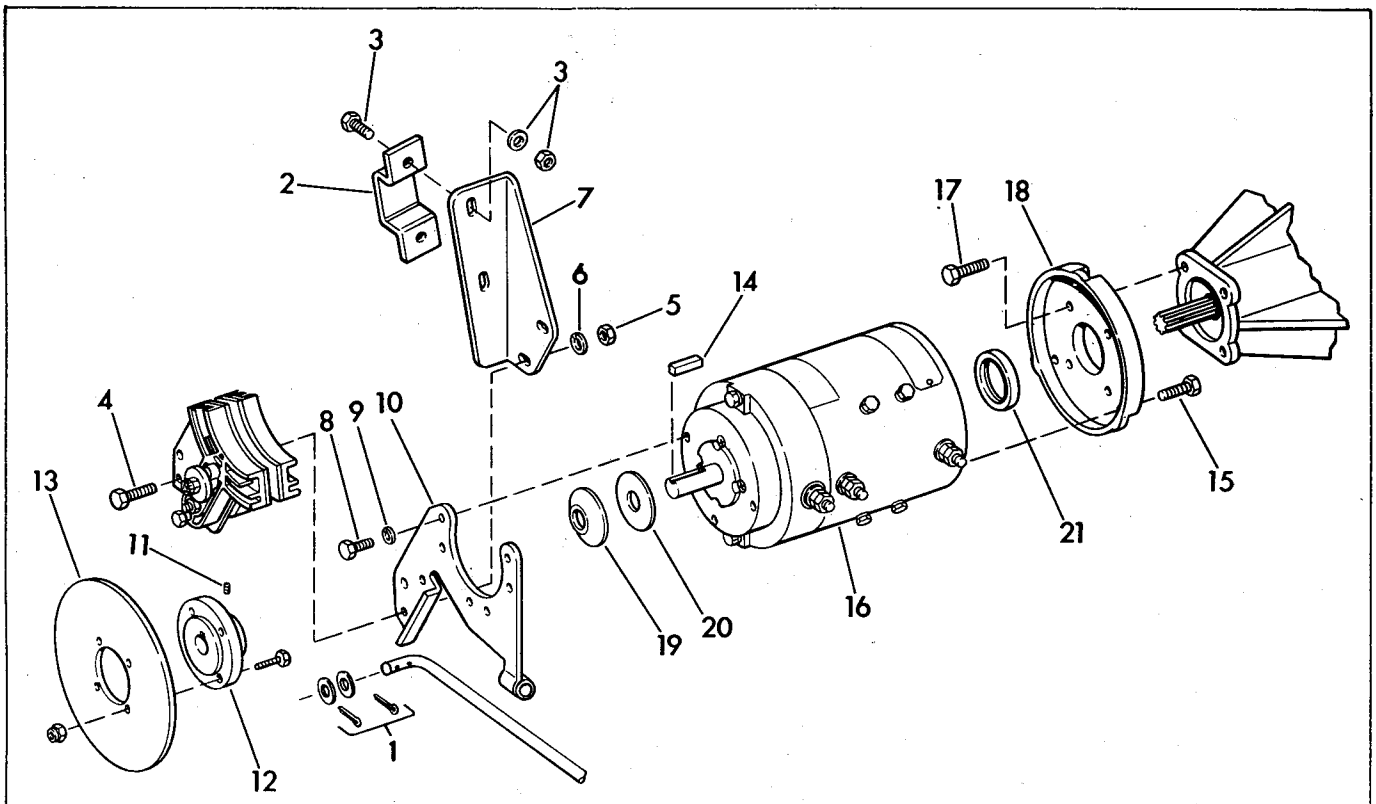
Check oil level in the differential housing and add Harley-Davidson differential lubricant if necessary.



1. Cotter pin
2. Clevis pin
3. Bracket bolt
4. Locknut
5. Brake shoe assembly bracket
6. Brake assembly mounting bracket
7. Bolt (3)
8. Bolt
9. Nut, washer, lockwasher
10. Locknut (4)
11. Bolt (4)
12. Disc
13. Hub
14. Setscrews (2)
14A. Hex setscrew (1968)
15. Hub key*
16. Flange bolt (4)*
16A. Motor strap bolts (2)**
17. Lockwasher (2)*
17A. Washer (2)**
18. Shim (Variable No.)*
19. Gasket (2)*
20. Motor shaft seal
21. Nylon washer**
22. Nut**
23. Motor strap**
24. Motor mounting bolts (4)**
25. Spacers (2)**
26. Motor coupling**
26A. Retaining ring (1973 & later)
27. Setscrews (2)**
28. Key**
29. Motor coupling housing**
30. Coupling housing bolts (4)**
31. Cotter pin
32. Castle nut
33. Retainer**
34. Differential coupling**

*1966-1971
**1972-1974

Figure 5-53. Motor and Brake Assembly (1966-1974 Models) - Exploded View



1. Cotter pin (2), washer (2)
2. Motor brace clamp
3. Bolt, washer, locknut (2)
4. Bolt (2)
5. Nut (2)
6. Washer (2)
7. Motor brace
8. Bolt (3)
9. Washer (3)
10. Brake mounting bracket
11. Set screw
12. Brake disc hub
13. Brake disc
14. Key
15. Bolt (2 or 3)
16. Motor
17. Bolt (4)
18. End cover
19. Seal
20. Nylon washer
21. Oil seal

Figure 5-53A. Motor and Brake Assembly (1975 and Later Models) - Exploded View

REMOVING AND INSTALLING MOTOR (1975 and Later Models (Figure 5-53A)

Remove traction motor from differential housing as follows:

Disconnect motor wiring, making sure wires are identified.

