AMF

Harley-Davidson

SERVICE MANUAL

DE-40

Electric Golf Car

1976 to 1977

PART NO. 99494-77

1976 & 1977 DE-40 ELECTRIC CAR SERVICE MANUAL

The maintenance and repair information in this manual applies to the 1976 and 1977 Harley-Davidson DE-40 Electric Car.

PART NO. 99494-77

Printed in U.S.A.

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 Harley-Davidson product and assist him in performing basic maintenance and repair. Secondly, it will introduce to the professional Harley-Davidson mechanic the latest field-tested and factory-approved major repair methods. We sincerely believe that this manual will make your association with Harley-Davidson 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 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 Harley-Davidson 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 Harley-Davidson replacement parts.

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

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

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GENERAL

SPECIFICATIONS

GENERAL FEATURES

Model ..... DE-40, Electric Golf Car
4 Speeds Forward with Reverse
Maximum Speed on Level Ground ..... 11 mph
Turning Radius ..... 10 ft.

DIMENSIONS

Wheelbase ..... 69.8"
Overall Length ..... 94.5"
Overall Width ..... 45"
Overall Height ..... 45"
Ground Clearance ..... 4.5" Minimum
Weight (with batteries) ..... 900 lbs

TRACTION MOTOR

Type ..... Series wound - reversible
Rating ..... 2 hp @ 2800 rpm
7 hp Intermittent Rating
Manufacturer ..... General Electric or AMF
Electrosystems Division

TRANSMISSION

Motor direct coupled to differential assembly
Differential Capacity
(1976) ..... 32 oz. - Differential Lubricant
Differential Capacity
(1977 and Later)... 24 oz. - Differential Lubricant

BRAKE

Disc brake on drive shaft is mechanically operated. Brake pedal incorporates ratchet lock for parking, with automatic release controlled by accelerator pedal.

TIRES

Size ..... 8.50 x 8
Air Pressure ..... 12 psi - front and rear

BATTERIES

Type .... 6 volt, lead-acid storage battery - 6 used
Rating .... each - 190 ampere hours @20 hour rate
Charging Rate (total for six 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 located on the frame member in the left battery compartment.

LETTERS	MODEL NO.	SERIAL NO.	MFR	YEAR
DE-40	8D	10000 and up (5 digits)	H Harley-Davidson	7 (1977)

Traction motor serial number may be found on an identification plate located on the motor frame.

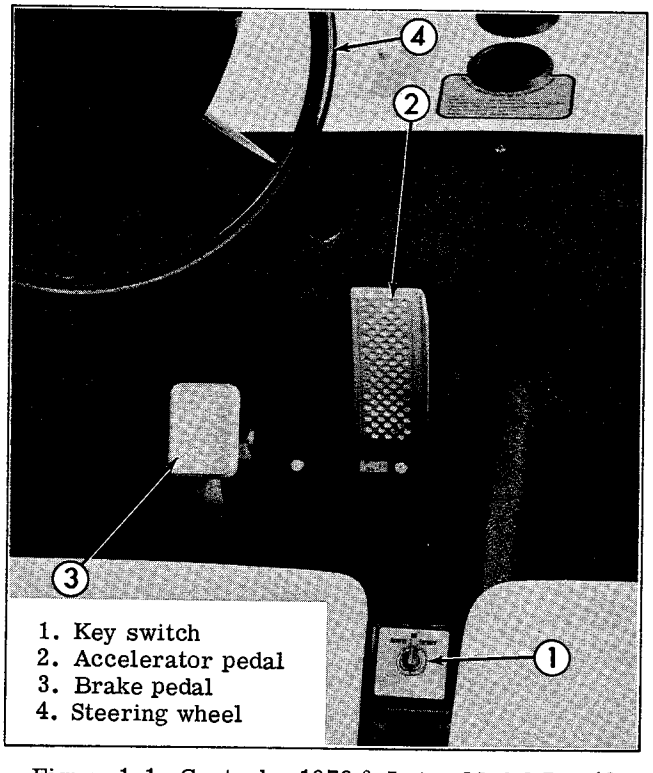
Always give these identification numbers when ordering parts or making inquiries.

CONTROLS AND OPERATION

CONTROLS (Figure 1-1)

Four controls are used to operate the Harley-Davidson DE-40 Electric Golf Car. To drive, turn key switch to desired position and depress accelerator pedal. Depress brake pedal to stop.

1. The switch requires key to operate and locks in "OFF" position when key is removed. Turn switch to "FORWARD" position to run car forward. Turn to "REVERSE" position to run car in reverse. A warning buzzer sounds when key is in "REVERSE" position.



1. Key switch
2. Accelerator pedal
3. Brake pedal
4. Steering wheel

Figure 1-1. Controls, 1976 & Later Model DE-40

2. Accelerator pedal controls speed of car. Slowly depress accelerator pedal to reach full speed. Speed is controlled through four stages for gradual acceleration.

3. Depress foot brake pedal to operate brake. To lock brake for parking, depress pedal and tilt forward.

Brake automatically releases when accelerator is depressed. Steering wheel controls direction of travel of the car.

DRIVING TIPS

Operating the DE-40 Electric Golf Car requires the normal precautions and driving ability such as are used when driving any vehicle. However special care is recommended when driving over rough and hazardous terrain.

— Drive slowly when making sharp turns.

— If possible, drive straight up and down hills and inclines.

— Do not use accelerator to hold car on a hill — use brake. Operate car in top speed whenever possible. Lower speeds waste energy and reduce range of car.

— Do not leave seat until car is brought to a complete stop.

— For personal safety, keep arms and legs inside car while it is in motion.

— Drive slowly when making turns on an incline.

— Do not reverse car while it is in motion.

— Do not leave car unattended unless key switch is "OFF" and foot brake is locked, since accidental movement of the accelerator pedal will put car in motion or car may coast down an incline. Park car on a level surface whenever possible.

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 Electric Car 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	Steering Wheel	Check operation and adjust if necessary.
X	X	Tires	Check pressure and correct if necessary. (See "Specifications," Section 1)
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	Speed Switch	Check condition of speed switch contacts.
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.

IMPORTANT

Rear axle mounting U-bolt torque must be checked after first two days or 36 holes of operation. Torque to 30 ft. lbs. (4 nuts).

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 Figure 1-2 when using the chart.

REGULAR SERVICE CHART

Regular Service Interval	Fig. Index No.	Service	Fig. Index No.	Lubrication
Daily	1	Charge batteries after each usage as shown in chart below.		
		CHARGING TIME CHART Using automatic charger		
		GOLF CAR USAGE: CHARGING TIME		
		9 Holes: 7 Hours		
		18 Holes or More: 12 Hours		
Weekly	2	Check electrolyte.	2	Clean tops of batteries and terminals.
Every Month	3	Check tire pressure. (See "Specifications," Section 1)		
	4	Adjust brake shoes.		
	5	Check speed switch contacts.		
Every 2 Months	2	Check electrolyte and charge batteries when in storage.		
Every Year	6	Check motor brushes and commutator.		Check lubricant level
			8	Differential housing
			9	Steering gear housing
				Oil
			10	Speed switch rod
			11	Brake cable ends
			2	Battery terminal felts
			12	Brake and accelerator pedal bearings
				Grease
			13	Speed switch pivot shaft
			14	Brake shoe cam
			See Fig. 2-27	Front suspension
	7	Check steering wheel play and adjust if necessary.		
	—	Check tightness of all nuts and bolts.		

LUBRICANTS TO USE

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

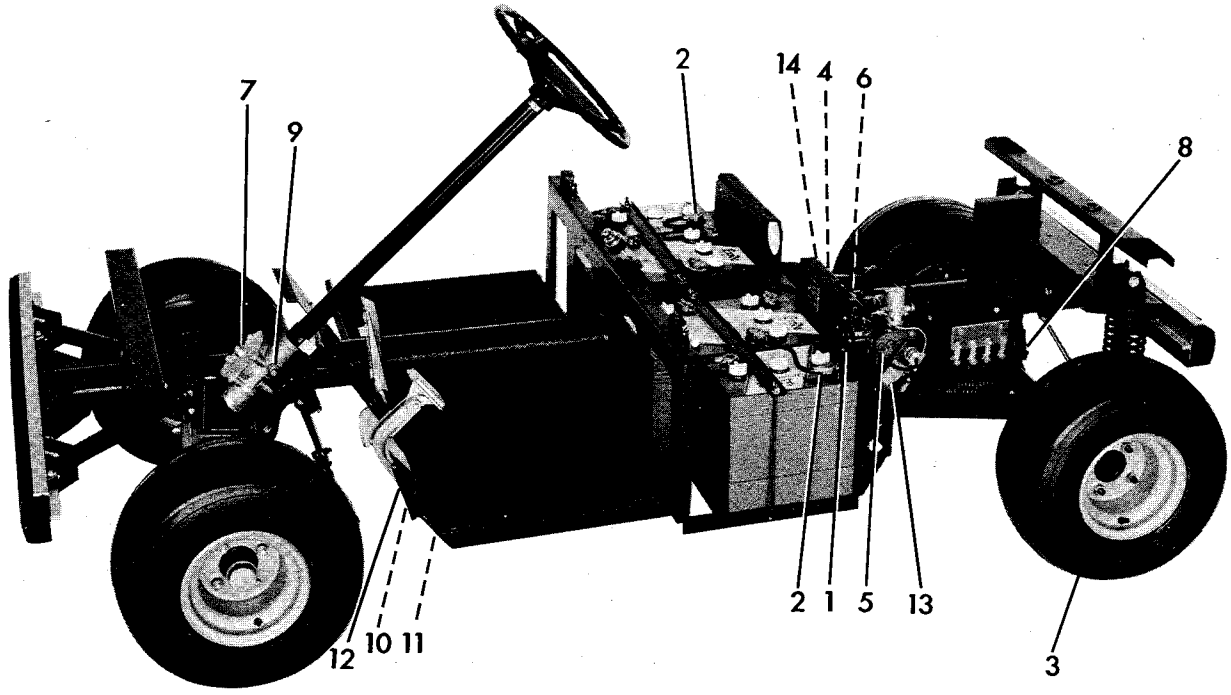


Figure 1-2. Lubrication and Service Chart

LOCATING TROUBLES

Your Harley-Davidson DE-40 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 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.

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 (Top Speed Too Low)		
Brake adjusted too tight.	Check brake adjustment.	2 BRAKE
Speed switch adjustment.	Check adjustment.	5 SWITCHES
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

TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
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
Snap switch defective.	Check operation of snap 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 solenoid (R) defective.	Check operation of reverse solenoid.	5 SWITCHES
Forward solenoid (F) stuck closed.	Check operation of forward solenoid.	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 solenoid (R) stuck closed.	Check operation of reverse solenoid.	5 SWITCHES
Forward solenoid (F) defective.	Check operation of forward solenoid.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and solenoids.	5 WIRING DIAGRAM

TROUBLE LOCATION CHART (CONT)

SYMPTOM AND CAUSE	CHECKS TO MAKE	REFER TO SECTION
CAR OPERATES IN ONE OR MORE SPEEDS, BUT NOT ALL		
Defective speed switch.	Check speed switch contacts and connections.	5 SWITCHES
Broken resistor.	Check resistor.	5 SWITCHES
Defective wiring - broken or shorted wires, loose terminal connections.	Check wiring continuity leading from speed switch and 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
RAPID SPEED SWITCH CONTACT BURNING		
Snap switch adjustment.	Check snap switch adjustment.	5 SWITCHES
HARD STEERING		
Dirty or low lubricant in gearbox.	Check gearbox lubricant level.	2 STEERING
Low tire pressure.	Check tire pressure.	2 WHEELS
Excessive wheel "toe-in" or "toe-out".	Check wheel alignment.	2 WHEELS
EXCESSIVE PLAY IN STEERING		
Gearbox mechanism out of adjustment.	Check and adjust.	2 STEERING

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)
Leafspring to
Kingpin Nut . . . . . 28-32 ft.-lbs. (3.9-4.5 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)							
mm	in.	mm	in.	mm	in.	mm	in.
.1	.0039	25	.9842	58	2.283	91	3.582
.2	.0078	26	1.024	59	2.323	92	3.622
.3	.0118	27	1.063	60	2.362	93	3.661
.4	.0157	28	1.102	61	2.401	94	3.701
.5	.0197	29	1.142	62	2.441	95	3.740
.6	.0236	30	1.181	63	2.480	96	3.779
.7	.0275	31	1.220	64	2.519	97	3.819
.8	.0315	32	1.260	65	2.559	98	3.858
.9	.0354	33	1.299	66	2.598	99	3.897
1	.0394	34	1.338	67	2.638	100	3.937
2	.0787	35	1.378	68	2.677	101	3.976
3	.1181	36	1.417	69	2.716	102	4.016
4	.1575	37	1.456	70	2.756	103	4.055
5	.1968	38	1.496	71	2.795	104	4.094
6	.2362	39	1.535	72	2.834	105	4.134
7	.2756	40	1.575	73	2.874	106	4.173
8	.3149	41	1.614	74	2.913	107	4.212
9	.3543	42	1.653	75	2.953	108	4.252
10	.3937	43	1.693	76	2.992	109	4.291
11	.4331	44	1.732	77	3.031	110	4.331
12	.4724	45	1.772	78	3.071	111	4.370
13	.5118	46	1.811	79	3.110	112	4.409
14	.5512	47	1.850	80	3.149	113	4.449
15	.5905	48	1.890	81	3.189	114	4.488
16	.6299	49	1.929	82	3.228	115	4.527
17	.6693	50	1.968	83	3.268	116	4.567
18	.7086	51	2.008	84	3.307	117	4.606
19	.7480	52	2.047	85	3.346	118	4.645
20	.7874	53	2.086	86	3.386	119	4.685
21	.8268	54	2.126	87	3.425	120	4.724
22	.8661	55	2.165	88	3.464	121	4.764
23	.9055	56	2.205	89	3.504	122	4.803
24	.9449	57	2.244	90	3.543	123	4.842

INCHES to MILLIMETERS (inches x 0.03937 = mm)							
in.	mm	in.	mm	in.	mm	in.	mm
.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
.1	2.540	1 1/16	36.51	2 13/16	71.44	4.2	106.68
1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

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CHASSIS 2

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DRIVE

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 (1977 and later) or to 1/2 inch below filler plug hole (1976). A bent wire may be used as a dipstick. See Figure 2-1. Harley-Davidson Differential 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 1976 models, remove differential cover fastened with bolts to drain and flush. On 1977 and later models, differential must be removed from car and disassembled for flushing.

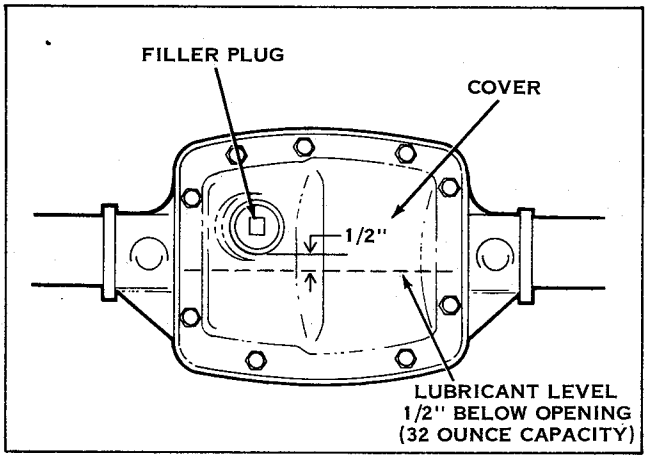


Figure 2-1. Differential Filler Plug and Cover (1976)

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

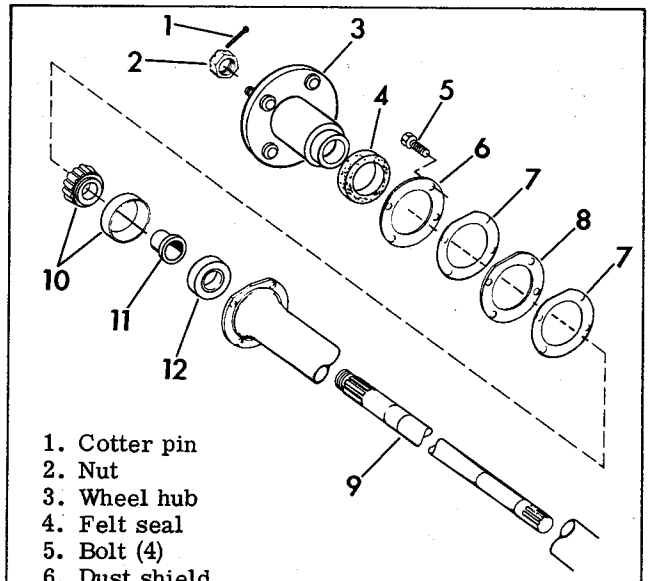
Rear axle noise can be confused with other noises in the car. Considerable care should be taken in the diagnosis of noises before deciding that the trouble is in the rear axle assembly.

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.

AXLES

REMOVING AXLE SHAFT - 1976 (Figure 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.



1. Cotter pin
2. Nut
3. Wheel hub
4. Felt seal
5. Bolt (4)
6. Dust shield
7. Gasket (2)
8. Bearing retainer
9. Axle
10. Bearing cone and cup
11. Sleeve
12. Oil seal

Figure 2-2. Rear Axle (1976) - Exploded View

Block car clear of ground and remove wheel (See WHEELS, Section 2). Wash flange end of axle free of dirt.

Remove cotter pin (1) and axle shaft nut (2). Wheel hub (3) fits a straight splined shaft and can be removed with an automotive type hub puller. Remove felt seal (4). Remove the four bolts (5) holding the dust shield to axle housing flange. Remove dust shield (6), gasket (7), bearing retainer plate (8) and other gasket (7). The axle shaft (9) is held in the axle housing by the bearing (10) and sleeve (11). The end of the axle shaft in the differential is a splined fit in the differential bevel gear and can be pulled out of the housing using an axle puller. If cup portion of bearing (10) remains in axle housing it may be removed with a puller. Bearing (10) and sleeve (11) may now be pressed off axle. Clean bearing and inspect to determine whether or not it is suitable for further service. Bearing (10) is a preset spacer bearing. The cup and cone are epoxied together during manufacture but usually split apart when axle shaft is removed from axle housing. If bearing is not worn, it may be reused even if it has split apart. Clean and inspect oil seal (12) and replace if necessary.

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

INSTALLING AXLE SHAFT - 1976 (Figure 2-2)

Press oil seal (12) into axle housing. Press sleeve (11) and bearing (10) onto axle shaft (9). If new bearing is used, cup side of bearing should face into axle housing. If old bearing is reused, press bearing cup into axle housing. Pack bearing with Harley-Davidson Bearing Grease 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 gaskets (7), bearing retainer (8), dust shield (6) and bolts (5). Assemble felt seal (4) to wheel hub. Coat spline on end of axle with Loctite 601. Assemble wheel hub (3) to axle shaft. Turn on axle shaft nut (2) and tighten to 50 ft.-lbs. torque. Then tighten until nearest cotter pin hole lines up. Install cotter pin (1).

REMOVING AXLE SHAFT - 1977 AND LATER (Figure 2-2A)

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 - 1977 AND LATER (Figure 2-2A)

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.

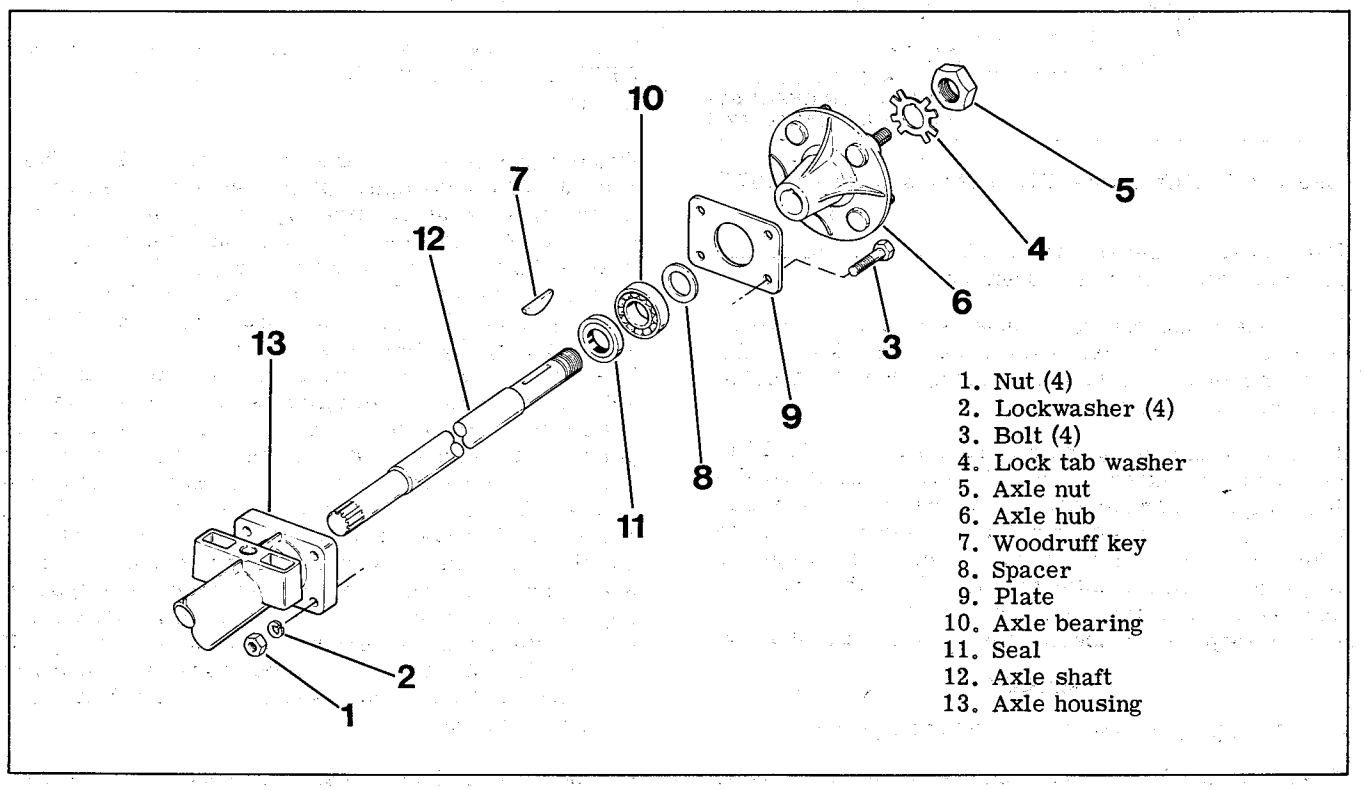


Figure 2-2A. Rear Axle - Exploded View

DIFFERENTIAL

REMOVING REAR AXLE AND DIFFERENTIAL ASSEMBLY - 1976 (Figure 2-28)

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

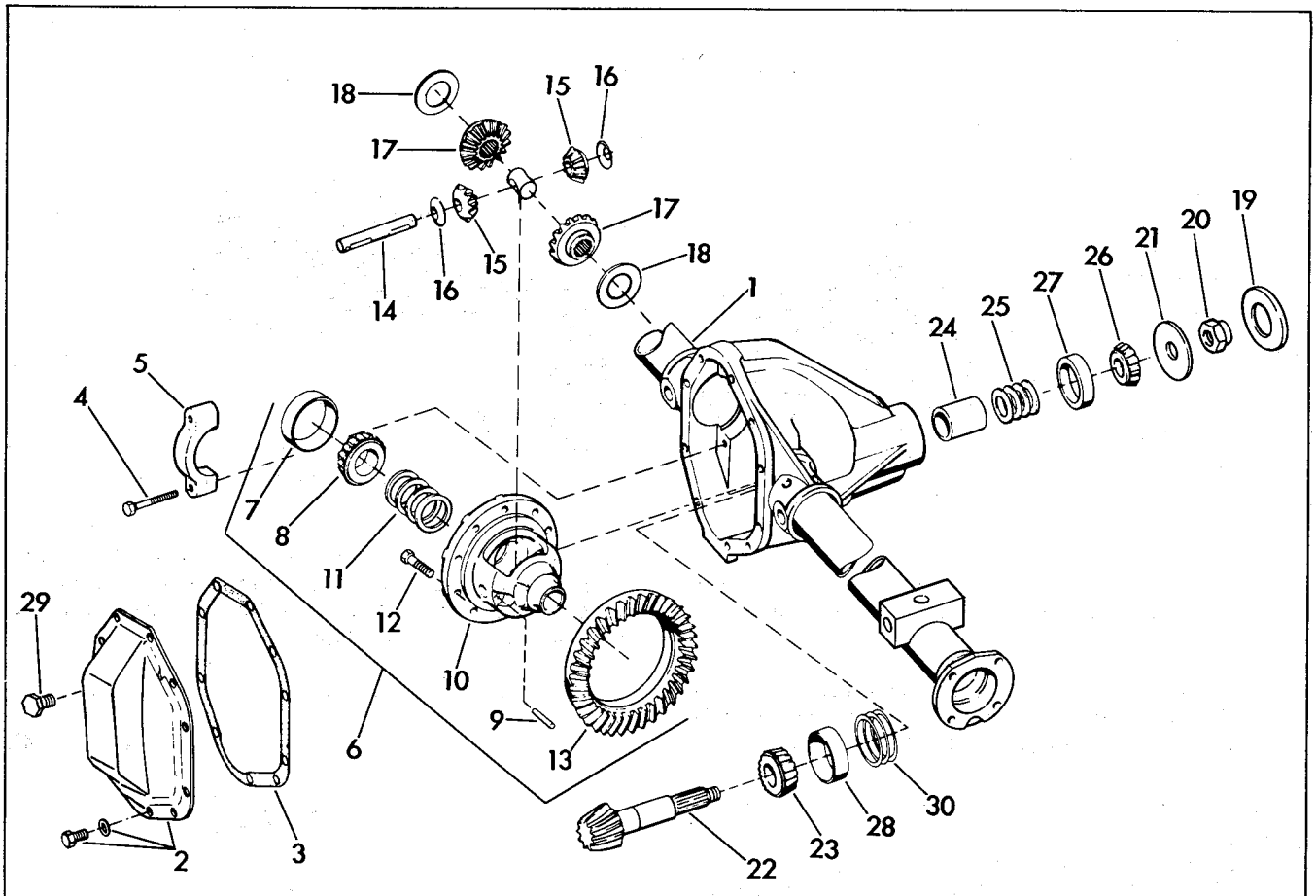
Block car clear of ground, supporting rear frame section, not under differential housing. Disconnect electric motor wiring. Remove disc brake caliper assembly (see BRAKE). Remove rear wheels (see WHEELS). Remove sway bar (1) and lockwasher (2) from axle housing. Do not remove sway bar from frame. Remove eight locknuts (3) and four U-bolts (4). Remove U-bolt brackets (5) and axle mounting pads (6).

