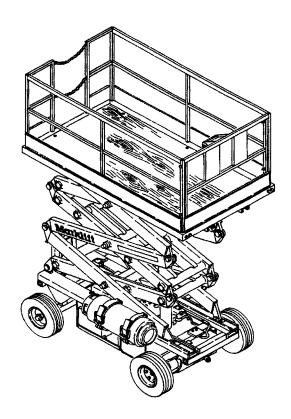
The Mark Industries A Product of Mark Industries

SELF-PROPELLED SCISSOR OPERATION MAINTENANCE AND PARTS MANUAL



Models: M20G & M20GT

FIRST EDITION: May 1988



Mark Industries

P.O. Box 2255
Brea, California 92622
205 South Puente Street, Brea, California 92621
(714) 879-MARK, FAX (714) 879-8884

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PARTS CATALOG

THIS MARKLIFT SELF PROPELLED DUAL FUEL SCISSOR LIFT MODELS M-20G AND M-20GT* OPERATION, MAINTENANCE AND PARTS MANUAL IS DESIGNED AS:

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ILLUSTRATED PARTS CATALOG

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PARTS CATALOG

The purpose of this manual is to provide the customer with operation, maintenance and parts information that will enhance the reliable performance of the MARKLIFT. Schematic and vendor information is also furnished.

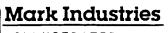
IMPROPER USE OF THIS MARKLIFT WILL RESULT IN WARNING: SERIOUS INJURY OR DEATH! TO PROTECT YOURSELF AND THE EQUIPMENT, STUDY THIS MANUAL BEFORE STARTING OPERATIONS.

The model capacity, pressure settings and serial number can be found on the ID Plate mounted on the side, rear of the base.

The serial number should be used when ordering parts. This will insure our Parts Department in giving prompt and accurate service.

If additional information or service is needed, we recommend the customer contact his local dealer. If this is not possible, contact the MARK INDUSTRIES Service Department.

All MARKLIFTS are tested and operated to assure their proper operating condition before shipment. necessary adjustments have been made and an overall physical inspection was conducted. After the unit is delivered, however, some minor adjustments inspections must be made before putting the unit These functions are outlined in the INSPECTION AND CHECKOUT INSTRUCTIONS in the operation section of this manual.



ILLUSTRATED PARTS CATALOG

SPECIFICATIONS (M-20G)

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	DESCRIPTION	ENGLISH	METRIC
	WORKING (MAXIMUM)	26'	7.92 m
	HEIGHT PLATFORM (MAXIMUM)	20'	6.09 m
	(MINIMUM)	44"	1.12 m
	LENGTH (OVERALL)	96"	2.44 m
	WIDTH (OVERALL)	54"	1.37 m
	DIMENSIONS (INSIDE)	52.5" x 94.5"	1.33 m X 2.40 m
	PLATFORM SAFETY RAILS (REMOVABLE)	42"	1.07 m
	TOE PLATE	6"	0.15 m
	LOAD CAPACITY (EVENLY DISTRIBUTED)	1000#	453 kg.
	WHEEL BASE	67.75"	1.72 m
۱	WHEEL TRACK	47.5"	1.21 m
ı	TURNING RADIUS (INSIDE)	7'7"	2.31 m
١	DRIVE SPEED LOW	1.5 mph	2.41 km/hr
	HIGH	3.0 mph	4.83 km/hr
	HIGH SPEED CUTOUT	6'	1.83 m
	LIFT/LOWER SPEED (MAXIMUM LOAD)	32/12 sec	32/12 sec
	POWER SYSTEM (Wisconsin)	16 hp, WI588	
١	CAPACITY GASOLINE	13	49.2 1
	LP FUEL		
	ALTERNATOR	15 AMP	
	TIRE SIZE		
	SHIPPING WEIGHT	3380#	1533 kg.
	SHIPPING CUBE	249 ft ³	7.05 m ³



SPECIFICATIONS (M-20GT)

GENL PAGE

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NOT AVAILABLE THIS REVISION

GENL PAGE

WARRAN

MANUFACTURERS' LIMITED WARRANTY

Mark Industries makes no warranty, express or implied, on any product manufactured or sold by Mark Industries except for the following limited warranty against defects in materials and workmanship on products manufactured by Mark Industries.

Mark Industries warrants the products manufactured by Mark Industries to be free from defects in material and workmanship under normal use and service for a period of six (6) months from the date of shipment. This limited warranty does not extend to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark industries. The warranty, if any, with respect to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries is limited to the warranty, if any extended to mark Industries by the manufacturer of the other product, part, component, accessory or attachment.

This limited warranty does not extend to any product (or any part or parts of any product) which has been subject to improper use or application, misuse, abuse, operation beyond its rated capacity, repair or maintenance except in accordance with the sales and service manuals and special instructions of Mark Industries, or modification without the prior written authorization of mark Industries (whether by the substitution of nonapproved parts or otherwise).

The sole obligation and liability of Mark Industries under this limited warranty (and the exclusive remedy for any purchaser, owner or user of Mark Industries products) is limited to the repair or replacement, at the option of Mark Industries, of any product (or any part or parts of any product) manufactured by Mark Industries which, within six (6) months from the date of shipment, shall have been returned to the Mark Industries facility in Carson. California (or any other location within the United States as shall be designated by Mark Industries), at no expense to Mark Industries, and demonstrated to the satisfaction of Mark Industries as being defective in material or workmanship.

To make a claim under this limited warranty, contact Mark Industries or the Mark Industries distributor from whom the product was originally purchased. A statement giving the model and serial number of the allegedly defective product, the date and a description of the alleged defect, the date of the purchase and proof of the purchase and purchase date must accompany the returned product (or any part or parts of any product). Any product (or any part or parts of any product) determined by Mark Industries to be defective will be repaired or replaced, at the option of Mark Industries, free of charge, f.o.b. Carson, California. No credit will be given for any allegedly defective product (or any part or parts of any product) not returned to Mark Industries.

There are no other warranties, express or implied, in addition to this limited warranty. This limited warranty is exclusive and in lieu of all other warranties, express or implied (in fact or by operation of law or otherwise), including the implied warranties of merchantability and fitness for a particular purpose.

Mark Industries shall not be liable for any special, indirect or consequential damages. Further, no representation or warranty made by any person, including any representative of Mark Industries, which is inconsistent or in conflict with, or in addition to the terms of the foregoing limited warranty (or the limitations of the liability of mark Industries as set forth above) shall be binding upon Mark Indkustries unless reduced to writing and approved by an officer of Mark Industries.

Tires, batteries, filter elements and electrical components are specifically excluded from this limited warranty.



Mark Industries

P.O. Box 2255 • Brea, California 92622 (714) 879-MARK • FAX (714) 879-8884

WARRANTY REGISTRATION

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COMPANY NAME		
ADDRESS		
TELEPHONE NUM	BER	
DATE SHIPMENT	RECEIVED	UNIT WILL BE USED
DATE OF INVOICE	CE C	UNIT WILL BE SOLD
DATE UNIT PUT	INTO SERVICE	
		PAINTING/SANDBLAST
INSPECTION	GEN'L MAINTENANCE_	
INSPECTION MINING	GEN'L MAINTENANCE	
INSPECTION MINING WELDING CONSTRUCTION	GEN'L MAINTENANCE	STEEL FABRICATIONRIGGINGROOFING
INSPECTION MINING WELDING CONSTRUCTION SCAFFOLDING	GEN'L MAINTENANCE	STEEL FABRICATIONRIGGING
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INSPECTION MINING WELDING CONSTRUCTION SCAFFOLDING MECHANICAL	GEN'L MAINTENANCE	STEEL FABRICATION RIGGING ROOFING GLAZING

NEW EQUIPMENT CONDITION REPORT

genl page 8

	PLATFORM CAPACITY DECALLBS ALL WARNING, CAUTION & EMERGENCY DEC		_
	EMERGENCY DESCENT VALVE FUNCTIONS PR		
	OPERATION INSTRUCTIONS PROPERLY INST		
	OPERATION & SAFETY HANDBOOK RECEIVED		
	ELECTRICAL SCHEMATIC RECEIVED		
	ALL CONTROLS (AERIAL & GROUND) ARE I		
	OPERATE CORRECTLY		<u>-00</u>
	STOP SWITCHES OPERATE PROPERLY (AERI		<u> </u>
	PLATFORM GUARD RAILS, SECURE AND UND		
	PLATFORM ACCESS GATE WORKS PROPERLY		
	HORN AND BEACON OPERATE PROPERLY (OF		
	BRAKES ADJUSTED AND OPERATE CORRECTL		
13.	CIRCUIT BREAKERS OPERATE PROPERLY		<u>−n</u> –n
14.	ENGINE R.P.M.	_	
	ALL HYDRAULIC CYLINDERS FREE OF LEAP		
	ALL HYDRAULIC CYLINDER RODS FREE OF		
	HYDRAULIC PUMP FREE OF LEAKS		_n
18.	HYDRAULIC HOSES & FITTINGS TIGHT		
19.	HYDRAULIC OIL LEVEL		
20.	HYDRAULIC TANK & FITTINGS FREE OF LE	AKS	— <u> </u>
21.	DRIVE MOTORS FREE OF LEAKS		— <u>1</u> —1
22.	TURRET ROTATION GEAR BOX OIL LEVEL		
23.	TURRET RING GEAR BOLTS TOROUED TC	FT. LES.	
24.	WHEEL LUG NUTS TORQUED TO	FT. LBS.	
25.	BATTERY WATER LEVEL	· · · · · · · · · · · · · · · · · · ·	——————————————————————————————————————
	ENGINE COOLANT (RADIATOR) LEVEL		
	COOLANT HOSES & FITTINGS FREE OF LEA		<u>-00</u>
	ELECTRIC RADIATOR FAN OPERATES FFOPE		
29.	TIRE PRESSURE PSI		- <u>0</u> - <u>0</u>
30.	SYSTEM PRESSURE FSIG		-0-0
31.	PILOT PRESSURE PSIG		-0-0
32.	FUEL TANK & FITTINGS FREE OF LEARS -		-0-0
	MANUAL OVERRIDES OPERATE PROPERLY —		
	MUFFLER TIGHT AND FREE OF LEAKS		
	ENGINE DIL LEVEL		
	ENGINE OIL FILTER, FREE OF LEAKS		
	ALL ELECTRICAL CONNECTIONS TIGHT		
	ENGINE ALTERNATOR FUNCTIONS PROPERLY		
39.	VALVE MANIFOLD & FITTINGS, FREE OF L	EAKS	-0-0
40.	DRIVE WHEEL, TOROUE HUB OIL LEVEL		
	RETRACTION CABLE TENSION		
42.	110V GENERATOR OPERATES PROPERLY (OP	TIONAL)	-0-0
MODEL	NUMBER	SERIAL NUMBER	
INSPE	CTOR	OPTIONS	

PARTS CATALOG

OPER PAGE

Every operator of the MARKLIFT must read, understand and follow the safety rules set forth herein.

- 1. The MARKLIFT self-propelled aerial work platform is a personnel lifting device, and it is essential that it be properly maintained and operated to perform all functions with maximum safety and efficiency.
- 2. The operation of any new and unfamiliar equipment can be hazardous in the hands of untrained operators. Only trained operators must be assigned to operate the MARKLIFT.
- 3. Never exceed manufacturer's recommended platform load capacity. The load capacity of the MARKLIFT is the total combined weight of personnel and tools, fixtures, acessories, etc. Secure all equipment and distribute the weight evenly.
- 4. Although the MARKLIFT conforms to specified ANSI & OSHA requirements, it is the responsibility of the owner to instruct the operators with safety requirements made not only by MARK INDUSTRIES, but by various local safety boards, as well as the ANSI & OSHA requirements.
- 5. The MARKLIFT is an uninsulated personnel carrier and must not be operated within 10 feet of a 50,000-volt line. (see pages 10 & 11)
- 6. It is recommended that head gear (hard hats) be worn by all personnel in the work platform.
- 7. Under no circumstances should horseplay be tolerated.



(continued)

ILLUSTRATED PARTS CATALOG

- 8. The MARKLIFT structure must not be used as a welding Disconnect both battery leads prior to performing any welding operations.
- DO NOT lean over platform guard railings to perform work.
- DO NOT use ladders or scaffolding on the platform to obtain greater height.
- 11. DO NOT store loose material in the work platform such as pipe, rope, extension cords, wire or miscellaneous boxes. If necessary to store such items, they must be positioned in such a way that no one will trip over them when operating or working in the platform.
- 12. DO NOT alter equipment in any fashion.
- 13. DO NOT override any hydraulic, mechanical or electrical safety devices.
- 14. DO NOT drive on uneven, sloping or soft terrain, as this is hazardous and must be avoided. The MARKLIFT must not be operated on more than a 6-degree out-of-level condition fore and aft nor more than 3 degrees to the side.
- 15. DO NOT work on the platform if you feel dizzy or unsteady in any way.
- 16. DO NOT jump start other vehicles using the MARKLIFT battery.
- 17. DO NOT fill fuel tanks with the engine running.
- 18. When a machine is not in use, remove the key from the ground control panel to prevent unauthorized use.
- 19. When working under the elevated platform, always remember to raise the Safety Support Arm (See Chapter Part, Section 4, Figure 1A or 1B for location) to prevent accidental platform descent.