Disconnect brake cable clevis from brake shoe lever by removing cotter pin, washer and clevis pin (1). Remove motor brace clamp (2) by removing two bolts, washers and locknuts (3). Remove brake shoe bracket bolts (4), nuts (5) and washers (6). Motor brace (7) is now free. Remove three bolts (8) and lockwashers (9) securing brake mounting bracket (10) to motor.

Back off set screw (11). Remove hub (12) and brake disc (13) assembly from motor shaft. Remove key (14).

While supporting motor, remove bolts (15) from end of motor. Remove motor (16). Remove bolts (17) securing motor end cover (18) to differential. Remove motor shaft seal (19) and nylon washer (20) from motor.

Inspect oil seal (21) in motor end cover (18). Replace if damaged or worn.

CAUTION

Do not drop foreign material into axle housing.

Reassemble in reverse order of disassembly, observing the following:

Before reassembling, grease motor shaft seal (19), position nylon washer (20) and shaft seal on motor shaft so that outside edge of seal lightly contacts nylon washer. Make sure motor end cover (18) and flange on differential housing are clean and free of oil and grease. Apply a 1/16 in. bead of silicone rubber (RTV) to the flange on the differential housing. Assemble motor end cover (18) to differential using four bolts (17). Tighten to 31 ft.-lbs. torque. Grease splines on differential pinion shaft before installing motor. When installing motor tighten bolts (15) to 90-100 in.-lbs. torque. Tighten the three bolts (8), which hold bracket (10) to the motor, to 90-100 in.-lbs.

Check oil level in the differential housing and add Harley-Davidson Differential Lubricant if necessary. See DIFFERENTIAL AND AXLE.