Remove motor from axle and differential assembly (see MOTOR).

DISASSEMBLING DIFFERENTIAL CASE AND DRIVE PINION - 1973-1976 (Figure 2-3)

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 REMOVING AXLE SHAFT.



1. Rear axle and differential assembly
2. Cover bolts and cover
3. Gasket
4. Bolt (4)
5. Bearing cap (2)
6. Case assembly
7. Bearing cup (2)
8. Bearing cone (2)
9. Lock pin
10. Case
11. Shims
12. Screw (10)
13. Drive gear
14. Pinion mate shaft
15. Pinion mate gear (2)
16. Thrust washer (2)
17. Side gear (2)
18. Thrust washer (2)
19. Pinion nut cup
20. Pinion nut
21. Oil slinger
22. Drive pinion shaft
23. Bearing cone
24. Sleeve
25. Shims
26. Bearing cone
27. Bearing cup
28. Bearing cup
29. Filler plug
30. Shims

Figure 2-3. Differential Assembly (1976) - Exploded View

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

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

3. Flush differential gears, bearings, and other internal parts of gear carrier with a non-flammable cleaning solvent. At this point, rotate drive gear, check drive gear back face for runout with a dial test indicator. See Figure 2-4. 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.

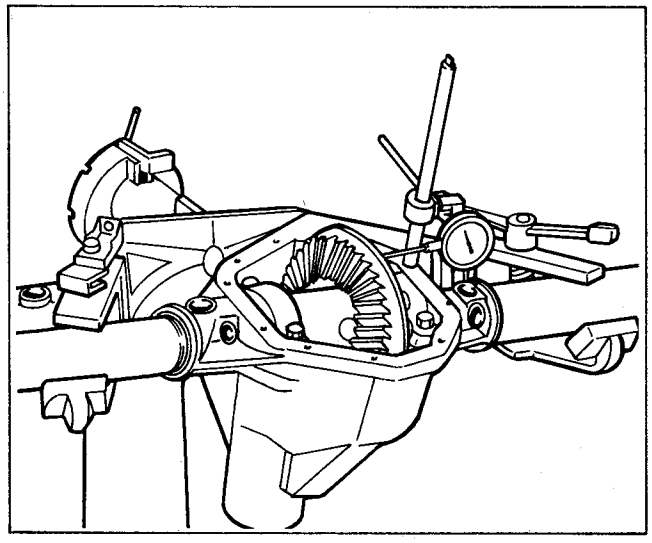


Figure 2-4. Check Drive Gear for Runout

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

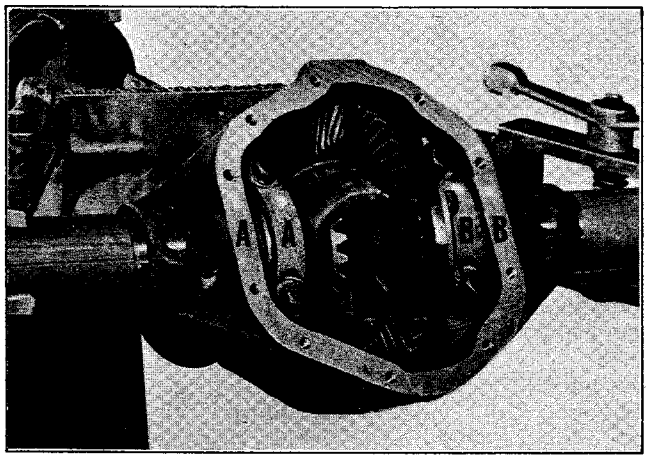


Figure 2-5. Carrier and Bearing Cap Matching Marks

5. Pry differential case assembly (6) 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 (7) from differential case bearings (8). 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 (9) securing differential pinion mate shaft to case (10). See Figure 2-6.

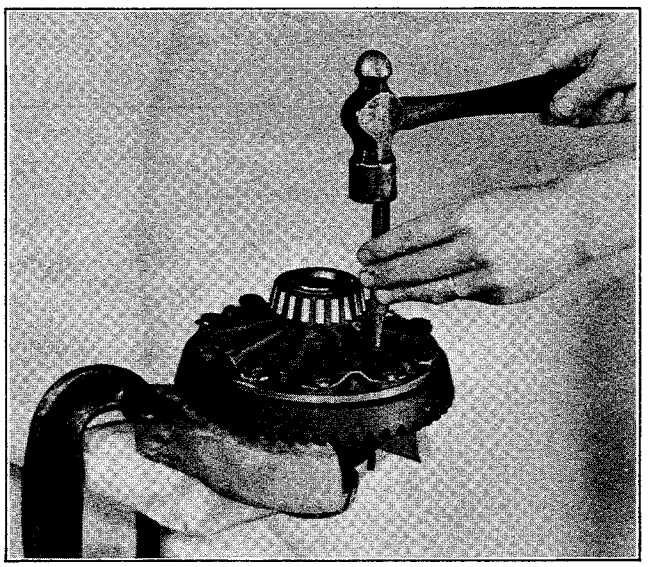


Figure 2-6. Removing Lock Pin

8. Remove differential bearing cones (8). 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.

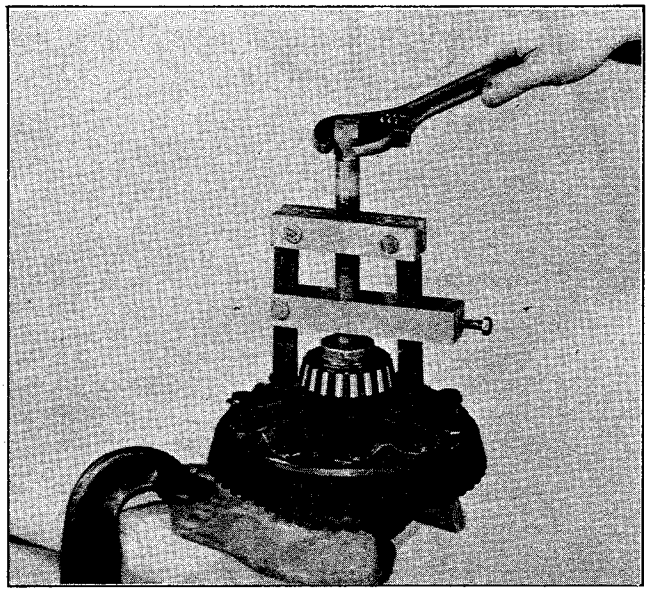


Figure 2-7. Bearing Cone Removal

9. Remove shims (11). NOTE: If drive gear and drive pinion are to be reassembled, note position of shims and replace accordingly.

10. Remove screws (12) and drive gear (13).

11. Remove differential pinion mate shaft (14), differential pinion mates (15) and thrust washers (16), (one back of each pinion). Remove differential side gears (17) and thrust washers (18), (one back of each gear).

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

13. Remove pinion nut cup (19). Remove and discard pinion shaft nut (20). Remove oil slinger (21).

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 (23) will remain on shaft. Remove bearing cone (26), bearing spacer sleeve (24) and adjusting shims (25), placing these parts with pinion shaft.

NOTE

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

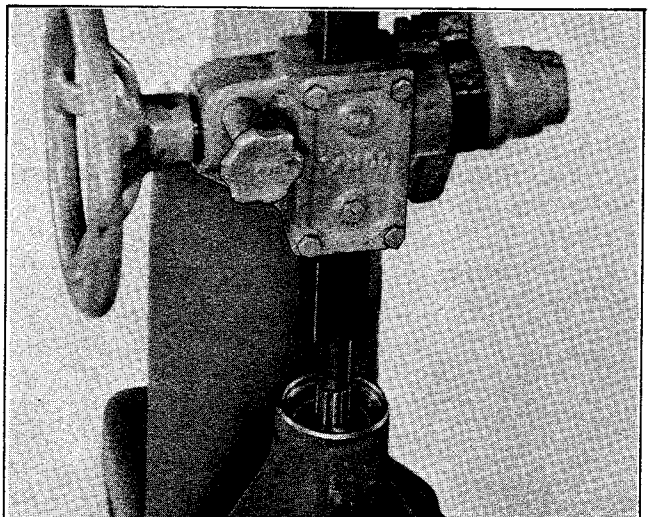


Figure 2-8. Pressing Shaft Out

15. Remove drive pinion shaft rear bearing cone (23), with press tool similar to one shown in Figure 2-9.

16. Remove drive pinion shaft bearing cups (27) and (28) from housing with a drift or suitable puller. When removing bearing cup (28), remove adjusting shims (30), and record thickness of shims.

17. Wash all parts including carrier and tube assembly with non-flammable cleaning solvent. Do not steam to clean.

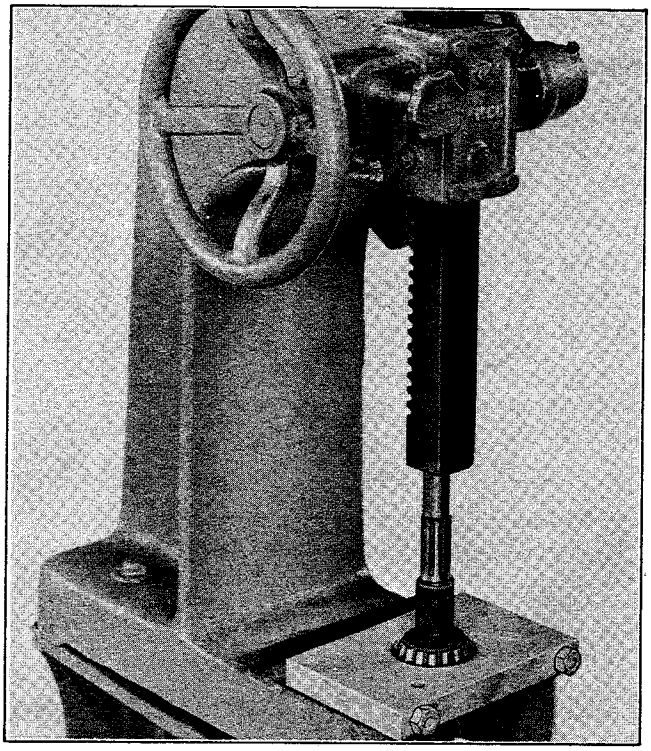


Figure 2-9. Removing Pinion Shaft Rear Bearing Cone

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

19. 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.

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

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

22. 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 - 1976

1. Install differential side gears (17) thrust washers (18), differential pinion mates (15), thrust washers (16), and differential pinion mate shaft (14) 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. Place differential case assembly (10) in a suitable holding fixture.

3. Align lock pin hole in differential pinion mate shaft (14) and drive in differential pinion mate shaft

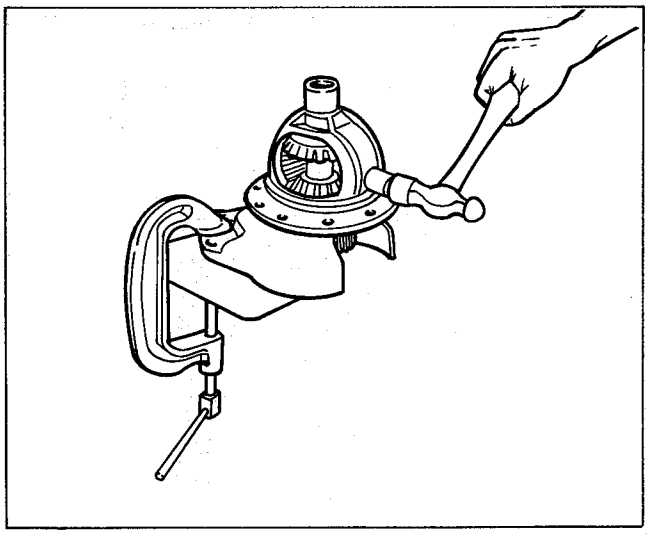


Figure 2-10. Peening Case Over Top of Pin

lock pin (9). Peen case metal over top of pin to lock in place (see Figure 2-10).

4. Install drive gear (13) with screws (12). Torque screws to 45 ft.-lbs.

5. Position under arbor press. Press on differential bearing cones (8) without shims (11). Use press tool similar to one shown in Figure 2-11.

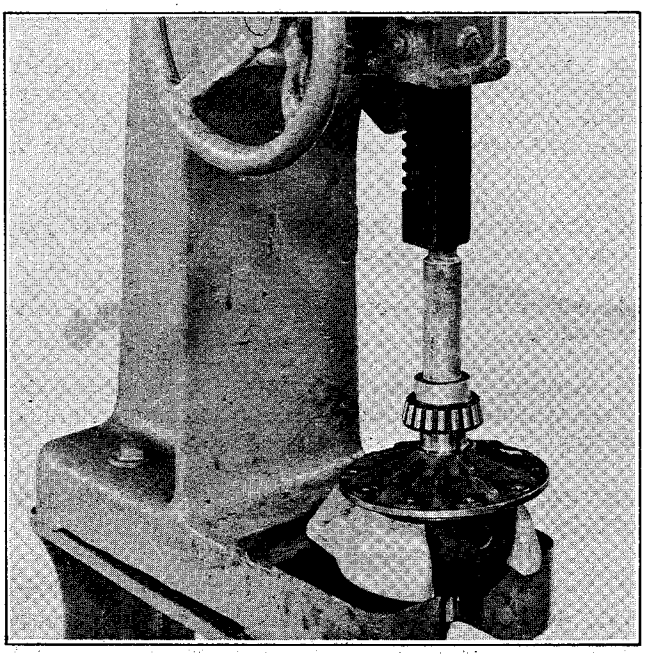


Figure 2-11. Pressing Bearing Cone On

6. Place bearing cups (7) on the bearing cones (8). 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 (10) in housing (1).

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

9. Set up dial indicator gage shown in Figure 2-12 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 2-13. This reading will be the shim pack thickness to be placed between bearing cone assembly (8) and differential case (10) later in the procedure.

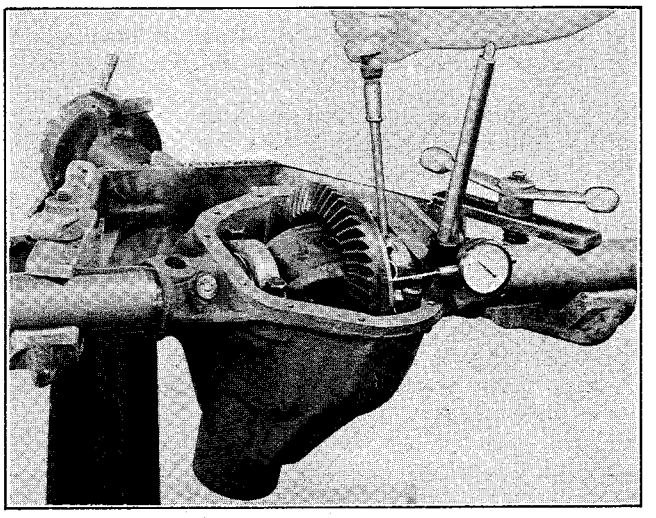


Figure 2-12. Dial Indicator Gage Set Up

10. Remove bolts (4), differential bearing caps (5) and place differential assembly (10) in a holding fixture or vise.

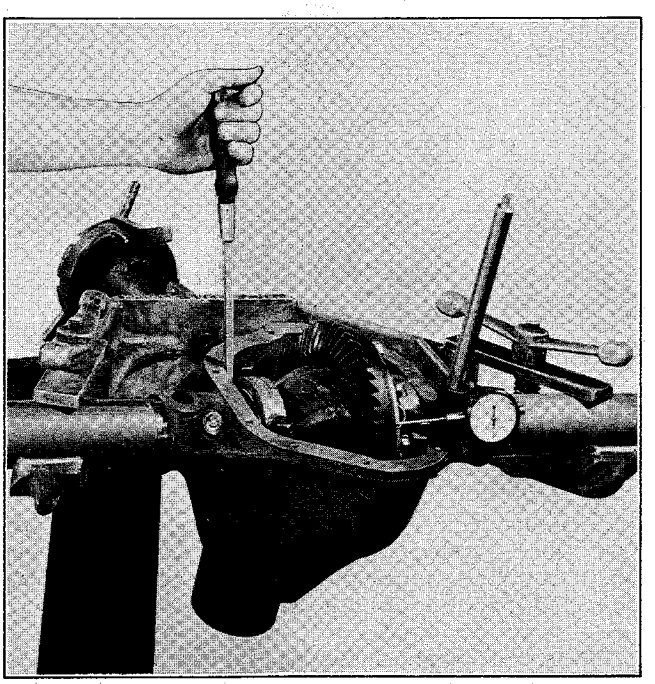


Figure 2-13. Dial Indicator Gage Reading

11. Note figures etched on drive pinion (22) end. See Figure 2-14. 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).

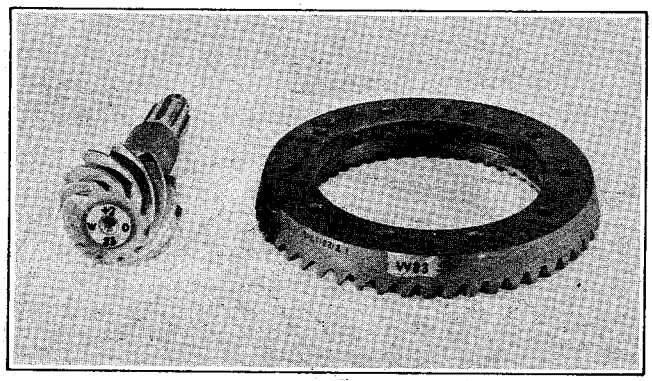


Figure 2-14. Drive Pinion and Drive Gear

12. Install drive pinion shaft rear bearing cone (23) and spacer (24) with press tool similar to one shown in Figure 2-15.

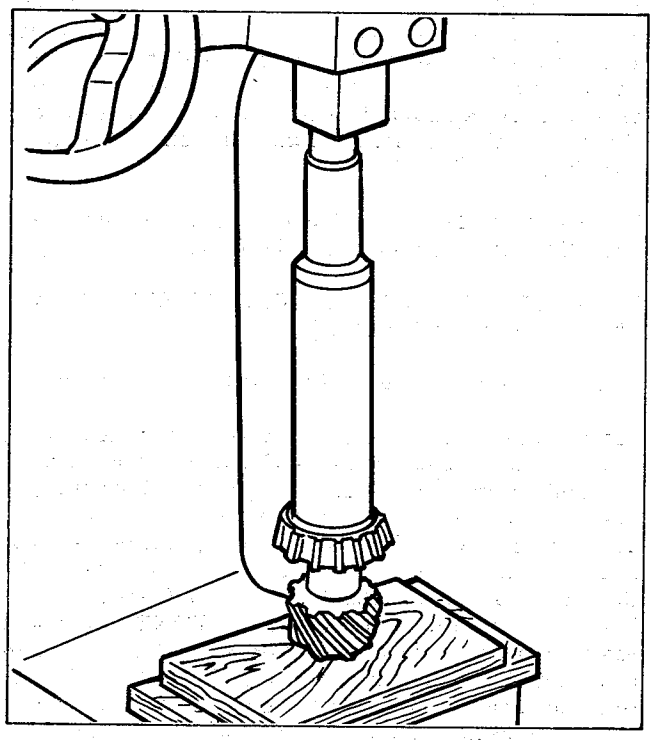


Figure 2-15. Installing Rear Bearing

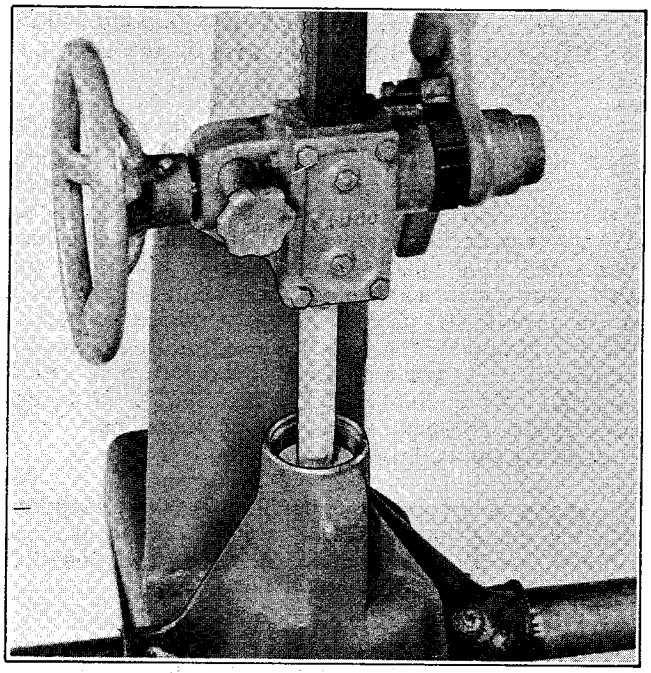


Figure 2-16. Installing Front Bearing Cup

13. Press drive pinion rear bearing cup (28) and shim pack (30) in carrier, using tool similar to one shown in Figure 2-16.

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 (27) in carrier with press tool similar to one shown in Figure 2-16. Install drive pinion shaft.

15. Press drive pinion shaft front bearing cone (26) 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 (30) from behind rear pinion bearing cup (28) to correct reading. See Step 13.

16. Install oil slinger (21) and pinion nut (20). Finish tightening nut with torque wrench and socket to 50 to 70 ft-lbs.

17. 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 2 to 13 in.-lbs. Torque reading to start shaft turning will be disregarded. If torque is more than 13 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", and .030". If torque reading is correct, stake top of pinion nut (20) in two places and install pinion nut cup (19).

18. Place drive gear and differential case assembly, bearing cups included, in carrier. Place bearing caps (5) in their respective positions, align identification marks, with screws (4) finger tight.

19. Move drive gear into drive pinion and, from shim requirements as determined in Step 9, place shims (11) between cup and carrier as shown in Figure 2-17. Force shims in both sides so as to use total required 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.

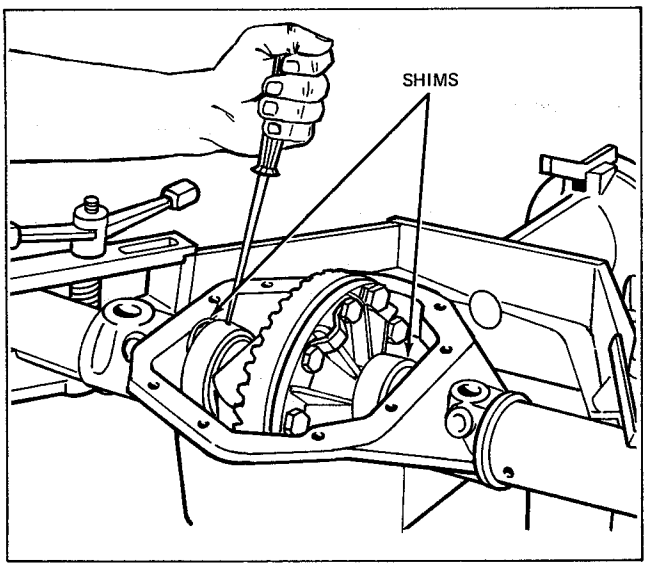


Figure 2-17. Adding Shims

20. Place differential case in fixture and remove differential bearing cones (8). Install shims as indicated in Step 19 against case (10) and then press on bearing cones. Lubricate bearings with differential lubricant.