DIVISION OF INDUSTRIAL SAFETY

PARTS CATALOG

DIVISION OF INDUSTRIAL SAFETY (Register 73, No. 30--7-28-73)

358.38.113

Minimum Required

Clearance (Feet)

Article 86. Provisions for Preventing Accidents

Article 86. Provisions for Preventing Accidents Due to Proximity to Overhead Lines

2946. Provisions for Preventing Accidents Due to Proximity to Overhead lines. (a) General. No person, firm, or corporation, or agent of same, shall require or permit any employee to perform any function in proximity to energized high-voltage lines; to enter upon any land, building, or other premises and thereto engage in any excavation, demolition, construction, repair, or other operation; or to erect, install, operate, or store in or upon such premises any tools, machinery, equipment, materials, or structures (including scaffolding, house moving, well drilling, pile driving, or hoisting equipment) unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

(b) Clearances or Safeguards Required. Except where electrical distribution and transmission lines have been de-energized and visibly grounded or effective barriers have been erected to prevent physical and arcing contacts with the high-voltage lines, the following provisions

shall be met:

(1) Over Lines. The operation, erection, or handling of tools, machinery, apparatus, supplies, or materials, or any part thereof, over

energized high-voltage lines shall be prohibited.

Nominal voltage

(Phase to Phase)

(2) Equipment and Materials in Use. The operation, erection, or handling of tools, machinery, equipment, apparatus, materials, or supplies, or any part thereof within the minimum clearances from energized lines set forth in Table X shall be prohibited.

Table X Required Clearances from Overhead High-Voltage Lines

(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			,	
	750	-	50,000	10
over	50,000	-	75,000	11
over	75,000	-	125,000	13
over	125,000	-	175,000	15
over	175,000	-	250,000	17
over	250,000	-	370,000	21
over	370,000	-	550,000	27
over	550,000	-	1,000,000	42

(3) Transportation or Transit. The transportation or transit of any tool, machinery, equipment, or apparatus, or the moving of any house or other building in proximity to overhead high-voltage lines shall be expressly prohibited if at any time during such transportation or transit such tool, machinery, equipment, apparatus, or building, or any part thereof, can come closer to high-voltage lines than the minimum clearances set forth in Table Y.

PARTS CATALOG

(CONTINUED)

Minimum Required

Article 86. Provisions for Preventing Accidents

Except where the boom of boom-type equipment is lowered and no load is imposed thereon, the equipment in transit shall conform to the minimum required clearances set forth in Table X.

Table Y Required Clearances from Energized High-Voltage Conductors (While in Transit)

(Phase	to	Phase)	Clearance (Feet)
750 over 50,000 over 345,000 over 750,000	-	750,000	6 10 16 20

Nominal Voltage

(Phase to Phase)

- (4) Storage. The storage of tools, machinery, equipment, supplies, materials, or apparatus under, by, or near energized highvoltage lines is hereby expressly prohibited if at any time during such handling or other manipulation it is possible to bring such tools, machinery, equipment, supplies, materials, or apparatus, or any part thereof, within the minimum required clearances from highvoltage lines as set forth in Table X.
- (c) The specified clearance shall not be reduced by movement due to any strains impressed (by attachments or otherwise) upon the structures supporting the high-voltage line or upon any equipment, fixtures, or attachments thereon.
- (d) Insulated cage-type boom guards, boom stops, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not alter the required clearances set forth in Table X.
- (e) Any overhead conductor shall be considered to be energized unless and until the person owning or operating such line verifies that the line is not energized, and the line is visibly grounded at the work site.
- 2947. Warning Signs Required. The owner, agent, or employer responsible for the operations of equipment shall post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable warning sign legible at 12 feet reading: "Unlawful To Operate This Equipment Within 10 Feet of High-Voltage Lines of 50,000 Volts Or Less.

In addition to the above wording, the following statement in small lettering shall be provided on the warning sign: "For Minimum Clearances of High-Voltage Lines In Excess of 50,000 Volts, See Article 86, Title 8. High-Voltage Electrical Safety Orders."

PARTS CATALOG

WARNINGS AND CAUTION DECALS

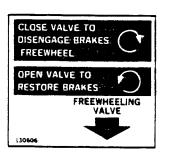
OPER PAGE

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OBSERVE ALL DANGER, WARNING, CAUTION AND EMERGENCY DECALS AT THE VARIOUS LOCATIONS ON THE MARKLIFT IN ORDER TO TAKE TIMELY PREVENT-IVE AND CORRECTIVE ACTIONS.

ATTACH SAFETY CHAINS BEFORE RAISING PLATFORM





LOAD CAPACITY LBS. (EYENLY DISTRIBUTED LOAD)





THE ANSI SAFETY ALERT SYMBOL
HAZARD DESCRIBED ON MARKLIFT DECALS.
HAZARDS INDICATED BY THESE MESSAGES.

IDENTIFIES PERSONNEL SAFETY BE ALERT TO THE POTENTIAL

IT IS THE PRIMARY RESPONSIBILITY OF THE USER AND OPERATOR TO BE THOROUGHLY KNOWLEDGEABLE OF ALL DECALS - INFORMATION, DEFINITION AND LOCATION.

THE FOLLOWING PAGE CONTAINS A CHART IN WHICH DECALS FOR THE MARK-LIFT CAN BE IDENTIFIED FOR REPLACEMENT IF THE EXISTING DECAL(S) IS WORN-OUT, TORN, OR ILLEGIBLE. THIS CHART ALSO REFERS TO LOCATION AND QUANTITY USED IN THAT APPLICATION.

WARNING AND CAUTION DECALS

OPER PAGE

(continued)

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DECAL P/N	DECAL DESCRIPTION	ASSEMBLY (LOCATION)	QTY
67403	DECAL SET	(ALL STANDARD DECALS)	1
2002	FORKLIFT BOOT	FINAL ASSY	2
2004	USE VAPOR TANK ONLY	FINAL ASSY	1
2014	CAUTION, HIGH VOLTAGE	AERIAL CONTROL PANEL	1
2015	WARNING UNSTABLE CONDITION	AERIAL CONTROL PANEL	1
2016	CAUTION - DO NOT WORK UNDERNEATH	FINAL ASSY	2
2017	THE HYDRAULIC SYSTEM	FINAL ASSY	1
2020	GASOLINE OR PETROL	FINAL ASSY	1
2024	LOAD CAPACITY 1000 LBS	FINAL ASSY	4
2041	DO NOT LIFT FROM THIS END	FINAL ASSY	1
11064	ATTACH SAFETY CHAINS BEFORE	FINAL ASSY	1
20413	ENGINE CHOKE	AERIAL CONTROL PANEL	1
20660	IDENTIFICATION PLATE	FINAL ASSY	1
20661	ANSI A92 PLATE	FINAL ASSY	1
23783	FUEL SELECTOR	AERIAL CONTROL PANEL	1
30520	PATENT NUMBER PLATE	FINAL ASSY	1
31109	CAUTION - GUARD RAILS	FINAL ASSY	2
31259	MARKLIFT	FINAL ASSY	2
31280	AERIAL CONTROL PANEL	AERIAL CONTROL PANEL	1
32368	M-SERIES	FINAL ASSY	1
130596	A PRODUCT OF MARK INDUSTRIES	FINAL ASSY	2
130606	FREEWHEELING VALVE	FINAL ASSY	1
130820	OPERATION AND SAFETY HANDBOO	OK FINAL ASSY	1
130938	MARK	FINAL ASSY	1
131151	OPERATION INSTRUCTIONS	FINAL ASSY	1
131154	GROUND CONTROL PANEL	GROUND CONTROL PANEL	1
185707	110 VAC	GROUND CONTROL PANEL	1

PARTS CATALOG

OPERATING INSTRUCTIONS

OPER PAGE

It shall be the responsibility of all MARKLIFT operators to read and comply with the following operating instructions. They are designed to promote safety and a better understanding of the operation of the self-propelled aerial platform.

OPERATION INSTRUCTIONS

BE SURE TO USE ALL SAFETY EQUIPMENT, AS REQUIRED BY O.S.H.A.



(1) STARTING

BEFORE THE AERIAL OR GROUND CONTROL BOXES WILL FUNCTION, THE MASTER SWITCH AT THE GROUND CONTROL BOX MUST BE TURNED ON.

GROUND CONTROL

BE SURE SELECTOR SWITCH IS IN GROUND POSITION THEN TURN (KEY) MASTER SWITCH TO "START"

AERIAL CONTROL

ATTACH SAFETY CHAINS AFTER ENTERING PLATFORM!

PULL EMERGENCY ON/OFF SWITCH OUT, DEPRESS MOMENTARY START BUTTON UNTIL ENGINE IS RUNNING. AERIAL CONTROLS AND WARNING DEVICES ARE NOW

2 FORWARD OR REVERSE DRIVE

TURN ROTARY DRIVE SWITCH TO DIRECTION AND SPEED DESIRED.

IT IS THE OPERATOR'S
RESPONSIBILITY TO READ AND
UNIDERSTAND, THE OPERATION
& SAFETY HANDBOOK AND ALL
DECALS BEFORE USING THIS
MACHINE!

3 TO STEER MACHINE

PUSH TOGGLE SWITCH LEFT OR RIGHT

4) TO RAISE OR LOWER PLATFORM

PUSH LIFT SWITCH UP OR DOWN

(5) WARNING LIGHT

WHEN LIGHT IS ON. MACHINE IS IN AN UNSAFE OUT OF LEVEL CONDITION, AND THE PLATFORM WILL LOWER AUTOMATICALLY.



WARNING WHEN MACHINE IS NOT IN USE REMOVE KEY FROM GROUND CONTROL BOX TO PREVENT UNAUTHORIZED USE.

1. STARTING

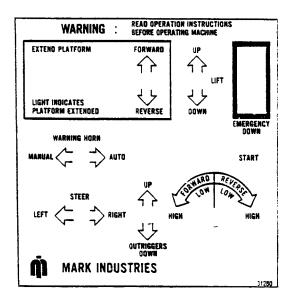
The MARKLIFT can be started from either AERIAL or EMERGENCY GROUND Before either position will function, the master switch must be ON, and the selector switch must be activated. Push the selector switch on the ground control up to activate the aerial control or down to activate the ground control .

(continued)

AERIAL CONTROL

Position the selector switch to AERIAL; then enter the platform. First, ATTACH SAFETY CHAIN BEFORE RAISING THE PLATFORM.

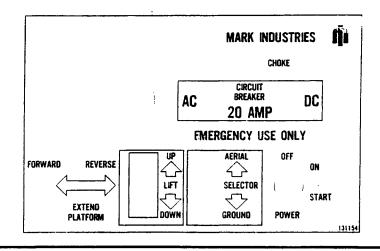
- Select fuel, PROPANE or GASOLINE, with the switch on the right side of the box.
- Pull out the red emergency ON/OFF knob located in the 2. middle of the aerial control panel.
- Use the engine choke on the left side of the box as needed.



EMERGENCY GROUND CONTROL В.

The only functions that can be operated from the lower control station are START/ON/OFF, LIFT UP/DOWN, and selector AERIAL/ GROUND.

- Position the selector switch to GROUND.
- Start the engine with the master switch. 2.
- 3. Use the choke as needed.



OPERATING INSTRUCTIONS

(continued)

2. DRIVE

Forward and reverse travel is performed from the aerial control panel only. The MARKLIFT is capable of two speeds for both forward and reverse travel: LOW and HIGH.

Low and high speed travel are activated with a rotary switch: LEFT FOR FORWARD, RIGHT FOR REVERSE.

In either direction, the first position is low speed and the second is high.

3. STEERING

The steering of the MARKLIFT is performed from the aerial control panel only. While the engine is running, push the steering switch to the left or right to turn the front wheels. Because a momentary type switch is used, when the operator releases the switch it will automatically return to the off center position. will remain at the last angle traveled until changed by again pushing the toggle switch in the direction desired.

4. LIFT

Raising and lowering of the platform is performed from either the aerial control panel or the ground control panel. The momentary switch has been designed so that, in order to raise the platform, the operator must push the lift switch to the UP position, and to lower the platform, to the DOWN position. When the switch is released, it will automatically return to the off (center) position, and the platform will remain stationary.

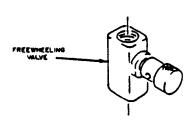
(continued)

5. FREE WHEELING (BRAKE VALVE)

In order to move the MARKLIFT in a free wheeling condition for loading, unloading and positioning, make sure that the ground control selector switch is in the OFF position. may be free wheeled for very short distances at no greater than five (5) miles per hour.

When preparing for free wheeling, always check that the MARK-LIFT is on a level surface!

The brake is disengaged by closing the free wheeling valve and momentarily activating the rotary drive switch. Use caution when brakes are disengaged!





ALWAYS REMEMBER TO OPEN FREE WHEELING VALVE TO RESTORE BRAKING.

EXTENDING PLATFORM (M-20GT) 6.

Platform extending toggle switch, is located on the face of the aerial control box (upper center). Platform may be extended forward or reverse, by pushing extend platform toggle switch in direction desired.

When yellow extend platform light is on, platform is extended. Drive and descent are inactive.

OPERATING INSTRUCTIONS

(continued)

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7. EMERGENCY DESCENT (M-20GT)

If the operator has platform extended and needs to descend, push down and hold emergency down switch, push the lift switch down.

Use caution when lowering platform in extended mode!

Remember to check below extended platform before using emergency down switch, to avoid damage to anything underneath.

8. OUT-OF-LEVEL WARNING LIGHT

As a safety feature, the MARKLIFT has been equipped with a series of mercury switches that will disable the lift circuit whenever the unit is in an unsafe, out-of-level condition. An unstable condition consists of a tilt of three (3) degrees to the side and six (6) degrees forward and aft, is indicated by a red light located in the top center of the aerial control panel. If the platform is raised it will automatically descend; if in the down position, it cannot be raised.

9. WARNING HORN (OPTION)

For some industrial applications, and to meet particular safety requirements, a warning horn may be needed. The warning horn option on the MARKLIFT can be used as an automatic movement indicator, or manually activated, as required. The horn is activated by a three-position switch on the aerial control panel. The middle position is OFF. When the switch is positioned to the right, the horn will sound when either the drive or lift function is activated (forward and reverse, up and down).

10. HYDRAULIC SYSTEM PRESSURE

MARK INDUSTRIES has incorporated an integrated hydraulic system in all models. To prevent damage to either the pumps or any other part of the hydraulic system, the maximum system pressure should be 2700 psig.