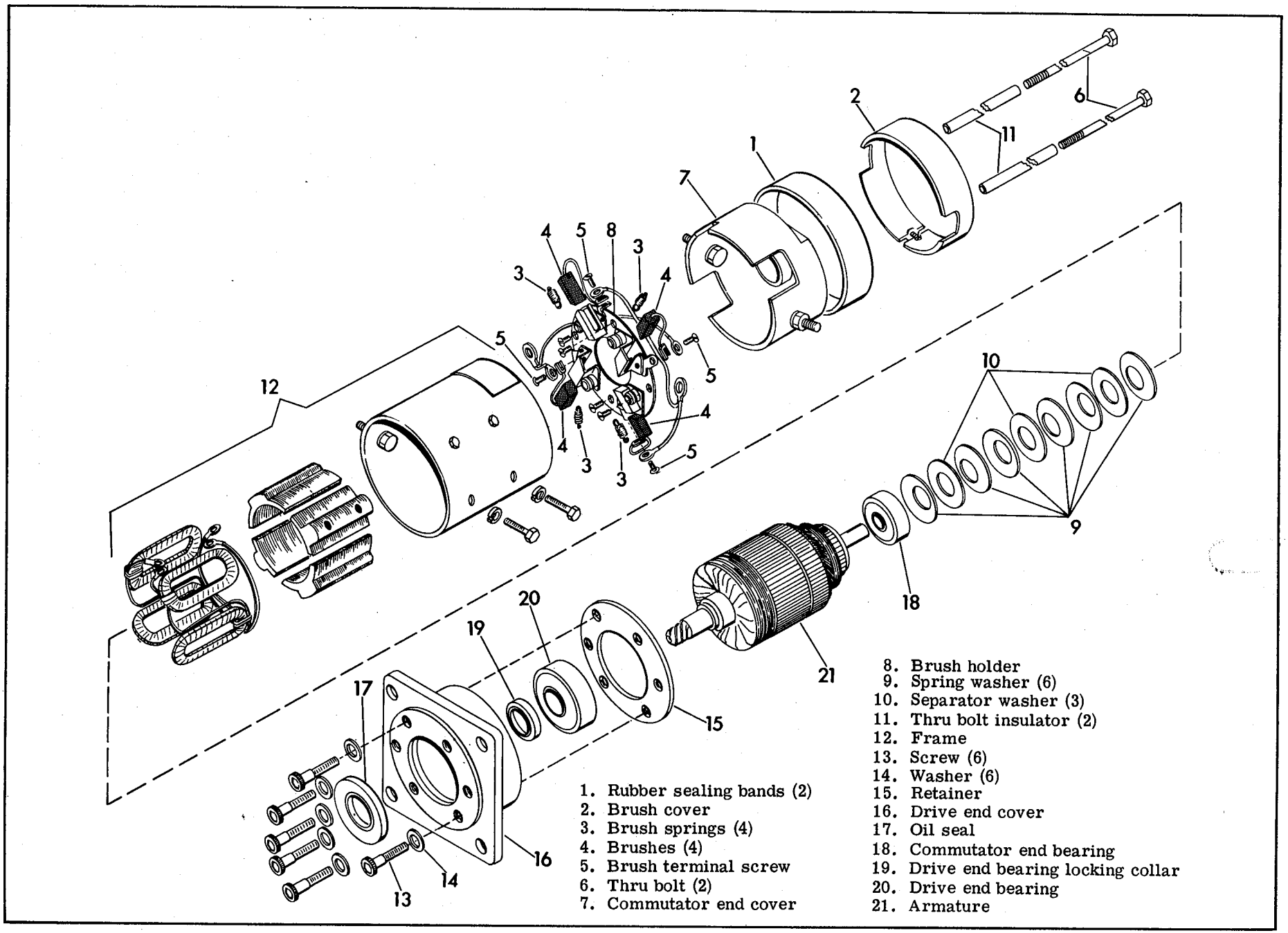
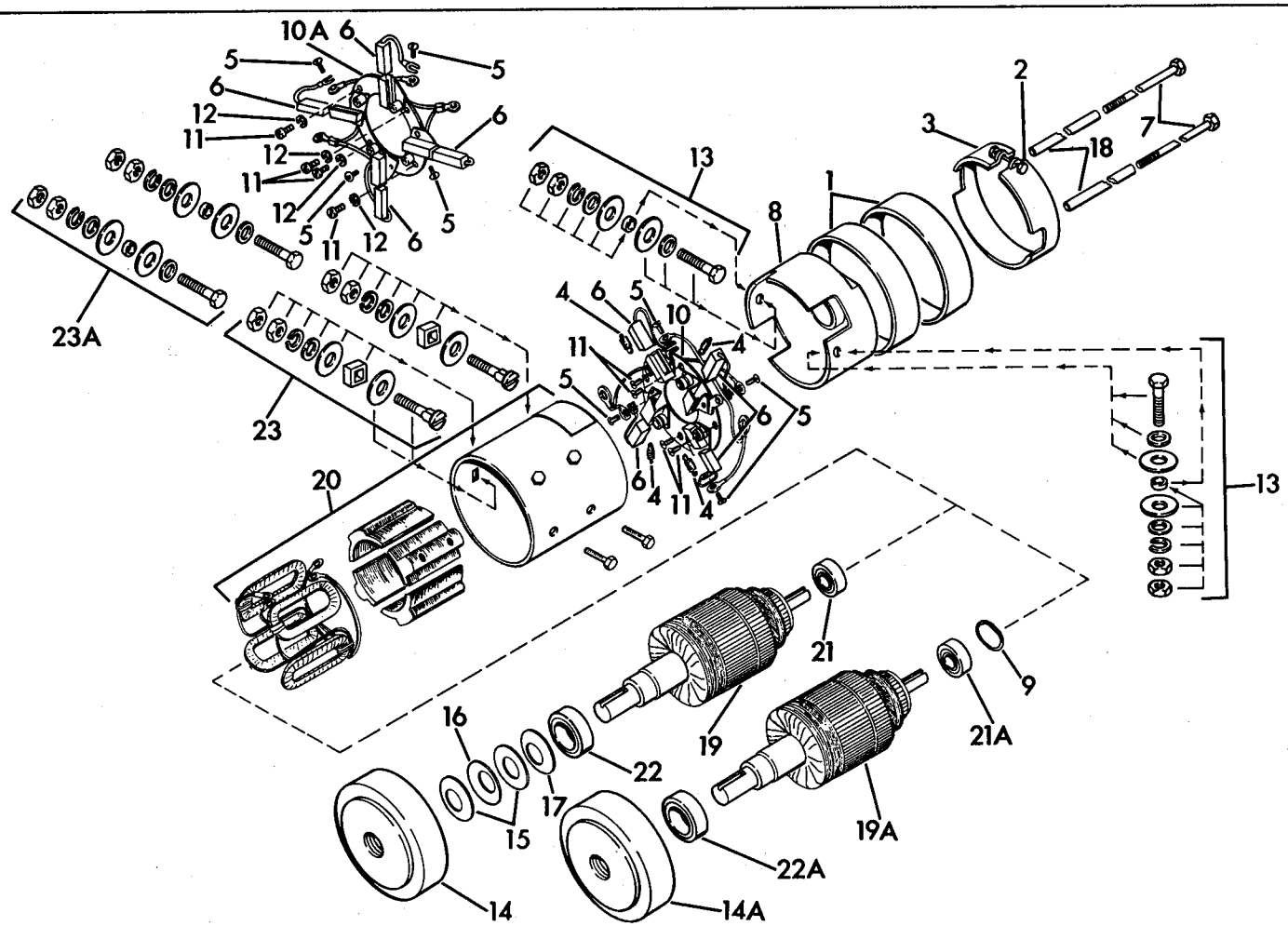


Figure 5-54. GE Traction Motor (1966 to 1971) - Exploded View



1. Rubber sealing bands (2)
2. Screw
3. Brush cover
4. Brush springs (4)
5. Brush terminal screw (4)
6. Brushes (4)
7. Thru bolts (2)
8. Commutator end cover
9. Spring washer - Westinghouse
10. Brush holder - G.E.
10A. Brush holder - Westinghouse
11. Screws (4)
12. Washers (4) - Westinghouse
13. Terminal assemblies (2)
14. Drive end cover - G.E.
14A. Drive end cover - Westinghouse
15. Spring washers (2) - G.E.
16. Spacer - G.E.
17. Flat shim - G.E.
18. Insulating sleeves (2)
19. Armature assembly - G.E.
19A. Armature assembly - Westinghouse
20. Frame assembly
21. Commutator end bearing - G.E.
21A. Commutator end bearing - Westinghouse
22. Drive end Bearing - G.E.
22A. Drive end bearing - Westinghouse
23. Terminal assembly (2) - G.E.
23A. Terminal assembly (2) - Westinghouse

Figure 5-55. GE and Westinghouse Traction Motors - 1972-1974 DE, DE-4 - Exploded View

SERVICING MOTOR

Electric motor repairs are available at G.E. or Westinghouse electric motor service shops located in most larger cities. A list of these service stations is available from our service department. Principal renewal parts such as brushes, bearings and seals are available from our parts and accessories division. A list of these parts appears in our parts catalog.