21. Install differential drive gear and case assembly (6), including bearing cups (7), 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.

22. Install differential bearing caps (5). Bearing cap marks must match marks on carrier. Coat cap screw (4) threads with sealing compound, and torque screws to 45 ft.-lbs. Be sure all surfaces are clean and free from mutilation.

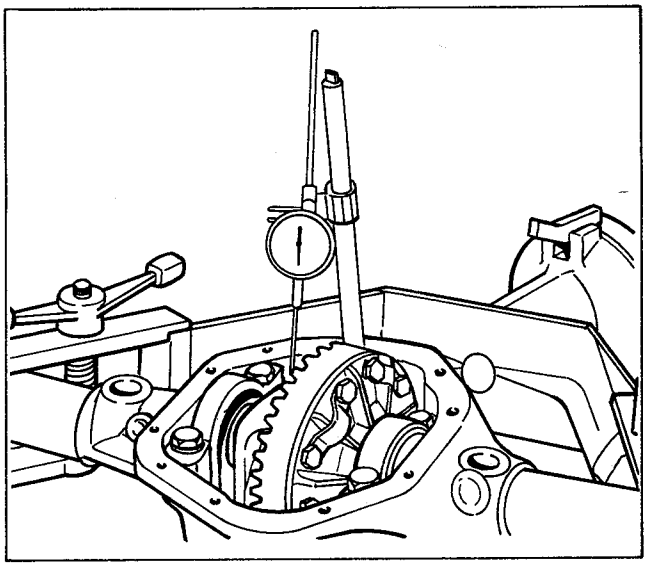


Figure 2-18. Checking Backlash

23. Set up dial indicator and with contact point on a drive gear tooth, check backlash between drive gear and drive pinion. See Figure 2-18. 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 19.

24. Install gasket (3) and cover (2) using a new gasket. Torque cover screws to 20 ft.-lbs.

INSTALLING REAR AXLE AND DIFFERENTIAL ASSEMBLY - 1976 (Figure 2-28)

Install electric motor (See MOTOR, Section 5).

Install axle and differential assembly in car using U-bolts (4), U-bolt brackets (5), axle mounting pads (6), and locknuts (3). Before tightening locknuts (3), install sway bar (1). Check to see that swing arms are square with frame. If swing arms are not square with frame, adjust length of sway bar until they are. Tighten locknuts (3) to 30 ft.-lbs torque. Install disc brake caliper (See BRAKE). Connect electric motor wiring (See WIRING). Fill rear axle differential with 32 oz. of Harley-Davidson Differential Lubricant. Axle mounting U-bolt nut (3) torque must be checked after first two days or 36 holes of operation. Torque to 30 ft.-lbs. torque.

REMOVING PINION AND PINION BEARING - LATE 1977 AND LATER (Figure 2-19)

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

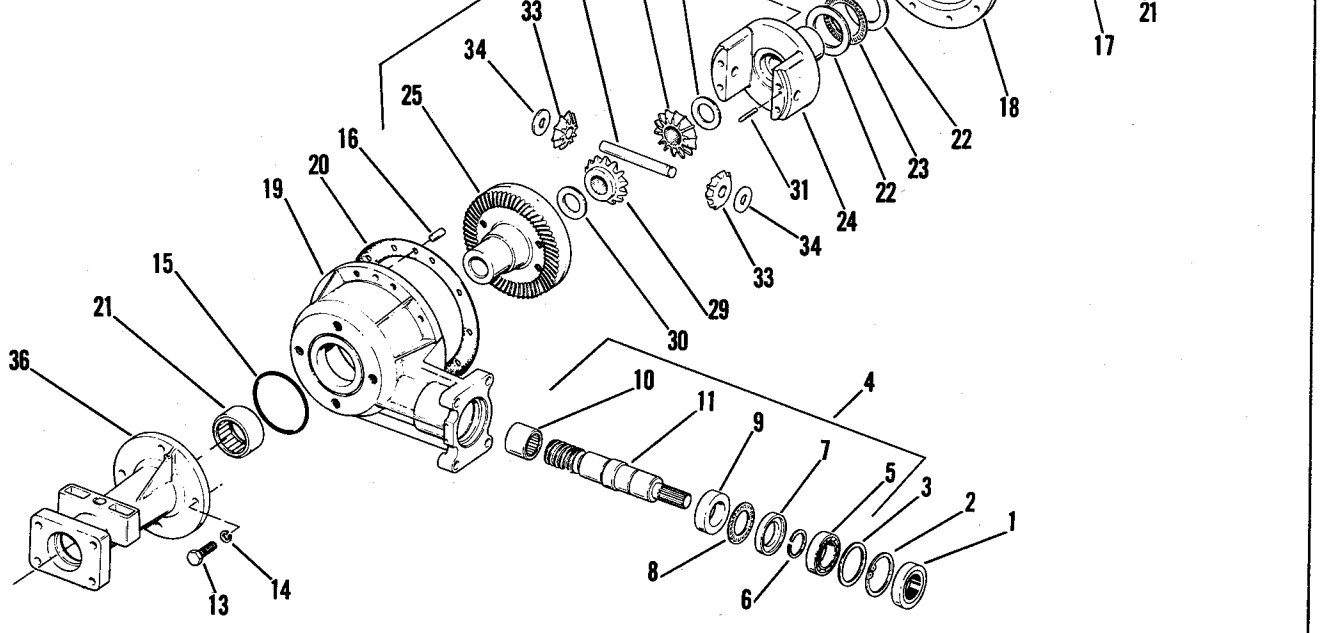
Drive gear and pinion are available in matched sets only. Do not replace one without replacing the other. Failure to replace both gears will result in excessive wear and premature breakdown.

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 - LATE 1977 AND LATER (Figure 2-19)

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



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

Figure 2-19. Differential Assembly - Late 1977 and Later - Exploded View

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 - LATE 1977 AND LATER (Figure 2-28)

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 (1) and lockwasher (2) from axle. Support differential assembly and remove eight locknuts, lockwashers (3) and four U-bolts (4) securing axles to frame.

DISASSEMBLY OF DIFFERENTIAL CASE - LATE 1977 AND LATER (Figure 2-19)

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.

3. Separate differential carrier (24) from ring gear (25) by removing the four bolts (26), lockwashers (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 - LATE 1977 AND LATER (Figure 2-19)

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) as shown in Figure 2-18A. 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 (14). Reinstall axles. See AXLES .

INSTALLING REAR AXLE AND DIFFERENTIAL ASSEMBLY - LATE 1977 AND LATER (Figure 2-28)

Install traction motor (see "TRACTION MOTOR") on differential. Install motor and differential assembly in car using U-bolts (4), locknuts and lockwashers (3). Be sure mounting pads (6) and bracket (5) are positioned properly on swing arms (7). Snug up locknuts (3) but do not tighten. Install sway bar (1) and adjust length until swing arms (7) are square with car frame. Tighten locknuts (3) 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 Differential 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 (Figure 2-20)

Raise front wheels off the ground with a small jack or lift. Remove hub caps, wheel rim mounting nuts, and wheel.

To remove wheel hubs, Figure 2-20, remove grease cap (1), cotter pin (2) and castle nut (3). Remove hub assembly (4) from axle (5).

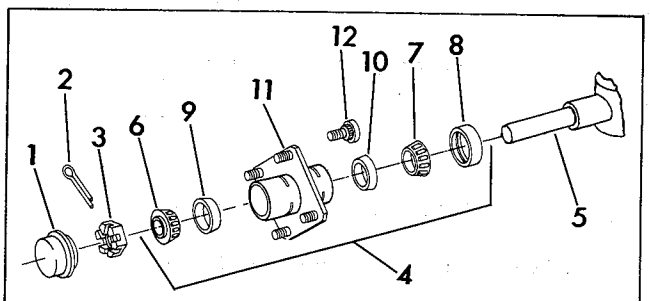
To disassemble wheel hub, remove bearings (6) and (7) from each side of wheel hub. If bearing cups (9) and (10) are worn or pitted, drift out from opposite sides of hub. This will also remove seal (8). Clean all parts and examine for damage or wear. Replace all damaged or worn parts.

Pack wheel bearing (6) and (7) with Harley-Davidson Bearing Grease. If bearing cups (9) and (10) have been removed, press new cups into hub (11). Install wheel bearings (6) and (7). Press seal (8) into hub with lip facing hub. Apply a small amount of grease to lip of seal and install hub assembly 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 lose rather than preloaded.

Assemble wheel to hub assembly (4) and tighten wheel rim mounting bolts. Install hub cap.

REMOVING AND INSTALLING REAR WHEELS

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



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

Figure 2-20. Front Wheel Hub - Exploded View

REMOVING TIRE FROM RIM, FRONT OR REAR WHEEL (Figure 2-20A)

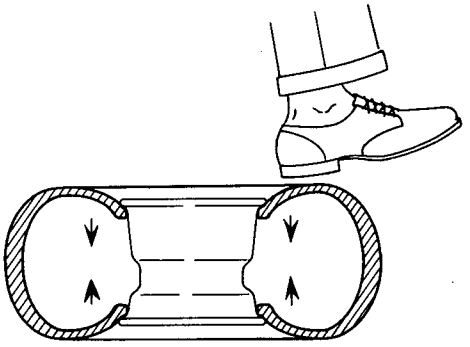
The car is fitted with low pressure tubeless tires.

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.

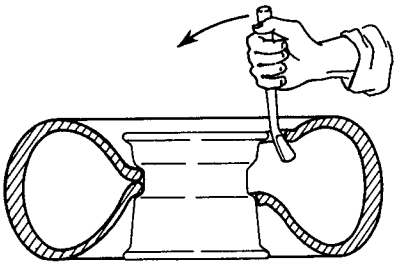
To remove tire from wheel rim, remove valve cap and valve core to free air from tire. Loosen both tire beads from rim flanges by stepping on tire side walls. Push tire bead off of wide rim flange into rim well. Using tire tools, carefully start upper bead over edge of wheel rim. Do not use excessive 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.

CHECK CHART

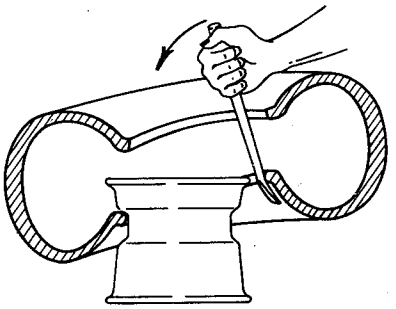
CHECK FOR	REMEDY
1. Loose axle nuts and rear wheel mounting nuts.	1. Tighten loose nuts.
2. Incorrect tire inflation.	2. Inflate front and rear tires. See specifications, Section 1.
3. Excessive freeplay in steering mechanism.	3. Adjust steering mechanism. See Section "Adjusting Steering Mechanism."



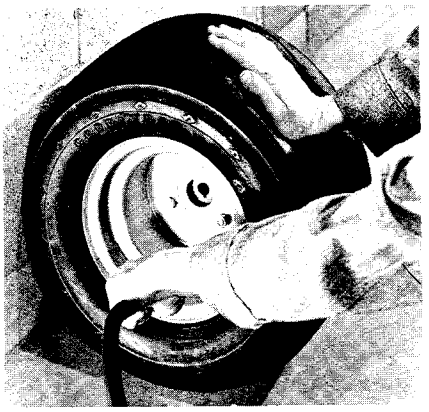
STEP I. BREAK TIRE BEADS FREE OF RIM



STEP II. REMOVING UPPER BEAD FROM RIM



STEP III. REMOVING LOWER TIRE BEAD FROM RIM



INFLATING TIRE

Figure 2-20A. Tire Replacement

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 rim 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 2-20. 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. 2-21, 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 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.

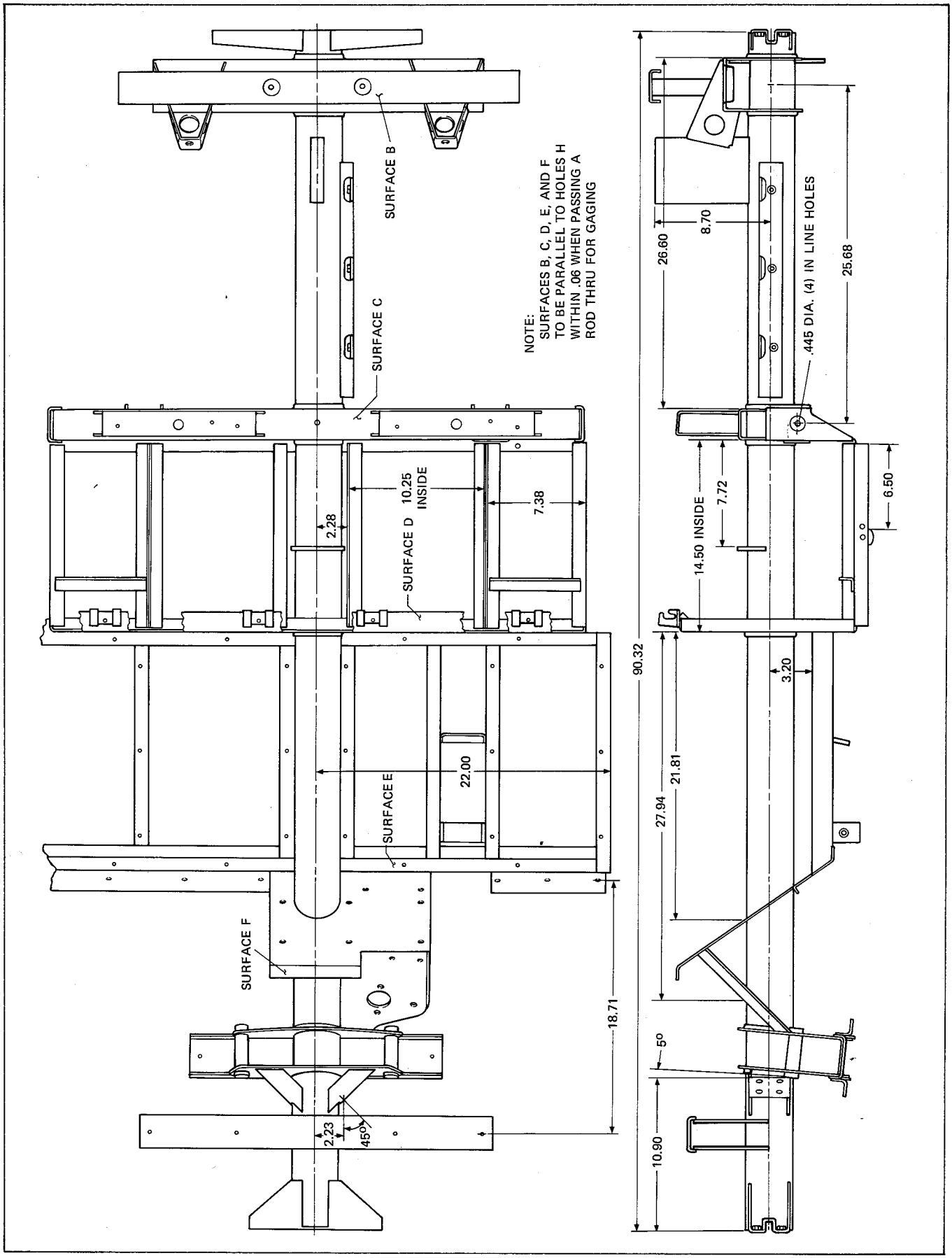


Figure 2-21. DE-40 Basic Frame Dimensions

STEERING AND SUSPENSION

STEERING

GENERAL

Steering linkage, Figure 2-22, does not require frequent lubrication. Lubricant level in steering gear housing should be checked yearly. Fill to level of hole with Harley-Davidson Transmission Lubricant as required. The 4 tie rod ball joints are lubricated and sealed at time of manufacture. The ball joints are provided with a plug which can be removed on a grease fitting installed for grease gun use if desired. If loss of seal occurs in gear unit, it must be disassembled for repair. Tie rod is serviced as an assembly.

1. Score card holder
2. Steering wheel nut
3. Steering wheel
4. Cup
5. Dust seal
6. Bushing
7. Steering column and gear unit
8. Locknut (2)
9. Steering stop plate
10. Nut and lockwasher
11. Steering arm
12. Bolt and lockwasher (3)
13. Steering stop
14. Locknut (2)
15. Bolt (2)
16. Clamp
17. Support block
18. Bolt and lockwasher (4)
19. Side cover
20. Gasket
21. Steering shaft
22. Oil seal
23. Locking cup
24. End cap
25. O-ring
26. Lower bearing race
27. Lower bearing ball cage
28. Worm shaft
29. Upper bearing ball cage
30. Upper bearing race
31. Plug
32. Adjusting screw locknut
33. Adjusting screw

Figure 2-22. Steering Wheel and Steering Gear - Exploded View

ADJUSTING STEERING GEAR UNIT & LINKAGE

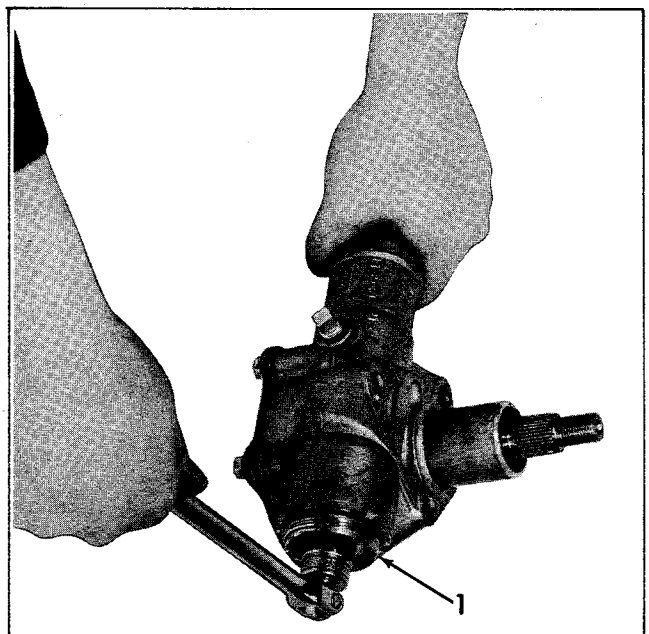
There are four adjustments on the steering gear unit and linkage.

1. Worm bearing preload adjustment.
2. Over-center adjustment.
3. Tie rod adjustment.
4. Camber adjustment.

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 gear arm from shaft splines. (See DISASSEMBLING STEERING GEAR ARM AND TIE ROD ASSEMBLY.)

1. Worm Bearing Preload Adjustment (Figure 2-23). Note that locking cup (23), Fig. 2-22, 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 locking cup. Turn cap inward to produce a slight amount of bearing drag and take out any up and down play in steering wheel shaft (See Figure 2-23). When the adjustment is finished, install locking cup, and use a punch to bend cup into housing notch to hold nut in position. Also stake edge of cup over end of nut to keep nut from turning.



1. End cap

Figure 2-23. Adjusting Worm Bearings

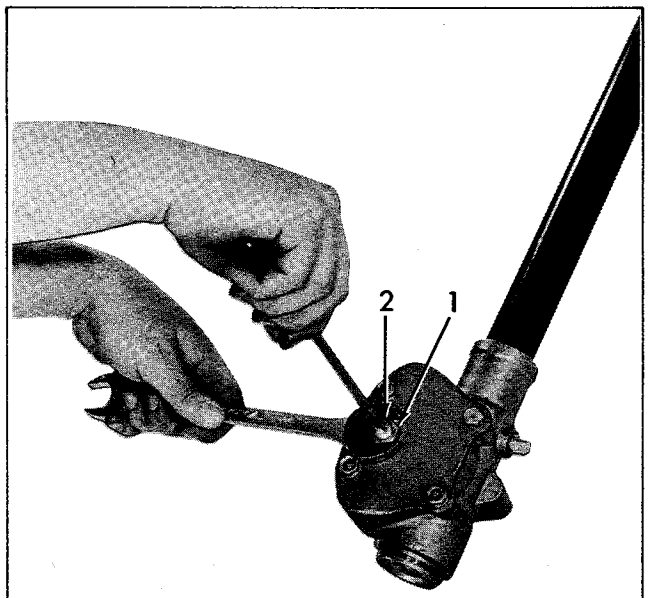
2. Over-Center Adjustment (Figure 2-24).

After making the worm bearing adjustment the worm finger adjustment screw (2) should be tightend to take up free play when the steering wheel is in the center position (turned half way (1-7/8 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 (1) and turn screw (2) in or out to eliminate play and while holding screw in desired position retighten locknut.

NOTE

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



1. Adjusting screw
2. Locknut

Figure 2-24. Making Over-Center Adjustment

3. Tie Rod Adjustment (Figure 2-27).

Tie rods (3), (4) are threaded on both ends and are adjustable in threaded sleeves (4A). Both ends should be adjusted in the sleeve an equal number of threads.

Overall Linkage Adjustment on Car

Adjust steering linkage in the following manner.

1. Set steering wheel shaft at the midpoint of its travel (approximately 1-7/8 turns from either extreme). Install steering arm (1) at approximate midpoint of steering stops.

2. Install short tie rod assembly (3). 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 has 1/8" toe-in.

3. Install long tie rod (4) and check alignment of left front wheel with a straight edge extending across the left front and rear wheels. Front wheel should have 1/8 in. toe-in. Adjust the thread sleeve on long tie rod if necessary.

4. Tighten clamping bolts and nuts (31) on both tie rod sleeves.

5. Camber Adjustment (Figure 2-27)

Front wheels should be set for 0° camber (front wheels perpendicular to ground with car weight on wheels). Check camber with a carpenters square against wheel with car sitting on a flat, hard surface. If adjustment is required, loosen nuts (8), and tilt wheel in required direction. Recheck camber and tighten nut.

REMOVING AND INSTALLING STEERING WHEEL AND STEERING GEAR UNIT (Figure 2-22)

Pry score card holder (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). Cup (4) can be depressed to gain clearance. Install jaws of puller behind wedge and turn screw against protective cap on shaft to pull wheel from splines (See Figure 2-22). Disassemble nut (2), steering wheel (3), cup (4), dust seal (5) and bushing (6) from steering column (7).

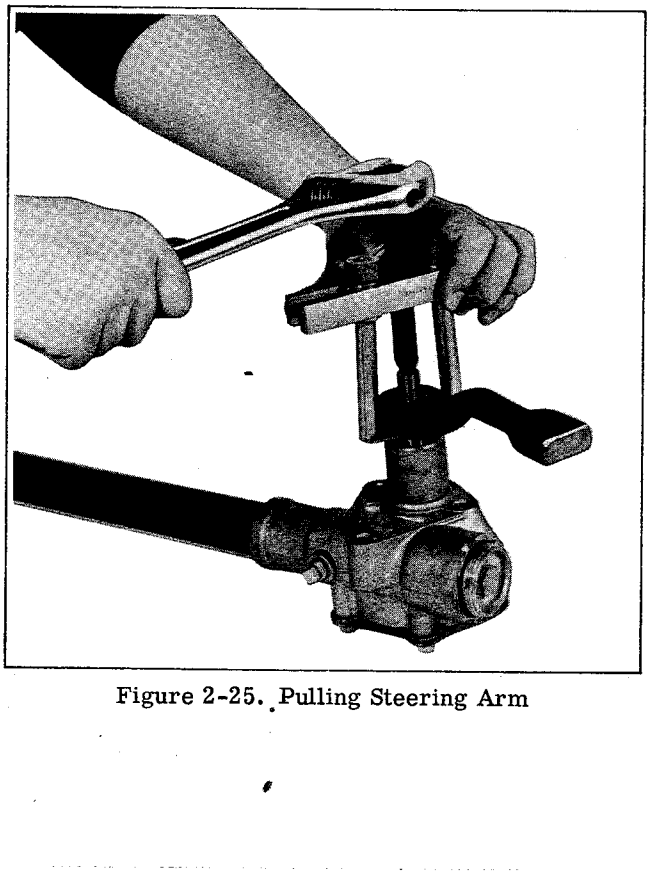


Figure 2-25. Pulling Steering Arm

After removing locknuts (8), steering stop plate (9) and nut and lockwasher (10), use a claw puller to remove steering gear arm (11) as shown in Figure 2-25. Remove three bolts and lockwashers (12) securing steering stop (13) and steering gear unit to chassis. Steering gear unit and steering column can be removed from the car after removing locknuts (14), bolts (15), clamp (16) and support block (17).