OPER

PAGE

12

UNLOADING AND TRANSPORTING

MARK INDUSTRIES AUTHORIZED UNLOADING AND TRANSPORTING PRODCEDURE FOR MARKLIFT SELF-PROPELLED SCISSORS

1. UNLOADING

Before unloading the MARKLIFT, inspect for any physical damage. Note any such damage on the freight bill and report same to carrier.

When a loading dock is unavailable and a forklift must be used, make sure that the forklift used has forks sufficiently long for the forklift boots at the front of the unit. DO NOT attempt to lift the machine from the side .

2. TRANSPORTING

The MARKLIFT may be freewheeled for loading, unloading, and towing for a very short distances at a speed no greater than 5 mph. To transport the MARKLIFT over long distances, a truck or trailer must be used.

If a rollback truck with a winch is used, attach the winch cable to the tiedown brackets and pull the MARKLIFT onto the truck. Keep the winch cable taut at all times.

When securing the MARKLIFT to the truck, put the chains or straps through the tiedown brackets only. DO NOT CHAIN OR STRAP OVER THE PLATFORM OR GUARD RAILS. Severe damage to the scissor arms may result from excess pressure caused by securing the machine over the top of the platform.

INSPECTION AND CHECKOUT



All MARKLIFT units are tested and operated to assure their proper operating condition before shipment.

At time time, all necessary adjustments are made and an overall physical inspection is conducted. After the unit is delivered, some minor adjustments and inspections must be made before putting the unit into service.

The following items should be reviewed:

- Check gasoline power units.
 - A. Engine oil level
 - B. Air filter
 - C. Fuel filter
 - D. Fuel Level (regular gasoline or propane)
 - E. Fuel lines and valves
 - F. Battery condition
 - G. Start engine
- Check operation of functions from both the ground control panel and the aerial control panel.
 - A. Test drive: Forward and Reverse
 - B. Test steering: Left and Right
 - C. Test lift: Up and Down
- 3. Inspect all electrical connections.
 - A. See
 - B. Feel
 - C. Tighten
- 4. Check hydraulic system.
 - A. Hydraulic fluid level
 - B. In-line pressure valve filter
 - C. Hydraulic lines
 - D. Hydraulic pump
 - E. Hydraulic cylinders

INSPECTION AND CHECKOUT

OPER PAGE

14

(continued)

- 5. Check Tires and Wheels.
 - A. For Cuts
 - B. Correct pressure
 - C. Tight lugs and wheel spindle nuts
- 6. Structural connections and fittings
 - A. Check all nuts and bolts for tightness.
- 7. Brakes
 - A. Check for holding on incline up to four (4) degrees.

PARTS CATALOG

This preventive maintenance information is intended as a general Refer to vendor section in this manual for detailed inforguide. mation on engine, battery, etc.

MARK INDUSTRIES recommends the following items be checked:

DAILY

- Operation and safety decals in place and legible.
- Check gas & hydraulic tank levels. 2.
- 3. Check engine oil level.
- 4. Check for loose or worn hardware.

WEEKLY

- 1. Check tire condition (free of serious cuts or defects)
- 2. Check & clean engine intake air cleaner.
- 3. Operation and safety decals in place and legible.
- 4. Proper brake operation.
- 5. Record hourmeter reading.
- 6. Clean unit by removing all dirt, oil, and grease. Machine may be washed with soap and water.
- 7. Check for hydraulic leaks and correct.
- 8. Check for structural damage and correct.
- 9. Check overall performance.
- 10. Check for wear on cables and hoses.

PARTS CATALOG

To properly and efficiently service your MARKLIFT, several basic tools are required. The following list of tools should be available.

SERVICE TOOLS

- 1. Volt/Meter
- Hydraulic pressure gage 2. (0-3,000 PSI)
- Battery hydrometer 3.
- Battery load tester 4.
- 5. Photo tachometer
- Standard mechanics' handtools 6.
- 7. Scissor arm supports
- 8. Female quick disconnect Coupler (MI #842)
- Fuel pump Vacuum/Pressure 9. Gage (automatic type)
- 10. Electrical test light

PARTS CATALOG

Whenever troubleshooting any problem, the initial consideration must be to "Check the basics".

"Check the basics" means to insure that the batteries are in good shape and have at least a three-quarter charge, determined by use of a hydrometer and battery maintenance instructions. (See Maintenance Chapter, pages 3 and 4, for more information).

A large percentage of electrical problems can be attributed to insufficiently charged or defective batteries.

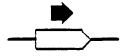
1. ELECTRICAL

- A. If a problem seems to be electrical, utilize your applicable schematic (See Schematic Chapter for more information) and test light to trace power flow (electrical current), starting at the battery and continuing through system until the problem is located.
- B. Keep in mind, if you DO NOT have a good ground to a valve coil, relay, etc. , then even if you have proper electrical current to the coil or relay, the items will not function properly.
- C. Diodes can be thought of as "One way electrical check valves" they permit current flow in one directon and stop it in the opposite direction.

Current Flow

ACTUAL

SCHEMATIC





TROUBLESHOOTING

(continued)

D. The basic purpose of a relay is to maintain full electrical current. When sending an electrical signal to the relay coil, the electrical current flows through the relay contacts and to the desired valve coil.

2. HYDRAULIC

- A. For the various hydraulic functions, the system pressure is utilized. If a slower drive speed is needed, a portion of the hydraulic fluid is dumped to tank by a flow control valve.
- B. Directional valves (Steering and Drive) have two opposite electrical coils with a movable spool between the coils.
- C. One-way valves (Lift, High-Drive and Descent) all can be both N/C (normally closed) or N/O (normally open), depending on whether flow is desired or not.

PARTS CATALOG

ENGINE 1.

- Will not start or run. Α.
 - Check ground control box circuit breaker.
 - 2) Make sure fuel shutoff valve is open.
 - 3) Fuel selector should be in the GASOLINE position.
 - 4) Check for low battery.
 - 5) Check for fouled spark plugs.
 - 6) Check for water in gas tank.
 - 7) Check engine points.
- Dies under load. В.
 - 1) Check governor setting.
 - 2) Check carburetor air/fuel mixture.

HYDRAULIC MOTOR AND PUMP 2.

- Wheel drive motor turns wheel while unloaded, but slows Α. down or stops when load is applied.
 - 1) Check hydraulic high pressure port with 3000 gage.
- В. Pump producing excessive noise.
 - 1) Check suction hose from tank to pump for kinks.
 - 2) Check hydraulic oil level (sight gage on tank).
 - 3) Check suction line fittings for tightness.
 - 4) Check oil.

PARTS CATALOG

3. STEERING

- Steers in one direction only. Α.
 - 1) Loose electrical connection.
 - 2) Spool sticking in one direction.
 - 3) Faulty steering switch.
 - 4) Flow control valve to steering cylinder out of adjustment.
 - 5) Faulty diode.

4. DRIVE

- Will drive forward. No reverse. Α.
 - 1) Loose electrical connection in reverse circuit.
 - 2) Faulty drive switch.
 - 3) Valve spool sticking in one direction.
 - 4) Faulty diode.
- No forward or reverse drive. B.
 - 1) Free wheeling valve open.
 - 2) Faulty drive switch.
 - 3) Stuck valve spool.
- C. No high speed.
 - 1) Loose electrical connections.
 - 2) High speed dump valve inoperative.
 - 3) Low speed relay inoperative.
- D. No functions working.
 - 1) Faulty circuit breaker.
 - 2) Loose power connections.
 - 3) Dump valve inoperative.

PARTS CATALOG

(continued)

- Ε. No system pressure.
 - 1) No hydraulic oil.
 - Hydraulic tank valve is in OFF position.
 - 3) Pressure relief valve inoperative.
 - 4) Hydraulic pump inoperative.
 - 5) Dump valve inoperative.
- Low system pressure. F.
 - 1) Pressure relief valve out of adjustment.
 - 2) Low speed dump valve faulty.
 - 3) Hydraulic pump faulty.
 - 4) Hydraulic tank suction filter obstructed.

5. LIFT

- Α. Will not lift. All other functions work.
 - 1) Loose electrical connections.
 - 2) Descent valve stuck open.
 - 3) Faulty lift switch.
 - 4) Tilt switches out of adjustment.
- B. Will not lift rated load.
 - 1) Low system pressure.
 - 2) Internal seal leaking in cylinder.

If this troubleshooting checklist does not help to solve your problem, contact your local MARKLIFT representative or the MARK INDUSTRIES service department.

-BATTERY MAINTENANCE

MAIN PAGE

A new fully charged battery will have a specific gravity of 1.260 or 1.280 at 80° F.

The tables (on Maintenance page 4) show the specific gravity as a function of percentage battery charge

1.260 Sp. Gr.	1.280	100% charged
1.230	1.250	75% charged
1.200	1.220	50% charged
1.170	1.190	25% charged
1.40	1.160	Very little useful capacity
1.110	1.130	Discharged

The percentage charge of a battery should be checked with a good hydrometer that has a thermometer and temperature correction scale built into it. This allows a temperature correction to be made readily. A correction of 0.04 points in gravity shall be made for each ten degrees either above or below 80°F. For every 10°F below 80°F, subtract 0.04 points; and for every 10°F above 80°F, add 0.04 points.

Within every thirty day period, the cell of each battery should be checked to determine the percentage charge. If any cell has a hydrometer reading of more than 0.020 less than the other cells in the battery, that cell is bad and the battery should be removed from service.

Periodic checks by hydrometer after charging, but prior to any discharge, is recommended to determine if batteries are receiving a full charge.

Either excessive overcharge or moderate undercharge can shorten battery life.

BATTERY MAINTENANCE

MAIN PAGE

(CONTINUED)

With proper attention to water level and charging time, compared to hydrometer reading, the batteries should give a long useful life.

TEMPERATURE/SPECIFIC GRAVITY CORRECTION TABLE FOR BATTERIES Actual Hydrometer Reading at Actual Temperature*

80 ⁰ F (27 ⁰ C)	0°F (-18°C)	-10°F .	-20 [°] F (-29 [°] C)	-30 [°] F (-34 [°] C)	-45 [°] F (-43 [°] C)	-65 [°] F (-54 [°] C)	Approx. State of Charge In %
1.280	1.312	1.316	1.320	1.324	1.330	1.338	100
1.250	1.282	1.286	1.290	1.294	1.300	1.308	75
1.220	1.252	1.256	1.260	1.264	1.270	1.278	50
1.190	1.222	1.226	1.230	1.234	1.240	1.248	25
1.160	1.192	1.196	1.200	1.204	1.210	1.218	0

Specific Gravity		
Corrected to 80°F (17°C)	Freezing Temperature	
1.280	-90°F -68°C	
1.250	-62°F -52°C	
1.200	-16°F -27°C	
1.150	+ 5°F -15°C	
1.000	+19°F - 7°C	

HYDRAULIC FLUID TABLE

MAIN PAGE 10

MI	LESTONE		HYDRAULIC FLUID TABLE					
OIL	COMPANY		CHEVRON	CHEVRON GULF SHELL		UNION		
BR	AND NAME		ATF Dexron 11	ATF Dexron 11	Donaz-T6	ATF Dexron		
	SUS AT 100°F (37.8°C)		187.4	195	200	200		
VICCOCITY	SUS AT 210 ⁰ F (98.9 ⁰ C)		49.2	50.4	50	52.3		
VISCOSITY	INDEV	° _F	153 ⁰	155 ⁰	160°	172 ⁰		
	INDEX	°c	67.2°	68.3 ⁰	71.10	77.8°		
FLASH POINT		°F	400°	405°	390°	395°		
PLASH	POINT	°C	204.4 ⁰	207.20	198.9°	201.70		
0.0110	°F		-40°	-50°	-50°	-45°		
POUR	POINT	°c	-40°	-45.6°	-45.6 ⁰	-42.8°		

MAINTENANCE CHECK LIST

MAIN PAGE 11

DATE SOLD WARRANTY PERIOD REMARKS OPTIONS SER. NO. HR METER ME CH. ¥.0 CODE: C-CHECKED A-ADJUSTED R-REPAIRED DATE IN SERVICE DATE DATE



MARKLIFT SERVICE MAINTENANCE RECORD

MAIN PAGE 12

MODEL:	SERIAL NO.
DATE:	EQUIP. NO.
LOCATION:	MECHANIC:

ITEM	CODE	COMMENTS	ITEM	CODE	COMMENTS
ENGINE OIL			SAFETY CUT-OUTS		
ENGINE OIL FILTER			BUSHINGS	<u> </u>	
AIR FILTER			ROLLERS		
FUEL FILTER			WEAR PAD		
TUNE-UP			FRONT END ASSY.		
CHOKE			TIRE PRESSURE		
ENGINE PPM			TIPE CONDITION		
CHEROINE SYSTEM			WHEEL NOTS		
FUEL SISTEM LEG-GAS			WHEEL BEARING		
BATTERIES			NUTS & BOLTS		
CATTERY TERMINALS		·	GUARD PAILS		
MOTOP CRUSHES			LUBRICATION		
HIORAULIC FLUID			WARNING DECALS		
HYD. OIL FILTER			OPERATION INSTRUCTIONS		
HYDRAULIC SYSTEMS		· · · · · · · · · · · · · · · · · · ·	GENERAL DECALS		
HYDRAULIC PRESSURE			FAINT		
HYDRAULIC HOSES			ALL OPERATIONS		
CYLINDERS		· · · · · · · · · · · · · · · · · · ·	LIFT		· · · · · · · · · · · · · · · · · · ·
OFIVE MOTORS			STEERING		
<u>CPAKES</u>			FORWARD DEIVE		
EMERGENCY LOWERING VALVE			REVERSE DRIVE		
ASPIAL CONTROL BOX			TIET SWITCHES		
6300NO CONTROL BOX			FUEL LEVEL		
PELAYS			LITERATURE		
WIRE CONNECTIONS			OFTIONS		