IMPORTANT

Motors within warranty should not be disassembled but returned intact to your nearest G.E. or Westinghouse service station. AMF motors still under warranty should be returned intact to the factory.

The following repair procedures apply to the 1966 to 1971 direct drive traction motor, part No. 70499-66, G.E. Model No. 5BC48JB187. Some procedures also apply to 1963-65 V-belt drive traction motor, part No. 70499-63, G.E. Model No. 5BC48JB-92, G.E. Model No. 5BC48JB275, Westinghouse 388-P-342A.

DISASSEMBLING TRACTION MOTOR (1966 to 1971 Models) (Figure 5-54)

Move brush cover sealing bands (1) back on frame and remove brush cover (2). Note that clamping screw is opposite nameplate location (at bottom of motor) when it is installed on the car.

Unhook brush springs (3) from brushes (4) with a wire hook. Remove screws (5) from brush pigtail terminals and pull out brushes.

Mark position of end covers (7) and (16) with matching marks on end covers and frame.

Take out thru bolts (6) which clamp the motor together.

Carefully pull off commutator end cover (7) with brush holder (8). To disassemble brush holder from cover, remove 2 attaching screws and disconnect leads from cover. Note the number and arrangement of spring washers (9) and washers (10) in the end cover bearing recess when the washers and shims are taken out.

Remove insulation tubes (11).

Remove frame assembly (12) from armature and drive end assembly.

Disassemble drive end cover (16) from armature (21) by removing bolts (13) and washers (14) securing bearing retainer (15).

DISASSEMBLING TRACTION MOTOR (1972-1974 General Electric 5BC48JB275 or Westinghouse 388-P-342A) (Fig. 5-55)

Move brush cover sealing bands (1) back on frame. Loosen screw (2) and remove brush cover (3). Note that clamping screw is opposite nameplate location (at bottom of motor). When it is installed on the car to prevent water from entering motor.

Unhook brush springs (4) from brushes with a wire hook or long-nose pliers. Remove screws (5) from brush pigtail terminals and pull out brushes (6).

Mark position of end covers with matching marks on end covers and frame.

Remove thru bolts (7) which clamp the motor together.

Remove the commutator end cover (8). On the Westinghouse motors remove the spring washer (9). To disassemble the brush holder (10 or 10A) from the cover, remove the 4 attaching screws (11) (and washers (12) where applicable). Disconnect leads from the cover by disassembling the 2 terminal assemblies (13). Remove the drive end cover (14 or 14A).

On the G.E. motors remove the two spring washers (15), the spacer (16), and flat shim (17). Be sure to note their relative positions.

Remove insulating sleeves (18).

Remove the armature assembly (19 or 19A) from the frame assembly (20).

INSPECTION AND REPAIR (1966 and Later Models)

COMMUTATOR

If commutator bars are deeply pitted or grooved in the brush track, the commutator must be refinished.

To refinish commutator -

Mount armature in a lathe and diamond turn the commutator.

Limit the depth of cut to 0.005 inch or less and repeat cut as often as required. Do not reduce the diameter to less than 2-5/8 inches.

If turning eliminates undercut of mica insulation between commutator bars, undercut approximately 1/32 inch. Finish turn commutator after undercut.

After refinishing commutator, check it for eccentricity. It should not exceed 0.001 inch runout.

Clean, assemble, and test per instructions.

OIL SEAL

NOTE

Internal oil seals are not used in the 1972 & later models.

If, upon inspection, the commutator or field coils appear oily, this is a symptom of a faulty oil seal allowing the differential lubrication to pass into the motor. Oil or grease on a commutator will introduce sparking, resulting in undesirable commutator and brush wear. Clean any oil or grease from commutator or field coils by wiping with kerosene-soaked cloth.

To replace oil seal (17) -

Drive seal (17) from drive end casting (16) with suitable punch and hammer.

Carefully check the combination bearing locking collar seal seat on the rotor shaft for grooves and scars, or if otherwise in poor condition, the seal seat should be corrected by replacement of the locking collar (19). See following paragraph "BEARINGS".

Apply liquid gasket to the mating surface before placement of the oil seal.

Press seal into position with a suitable press. Locate seal into the drive end cover with the seal lip spring facing away from the bearing.

Reassemble drive end cover to the armature. Use care in positioning the end cover to armature to prevent damaging the seal.

Place washers (14) on Allen hex head screws (13) and torque to 115-135 in.-lb. Seal retainer screw heads with Permatex #3, or equivalent.

Clean, assemble, and test per instructions.

BEARINGS

No provision is made for relubricating the ball bearings. The bearings are a shielded, sealed type bearing to protect against dirt or other foreign matter entering the bearing, and to prevent loss of grease. The bearings are prelubricated by the bearing manufacturer for expected service life and are not normally regreased.

Check bearings by turning them with your fingers. Feel for binding or gritty effects and for excessive looseness or wobble. If any defect is apparent, or if there is any doubt at all as to serviceability of the bearings, replace them with new ones as follows:

REPLACING BEARINGS (1966 to 1971 Models)

Press or pull commutator end bearing (18) with a claw puller.

Press new commutator end bearing into place by means of an arbor that exerts pressure on only the inner ring. Assemble with metallic shield toward shaft shoulder. Do not use a hammer for bearing replacement. It will damage the bearing.

Prior to replacement of the drive end bearing (20), check condition of the pinion teeth. If the teeth appear damaged or worn excessively, consider the armature not serviceable.