Installation is the reverse of removal with the following exceptions. Steering stop (13) must be assembled to chassis with the two arms in the lower position. See ADJUSTING STEERING GEAR UNIT AND LINKAGE for correct steering linkage adjustment.

DISASSEMBLING AND ASSEMBLING STEERING ARM AND TIE ROD ASSEMBLY (Figure 2-27)

To disconnect steering arm (1) from lever shaft, remove nut and lockwasher (2) and use claw puller, Part No. 97292-61 to pull arm (1) from shaft splines (See Figure 2-25).

IMPORTANT

When disconnecting a ball joint, no attempt should be made to drive a wedge between the joint and the attached part. Care should be taken so as not to damage rubber boots since they are not replaceable. On frozen sockets, moderate heat applied to the socket with a torch will aid in removal with claw puller. (In this case ball joints must be replaced.)

See Figure 2-26 for correct method of pulling ball joint.

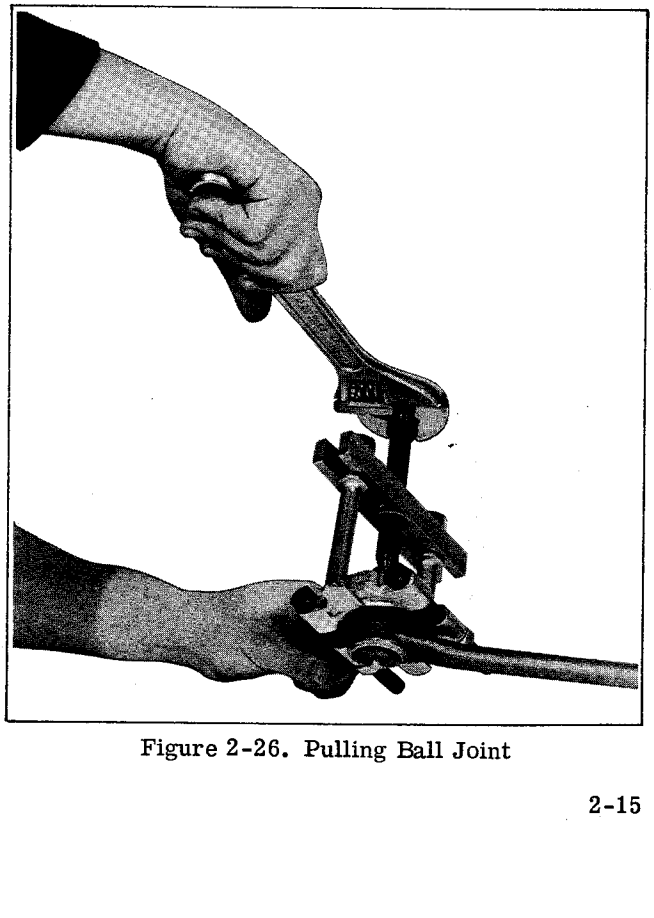
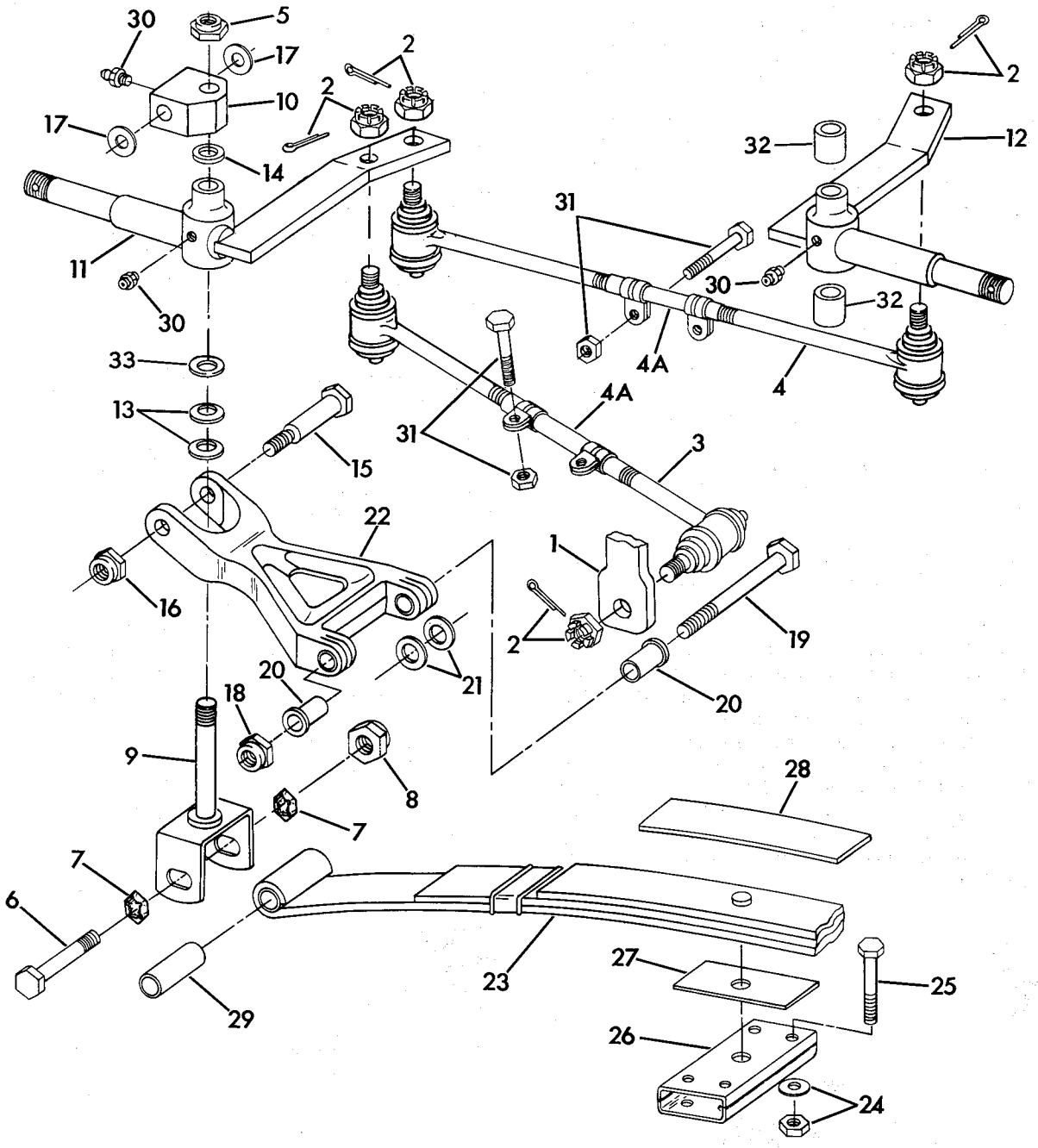


Figure 2-26. Pulling Ball Joint



1. Steering gear arm
2. Cotter pin and castle nut (4)
3. Short tie rod assembly
4. Long tie rod assembly
4A. Threaded sleeve (2)
5. Locknut (2)
6. Bolt (2)
7. Lockwasher (4)
8. Locknut (2)
9. Kingpin (2)
10. Pivot block (2)
11. Right steering arm
12. Left steering arm
13. Belleville washer (4)
14. Thrust washer (2)
15. Shoulder bolt (2)
16. Locknut (2)
17. Delrin washer (4)
18. Locknut (2)
19. Pivot bolt (2)
20. Spacer (4)
21. Thrust washer (4)
22. A-frame (2)
23. Leaf spring (1)
24. Locknut and washer (4)
25. Bolt (4)
26. Retainer plate
27. Spacer
28. Rubber insert
29. Spacer (2)
30. Grease fitting (4)
31. Clamping bolt and nut (4)
32. Bushing (4) (1977 and later)
33. Washer (2)

Figure 2-27. Front Suspension - Exploded View

Before reassembling tie rods, 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 and stud to steering arm, tighten the attaching castle nut to 25 to 28 ft-lbs torque before backing off to insert cotter pin. Overtightening could cause ball joint sockets to be deformed.

Install tie rod and steering arm on car in reverse order of disassembly and in correct relationship as described in OVERALL LINKAGE ADJUSTMENT.

DISASSEMBLING AND ASSEMBLING STEERING GEAR UNIT (Figure 2-22)

Remove steering gear from car as described previously.

Remove bolts and lockwashers (18), side cover (19), gasket (20) and withdraw steering shaft (21). Inspect oil seal (22) lip surface and replace if damaged. Remove locking cup (23), end cap (24), O-ring (25), lower bearing race (26) and ball cage (27), worm shaft (28) and upper bearing ball cage (29) and race (30). Replace balls and races and O-ring if worn or damaged.

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

Remove plug (31) 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.

Make adjustments described under ADJUSTING STEERING GEAR UNIT. Install steering gear unit in car and adjust linkage as described previously.

FRONT SUSPENSION

DISASSEMBLY (Figure 2-27)

Raise front end of car and support underneath frame. Remove front wheels and hubs as described under WHEELS. Pull steering gear arm (1) as described under DISASSEMBLING AND ASSEMBLING STEERING ARM AND TIE ROD ASSEMBLY.

Remove cotter pins and castle nuts (2). Remove the two tie rod assemblies (3), (4).

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

Remove locknut (5), bolt (6), lockwashers (7), and locknut (8). Withdraw kingpin (9) from pivot block (10). Steering arm (11) is now free. Note position of belleville washers (13), and thrust washer (14). Press bushings (32) from steering arm (11), (12). Remove shoulder bolt (15), locknut (16), Delrin washers (17) and pivot block (10). Remove locknut (18), pivot bolt (19), spacers (20), thrust washers (21) and A-frame (22). To remove leaf spring (23), remove four nuts and washers (24) and bolts (25), remove plate (26), spacer (27) and rubber insert (28). Remove spacer (29) from leaf spring end.

Clean all parts and examine for wear or damage. 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 amount of grease to ball underneath each rubber boot. Examine spacers in A-frames and leaf spring ends (22), (23); if they are worn or damaged they must be replaced. Bushings (32) must be replaced if damaged or worn.

Assembly is basically the reverse of disassembly with the following exceptions. Coat outside diameter of spacer (29) with Harley-Davidson Grease All grease before assembly. Tighten kingpin locknut (5) until free play is taken up in steering arm (11), (12), yet arm should pivot freely. DO NOT overtighten. Pack pivot block (10) and steering arm (11), (12) with Harley-Davidson bearing grease. Use a grease gun on fittings (30) and pack until grease comes from seams. Locknuts (8) should be tightened to 28-32 ft.-lbs. torque.

Adjust steering linkage as described under ADJUSTING STEERING GEAR UNIT AND LINKAGE.

REAR SUSPENSION

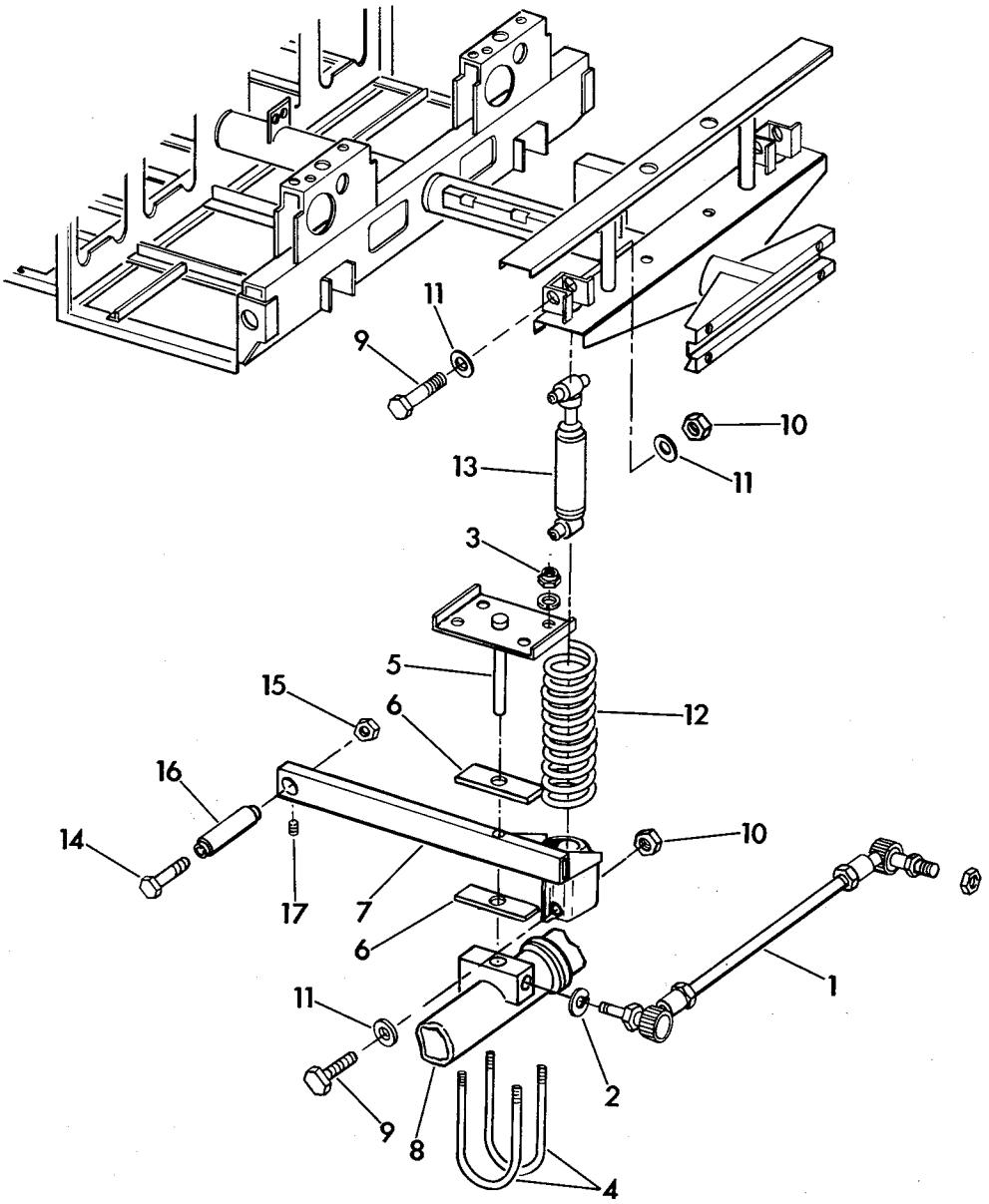
DISASSEMBLING AND ASSEMBLING REAR SUSPENSION (Figure 2-28)

To disassemble rear suspension, support rear end of car main frame with suitable blocking.

Remove sway bar (1). Remove locknuts (3), U-bolts (4), U-bolt bracket (5), and axle mounting pads (6). Remove upper and lower shock absorber mounting bolts (9), locknuts (10), and washers (11). Remove spring (12) and shock absorber (13). Remove motor brace bracket from right swing arm. See DISC BRAKE. Remove pivot bolt (14) and locknut (15) to free swing arm (7) from frame.

If swing arm bushing (16) must be replaced, remove set screw (17) and press bushing from swing arm. When installing new bushing, press only on outer metal sleeve. Bushing should be centered in the swing arm. Replace set screw (17).

Clean all metal parts with non-flammable cleaning solvent and inspect for damage or wear. Replace sway bar ends if ball is loose in socket. Replace axle mounting pads (6) if they are worn or distorted. Examine shock absorber for traces of fluid, 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.



1. Sway bar
2. Lockwasher
3. Locknut and lockwasher (8)
4. U-bolt (4)
5. U-bolt bracket (2)
6. Axle mounting pad (4)
7. Swing arm (right and left)
8. Axle housing
9. Bolt (4)
10. Locknut (4)
11. Washer (6)
12. Spring (2)
13. Shock absorber (2)
14. Pivot bolt (2)
15. Locknut (2)
16. Bushing (2)
17. Set screw (2)

Figure 2-28. Rear Suspension - Exploded View

Assembly is the reverse of disassembly with the following exceptions. Tighten locknuts (10), (15) to 50 ft. lbs. torque. Tighten axle U-bolt locknuts (3) to 31 ft. lbs. torque. It is important that locknuts (3) be retorqued after 2 days or 36 holes of operation. Swing arms should be square with frame crossmember. If not, adjust length of sway bar (1) as necessary.

BRAKES

DISC BRAKE

DESCRIPTION

When the brake pedal is depressed, it transmits a clamping action to the caliper type brake shoes through the brake cable and rod assembly. The brake shoes apply this action against the brake disc attached to the traction motor armature shaft, 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.

ADJUSTING DISC BRAKE (Figure 2-29)

WARNING

Disconnect cable leads from battery before making any adjustments to brake or brake pedal.

NOTE

On models with an automatic seat brake, the seat brake clevis pin (6, Figure 2-31A) on 1976 and earlier models or (13, Figure 2-31C) for 1977 and later models must be removed before adjusting disc brake. Always adjust seat brake after foot disc brake has been adjusted. See ADJUSTING AUTOMATIC SEAT BRAKE.

When brake lever free travel becomes excessive, indicating that brake adjustment is necessary, proceed as follows. (See Figure 2-30.) Remove cotter pin (34) and washers (33), then remove rod from cam lever. (See Figure 2-29.) Remove cotter pin (4) and tighten adjusting nut (5) until brake cam lever (8) is fully seated on cam surface of brake shoes (11). With cam lever centered in this position, reconnect brake rod to brake cam lever.

If rod does not line up with hole in brake cam lever, correct by turning rod either in or out of rod end (30, Figure 2-30). Loosen locknut (31) and screw rod (32) in or out to align rod with cam lever. Tighten locknut (31). Assemble rod (32) to cam lever with washers (33) and cotter pins (34).

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

Brake shoes (11, Figure 2-29) must be parallel when they contact brake disc. If the brake shoes are not parallel, brake chatter and uneven brake lining wear will develop.

To adjust brake shoes, tighten adjusting nut (5) until brake linings (16) bear lightly on brake disc (19). Back off stop nut (9) and adjust pivot screw (10) until brake shoes are parallel. Loosen adjusting nut (5) until .010 to .020 in. clearance is obtained

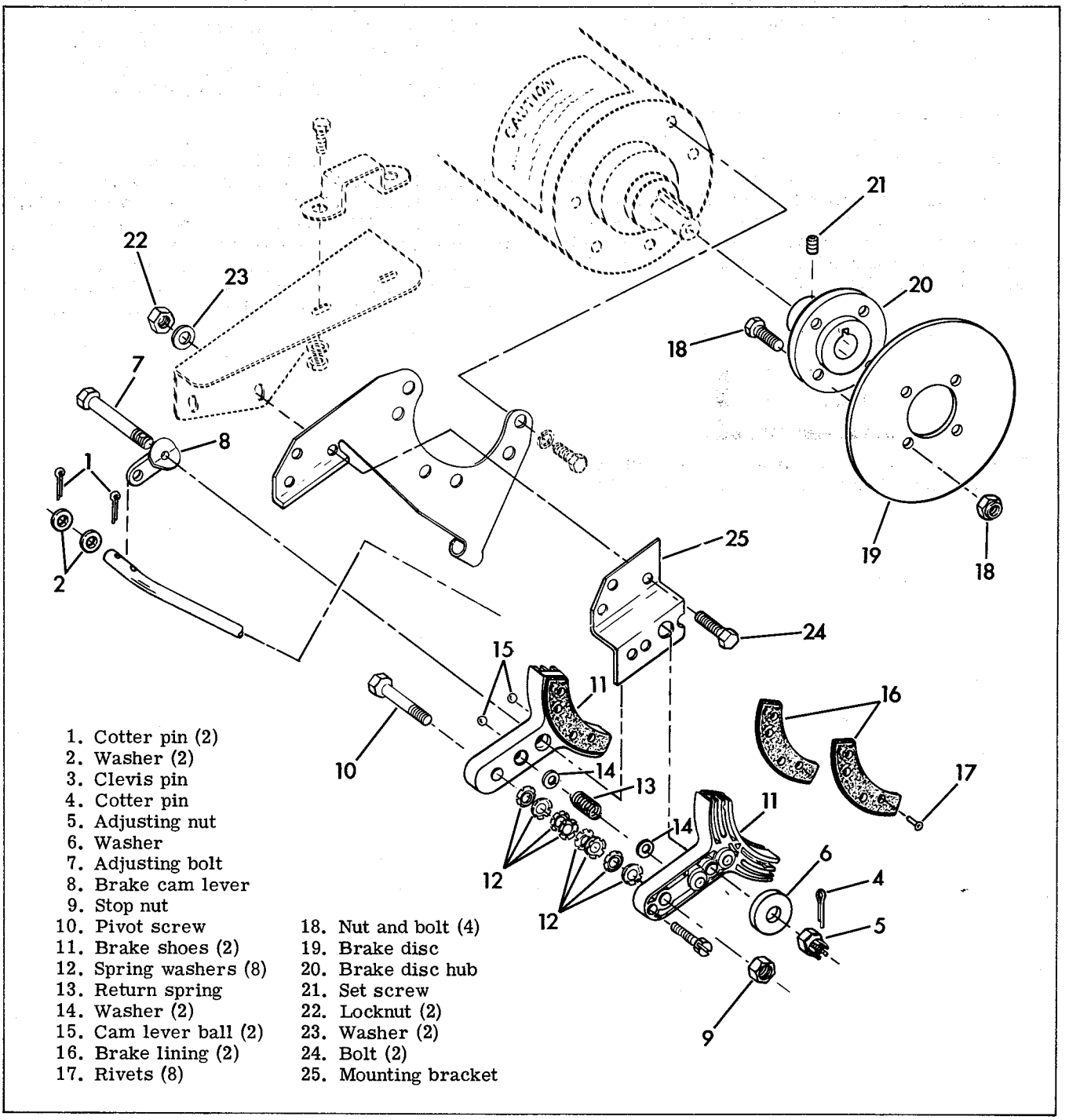


Figure 2-29. Disc Brake Assembly - Exploded View

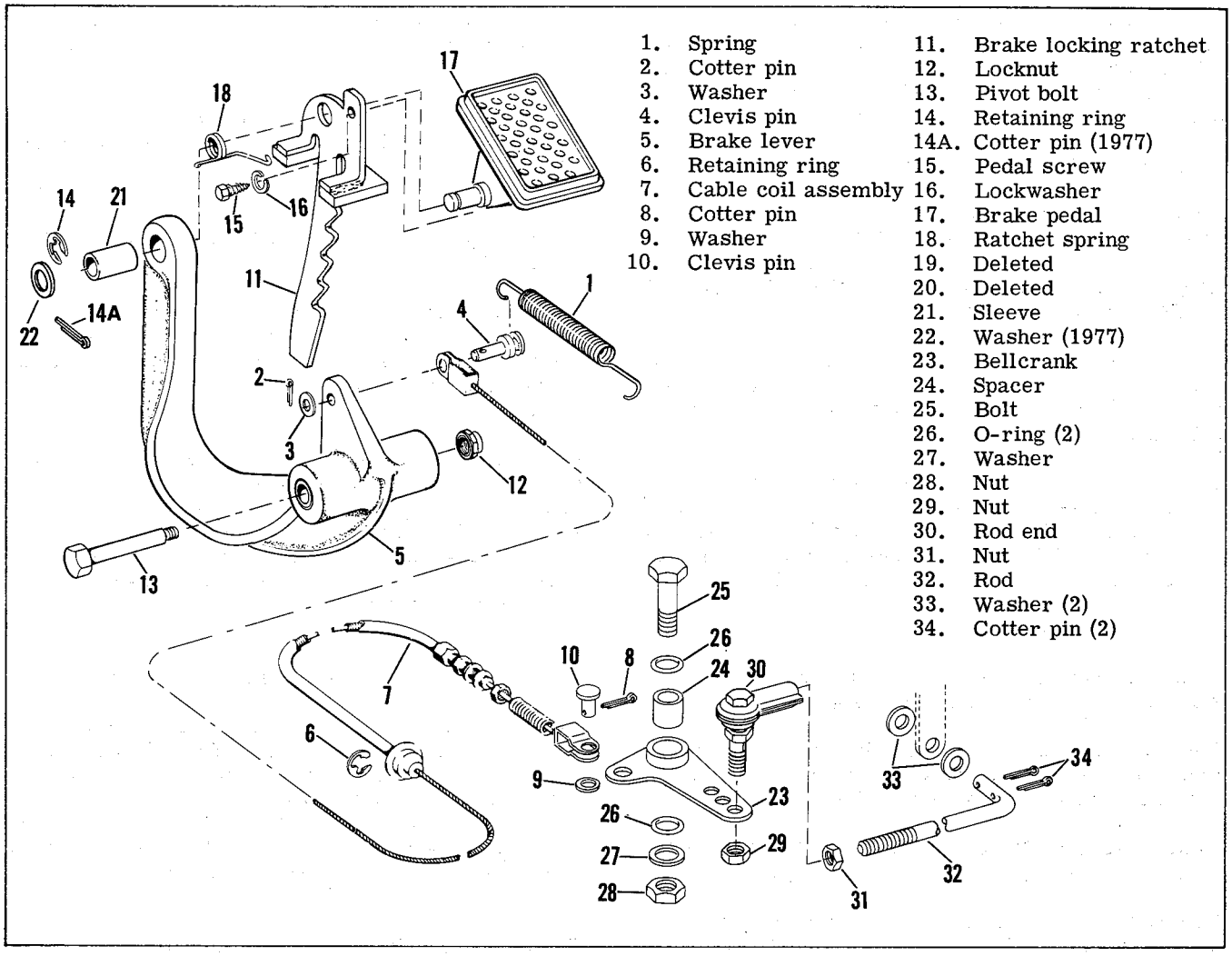


Figure 2-30. Brake Pedal and Cable Assembly - Exploded View

between each brake lining and the brake disc. Tighten stop nut (9) until it contacts brake shoe. Secure adjusting nut (5) in correct position and reinstall cotter pin (4). Operate car to make sure there is no brake drag or chatter.