CODE

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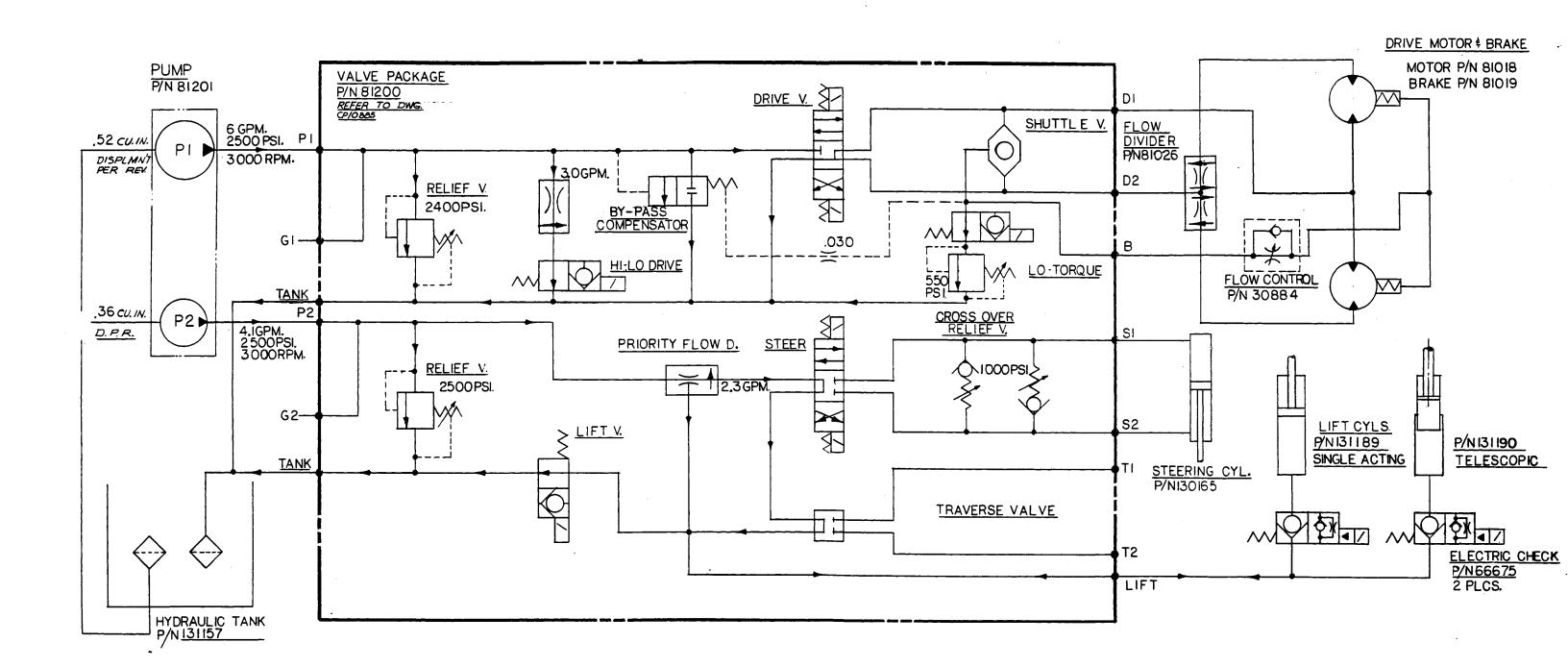
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OTHER COMMENTS:

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HYDRAULIC SCHEMATIC M-20GT

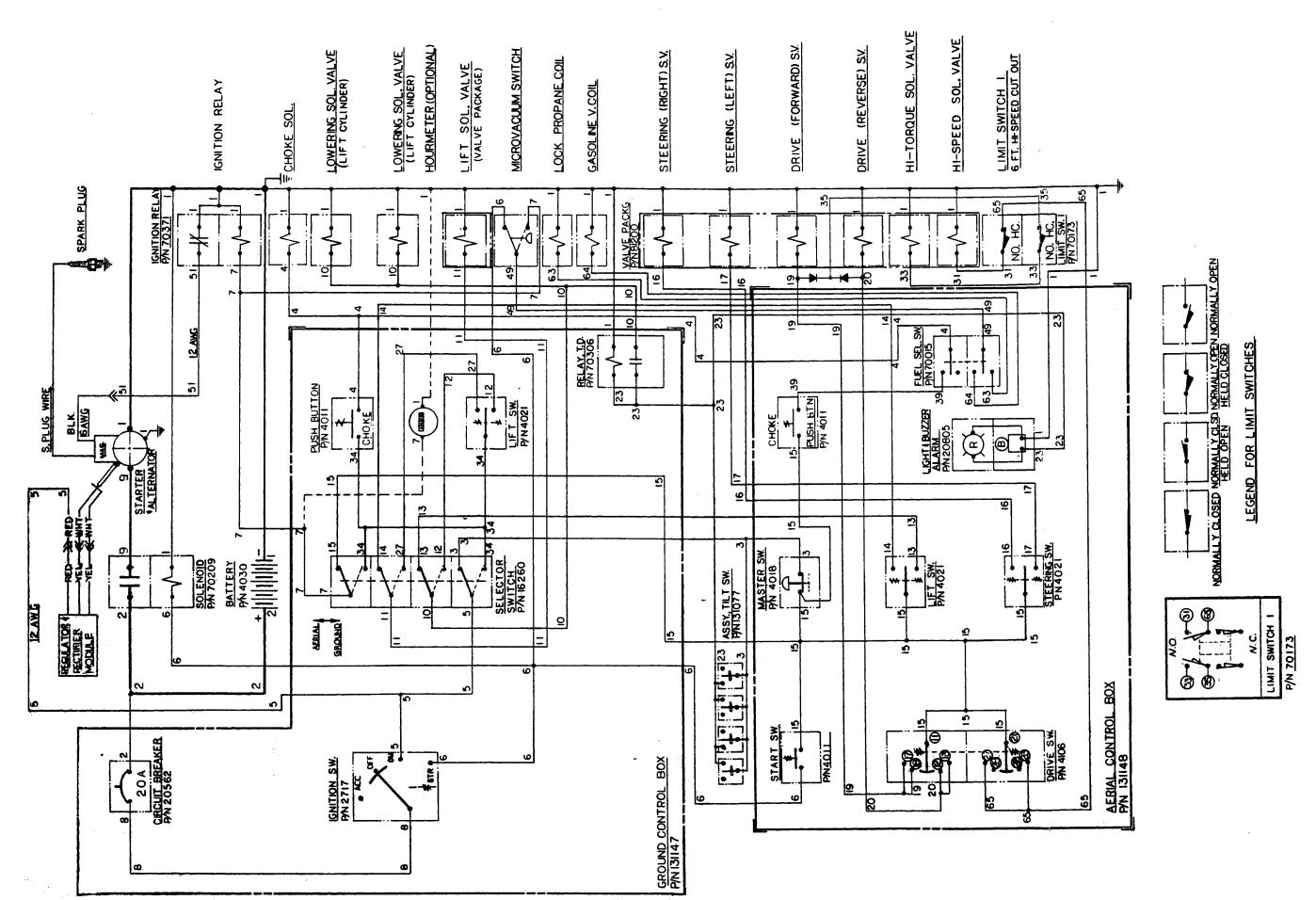
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SCHE PAGE





ELECTRICAL SCHEMATIC M-20GT

SCHE PAGE

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THE MARKLIFT ILLUSTRATED PARTS CHAPTER

PARTS SECT.

1

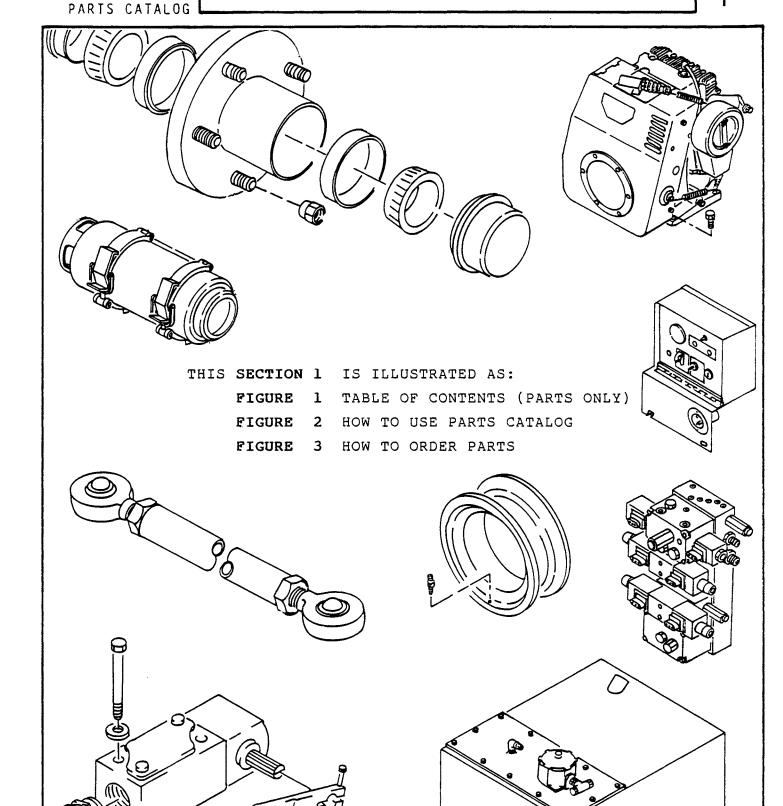


TABLE OF CONTENTS (PARTS ONLY)

SECT.1 FIG. 1

PARTS

PAGE 1

THIS PARTS CHAPTER IS DESIGNED AS:

SECTION	1	THE MARKLIFT PARTS CATALOG
FIGURE	1	TABLE OF CONTENTS (PARTS ONLY)
FIGURE	2	HOW TO USE PARTS CATALOG

FIGURE 3 HOW TO ORDER PARTS

SECTION 2 FINAL ASSEMBLIES

FIGURE 1A FINAL ASSEMBLY M-20G

FIGURE 1B FINAL ASSEMBLY M-20GT *

FIGURE 2 DECALS

FIGURE 3 HYDRAULIC HOSE INSTALLATION

FIGURE 4 UPPER CONTROL BOX ASSEMBLY

SECTION 3 FRAME ASSEMBLIES

FIGURE 1A FRAME ASSEMBLY M-20G

FIGURE 1B FRAME ASSEMBLY M-20GT *

FIGURE 2 TIRE AND WHEEL ASSEMBLY

FIGURE 3 HUB ASSEMBLY

FIGURE 4 DRIVE MOTOR/BRAKE ASSEMBLY (R.H.)

FIGURE 4A DRIVE MOTOR/BRAKE ASSEMBLY (L.H.)

FIGURE 5 TIE ROD ASSEMBLY

FIGURE 6 STEERING CYLINDER ASSEMBLY

FIGURE 7 FUEL TANK ASSEMBLY (GASOLINE)

FIGURE 8 BELLY PAN ASSEMBLY

FIGURE 9 DUAL FUEL KIT

FIGURE 10 TILT SWITCH ASSEMBLY

FIGURE 11 ENGINE AND PUMP ASSEMBLY

FIGURE 12 HYDRAULIC TANK ASSEMBLY

FIGURE 13 GROUND CONTROL BOX ASSEMBLY

FIGURE 14 VALVE PACKAGE ASSEMBLY

FIGURE 15 FLOW DIVIDER ASSEMBLY

TABLE OF CONTENTS (PARTS ONLY)

PARTS SECT. 1

FIG. 1

(continued) PAGE 2

SECTION 4	SCISSOR	ASSEMBLY

FIGURE 1 SCISSOR ASSEMBLY

FIGURE 2 LIFT CYLINDER ASSEMBLY (SINGLE ACTING)

FIGURE 3 LIFT CYLINDER ASSEMBLY (TELESCOPIC)

FIGURE 4 INNER ARM SUPPORT ASSEMBLY

FIGURE 5 OUTER ARM SUPPORT ASSEMBLY

FIGURE 6 INNER ARM ASSEMBLY (LOWER)

FIGURE 7 INNER ARM ASSEMBLY (MIDDLE)

FIGURE 8 INNER ARM ASSEMBLY (UPPER)