Also check eccentricity of the shaft diameter between gear and collar with respect to shaft centers. The eccentricity should not exceed .0025 TIR. If it does, the armature is damaged and must be replaced.

Inspect the bearing retainer plate (15) and place on shaft prior to placement of bearing.

If drive end bearing replacement is necessary, use claw puller wedge attachment to pull bearing collar (19) from shaft. Press or pull drive end bearing (20) from shaft with claw puller.

NOTE

Bearing collar (19) is a heavy press fit on shaft and may require heating with torch to aid in removal. If necessary, machine down to within .010 of shaft and strike with chisel to crack off thin ring.

Press the drive end bearing into place by means of an arbor that exerts pressure on only the inner ring. Do not use a hammer for bearing replacement. It will damage the bearing.

Apply a thin coat of liquid gasket on the shaft prior to assembly of collar (19).

Press the collar (19) in place (collar chamfer to face bearing inner ring) against the inner ring of the bearing. The minimum force required to press collar in place is 3500 lbs. Any force less than 3500 lbs. will result in a floating shaft that will eventually damage the pinion.

When the drive end bearing and the locking collar are assembled on the rotor, there should be no axial clearance between the inner race of the bearing and the shaft shoulder on one side, or the inner race of the bearing and the locking collar on the other side.

Reassemble drive end cover to the armature. Use care in positioning the end cover to armature to prevent damaging the seal.

Place washers (14) on Allen hex head screws (13) and torque to 115-135 in.-lb. Seal retainer screw heads with Permatex #3, or equivalent.

Clean, assemble, and test per instructions.

REPLACING BEARINGS (1972 and later Models)

Commutator end bearing (21, 21A) and drive end bearing (22, 22A) are replaced in the following manner:

Remove bearing with a claw puller.

Press the new bearing on the shaft applying steady pressure to inner race only. Hammer blows will damage the bearing.

Clean, reassemble and test per instructions.

ARMATURE WINDINGS

If deep burned sections are evident, either in the brush track or on the riser ends of the commutator bars, this is a symptom of an open circuit in the rotor winding.

If one or more rotor conductors are abnormally black or appear burned compared with the other ro-

tor conductors, this is an indication of shorted and/or grounded rotor winding. If such evidence is detected, the rotor should be checked as follows with a Sun Model AT-76 armature tester.

Open circuit rotor winding can be determined with commutator probes between adjacent bars to check output of each coil - meter should give uniform readings.

Grounded rotor winding can be determined by testing with continuity tester probes from any commutator bar to the armature shaft - lamp should not light.

Shorted rotor winding can be determined by testing with hacksaw blade on all rotor laminations - a shorted winding will magnetize the shorted coil.

The armature is not normally rewound due to the difficulty encountered in the process of removing the copper conductors which are bonded to the rotor core. If the armature is grounded, shorted, or has open coils, replace with a new armature.

FIELD COILS

If, upon inspection, the insulation on the field coils appears blackened or charred, the serviceability of the coils is questionable. Burned or scorched coil insulation is a symptom of coil overheating due to overloads, grounded, or short circuited winding.

To check the windings electrically for grounds or open circuits, a continuity tester, megger, and ohmmeter are required.

A(grounded field winding may be checked by using the Model AT-76 continuity tester probes between terminal stud labeled S1 or S2 and motor frame. Lamp should not light. This test may not show a high resistance short which can be determined by checking with a high potential tester (Megger) in place of the circuit tester.

The open field winding may be determined by using a 3 c.p. tail lamp bulb and battery and testing for continuity between terminal studs S1 and S2.

The short circuited field winding may be determined by measurement of field winding resistance between terminal studs: Terminal stud S1 to S2 - resistance = .027 plus or minus .003 ohm at 77°F.

REASSEMBLING TRACTION MOTOR (1966 to 1971 Models)

Set commutator end cover (7) on bench with brush rigging facing upward, brushes retracted to avoid striking with the rotor.

Insert spring washers (9) and separator washers (10) into bearing housing in end cover.

Mount frame (12) to end cover (7) with mark on frame to match mark on end cover.

With stator frame mounted, and with shaft vertical, insert thru bolts (6) and slip insulation tubes (11) on them.

With bearings and drive end cover assembled, insert armature (21) with commutator end leading into the end cover (7). Match mark on drive end cover (16) with mark on frame (12).

Tighten the thru bolts to a torque of 90 to 95 in.-lb. Check to determine that armature is free to turn. If it will not turn, the parts have been assembled to cause binding.

Connect brush tension springs (3) to hooks and tuck brush pigtails inside of end cover.

Slip on the cover (2) in the original position and tighten. Replace rubber sealing bands (1).

REASSEMBLING TRACTION MOTOR (1972-1974 Models) (Fig. 5-55)

Place drive end cover (14, 14A) (with bearing housing up) on a bench centered over a hole large enough to clear the armature shaft.

On the G.E. Motor insert the 2 spring washers (15), the spacer (16), and flat shim (17) in the drive end cover bearing housing.

With the armature shaft (19, 19A), vertical, commutator end up, insert drive end bearing (22, 22A) in the bearing housing of the drive end cover.

Place frame assembly (20) over armature assembly and assemble to drive end cover matching the marks on the frame and the cover.