Brake disc (19) 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 straight edge against disc surface.

Lubricate brake cam lever and rear brake shoe cam surface with grease to prevent wear and brake drag. Also, oil pedal and linkage parts periodically. DO NOT get grease or oil on brake disc or brake linings — doing so could cause brake failure.

REMOVING AND INSTALLING DISC BRAKE SHOES (Figure 2-29)

If brake shoe linings (16) become worn thin or damaged, the brake can be disassembled for lining replacement and other repairs as follows: Remove cotter pin (1), washer (2), and clevis pin (3) or cotter pins and washers on later models. Remove cotter pin (4), adjusting nut (5), washer (6), adjusting bolt (7), brake cam lever (8), and stop nut (9). Remove bolt (10) and separate brake shoes (11) from mounting bracket. Be sure to note the position of the formed spring washers (12), the brake return spring (13) and washers (14) and the cam lever bearing balls (15). Clean all parts and inspect for wear or damage. Replace worn or damaged parts.

To replace worn or damaged brake linings (16), press out rivets (17) 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 2-30)

Remove cotter pin (34) and washers (33) from brake rod (32) and remove rod from brake cam lever. This will allow bellcrank (23) to move freely and will give access for removal of brake cable clevis pin (10), cotter pin (8) and washer (9) from shorter arm of bellcrank. Loosen jam nuts and slide cable out of rear mounting bracket.

Unhook pedal return spring (1). Remove cotter pin (2), washer (3) and clevis pin (4) from brake lever (5). Remove cable mounting bracket from front mounting boss and slide cable core out of mounting boss.

Install new cable in reverse order.

Brake adjustment is necessary after new cable assembly is installed, see ADJUSTING BRAKE.

REPLACING DISC BRAKE ROD AND BELLCRANK ASSEMBLY (Figure 2-30)

Remove cotter pin (34) and washers (33) from brake rod (32) and remove rod from brake cam lever. Remove locknut (29) and remove rod end (30) from bellcrank.

To remove bellcrank, remove cotter pin (8), washer (9) and clevis pin (10) disconnecting brake cable clevis from bellcrank. Remove nut (28), washer (27) and "O" ring (26) from bellcrank. Pull bellcrank with spacer (24) and "O" ring (26) from bolt (25).

Discard "O" rings.

Clean all components in a non-flammable cleaning solvent and blow dry with compressed air.

Lubricate and insert new "O" rings into top and bottom recesses in bellcrank and re-install bellcrank and brake rod in reverse order of disassembly.

REMOVING AND INSTALLING DISC BRAKE ASSEMBLY (Figure 2-29)

Disconnect brake cable or rod from brake cam lever as described previously. Remove 4 nuts and bolts (18) which attach brake disc (19) to brake disc hub (20). Loosen set screw (21) to remove brake disc hub (20) from motor shaft.

Remove two locknuts (22), washers (23) and bolts (24) which attach brake assembly to mounting bracket (25).

Assembly is the reverse of disassembly. After assembly, adjust brake as described under ADJUSTING BRAKE.

ADJUSTING PARKING BRAKE LOCKING RATCHET (Figure 2-30)

If brake locking ratchet (11) fails to engage or release from the accelerator pedal interlocking ear when the brake pedal is tilted, the accelerator pedal mounting bracket must be adjusted for proper brake locking and releasing.

Disconnect batery leads. Loosen, but do not remove nuts which secure accelerator pedal bracket to floor panel. Depress brake pedal and tilt foot pedal forward. Shift bracket so that ear engages one of the notches. Tighten bracket mounting nuts while holding bracket in this position. Check speed switch adjustment as described in Section 5.

DISASSEMBLING BRAKE PEDAL (Figure 2-30)

Remove return spring (1), cotter pin (2), washer (3) and clevis pin (4). Remove locknut (12) and pivot bolt (13). Pedal assembly is now free of car. Remove retaining ring (14) or washer (22) and cotter pin (14A), pedal screw (15) and lockwasher (16). Slide brake pedal (17) out of brake ratchet (11) and brake lever (5). Remove ratchet spring (18).

Clean all parts and inspect for wear or damage. Replace any worn or damaged parts. If sleeve (21) is worn, press out old one and press in new sleeve. Assemble brake in the reverse order of disassembly.

AUTOMATIC SEAT BRAKE — (1976)
(OPTIONAL EQUIPMENT)

The automatic seat brake option provides an additional control mechanism which applies the disc brake independently of the foot brake. See Figure 2-31. 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 2-31B) 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 2-31A) can enter slotted hole in plunger (26, Figure 2-31A). 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 (Fig. 2-31)

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, tighten clevis assembly (decrease distance B) to obtain specified play.

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

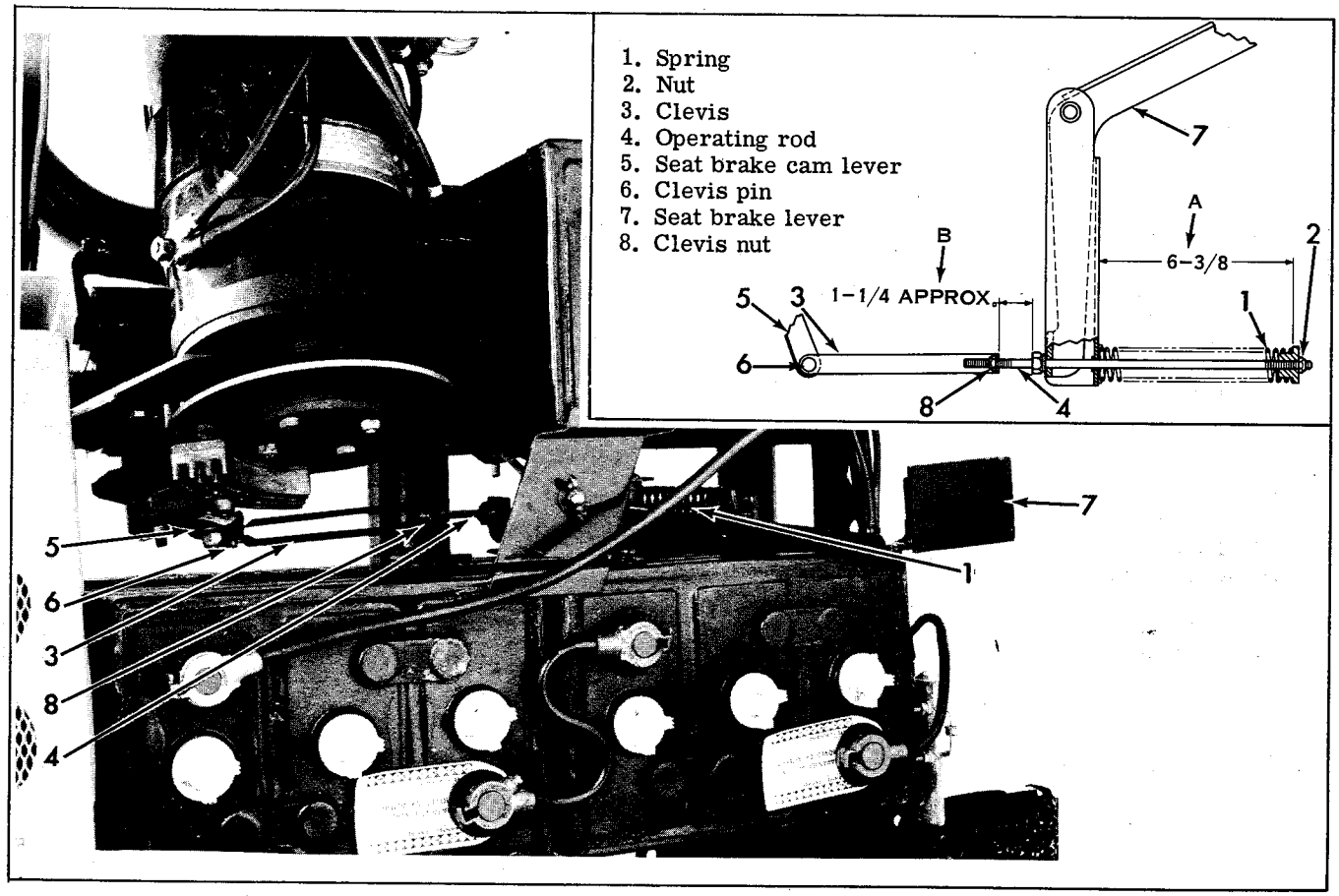


Figure 2-31. Adjusting Automatic Seat Brake (1976)

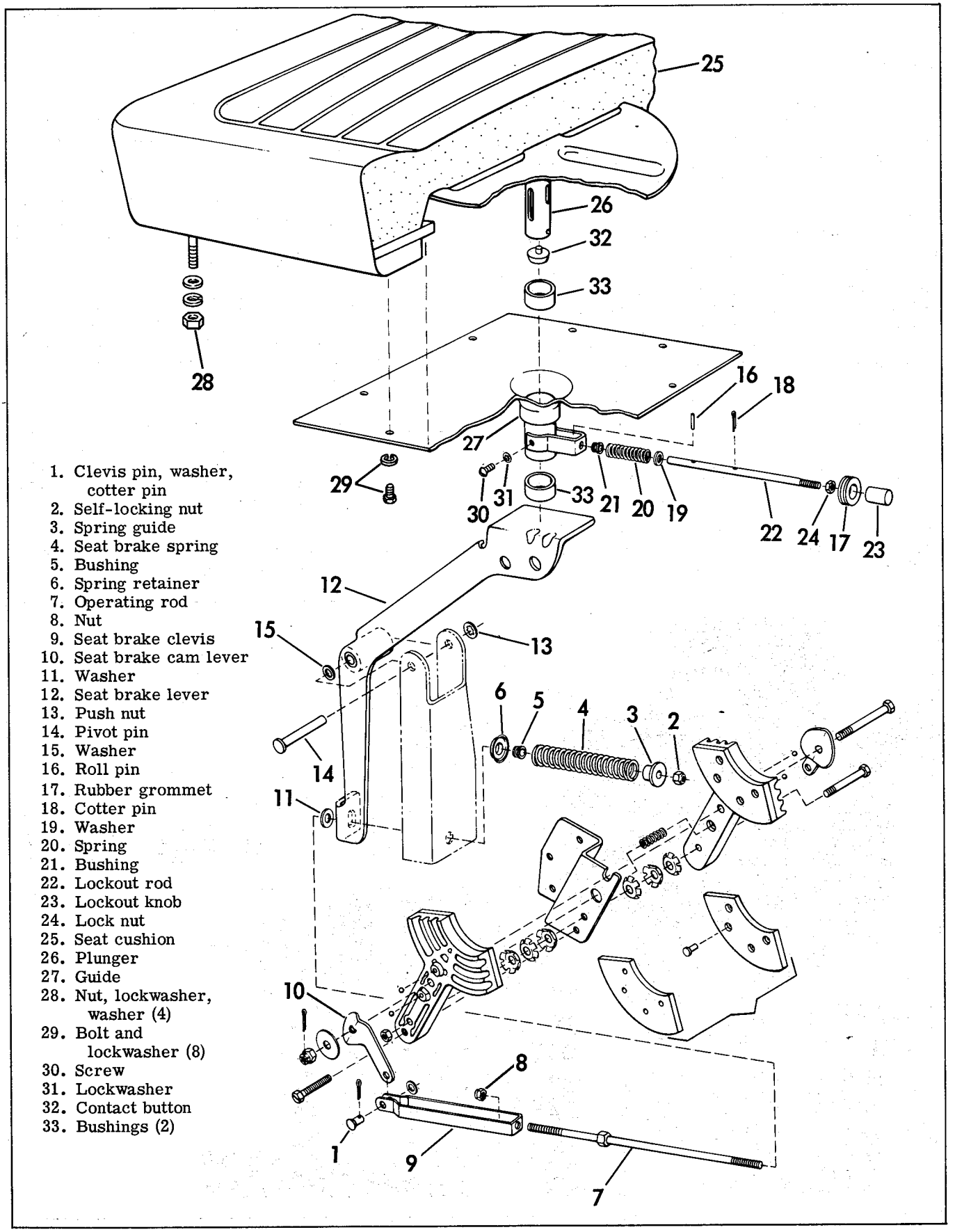


Figure 2-31A. Automatic Seat Brake (1976)

DISASSEMBLING AND ASSEMBLING AUTOMATIC SEAT BRAKE (Fig. 2-31A)

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) assemblied 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

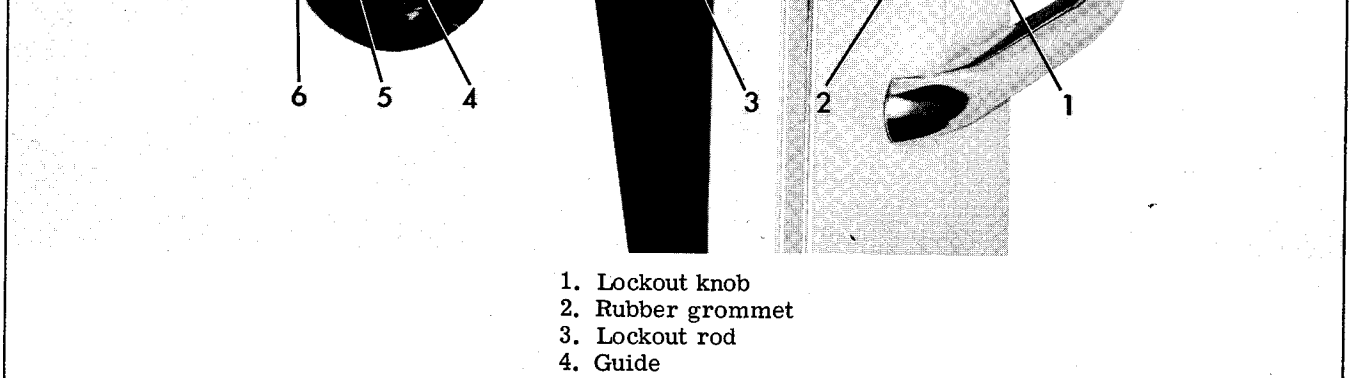
Bushings must be flush with the ends of the sleeve.

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.

AUTOMATIC SEAT BRAKE - 1977 AND LATER (OPTIONAL EQUIPMENT) (Fig. 2-31C)

The automatic seat brake option provides an additional control mechanism which applies the disc brake independently of the foot brake. See Figure 2-31C. Driver's weight on seat releases the brake allowing car to be driven. Driver's weight removed from the seat automatically applies parking brake through a lever and spring arrangement.



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

Figure 2-31B. Automatic Seat Brake Lockout Mechanism (1976)

The lockout mechanism is provided to hold the brake in the released position for moving or towing the car. To lockout brake, turn seat hold down screw (located behind seat) parallel with slot in seat, and raise seat. Push down on plunger (22, Figure 2-31C), then pull out knob (18) until large diameter portion is centered in cut-out of chassis frame. Release plunger (22) to lock knob (18) in this position which locks out seat brake operation. Lower seat and lock with hold down screw for towing. To release, push lockout knob (18) in. Spring tension will automatically apply brake until downward pressure is again applied to seat.

ADJUSTING AUTOMATIC SEAT BRAKE (Figure 2-31C)

Before adjusting the automatic seat brake, it will be necessary to adjust the foot disc brake. See ADJUSTING DISC BRAKE.

Pull out knob (18) to lockout brake. Remove clevis pin (13), washer and cotter pin (13) and loosen locknut (11) on clevis (12). Turn clevis in or out so that when hole in clevis lines up with hole in lever arm (14) there will be a slight drag on the brake as adjusted under ADJUSTING DISC BRAKE. Insert clevis pin, washer and cotter pin (13) and tighten locknut (11) against clevis (12).

Check plastic button (24) for wear and replace if necessary. Use Harley-Davidson Multi-purpose grease on arm (14) pivot points. DO NOT get any grease on brake shoes or brake disc.

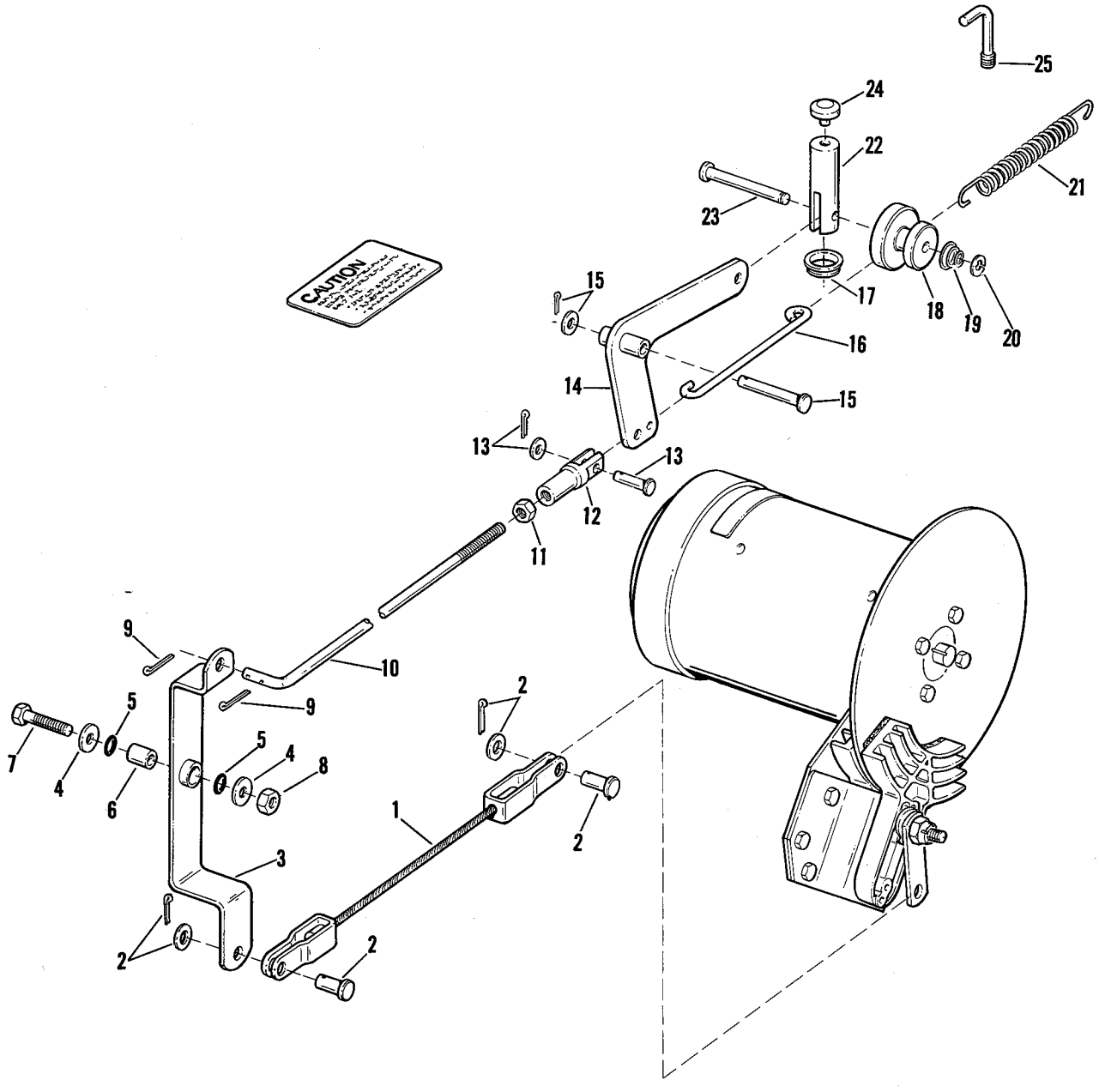
DISASSEMBLING AND ASSEMBLING AUTOMATIC SEAT BRAKE (Figure 2-31C)

Disconnect spring (21) and rod (16) from arm (14). Disconnect clevis (12) by removing clevis pin, washer and cotter pin (13) and loosening locknut (11). Remove retaining ring (20), spring (19), knob (18) and clevis pin (23) to remove plunger (22). Remove and examine bushing (17) and button (24) for wear and replace as necessary. Remove cotter pin, washer and clevis pin (15) to remove arm (14) from frame.

Disconnect operating rod (10) from lever (3) by removing outside cotter pin (9). Disconnect brake cable (1) from brake assembly and lever (3) by removing cotter pins, washers and clevis pins (2). Remove locknut (8) to remove lever assembly from frame. Disassemble bolt (7), washers (4), O-rings (5) and spacer (6) from lever. Use new O-rings when reassembling.

Reassemble in reverse order of disassembly. Lubricate spacer (6) and arm (14) pivot with Harley-Davidson multi-purpose grease. Be sure to install small diameter of spring (19) toward retaining ring (20).

Adjust automatic seat brake as described under ADJUSTING AUTOMATIC SEAT BRAKE.



1. Brake cable
2. Clevis pin, washer and cotter pin (2)
3. Lever
4. Washer (2)
5. O-Ring (2)
6. Spacer
7. Bolt
8. Locknut
9. Cotter pins
10. Operating rod
11. Nut
12. Clevis
13. Clevis pin, washer and cotter pin
14. Arm
15. Clevis pin, washer and cotter pin
16. Rod
17. Bushing
18. Knob
19. Spring
20. Retaining ring
21. Spring
22. Plunger
23. Clevis pin
24. Button
25. Hold down screw

Figure 2-31C. Automatic Seat Brake (1977 and Later)

BODY

GENERAL

The DE-40 golf car body, front housing, optional top and modesty panel are of fiberglass construction. Fiberglass will not discolor, rot or deteriorate. For proper maintenance of fiberglass body sections, see FIBERGLASS BODY CARE AND REPAIR.

The optional windshield is made of a clear durable plastic. Use a mild soap or detergent with water for normal cleaning. Flush with clear water first to soften dirt. Then wipe clean with sponge or soft cloth using plenty of water. Do not wipe windshield when dry or with dry towel because dirt particles may scratch surface.

Seats are secured to the frame by means of hinges at the front and a seat hold down screw at the rear. Seats can be tilted forward for easy battery servicing. To remove seat from frame, tilt it forward approximately 45° and lift toward the rear of the car.

SEAT MAINTENANCE

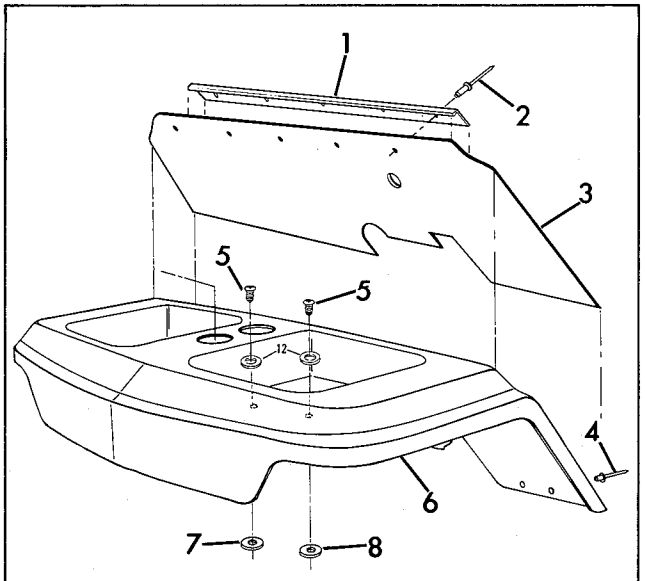
Proper cleaning of the DE-40 golf car seats will maintain their appearance and increase their usable life. Do not use any harsh detergents or cleaning solvents which contain ammonia, aromatic solvents or alkali materials. Consult the chart below for proper cleaning procedures.

An occasional application of wax to the seat covering material will improve its soil resistance and cleanability.