SECTION 5 PLATFORM ASSEMBLIES

FIGURE 1A PLATFORM ASSEMBLY M-20G

FIGURE 1B PLATFORM ASSEMBLY M-20GT *

SECTION 6 OPTIONAL ASSEMBLIES

FIGURE 1 OPTIONAL ASSEMBLIES

FIGURE 2 REMOTE DRIVE KIT

FIGURE 3 2500 WATT GENERATOR

FIGURE 4 HOURMETER

FIGURE 5 P.Q. SLOPE SENSOR

FIGURE 6 TRAVEL WARNING HORN *

FIGURE 7 ALL MOTION ALARM *

FIGURE 8 12 VOLT PLATFORM WORK LIGHT *

FIGURE 9 ROTATING AMBER BEACON *

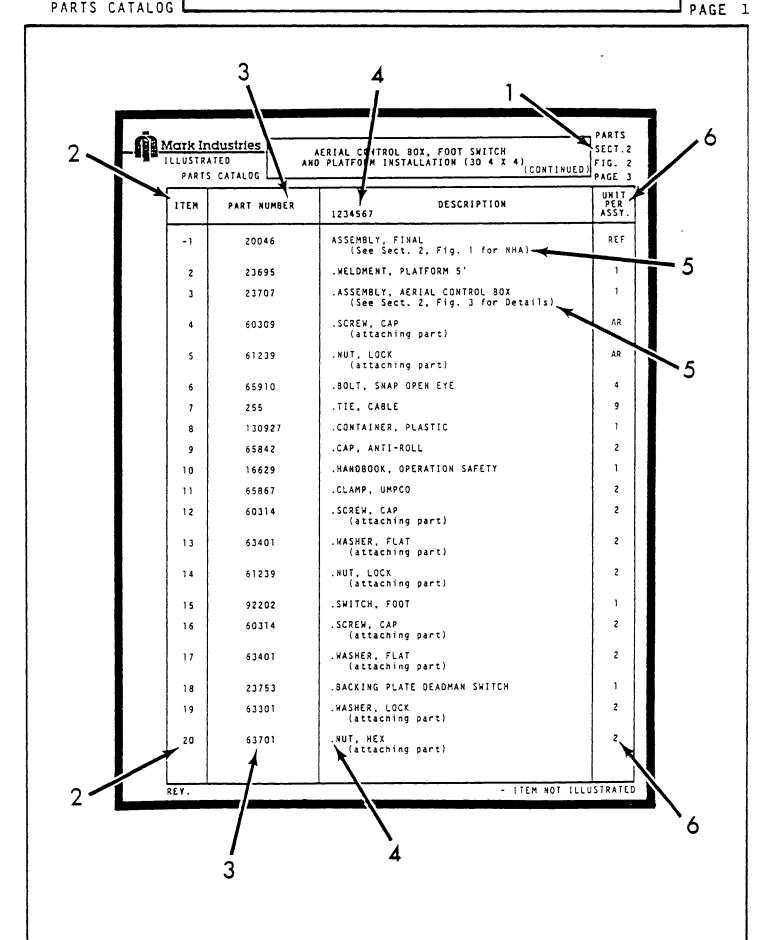
FIGURE 10 FEMALE REMOTE DRIVE PLUG *

FIGURE 11 PROPORTIONAL DRIVE CONTROLS *

FIGURE 12 TUV PACKAGE *

HOW TO USE PARTS CATALOG

PARTS SECT. 1 FIG. 2



HOW TO USE PARTS CATALOG

PARTS SECT. 1 FIG. 2 PAGE 2

(continued)

- 1. This area refers to the corresponding illustration.
 - 1) Chapter should be divided with General, Operation, Maintenance, Schematics, Parts, Vendor and Service Bulletins.
 - 2) Section and Figure belong to Parts Chapter only.
 Please check page of contents and each Section in Parts Chapter.
 - Page numbers are followed for chapter or section, and figure.
- The Item Number corresponds to the item number shown for the part in the illustration. (Parts with item numbers preceded by a dash are not illustrated such as -1, -5, etc.)
- 3. Parts that carry a Mark Industries part number.
- 4. The Indenture System used in the detail parts list of this catalog shows the relationship of one part to another. For a given item, the number of indentures depicts the relationship of the item to the associated installation, next higher assembly, or components of the item as follows:

1 2 3 4 5 6 7

Installation

- . Detail parts for installation
- . Assembly
- . Attaching parts for Assembly
- . . Detail parts for Assembly
- . . Sub-Assembly
- . . Attaching parts for Sub-Assembly
- . . Detail parts for Sub-Assembly
- . . Sub-Sub-Assembly
- . . Attaching parts for Sub-Sub-Assembly
- . . . Detail parts for Sub-Sub-Assembly
- . . . Sub-Sub-Sub-Assembly

HOW TO USE PARTS CATALOG

(continued)

SECT.1 FIG. 2 PAGE 3

PARTS

5. NHA (Next Higher Assembly) and DETAILS - Section and Figure reference catalog location indicates where the installation or assembly is listed under NHA and where illustrated for more detailed breakdown.

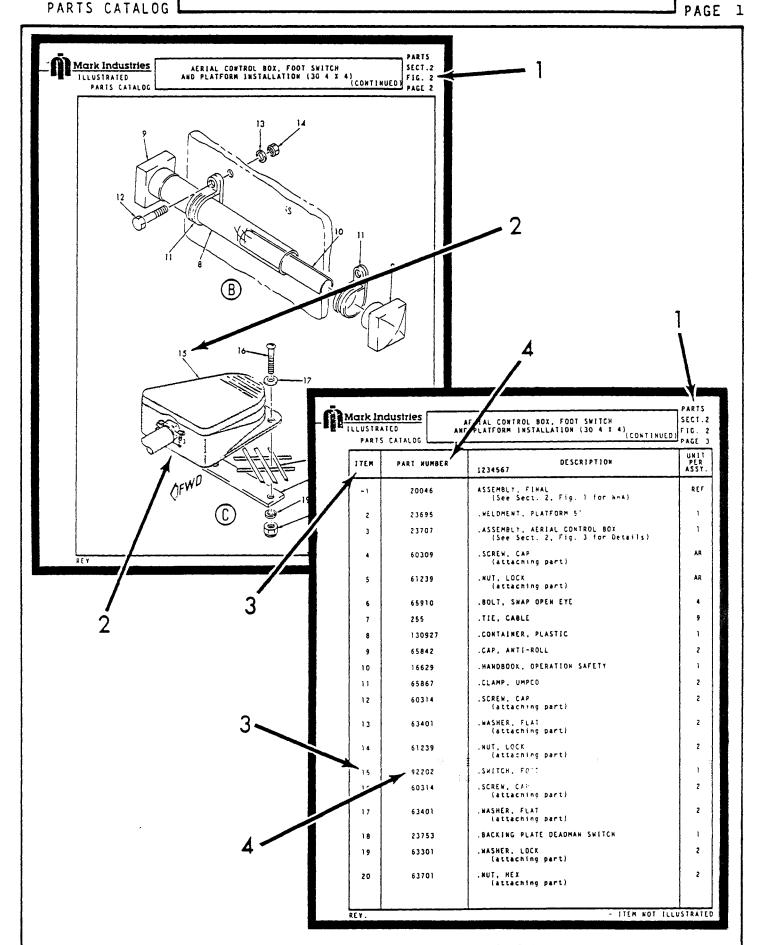
- 6. UNIT PER ASSEMBLY Entries are as follows:
 - 1) "REF" indicates the item is listed previously in the NHA and then again in this figure.
 - 2) "AR" indicates the part is used in a quantity "As Required."
 - 3) A number entry indicates the quantity of the part used in its next higher application.



HOW TO ORDER PARTS

PARTS SECT. 1

FIG. 3



PARTS CATALOG

HOW TO ORDER PARTS

(continued)

SECT. 1 **FIG.** 3 PAGE 2

PARTS

1. PART NUMBER

- STEP 1. Locate Section and Figure number within the table of contents and each Section page.
- STEP 2. Match your required part with the illustration page.
- STEP 3. Refer to the item number on the detail part list page.
- STEP 4. Part number is located in the part number column. Order by using that part number.

2. TO ORDER:

By phone: Service Department

(800) 421-1826 or (213) 639-9700

By mail: Attention Service Department

> MARK INDUSTRIES Post Office Box 720 Long Beach, CA 90801



MARK INDUSTRIES

2662 East Del Amo Boulevard, Carson, CA 90746 Post Office Box 720, Long Beach, CA 90801

ILLUSTRATED PARTS CATALOG

THIS SECTION 2 IS ILLUSTRATED AS:

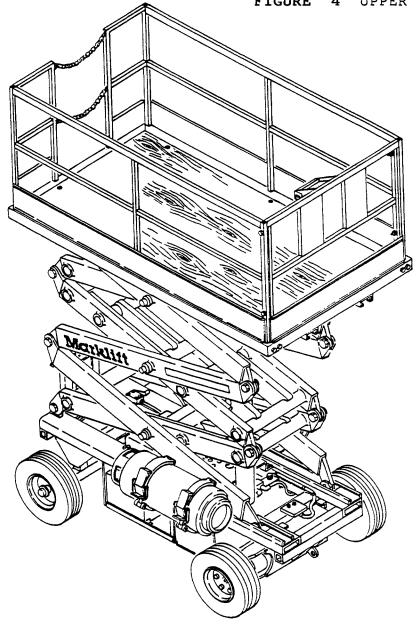
FIGURE 1A FINAL ASSEMBLY M-20G

FIGURE 1B FINAL ASSEMBLY M-20GT*

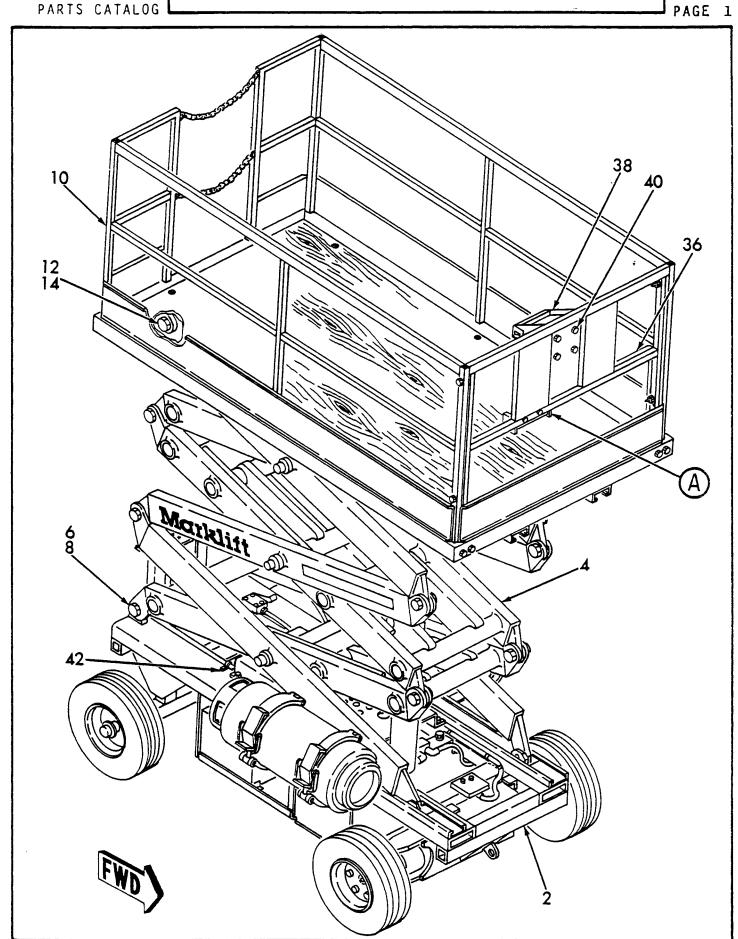
FIGURE 2 DECAL KIT

FIGURE 3 HYDRAULIC HOSE INSTALLATION

FIGURE 4 UPPER CONTROL BOX ASSEMBLY



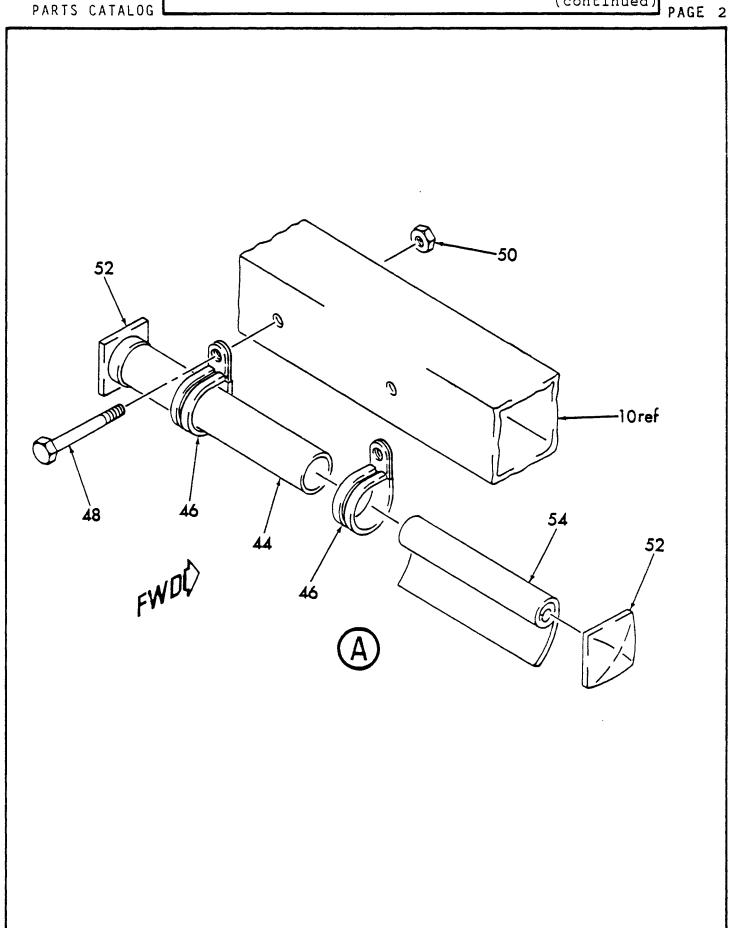
PARTS SECT. 2 FIG. 1A



(continued)

SECT. 2 FIG. 1A

PARTS



SECT. 2 FIG. 1A

PARTS

(continued) PAGE 3

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130037	ASSEMBLY, FINAL	REF
2	131125	.ASSEMBLY, FRAME (See Sect. 3, Fig. lA for details)	1
4	131188	.ASSEMBLY, SCISSOR (See Sect. 4, Fig. l for Details)	1
6	130696	.BOLT, EAR PIVOT (attaching part)	2
8	61249	.NUT, HEX LOCK (attaching part)	2
10	130347	.ASSEMBLY, PLATFORM (See Sect. 5, Fig. lA for NHA)	1
12	130696	.BOLT, EAR PIVOT (attaching part)	2
14	61249	.NUT, HEX LOCK (attaching part)	2
-16		.DECALS (See Sect. 2, Fig. 2 for Details)	AR
-18	256	.TIE, CABLE	AR
-20	65116	.OIL, HYDRAULIC (13 Gl.)	AR
-22	131158	.INSTALLATION, HYDRAULIC HOSE (See Sect. 2, Fig. 3 for Details)	1
-24	131149	.SCHEMATIC, HYDRAULIC (See Schematic Section for Details)	1
-26	131931	.SCHEMATIC, ELECTRICAL (See Schematic Section for Details)	1
-28	65389	.PAINT, BLUE WATER BASE	AR
-30	16608	.PAINT, WHITE WATER BASE	AR
- 32	65368	.KRYLON, No. 1910 TRUE BLUE	1
-34	2673	.PAINT, WHITE KIT KOTE No. 1221	1
36	130337-51	.CABLE, CONDUCTOR	1
38	131166	.ASSEMBLY, UPPER CONTROL BOX (See Sect. 2, Fig. 4, for Details)	1
40	60342	.SCREW, CAP (attaching part)	4
42	16268	.CLAMP, CABLE	3
44	130927	.CONTAINER, PLASTIC	1