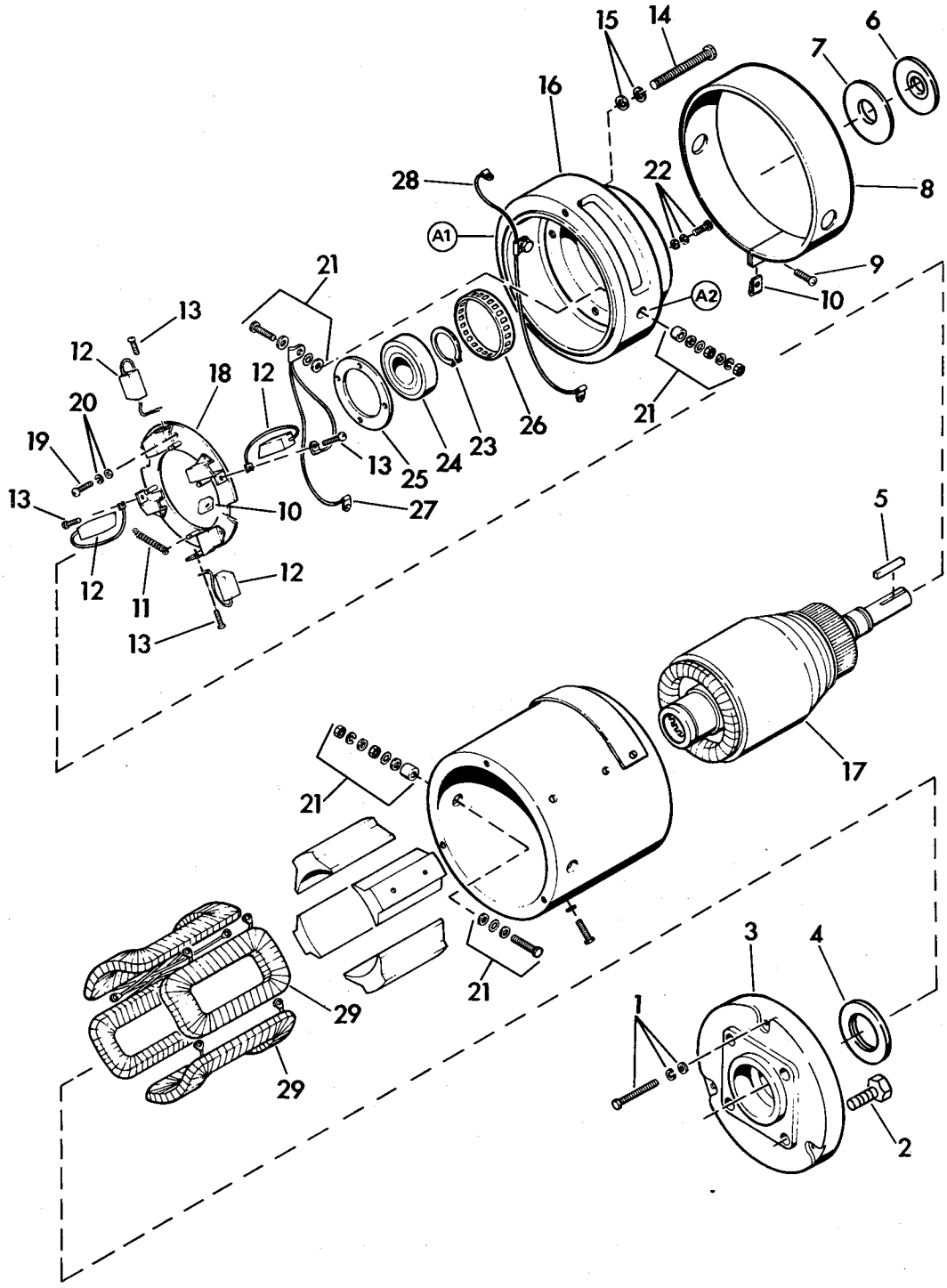
On the Westinghouse motor put the spring washer (9) in the commutator cover bearing housing. Hold the washer in place with a small amount of bearing grease.

Place commutator end cover (8), complete with brush rigging, over commutator. Assemble cover, matching the marks on the cover and frame.

Place insulating sleeves (18) over the thru bolts (7). Insert thru bolts in end cover and tighten with a torque wrench to 90 to 95 in. - lb.