REMOVING AND INSTALLING FRONT HOUSING

Remove steering wheel as described under REMOVING STEERING WHEEL AND STEERING GEAR UNIT. Remove floor mat molding (1) by drilling out 5 pop rivets (2) with a 3/16 in. drill. Peel off floor mat (3). Drill out 13 pop rivets (4) with a 3/16 in. drill. Remove 4 screws and washers (5). Front housing (6) may now be lifted free of car. Note the position of rubber washers (7), (8). The two larger diameter washers (7) are positioned under the two center screws.

Assembly is the reverse of disassembly. Use Harley-Davidson Contact Adhesive Part No. 99615-69 to secure floor mat to front housing.



1. Floor mat molding
2. Pop rivet (5)
3. Floor mat
4. Pop rivet (13)
5. Screw and washer (4)
6. Front housing
7. Large rubber washers
8. Small rubber washers

Figure 2-32. Front Housing - Exploded View

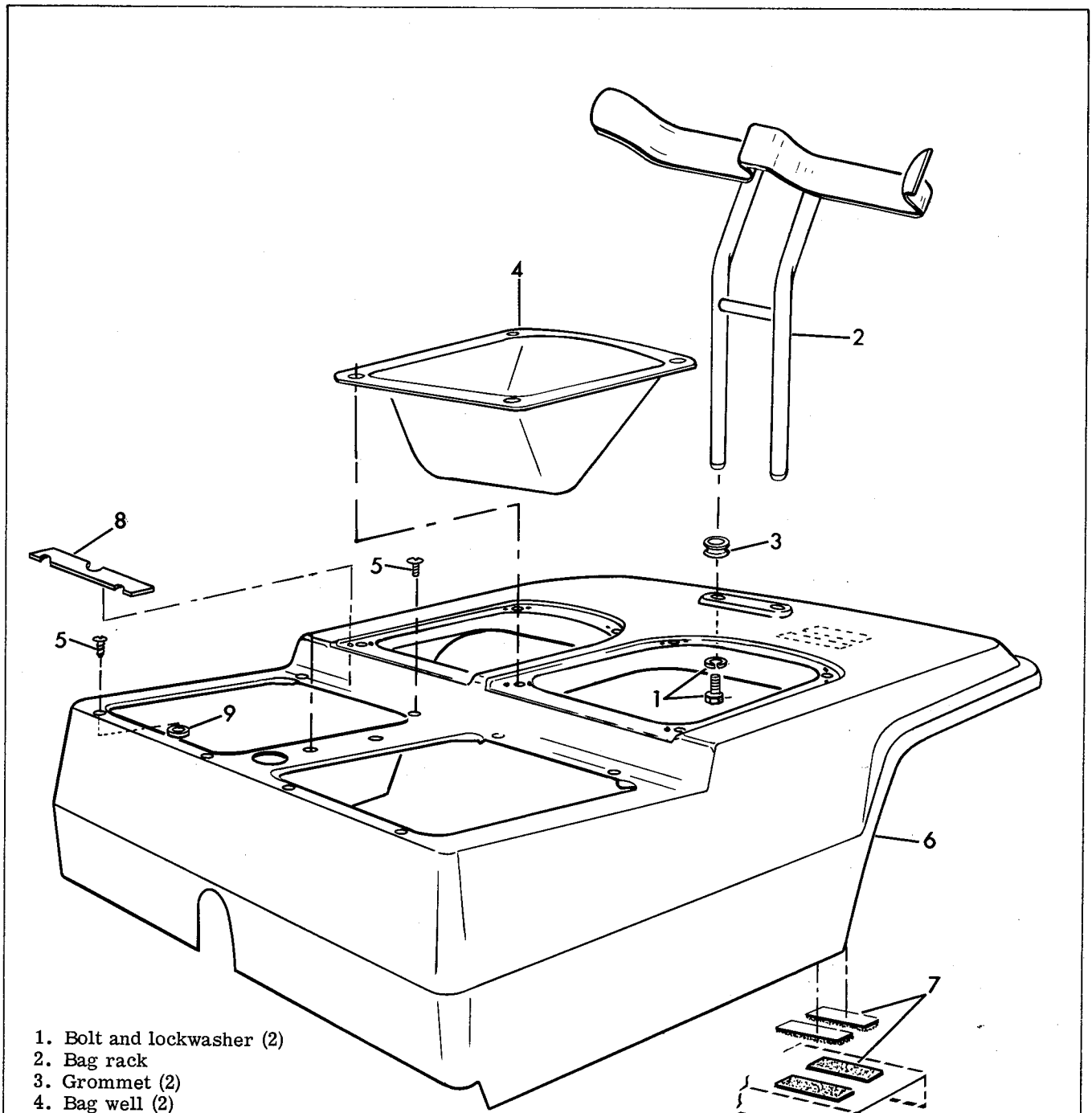
SEAT CLEANING CHART

Ordinary Dirt	Wash material with warm water and a mild soap. Apply soapy water to a large area, allow to soak for a few minutes, then rub briskly with a cloth or sponge.
Imbedded Dirt	In the case of stubborn or imbedded dirt in the grain of the material, a soft bristle brush may be used after the soap application has been made. If the dirt is extremely difficult to remove, cleaners such as Ajax or Comet may also be used. These should be used more cautiously.
Chewing Gum	Carefully scrape off as much as possible. Apply a dry cleaning fluid.
Tars, Asphalt, Creosote	These substances will stain if allowed to remain in contact with the seat material. Wipe off excess as quickly as possible and clean the area carefully with a cloth dampened with dry cleaning fluid.
Paint	Remove immediately if possible. Do not use paint remover or liquid type brush cleaners. Use a cloth dampened with dry cleaning fluid.

REMOVING AND INSTALLING BODY

Remove 2 bolts and lockwashers (1) securing bag rack (2) to frame. Pull bag rack up through rubber grommets (3). Remove bag wells (4). They are retained by quarter turn fasteners. Remove ignition switch from body. Do not disconnect wiring. Remove 8 self-tapping screws (5). Body (6) can now be lifted free of car. Rear end of body is held to frame with hook and loop pads (7) which will release with a sharp lifting motion. Note position of rubber pads (8) and washers (9).

Assembly is the reverse of disassembly.



1. Bolt and lockwasher (2)
2. Bag rack
3. Grommet (2)
4. Bag well (2)
5. Self-tapping screw (8)
6. Body
7. Hook and loop pad (2)
8. Rubber pad (2)
9. Rubber washer (4)

Figure 2-33. DE-40 Body - Exploded View

FIBERGLASS

FIBERGLASS BODY CARE AND REPAIR

GENERAL

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. Harley-Davidson Polish & Cleaner, Part No. 99701-35 is recommended.

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 2-34.

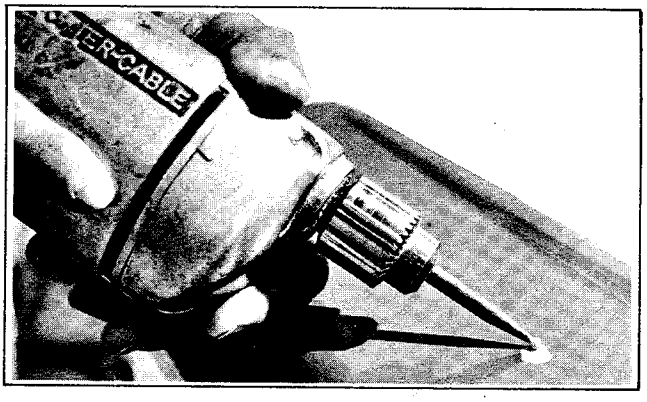


Figure 2-34. Roughing Damaged Area

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 2-35.

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 2-36.

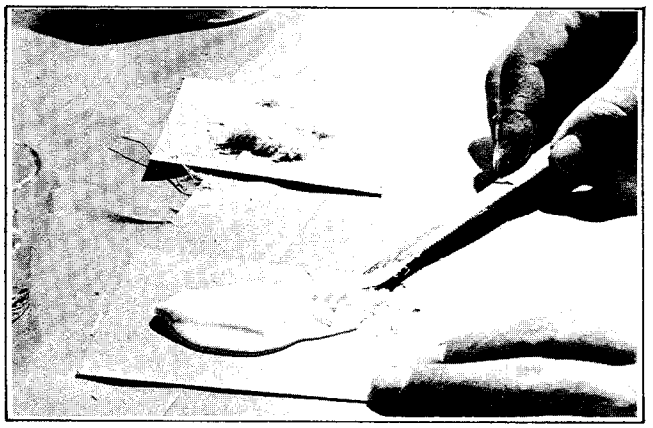


Figure 2-35. Mixing Gel Coat Glass Fibers

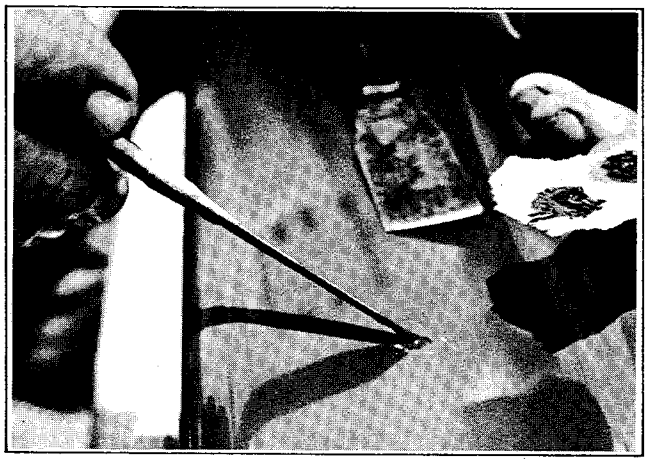


Figure 2-36. Filling Hole on Scratch

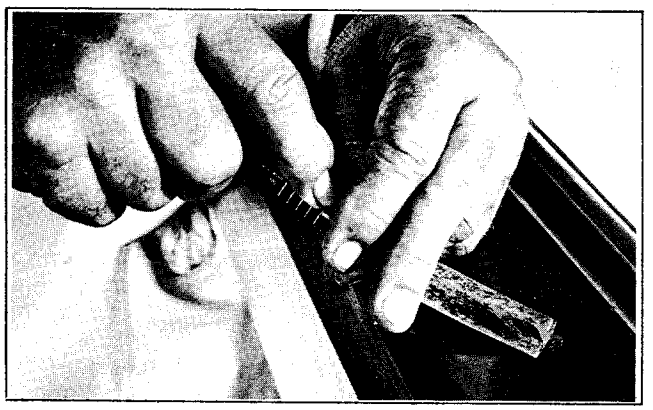


Figure 2-37. Trimming Patch

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 completely (30 - 60 minutes). Patch will shrink slightly as it cures, making a depression. See Figure 2-37.

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 undercut.

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 2-38. Gel coat can be covered with cellophane, if desired, to aid in spreading evenly. Remove cellophane after gel coat has cured.

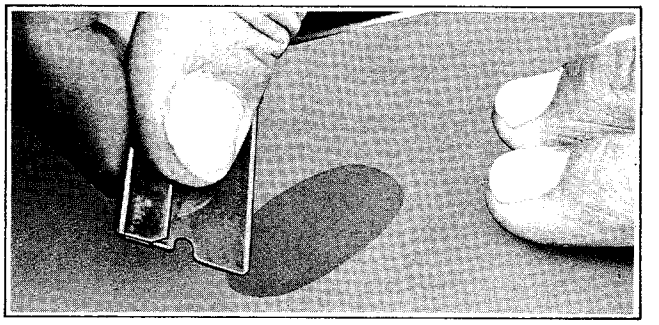


Figure 2-38. Spreading Gel Coat Evenly

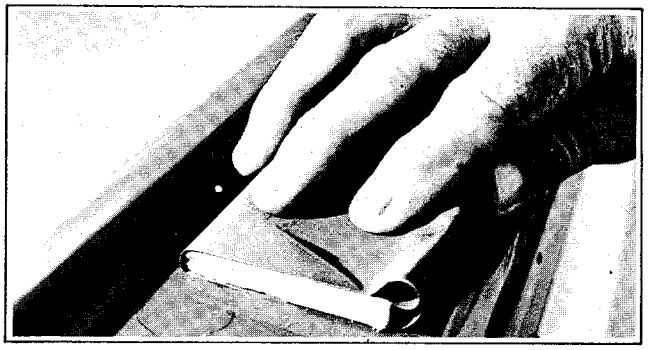


Figure 2-39. Sanding Patch

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 2-39.

NOTE

When 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 2-34.

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 2-38). 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.

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 2-40.

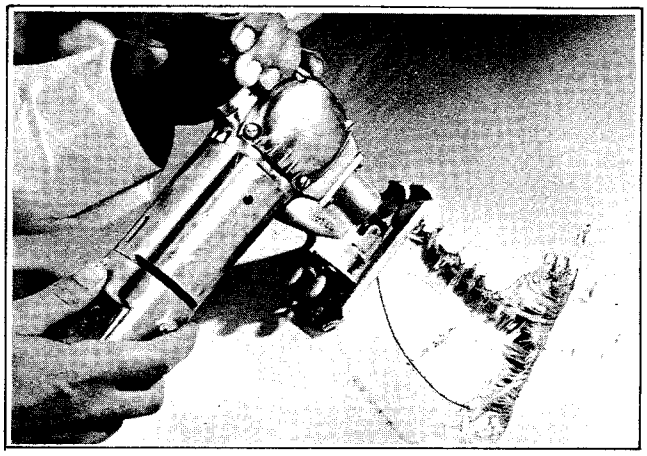


Figure 2-40. Sawing Out Damaged Area

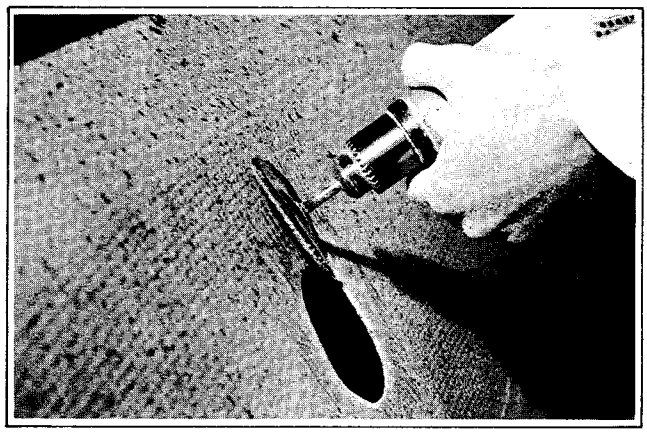


Figure 2-41. Rough Sanding Inside Surface

Figure 2-42. Taping on Backing

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 2-41.

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 2-42.

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 2-43.

NOTE

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

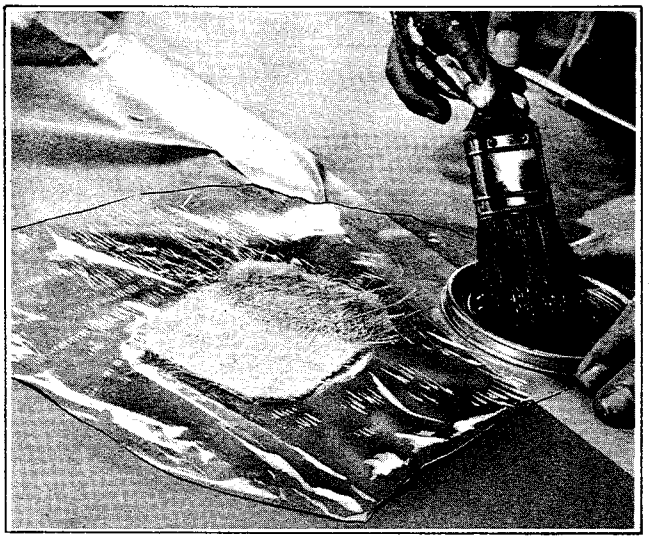


Figure 2-43. Applying Resin to Mat

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 2-44.

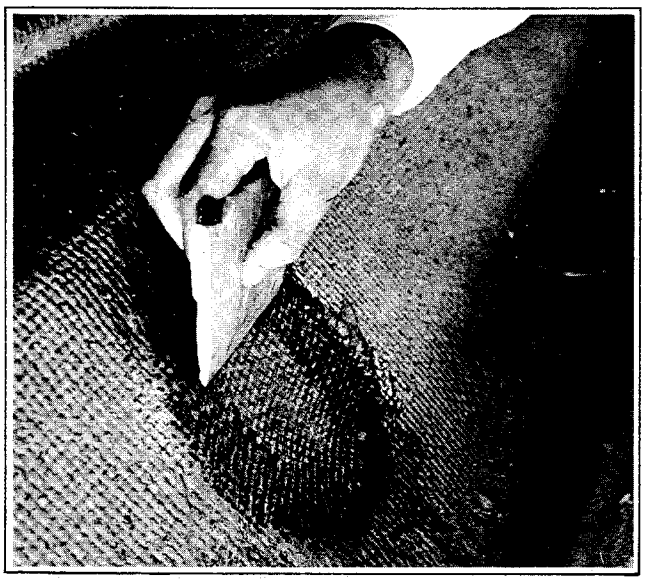


Figure 2-44. Squeegeeing Patch

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 2-45.

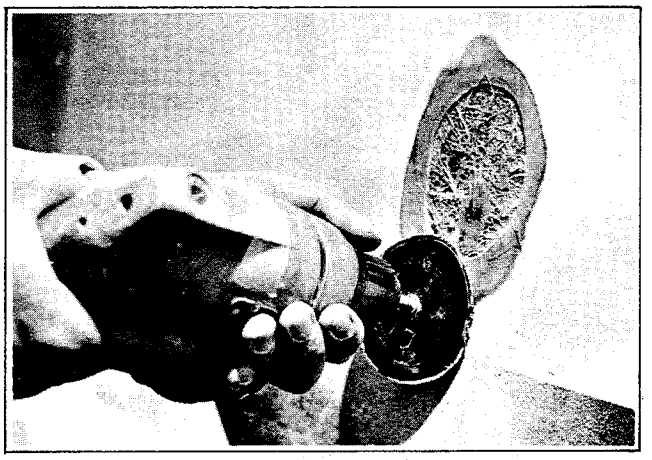


Figure 2-45. Rough Sanding Outside Surface

9. Mask area with tape and paper to protect the surrounding surface; then repeat B Steps 5, 6, 7, and 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 2-46.

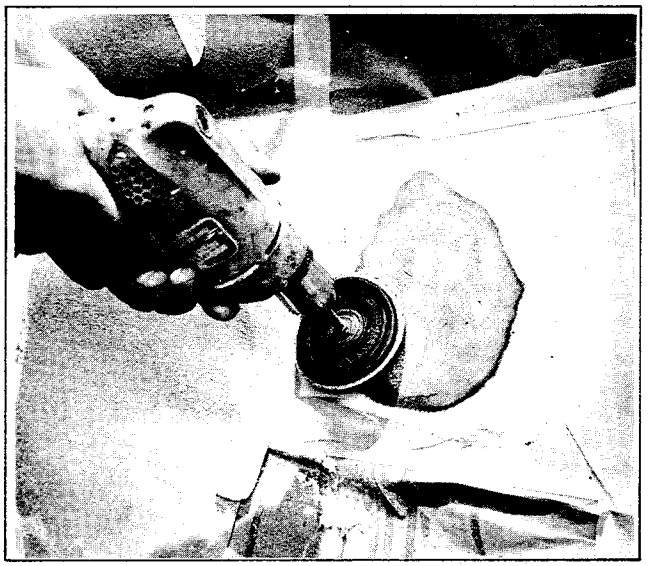


Figure 2-46. Bleeding Patch With Sander

11. Mix gel coat or filler coat with catalyst. Work Gel Coat into patch with fingers. See Figure 2-47. Filler Coat should be filled into patch with a putty knife.

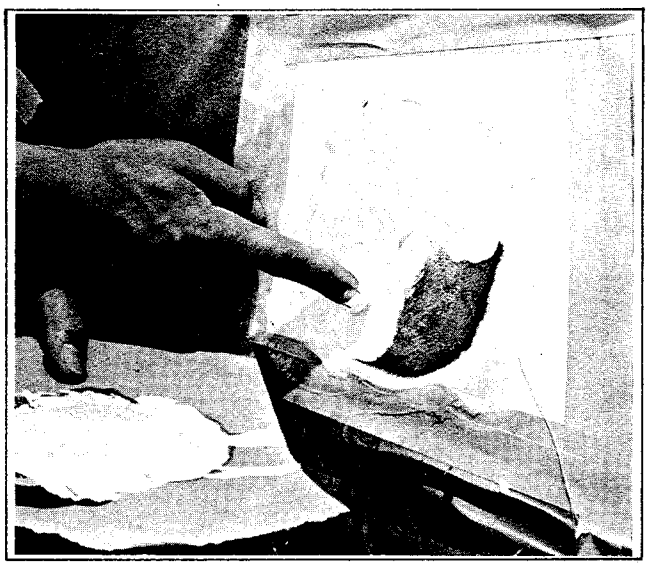


Figure 2-47. Working Gel Coat into Patch

12. Patch can be covered with cellophane to aid in spreading evenly (see Figure 2-38). Allow to cure completely before removing cellophane.

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 time. 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 2-48.

Figure 2-48. Buffing Finish

For large areas the gel coat can also be sprayed.

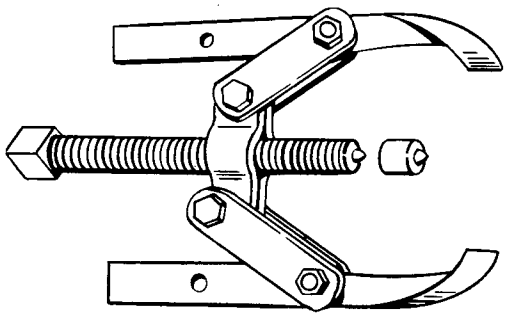
Where surface color of part has changed due to weathering, color match of patch may not be satisfactory. In this case, entire panel must be sprayed.

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.

NOTES

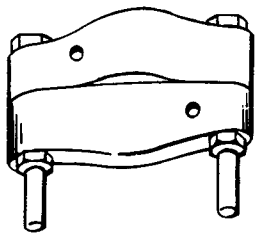
TOOLS



95635-46

ALL PURPOSE CLAW PULLER

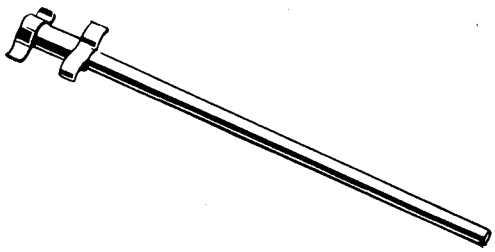
For variety of applications such as pulling transmission drive flange, gears, etc. Has center adapter for pulling objects from a small diameter shaft.



95637-46

WEDGE ATTACHMENT FOR CLAW PULLER

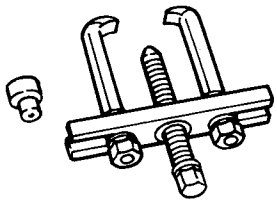
Used in combination with claw puller for pulling steering wheel, etc.



96806-40

BENDING BAR

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



97292-61

TWO JAW PULLER

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

NOTES

ELECTRICAL 5

TABLE OF CONTENTS

ELECTRICAL

GENERAL

DE-40 ELECTRIC CAR OPERATION AND CIRCUITS

There are two basic circuits involved in the operation of the DE-40 Electric Car:

1. Solenoid (Forward-Reverse) control circuit (36 volts, light gage wire) includes key switch, solenoid coils, snap switch and buzzer.

2. Traction Motor circuit (36 volts, heavy gage wire) includes solenoid contacts, speed switch, resistors, traction motor and battery charger plug.

Speed control in the motor circuit is achieved by progressively reducing the amount of resistance in the circuit by means of a sliding contact switch. Three solenoids, electro-mechanical switches, are used in the reversing circuit to reverse the flow of current through the motor armature and field coils and achieve forward-reverse rotation of the traction motor.

CHARGING BATTERIES

See Figure 5-1.

Key switch is "OFF," speed switch is in off position. Control system is in the "charge" position placing batteries in series with charger output.

FORWARD SPEEDS

See Figure 5-2.

With key switch in the "FORWARD" position, solenoid coils B and F are connected into the solenoid control circuit. As the speed switch is operated, the contacts in the snap switch close completing the control circuit and energizing solenoids B and F allowing main battery current to flow to the traction motor through solenoids B and F main contacts. With the speed switch movable contact on contact #1 all three resistors are in the motor circuit to start the car in first speed. As the movable contact progresses to contacts #2 and #3, resistance is switched out of the circuit and the motor speed increases. When the movable contact is on stationary contact #5, all three resistors are switched out of the circuit and 36 volts is applied directly to the traction motor. The motor now turns at its highest speed.