SECT. 2 FIG. 1A

PARTS

PART	S CATALOG	(continued)	PAGE 4
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	65867	.CLAMP	2
48	60315	.SCREW, HEX HEAD CAP (attaching part)	2
50	60711	.NUT, LOCK (attaching part)	2
52.	65842	.CAP, ANTI-ROLL	2
54	130422	.HANDBOOK, OPERATORS	1
- 56	65787	.CLAMP, CUSHIONED	2
-58	765	.CLAMP, RUBBER	1
-60	2568 - 15	.HOSE, HYDRAULIC (15 Ft.)	1
- 62	2568 – 25	.HOSE, HYDRAULIC (25 Ft.)	1
-64	2594	.ELBOW, 90°SAE 37° SWIVEL	4
-66	255	.TIE, CABLE	AR
-68	65655	.CLAMP, CUSHIONED	c. y proprieta desta
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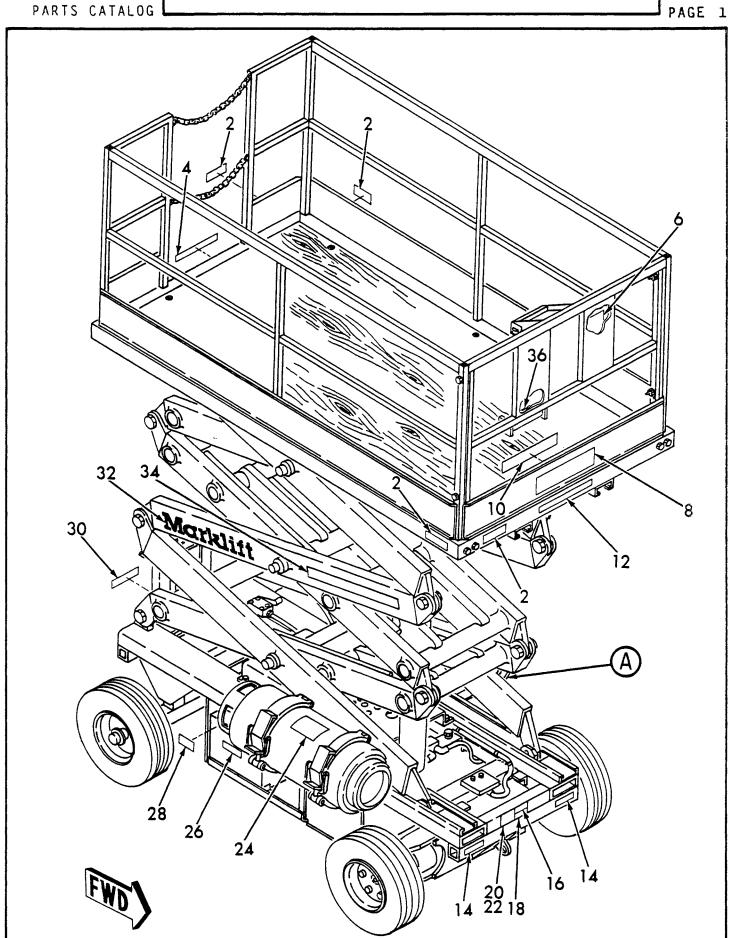
PARTS SECT. 2 FIG. 1B PAGE 1

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DECALS (M-20G)

PARTS SECT.2

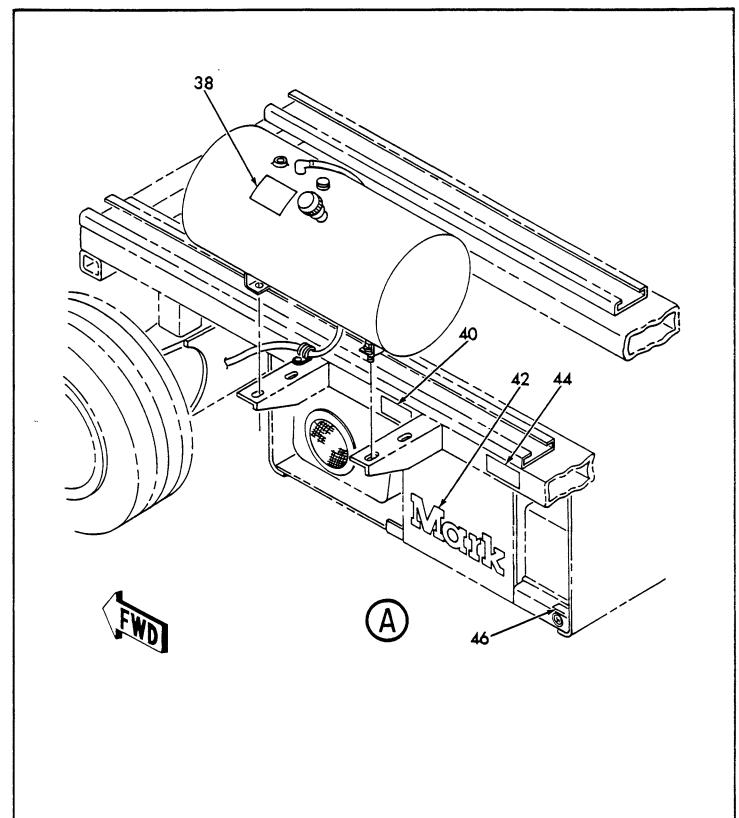
FIG. 2 PAGE 1



(continued)

SECT. 2 FIG. 2

PARTS



(M-20G) DECALS

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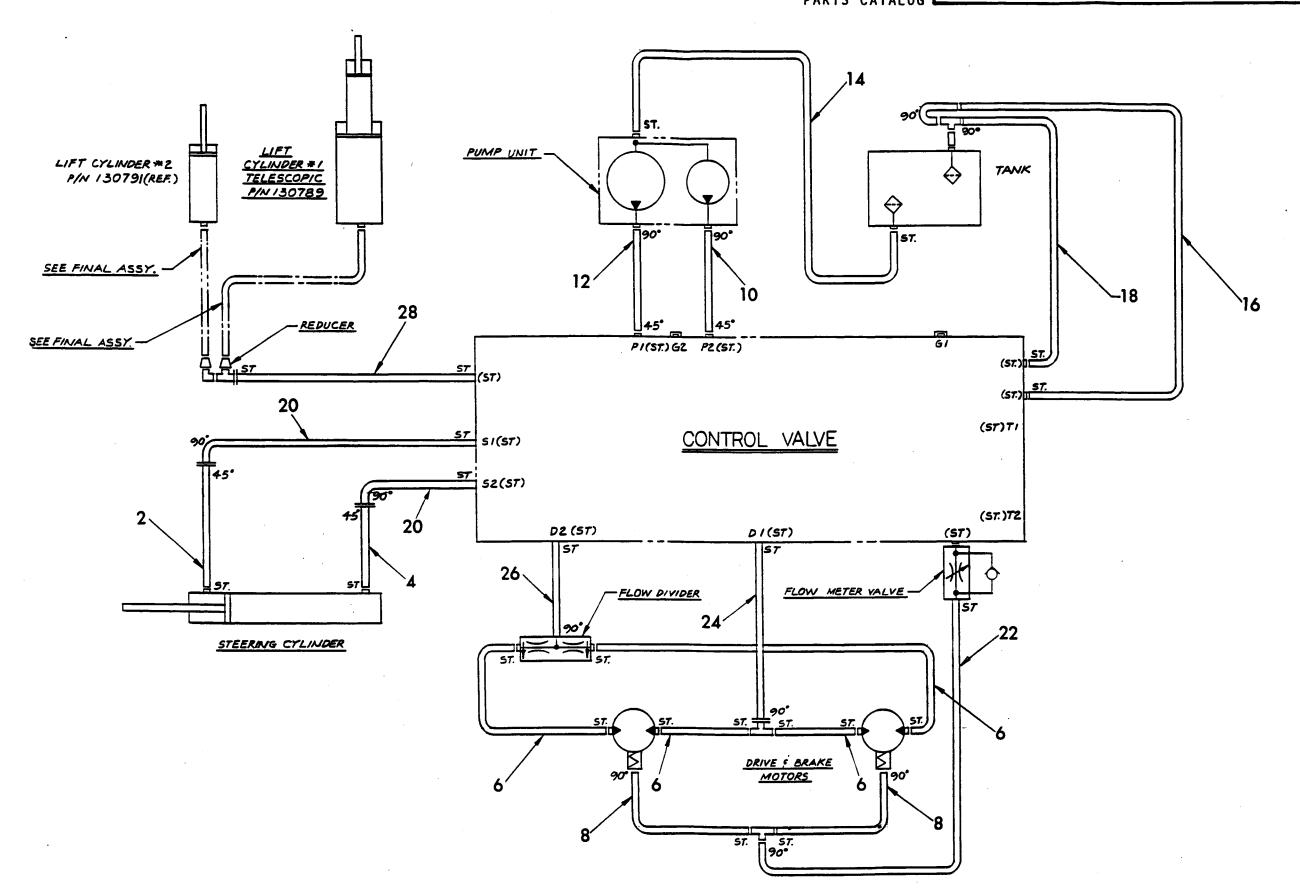
ontinued)	FIG.	2
	PAGE	3

PARTS

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1		DECALS (See Sect. 2, Fig. lA for NHA)	REF
2	2024	.DECAL, LOAD CAPACITY 1000 Lbs.	4
4	31109	.DECAL, CAUTION	2
6	131151	.DECAL, OPERATION INSTRUCTION	1
8	32368	.DECAL, M-SERIES	1
10	11064	.DECAL, SAFETY CHAIN	1
12	31109	.DECAL, CAUTION	2
14	2002	.DECAL, FORKLIFT BOOT	2
16	30520	.PLATE, PATENT NUMBER	1
18	20661	.PLATE, ANSI A92	1
20	20660	.PLATE, IDENTIFICATION	1
22	375	.RIVET, POP (attaching part)	12
24	2004	.DECAL, VAPOR TANK ONLY	ј.
26	2017	.DECAL, HYDRAULIC SYSTEM	1
28	2016	.DECAL, DO NOT WORK UNDER	1
30	2041	.DECAL, DO NOT LIFT THIS END	1
32	31259	.DECAL, MARKLIFT	2
34	130596	.DECAL, PRODUCT OF MARK INDUSTRIES	2
36	130820	.DECAL, OPERATION AND SAFETY HANDBOOK	1
38	2020	.DECAL, GASOLINE OR PETROL	1
40	130606	.DECAL, FREE WHEELING	1
42	130938	.DECAL, MARK	1
44	2016	.DECAL, DO NOT WORK UNDER	1
46	185707	.DECAL, 110 VAC	1

PARTS





Mark Industries ILLUSTRATED

PARTS CATALOG

HYDRAULIC HOSE INSTALLATION (M-20G)

SECT.2 FIG. 3

PARTS

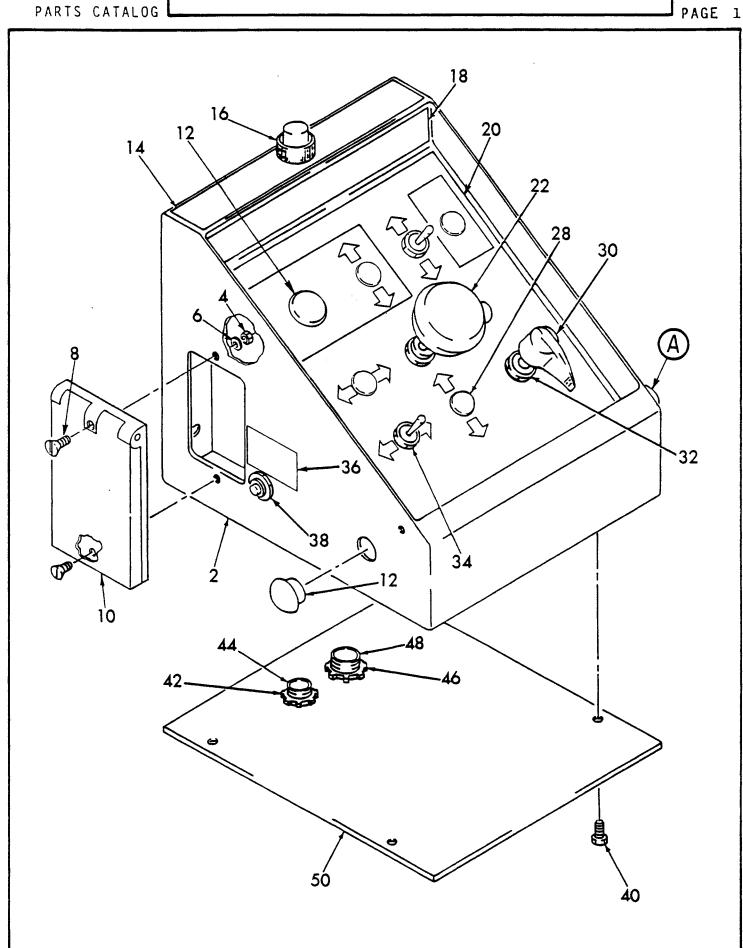
(continued) PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131158	INSTALLATION, HYDRAULIC HOSE (See Sect. 2, Fig. la for NHA)	REF
2	13211-04-0280	.ASSEMBLY, HOSE	1
4	13211-04-0340	.ASSEMBLY, HOSE	1
6	13210-08-0264	.ASSEMBLY, HOSE	4
8	13213-04-0310	.ASSEMBLY, HOSE	2
10	13216-08-0520	.ASSEMBLY, HOSE	1
12	13216-08-0480	.ASSEMBLY, HOSE	1
14	13205-12-0300	.ASSEMBLY, HOSE	1
16	13203-10-0254	.ASSEMBLY, HOSE	1
18	13203-10-0164	.ASSEMBLY, HOSE	1
20	13213-04-0412	.ASSEMBLY, HOSE	2
22	13213-04-0540	.ASSEMBLY, HOSE	1
24	13213-08-0520	.ASSEMBLY, HOSE	1
26	13213-08-0564	.ASSEMBLY, HOSE	1
28	13210-06-0494	.ASSEMBLY, HOSE	1