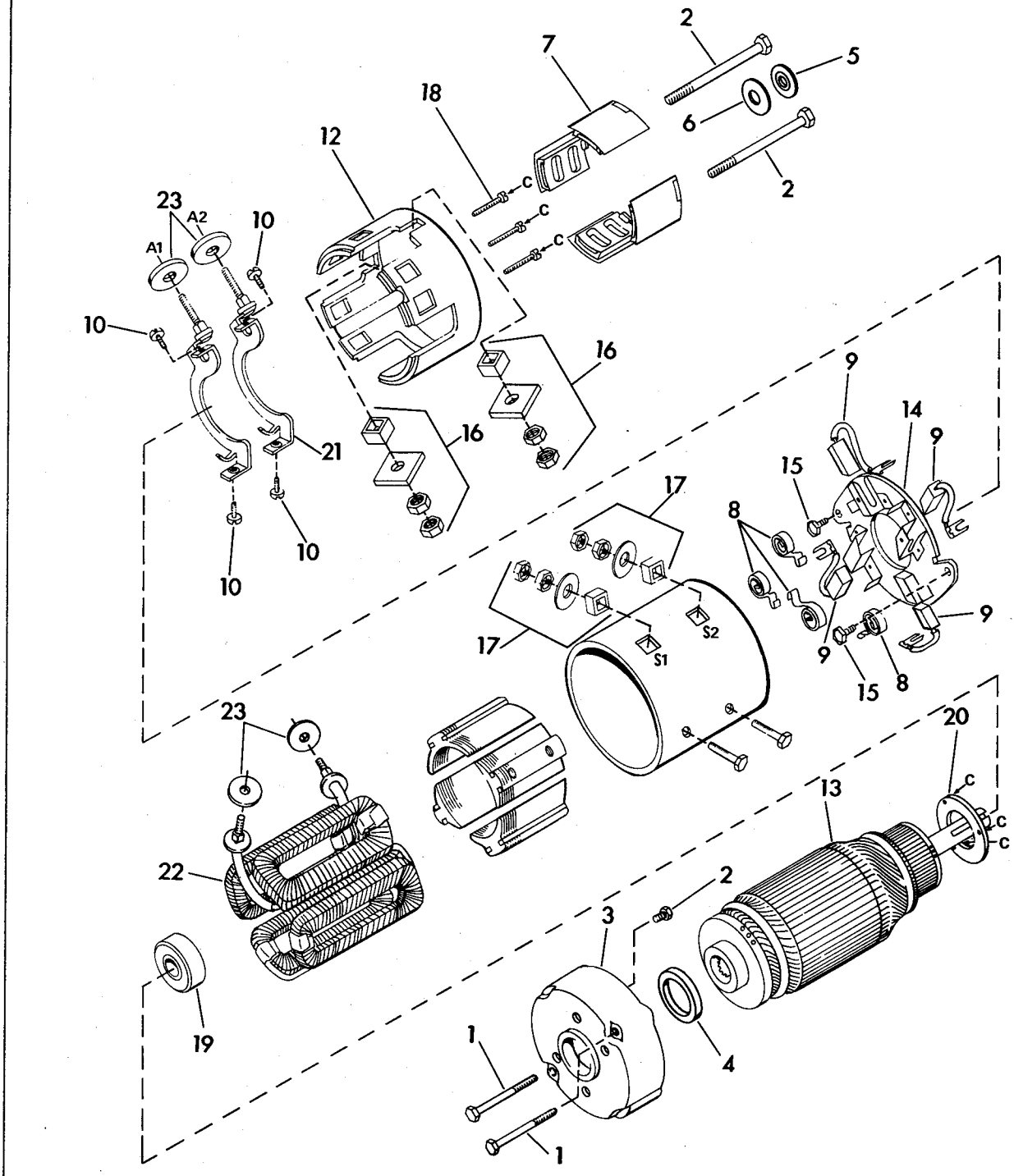
Connect brush springs (4) to brushes (6) and tuck pigtail lead into the cover. Make sure that the leads do not interfere with the brush movement. Check to see that the brushes move freely in their holders.

Slip on the brush cover (3) in the original position and tighten screw (2). Replace rubber sealing bands (1).



1. Bolt and washers (3)
2. Bolt (4)
3. End cover
4. Oil seal
5. Key
6. Seal
7. Nylon washer
8. Brush cover
9. Screw
10. Speed nut
11. Brush spring (4)
12. Brush (4)
13. Screws
14. Bolt (2)
15. Washers (4)
16. End cover
17. Armature
18. Brush holder
19. Screw (4)
20. Washers (4)
21. Terminal assembly (4)
22. Bolt, washer, lock washer (4)
23. Lock ring
24. Bearing
25. Bearing retainer
26. Housing bearing spacer
27. Wiring harness (A2)
28. Wiring harness (A1)
29. Field coil

Figure 5-56. AMF Traction Motor - 1975 and Later DE, DE-3, DE-4 - Exploded View



1. End cover bolt (2)
2. Bolt (4)
3. End cover
4. Oil seal
5. Seal
6. Nylon washer
7. Brush cover (4)
8. Brush spring (4)
9. Brush (4)
10. Screw (4)
11. Bolt (2)
12. End cover
13. Armature
14. Brush holder
15. Screw (2)
16. Terminal hardware
17. Terminal hardware
18. Screw (3)
19. Bearing
20. Bearing retainer
21. Terminal assembly (2)
22. Field coils
23. Insulated washer (4)

Figure 5-57. G.E. Traction Motor - 1975 and Later DE, DE-3, DE-4 - Exploded View

DISASSEMBLING TRACTION MOTOR (AMF-1975 and Later Models) (Figure 5-56)

Remove motor from car as described previously. Items 1 through 7 have been disassembled while removing motor from car.

Remove brush cover (8) by removing screw (9). Be careful not to lose speed nut (10). Unhook brush springs (11) from brushes (12). Loosen screws (13) securing brush pigtail terminals and pull out brushes.

Remove two bolts (14) and washers (15). Remove end cover (16) and armature (17) assembly. To disassemble brush holder (18) from end cover, remove screws (19) and washers (20).

DISASSEMBLING TRACTION MOTOR (GE - 1975 and Later Models) (Figure 5-57)

Remove motor from car as described previously. Items 1 through 6 have been disassembled while removing motor from car.

Remove brush covers (7). Unhook brush springs (8) from brushes (9). Loosen screws (10) securing brush pigtail terminals and pull out brushes.

Remove two bolts (11). Remove end cover (12) and armature (13) assembly. To disassemble brush holder (14) from end cover, remove screws (15).

INSPECTION AND REPAIR

COMMUTATOR

If commutator bars are deeply pitted or grooved in the brush track, the commutator must be refinished.

To refinish commutator, mount armature in a lathe and diamond turn the commutator. Limit the depth of cut to 0.005 inch or less and repeat cut as often as required. Do not reduce the diameter on the AMF motor to less than 2.745 inches. Do not reduce the diameter on the GE motor to less than 2.625 inches.