NOTE

The speed switch incorporates two (2) fourth speed contacts linked together to provide for greater pedal travel. This does not effect vehicle top speed.

REVERSE SPEEDS

See Figure 5-3.

The above circuit description also applies to 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 and armature, resulting in reversed armature rotation in all speeds. Also the reverse warning buzzer is connected to the batteries.

WARNING

Disconnect the battery leads whenever servicing or testing electrical system.

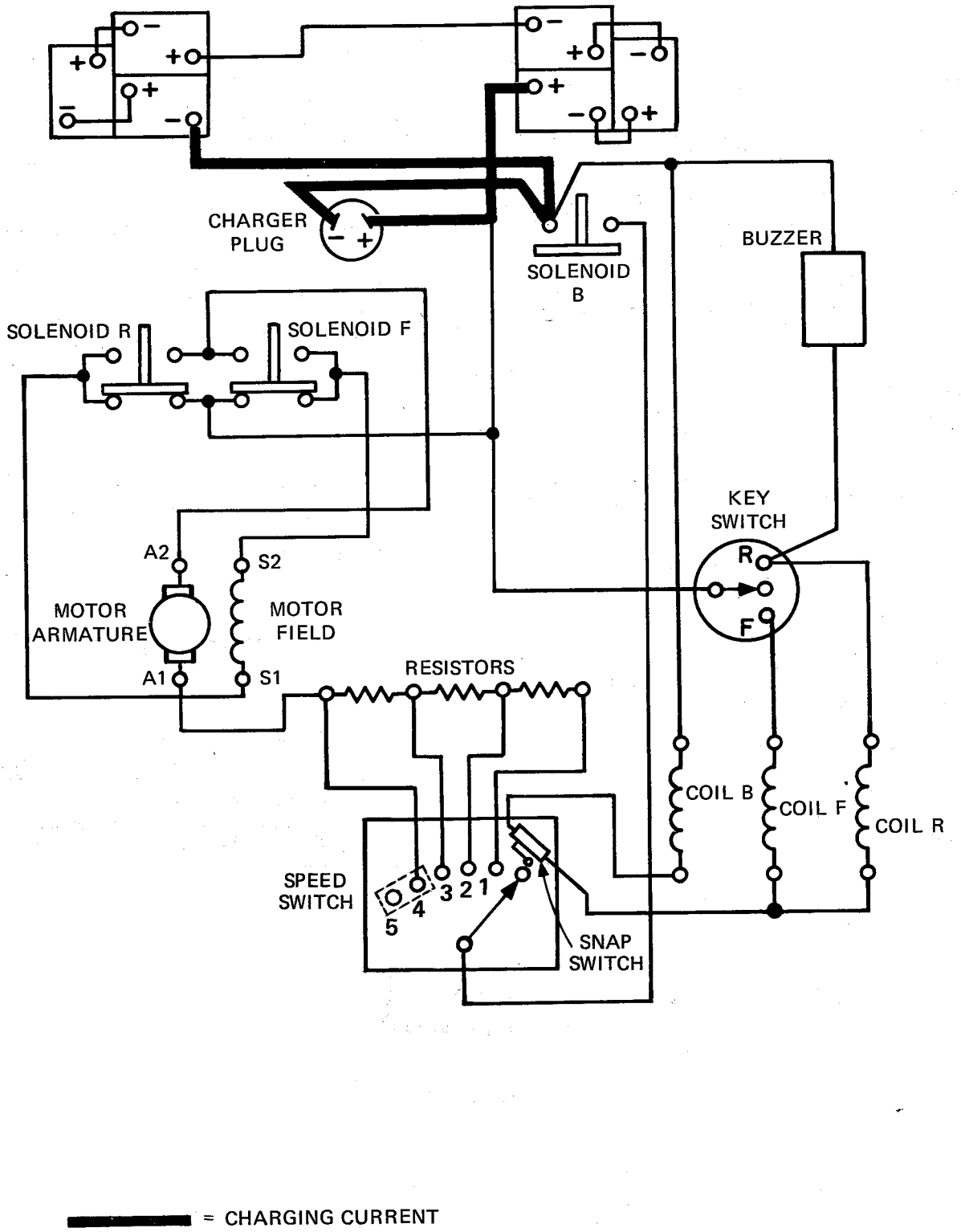


Figure 5-1. Battery Charging Circuit

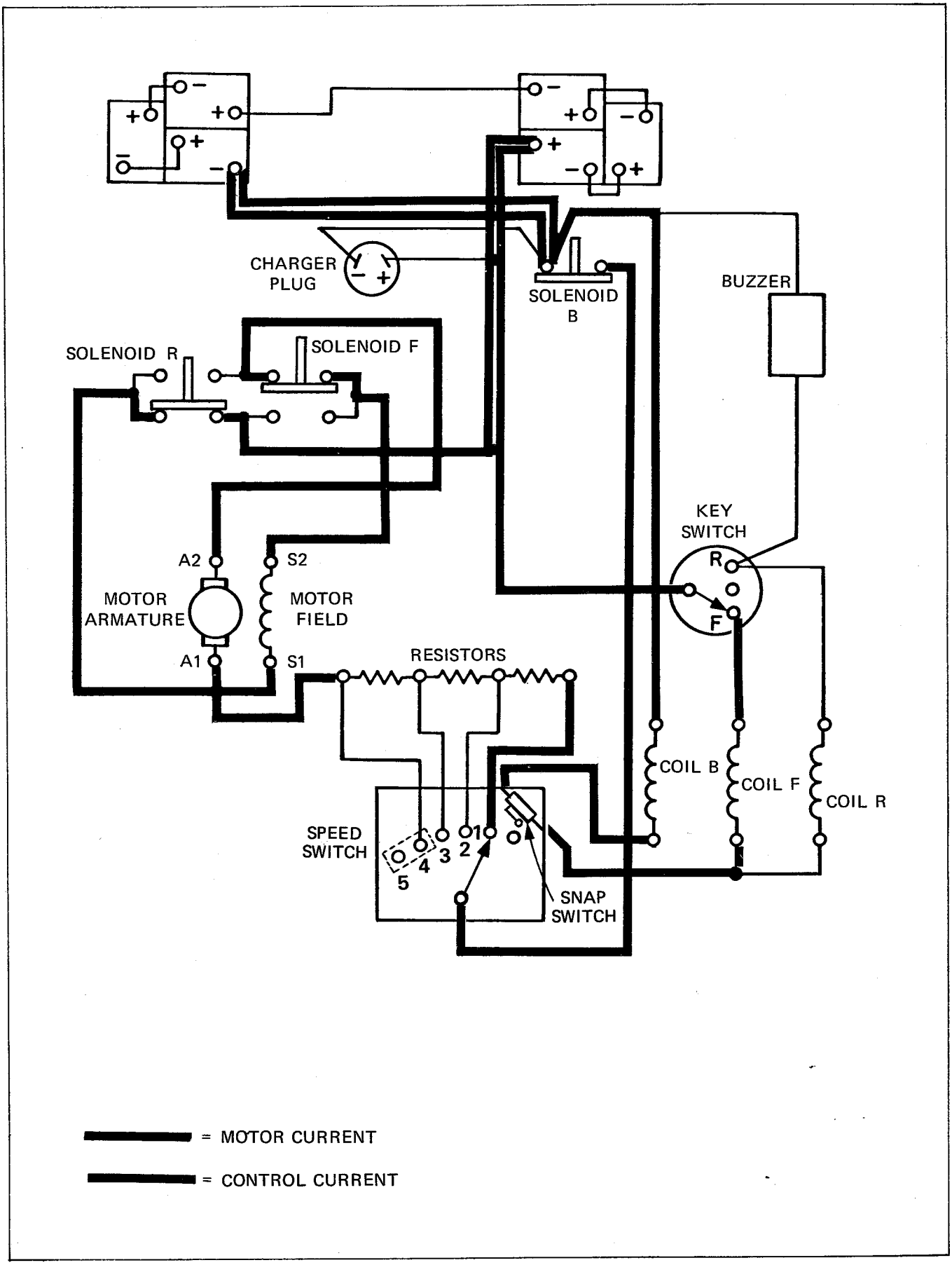


Figure 5-2. Forward Speed Circuits

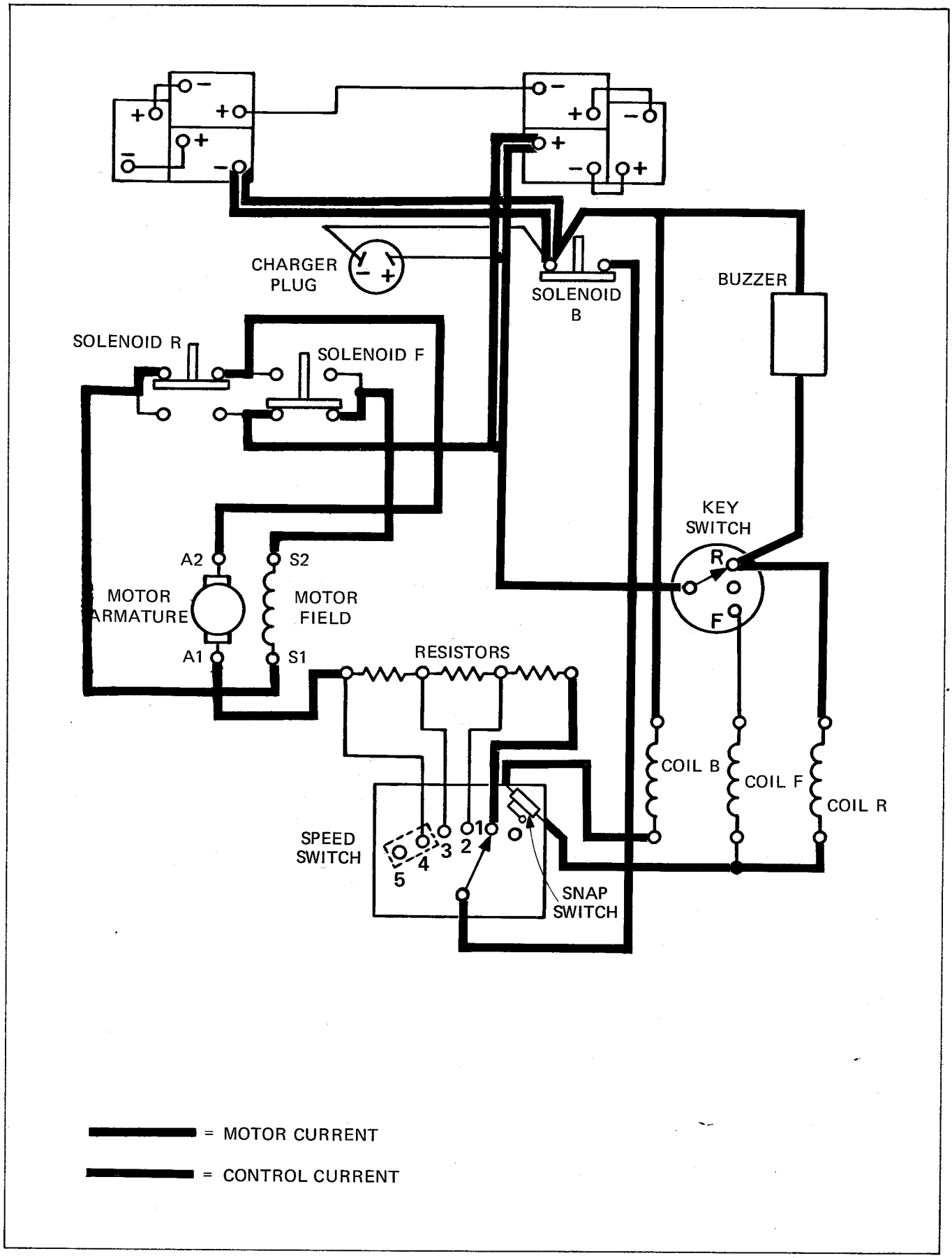


Figure 5-3. Reverse Speed Circuits

WIRING

TESTING CIRCUITS

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

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

WARNING

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

The control circuits and components can be tested as described in the section entitled SWITCHES.

A complete electrical trouble shooting guide is located in Section 1 near the beginning of this manual. Also, a convenient check chart is located underneath left bag well. Bag well is secured to body by means of 4 quarter turn fasteners.

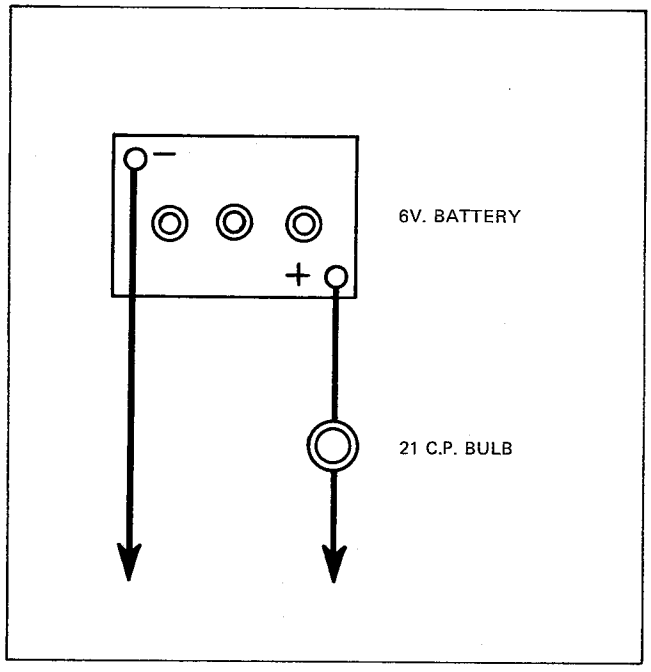
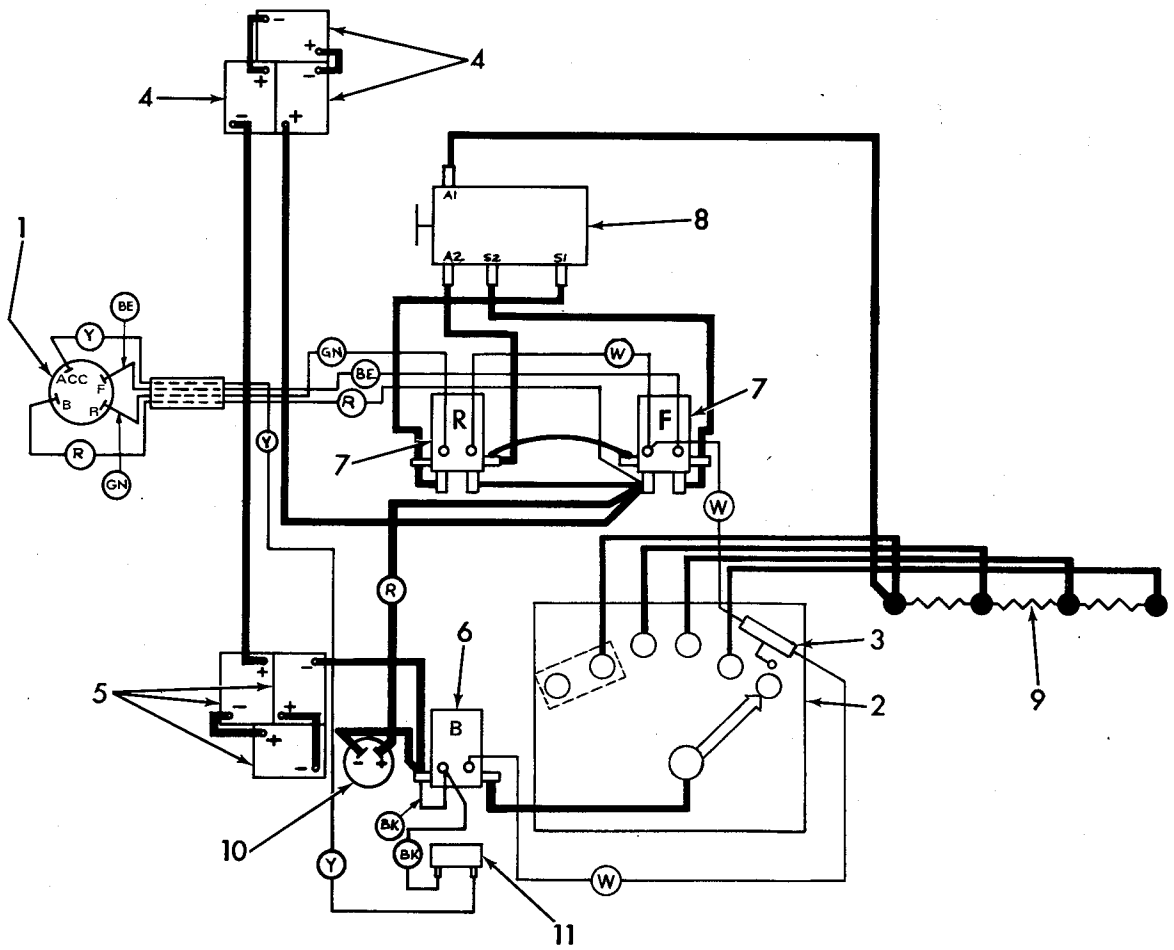


Figure 5-4. Test Circuit

KEY SWITCH CONTACTS	
SWITCH POSITION	CONNECTS TERMINALS
FORWARD	B - F
OFF	
REVERSE	B - R - ACC



1. Key switch
2. Speed switch
3. Snap switch
4. Right batteries (3)
5. Left batteries (3)
6. Solenoid single acting
7. Solenoid double acting (2)
8. Traction motor
9. Resistor
10. Charger plug
11. Reverse warning buzzer

COLOR CODE*			
BE	BLUE	BK	BLACK
GN	GREEN	Y	YELLOW
R	RED	W	WHITE

Unless otherwise specified, heavy cables are black.

Figure 5-5A. DE-40 Wiring Diagram

SWITCHES

SPEED SWITCH

PREVENTIVE MAINTENANCE

Clean speed switch and check condition of contacts monthly. Slight burning and pitted condition can be corrected by dressing with a fine mill file and/or emery cloth. Badly pitted contacts should be replaced. Grease switch arm pivot ONLY. DO NOT allow grease to get on switch contacts. Check and adjust switch as follows:

ADJUSTING SPEED SWITCH (Figure 5-6)

Disconnect cable leads from battery. Adjust parking brake locking ratchet as described in Section 2 under DISC BRAKE. With accelerator pedal in its release position, movable contact (1) will be up against stop bolt (6) and centered over OFF contact (2). With accelerator pedal all the way down, movable contact should be centered over last speed contact. If not, release pedal and disconnect accelerator rod (3) from pedal. Loosen locknut (4) and turn rod in or out as necessary for proper adjustment.

Next check the snap switch (7) adjustment. Switch must "click" before brush engages third contact — and after leaving first contact. Move mounting plate forward or backward on its slotted mounting holes to meet requirement of snap switch. Also, the accelerator rod may be adjusted "in" or "out" of the rod end (8) to make adjustment. Reconnect battery cables.

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.

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

The correct wiring arrangement and terminal connections at solenoids are shown in Figure 5-6. 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.

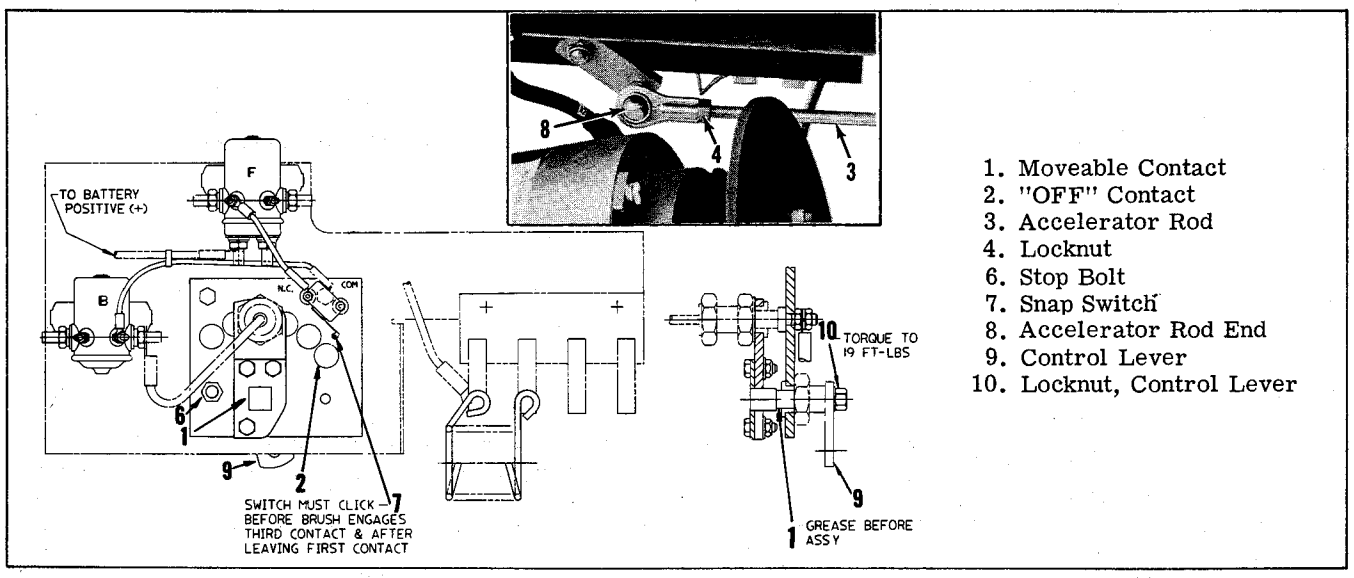


Figure 5-6. Speed Switch

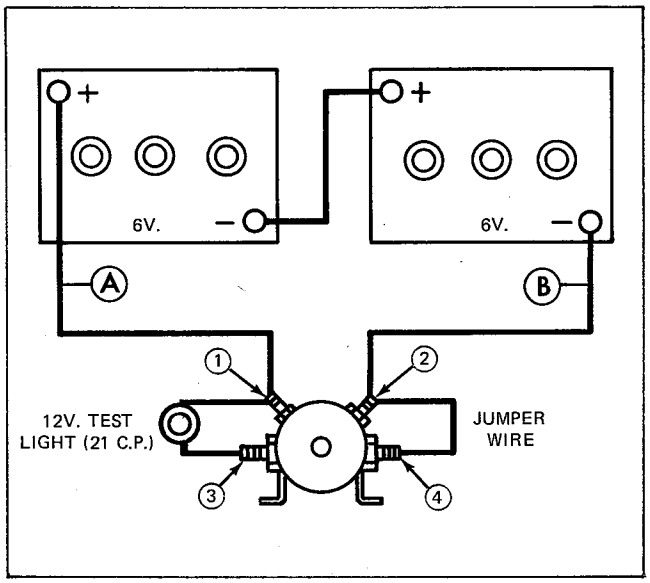


Figure 5-7. Test Circuit for Single or Double Contact Solenoid

WARNING

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

Using correct battery voltage, make circuit connections as shown in Figure 5-7.

Leads A (+) and B (-) 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.

TESTING SOLENOIDS IN CAR

WARNING

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.

SNAP SWITCH

GENERAL

Snap switch is permanently assembled. If it becomes defective, it must be replaced. When mounting switch, terminal marked "COMM" should be in the bottom position to avoid moisture contamination.

TESTING SNAP SWITCH

WARNING

Place key switch in off position and disconnect battery cables leading to car from battery posts.

Using continuity tester described in TESTING CIRCUITS, connect test leads to snap switch terminals and depress accelerator pedal to line up movable contact on first speed contact. Movable contact MUST NOT touch any other contact. If test lamp glows, switch is operating correctly.

RESISTORS

Resistors can be checked visually for breaks. Make sure coils of resistors are not touching each other.

KEY SWITCH

GENERAL

WARNING

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

The key switch is a permanently assembled unit. If it is defective, it must be replaced.

TESTING KEY SWITCH

Remove key switch from car. Using continuity tester described under TESTING CIRCUITS, connect one lead of tester to terminal marked "B." Turn key to the forward (clockwise) position and touch other lead of tester to the "F" terminal. Tester light should light. Make similar test with key in the reverse (counterclockwise) position. Light should glow when test lead is switched to the "R" and "ACC" terminals.

BATTERY AND CHARGER

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. Batteries are installed as shown in Figure 5-8. Numbers in diagram indicate order of installation.

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 approved batteries, which are designed for this type of service, should be used.

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!

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).

CAUTION

If battery is overly filled, some of the solution will be forced out through the vent holes when battery is charging. This will not only weaken the solution, but also may damage parts near the battery. Keep battery clean and lightly coat terminals with petroleum jelly to prevent corrosion. Do not overtighten terminal connections. To prevent battery case damage caused by pressure build-up, be sure breather tube is properly routed and not kinked or obstructed.

2. Keep batteries charged but do not overcharge.

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 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.