UPPER CONTROL BOX ASSEMBLY (M-20G)

PARTS SECT. 2

FIG. 4

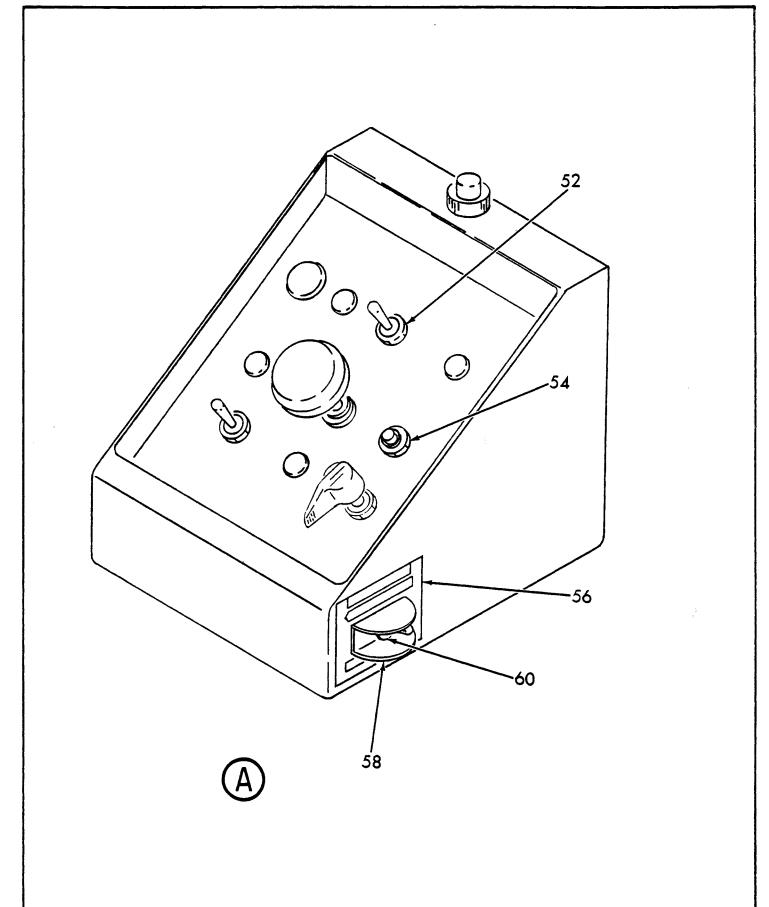


UPPER CONTROL BOX ASSEMBLY (M-20G)

(continued)

SECT. 2 FIG. 4

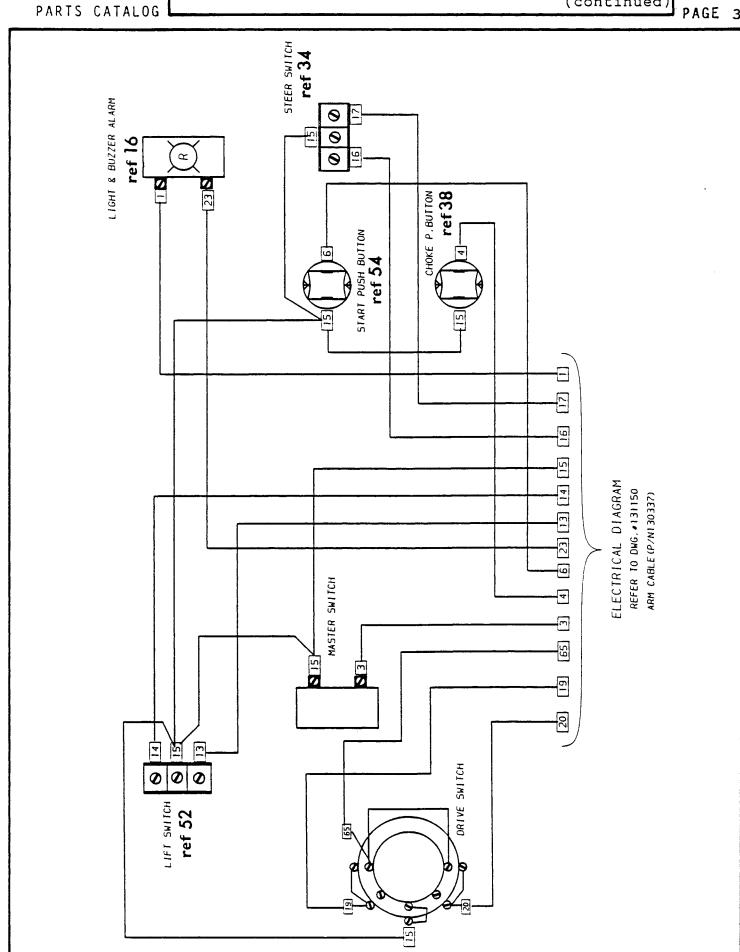
PARTS



(continued)

SECT. 2 FIG.

PARTS



Mark Industries

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PARTS CATALOG

UPPER CONTROL BOX ASSEMBLY (M-20G)

(continued)

SECT. 2 FIG. 4 PAGE 4

PARTS

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131148	ASSEMBLY, UPPER CONTROL BOX (See Sect. 2, Fig. lA for NHA)	REF
2	130741	.MACHINING, CONTROL BOX	1
4	61502	.NUT, HEX (attaching part).	2
6	63312	.WASHER, LOCK (attaching part)	2
8	62636	.SCREW, MACHINE (attaching part)	2
10	902	.PLATE, COVER	1
12	775	.PLUG, WHITE	2
14	2015	.DECAL, WARNING UNSTABLE CONDITION	1
16	20805	.ALARM, BUZZER	1
18	2014	.DECAL, CAUTION HIGH VOLTAGE	1
20	31280	.DECAL, AERIAL CONTROL PANEL	1
22	31080	.KNOB, EMERGENCY	1
- 24	4018	.SWITCH, PUSH AND PULL	1.
-26	65131	.NUT, RUBBERCOATED (attaching part)	1
28	771	.PLUG, WHITE	4
30	65151	.KNOB, DRIVE SWITCH	1
32	62209	.SCREW, SET (attaching part)	1.
34	4021	.SWITCH, TOGGLE	1
36	20413	.DECAL, ENGINE CHOKE	1
38	4011	.SWITCH, PUSH BUTTON	l
40	61711	.SCREW, CAP (attaching part)	4
42	2809	.NUT, LOCK (attaching part)	1
44	2807	.RELIEF, STRAIN	1

Mark Industries

ILLUSTRATED
PARTS CATALOG

UPPER CONTROL BOX ASSEMBLY (M-20G)

(continued)

PARTS SECT. 2 FIG. 4

	CATALOG L		PAGE
ITEM	PART NUMBER	DESCRIPTION 1234567	UNI PER ASSY
46		.NUT, LOCK (attaching part)	1
48		.RELIEF, STRAIN	1
50	130753	.COVER	1
52	4021	.SWITCH, TOGGLE	1
54	4011	.SWITCH, PUSH BUTTON	1
56	182717	.DECAL, FUEL SELECTOR	1
58		.GUARD, SWITCH	1
60		.SWITCH, TOGGLE	1
	•		
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3

USTRATED
PARTS CATALOG

THIS SECTION 3 IS ILLUSTRATED AS:

FIGURE 1A FRAME ASSEMBLY M-20G

FIGURE 1B FRAME ASSEMBLY M-20GT *

FIGURE 2 TIRE AND WHEEL ASSEMBLY

FIGURE 3 HUB ASSEMBLY

FIGURE 4 DRIVE MOTOR/BRAKE ASSEMBLY (R.H.)

FIGURE 4A DRIVE MOTOR/BRAKE ASSEMBLY (L.H.)

FIGURE 5 TIE ROD ASSEMBLY

FIGURE 6 STEERING CYLINDER ASSEMBLY

FIGURE 7 FUEL TANK ASSEMBLY (GASOLINE)

FIGURE 8 BELLY PAN ASSEMBLY

FIGURE 9 DUAL FUEL KIT

FIGURE 10 TILT SWITCH ASSEMBLY

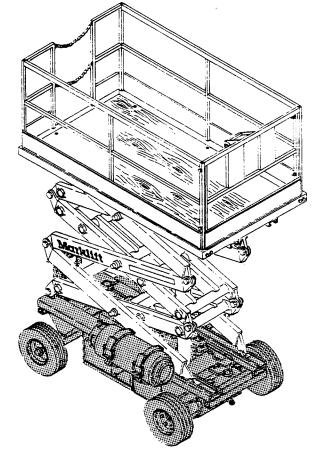
FIGURE 11 ENGINE AND PUMP ASSEMBLY

FIGURE 12 HYDRAULIC TANK ASSEMBLY

FIGURE 13 GROUND CONTROL BOX ASSEMBLY

FIGURE 14 VALVE PACKAGE ASSEMBLY

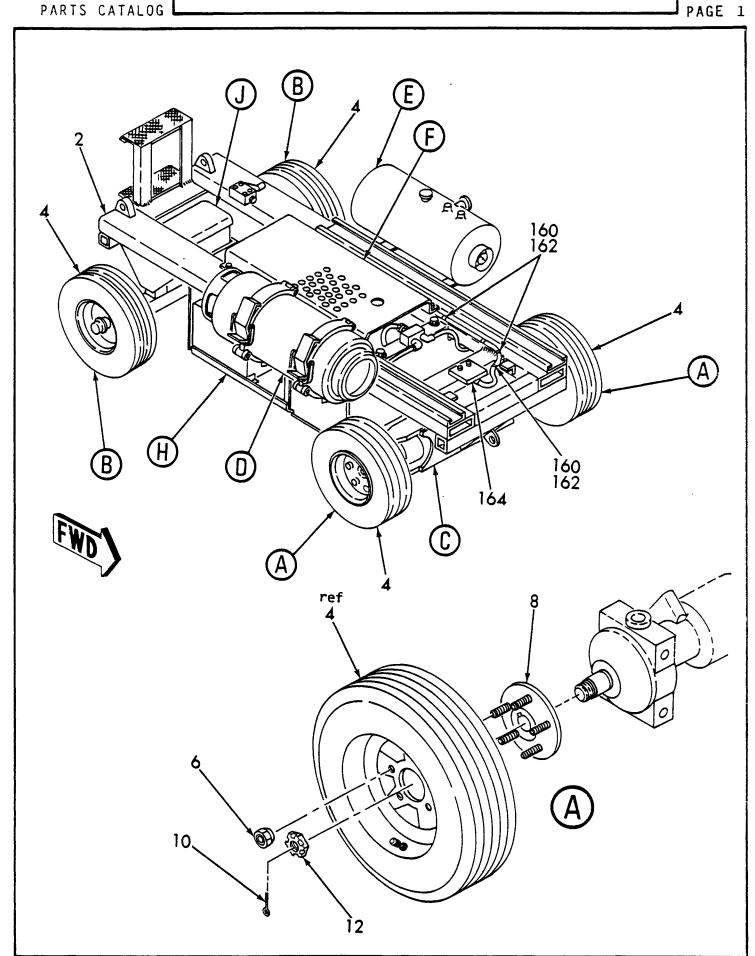
FIGURE 15 FLOW DIVIDER ASSEMBLY



* THIS FIGURE IS NOT AVAILABLE THIS REVISION

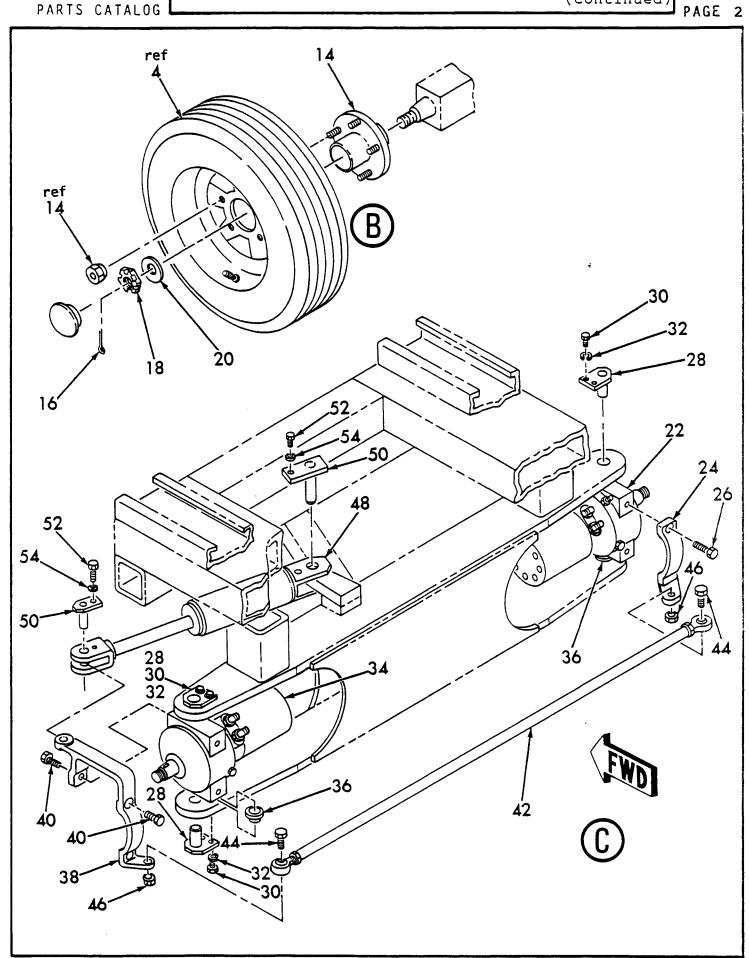
FRAME ASSEMBLY (M-20G)