If turning eliminates undercut of mical insulation between commutator bars, undercut approximately 1/32 inch. Finish turn commutator after undercutting mica. After refinishing commutator, check it for eccentricity. It should not exceed 0.001 inch runout.

Clean and assemble motor.

OIL SEAL

If, upon inspection, the commutator or field coils appear oily, this is a symptom of a faulty oil seal allowing the differential lubricant to pass into the motor. Oil or grease on a commutator will induce sparking, resulting in undesirable commutator and brush wear. Clean any oil or grease from commutator or field coils by wiping with kerosene soaked cloth.

To replace oil seal, drive out old seal with a suitable punch and hammer. Press new oil seal into position using a suitable press plug. Locate seal in end cover so that lip on seal faces inside of motor.

COMMUTATOR END BEARING

The commutator end bearing is a prelubricated, sealed type bearing that cannot be relubricated. Check bearing by turning with fingers. Check for binding and dirt and for excessive looseness and wobble.

If bearing is defective, replace as follows:

Remove old bearing with a claw puller. On AMF motors, lock ring (23), Figure 5-12, must be removed first.

Press new bearing on the shaft applying steady pressure to inner race only. Hammer blows will damage the bearing.

ARMATURE WINDINGS

Deep burned sections evident either in the brush track or on the riser ends of the commutator bars are a symptom of an open circuit in the rotor winding.

Rotor conductors which are abnormally black or appear burned as compared to other commutator rotors indicate shorted and/or grounded rotor windings. If such evidence is detected, the rotor should be checked as follows with a Sun Model AT-76 armature tester.

Open Circuit Rotor winding can be determined with commutator probes between adjacent bars to check output of each coil — meter should give uniform readings.

Grounded Rotor winding can be determined by testing with continuity tester probes from any commutator bar to the armature shaft — lamp should not light.

Shorted Rotor winding can be determined by laying a hack saw blade across the rotor laminations — a shorted winding will magnetize the shorted coil.

The armature is not normally rewound because of cost. If the armature is grounded, shorted, or has open coils, replace with a new armature.

FIELD COILS

If the insulation on the field coils appears blackened or charred, the serviceability of the coils is questionable. Burned or scorched coil insulation is a symptom of coil overheating due to overloads, grounded, or short circuited winding.

To check the windings electrically for grounds or open circuits, a continuity tester, megger, and ohmmeter are required.

A grounded field winding may be checked using the Model AT-76 continuity tester probes between terminal stud labeled S1 or S2 and motor frame — lamp should not light. This test may not show a high resistance short which can be determined by checking with a high potential tester (megger) in place of the circuit tester.

The open field winding may be determined by using a continuity tester connected between terminals S1 and S2 — lamp should light.

The short circuited field winding may be determined by measuring the field winding resistance between terminal S1 and S2 — resistances should be 0.012 ohms for the AMF motor and 0.018 ohms for the GE motor. Tolerances are plus or minus 0.003 ohms at 77°F.

REASSEMBLING TRACTION MOTOR (1975 and Later Models)

Reassembly of both motors is the reverse of disassembly. End cover bolts are tightened to 90 to 100 in. lbs. torque.

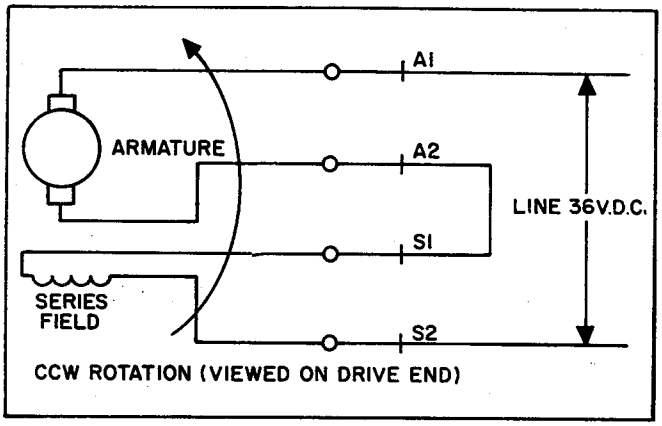
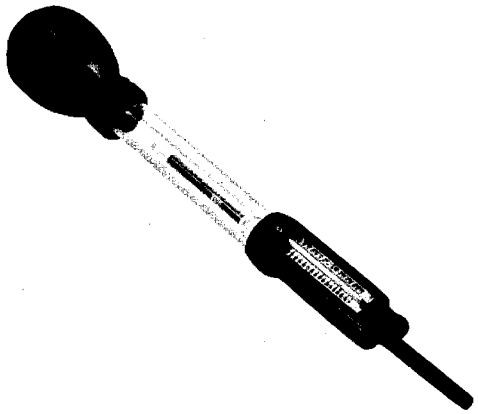


Figure 5-58. Traction Motor Test Wiring Diagram

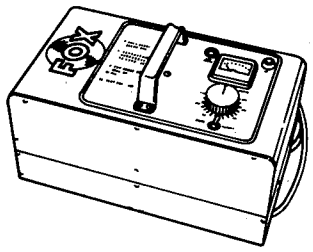
TESTING TRACTION MOTOR

Make connections shown on wiring diagram (Figure 5-58) with heavy cable. Be sure to secure frame before applying load.



96802-63 BATTERY HYDROMETER

For testing charge condition of batteries. Has built-in thermometer to correct readings for extremes in temperature.



FOX BATTERY TESTER MODEL NO. 450

For checking Electric Car battery bank (36 V.) capacity, to determine if batteries are in good condition.

Order from Fox Products Co., Philadelphia, Pennsylvania.