WARNING

Battery should be charged in a well ventilated area with the filler caps removed. Be sure charger is properly connected and adjusted, observing positve (+) and negative (-) polarity to battery.

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 (Harley-Davidson Charger)
9 Holes or Less 18 Holes or More	7 Hours 12 Hours
OTHER THAN GOLF COURSE 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.

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.

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 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.)

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 left and one of right 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), shunt prod tester (C), or load tester (D), 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	2.01 - 2.03

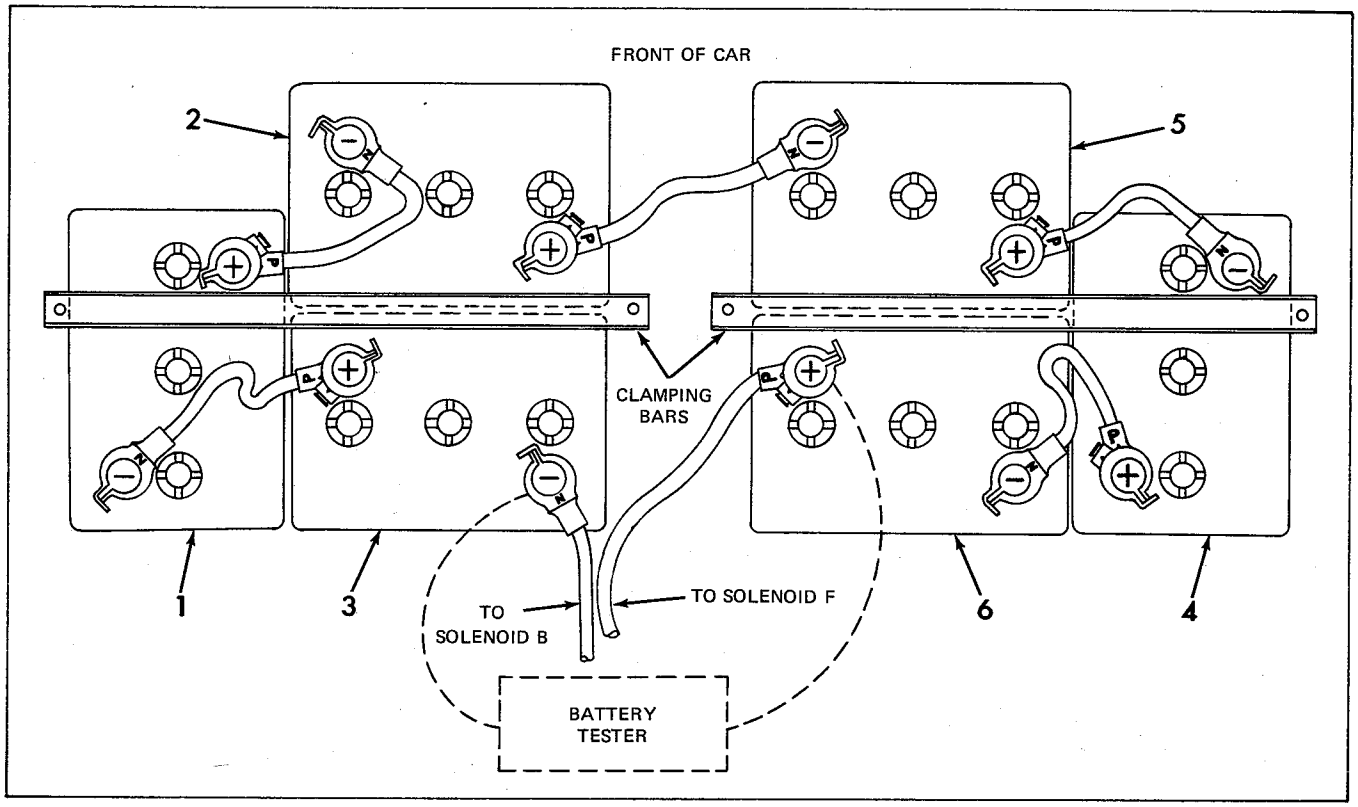


Figure 5-8. Battery Installation Diagram

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: (Follow manufacturer's instructions)

1. The golf car must stand idle for at least 5 minutes prior to testing with an open circuit voltmeter. If the battery has been on charge, the golf car should be run 2 to 3 minutes before testing to remove the surface charge, and then stand idle for at least 5 minutes to permit equalization of the voltage.

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. Connect Fox tester as shown in Battery Installation Diagram, Figure 5-8.

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 retest.)

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 call voltages check ok, 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.

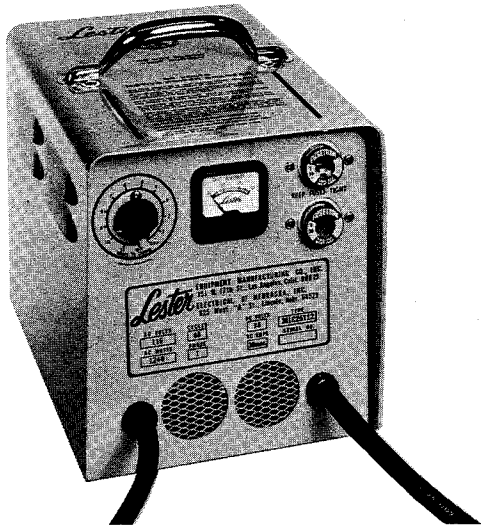
Batteries allowed to stand in a discharged condition (1.100 specific gravity) will freeze at 19°F. and ice may crack the container and damage the positive plates.

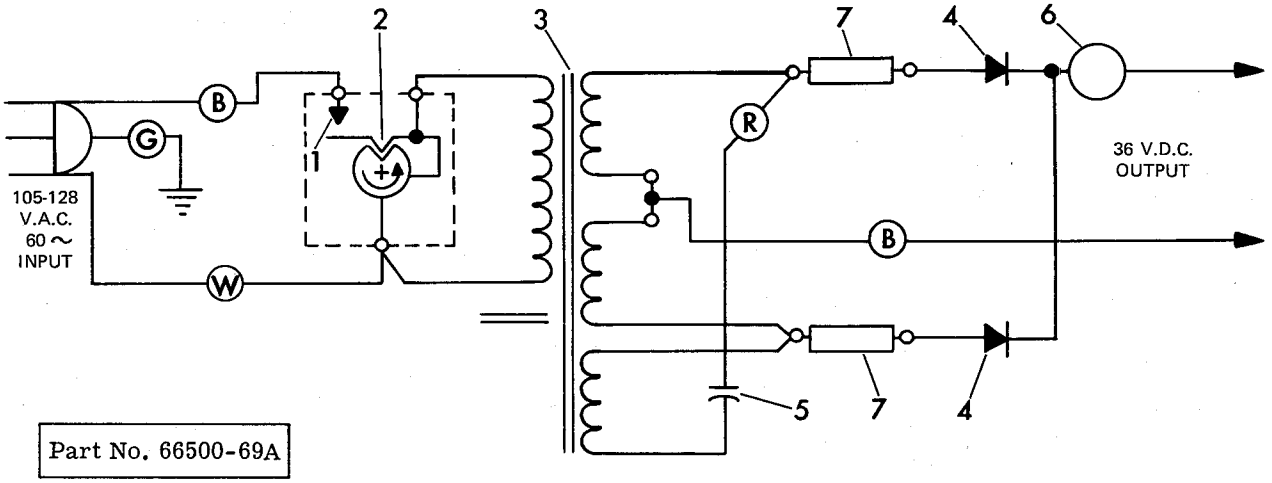
BATTERY CHARGER

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

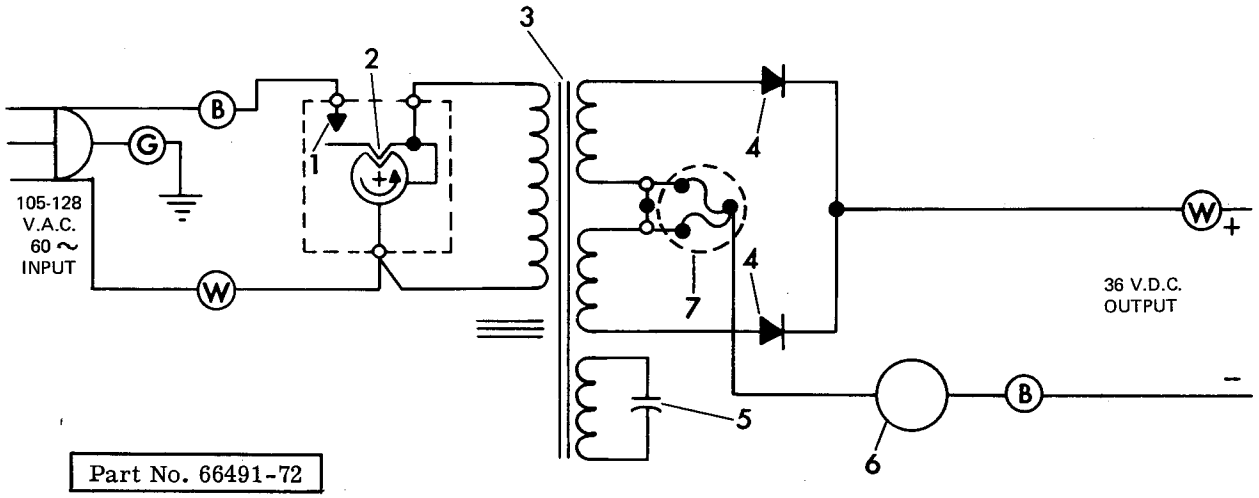
The charger power cord is equipped with a three-prong UL approved grounded type plug. For permanent locations, a three-prong receptacle that matches the plug should be installed, as this arrangement will automatically ground the car and charger and eliminate any electrical hazard.

The portable charger charging cord is equipped with a polarized connector which fits into a receptacle on the car.





Part No. 66500-69A



Part No. 66491-72

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

Figure 5-9. Battery Charger Schematic Diagram

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 timer switch on.

The 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.

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 DE-40 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.

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.

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 AMF motor, disconnect cables from the motor. Remove commutator cover band screw and pull cover back to expose opening. To inspect motor brushes in the G.E. motor, pull off the four rubber brush covers.

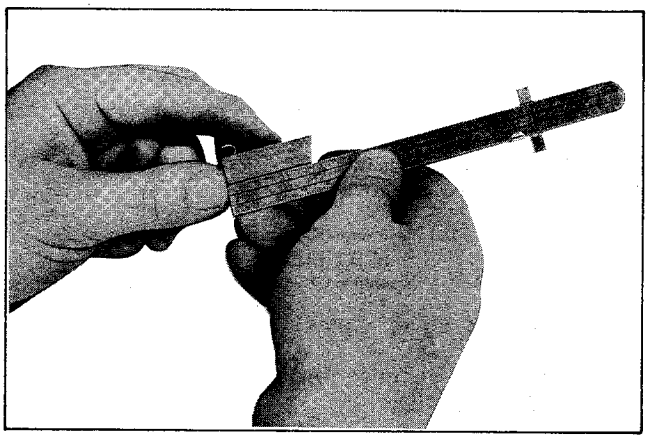


Figure 5-10. Measuring Brush Length at Heel of Brush

Detach pigtail terminal held by screw to brush holder, release brush springs with a wire hook and pull brushes out of brush holders. See Figure 5-10. 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. 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 INSPECTION AND REPAIR. 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.

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.

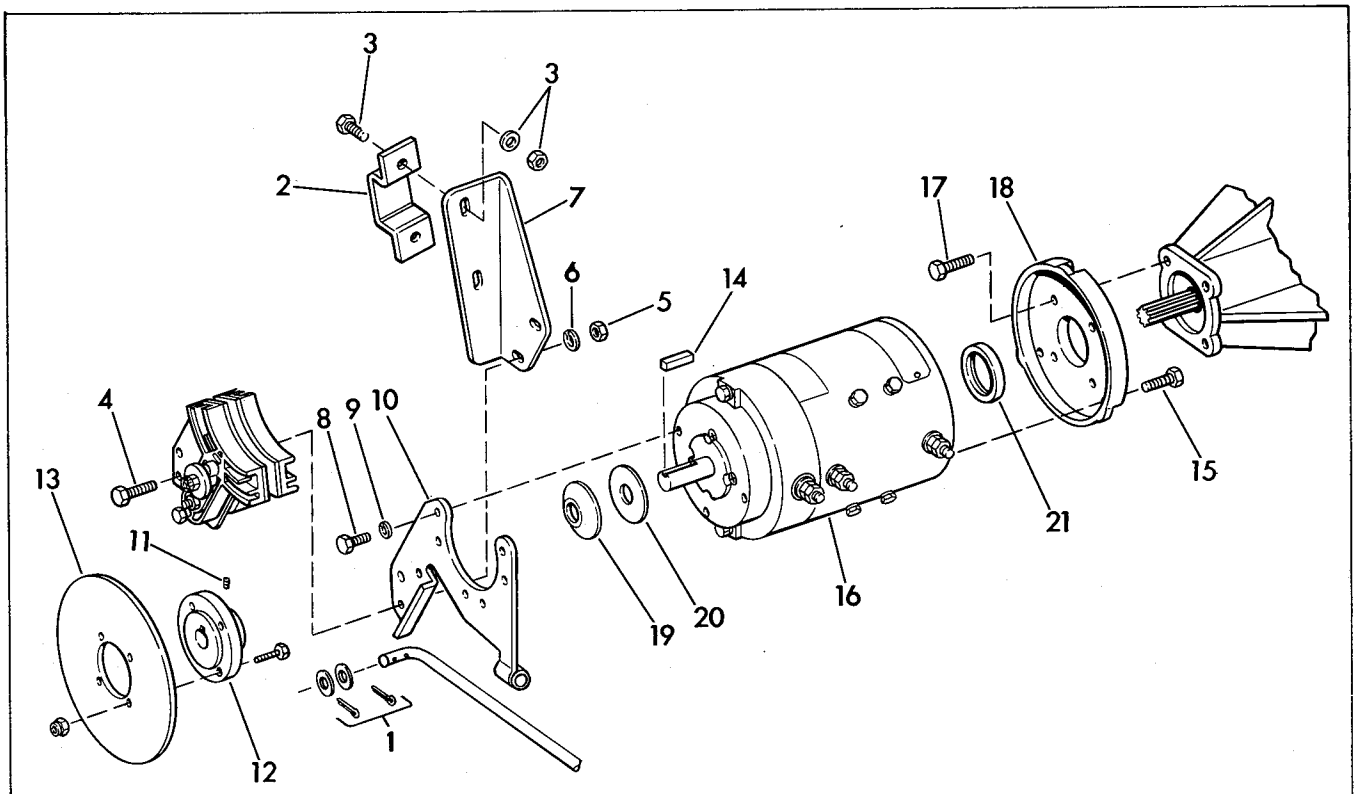
Use 6-volt continuity test circuit as described under TESTING CIRCUITS.

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). 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).



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 5-11. Motor and Brake Assembly - Exploded View

REMOVING AND INSTALLING MOTOR

See Figure 5-11.

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.

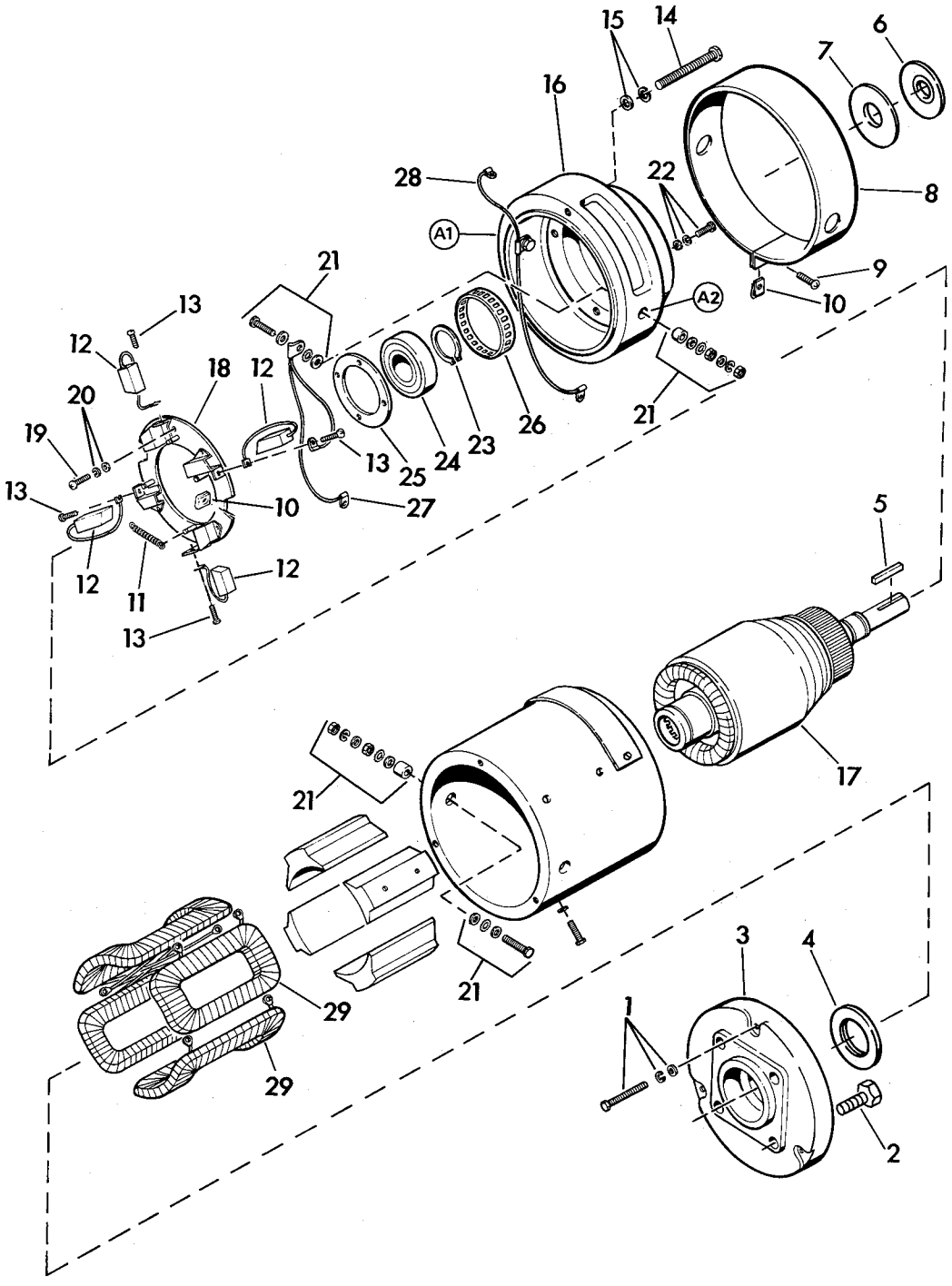
Inspect oil seal (21) in motor end cover (18). Replace if damaged or worn.

CAUTION

Do not drop foreign material into axle housing.

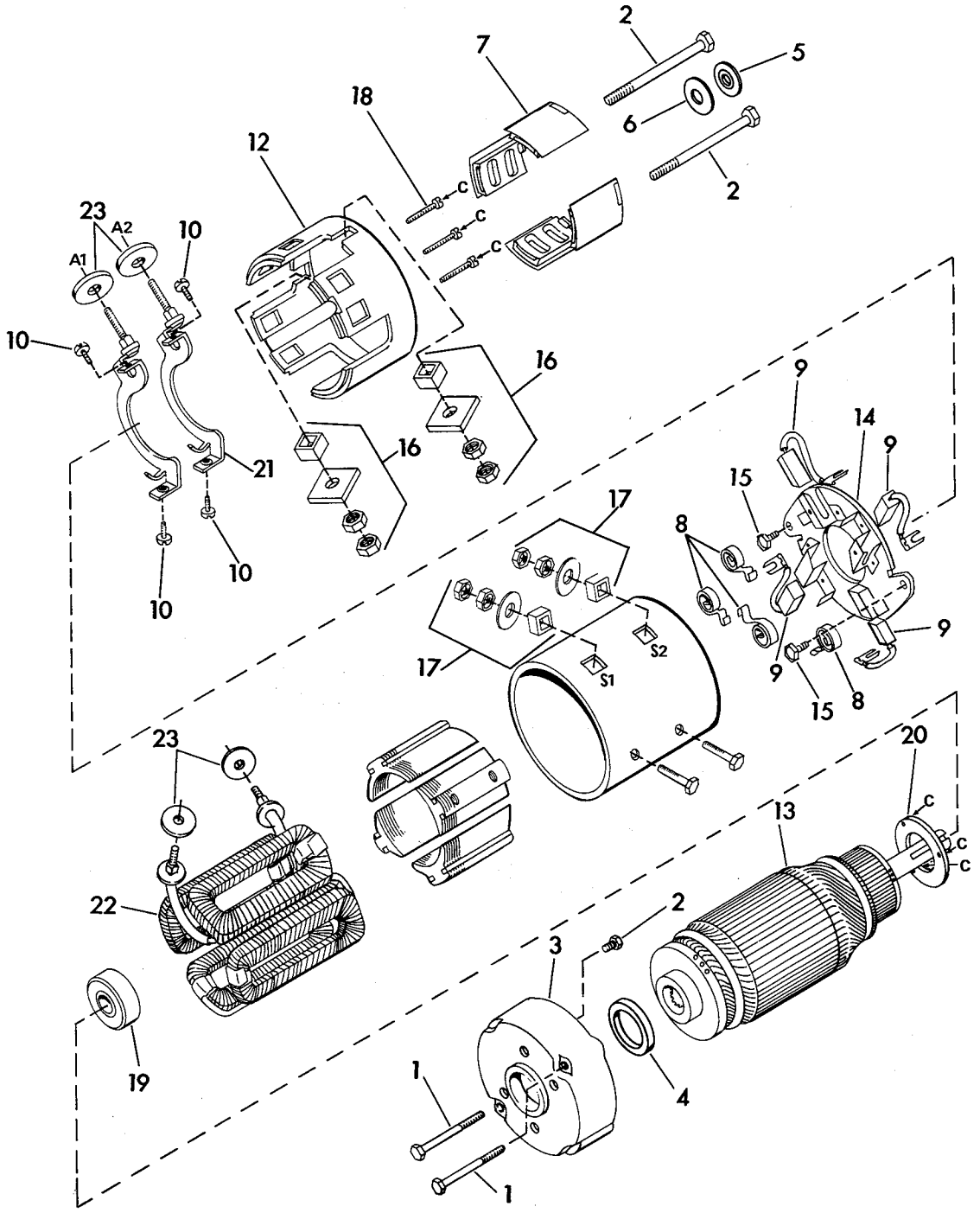
Reassemble in reverse order of disassembly, observing the following:

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.



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 5-12. AMF Traction Motor - 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 5-13. G.E. Traction Motor - Exploded View

Check oil level in the differential housing and add Harley-Davidson Differential Lubricant if necessary. See DIFFERENTIAL AND AXLE.

SERVICING MOTOR

Motor repairs for the G.E. traction motor are available at G.E. electric motor service shops located in most larger cities. A list of these service stations is available from our service department. G.E. motors within warranty should not be disassembled but returned intact to your nearest G.E. service station.

AMF motors still under warranty should be returned intact to the factory.

Principal renewal parts for both motors such as brushes, bearings and seals are available from our parts and accessories division. A list of these parts appear in our DE-40 Electric Golf Car Parts Catalog.

DISASSEMBLING AMF TRACTION MOTOR (Figure 5-12)

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 GE TRACTION MOTOR (Figure 5-13)

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.

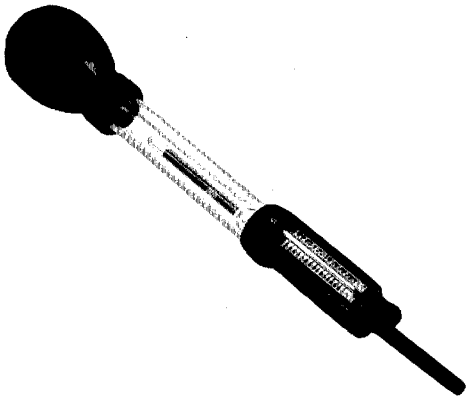
A grounded field winding may be checked using the Model AT-76 continuity tester probes between terminal stud labeled S1 or S2 and motor frame — lamp should not light. This test may not show a high resistance short which can be determined by checking with a high potential tester (megger) in place of the 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.

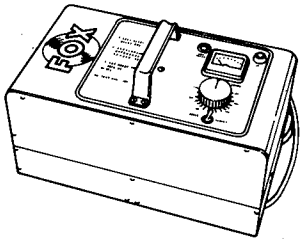
REASSEMBLING TRACTION MOTOR

Reassembly of both motors is the reverse of disassembly. End cover bolts are tightened to 90 to 100 in. lbs. torque.



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.

NOTES

Harley-Davidson
Milwaukee, Wisconsin 53201