PARTS SECT.3 FIG.1A



(continued)

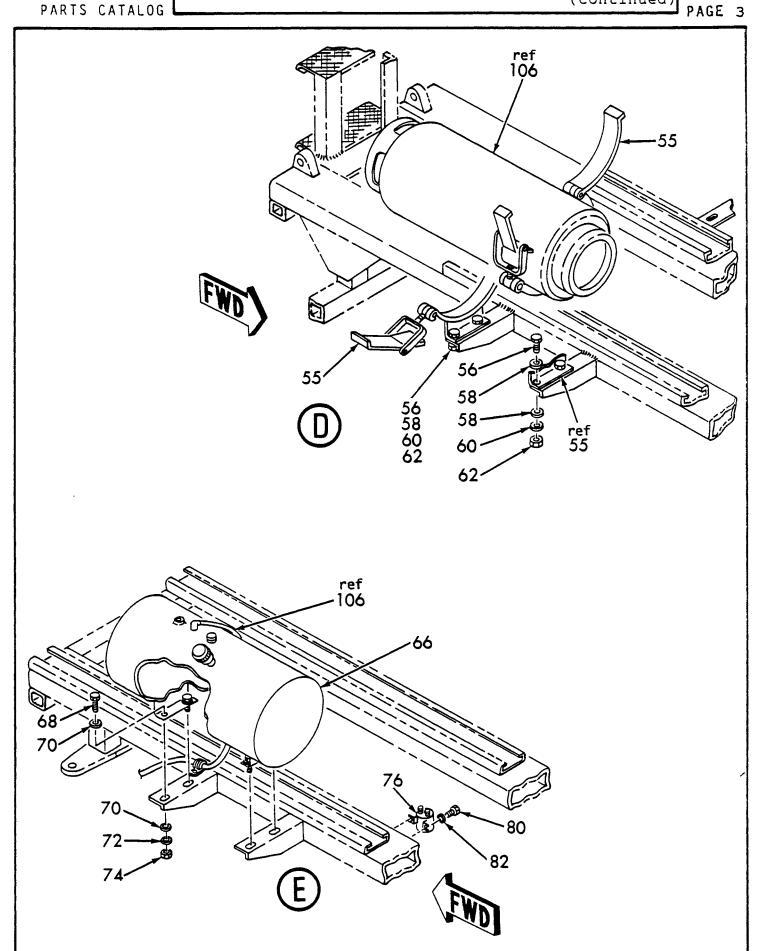
PARTS SECT. 3 FIG. 1A



FRAME ASSEMBLY(M-20G)

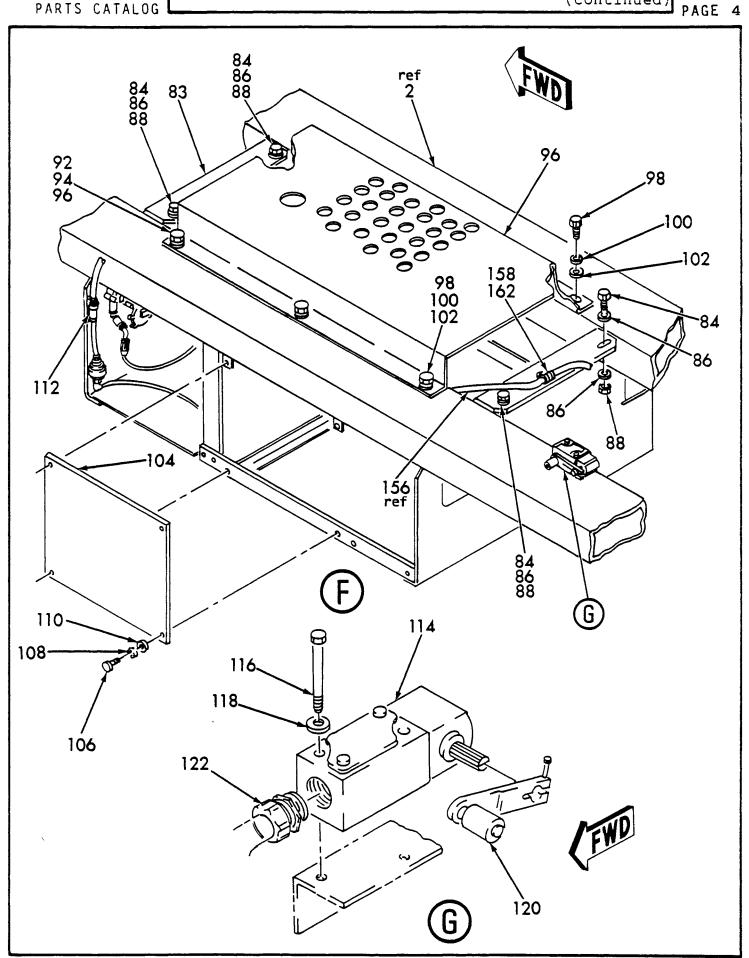
(continued)

PARTS SECT.3 FIG.1A



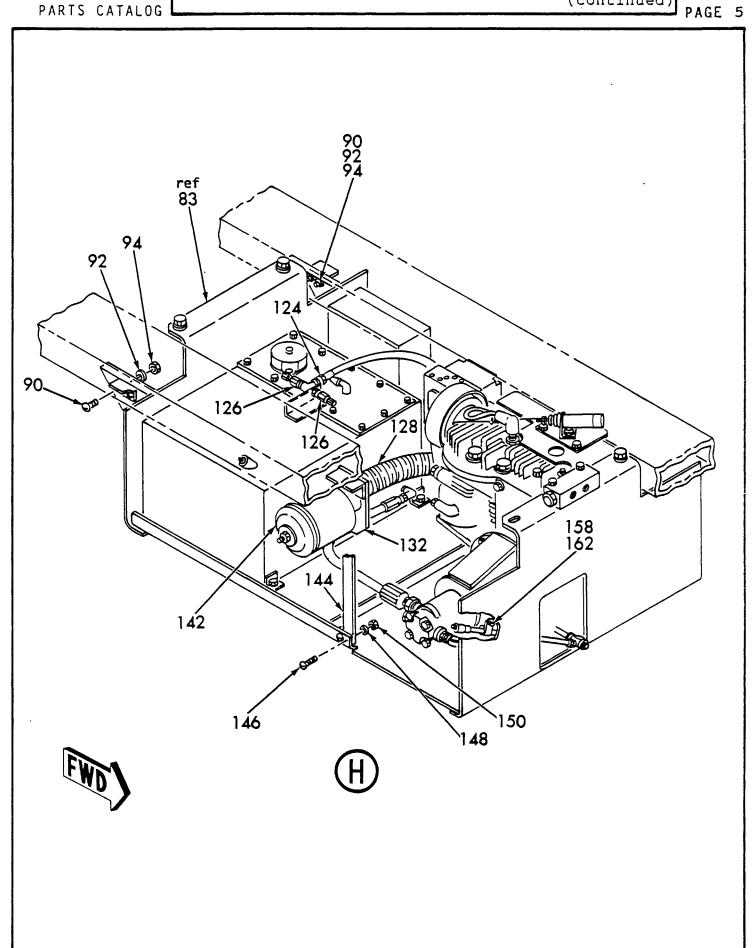
(continued)

PARTS SECT. 3 FIG. 1A



(continued)

PARTS SECT.3 FIG.1A

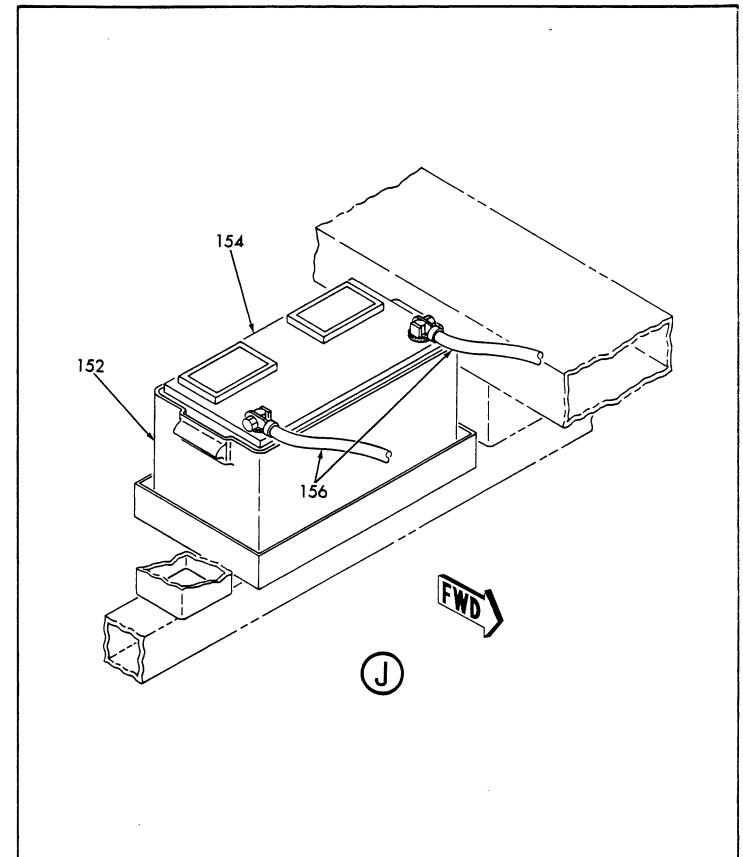


FRAME ASSEMBLY (M-20G)

(continued)

PARTS SECT. 3 FIG. 1A





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PARTS CATALOG

FRAME ASSEMBLY (M-20G)

(continued)

PARTS SECT. 3 FIG. 1A PAGE 7

			PAGE /
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131922	ASSEMBLY, FRAME (See Sect. 2, Fig. lA for NHA)	REF
2	131126	.WELDMENT, FRAME	1
4	131145	.ASSEMBLY, TIRE AND WHEEL (See Sect. 3, Fig. 2 for Details)	4
6	61316	.NUT, LUG (attaching part)	10
8	130425	.HUB, DRIVE	2
10	64306	.PIN, COTTER (attaching part)	2
12	65174	.NUT, SLOTTED HEX (attaching part)	2
14	134	.ASSEMBLY, HUB (See Sect. 3, Fig. 3 for Details)	2
16	64306	.PIN, COTTER (attaching part)	2
18	60811	.NUT, SLOTTED HEX (attaching part)	2
20	63409	.WASHER, FLAT (attaching part)	2
22	130607	.ASSEMBLY, DRIVE MOTOR/BRAKE (R.H.) (See Sect. 3, Fig. 4 for Details)	1
24	130396	.MACHINING, STEERING LEVER ARM, R.H.	1
26	60622	.SCREW, H.H.C. (attaching part)	2
28	131153	.PIN, STEERING	4
30	60338	.SCREW, H.H.C. (attaching part)	8
32	63302	.WASHER, LOCK SPLIT (attaching part)	8
34	130608	.ASSEMBLY, DRIVE MOTOR/BRAKE (L.H.) (See Sect. 3, Fig. 4A for Details)	1
36	65658	.BEARING, THRUST	2
38	130395	.MACHINING, STEERING LEVER ARM - L.H.	1
40	60622	.SCREW, H.H.C. (attaching part)	3
42	130443	.ASSEMBLY, TIE ROD (See Sect. 3, Fig. 5 for Details)	1
44	60393	.SCREW, H.H.C. (attaching part)	2
1		I	1

Mark Industries

ILLUSTRATED
PARTS CATALOG

FRAME ASSEMBLY (M-20G)

(continued)

PARTS SECT.3 FIG.1A PAGE 8

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	61242	.NUT, LOCK HEX (attaching part)	2
48	130237	.ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 6 for Details)	1
50	20252	.PIN, STEERING CYLINDER ANCHOR	2
52	60353	.SCREW, H.H.C. (attaching part)	2
54	63301	.WASHER, LOCK SPLIT (attaching part)	2
55	486-A	.BRACKET, CYLINDER MOUNTING KIT	2
56	60343	.SCREW, CAP (attaching part)	4
58	63403	.WASHER, FLAT (attaching part)	8
60	63319	.WASHER, LOCK (attaching part)	4
62	60703	.NUT, HEX (attaching part)	4
66	131184	.ASSEMBLY, FUEL TANK - GASOLINE (See Sect. 3, Fig. 7 for Details)	1
68	60343	.SCREW, CAP (attaching part)	4
70	63403	.WASHER, FLAT (attaching part)	8
72	63319	.WASHER, LOCK (attaching part)	4
74	60703	.NUT, HEX (attaching part)	4
76	70209	.SOLENOID	1
- 78	117-C	.CONNECTING RING (attaching part)	2
80	60342	.SCREW, CAP (attaching part)	2
82	63301	.WASHER, SPLIT LOCK (attaching part)	2
83	131142	.ASSEMBLY, BELLY PAN (See Sect. 3, Fig. 8 for Details)	1
84	60311	.SCREW, H.H.C. (attaching part)	4
86	63415	.WASHER, FLAT (attaching part)	8
88	61305	.NUT, LOCK (attaching part)	4

ILLUSTRATED
PARTS CATALOG

FRAME ASSEMBLY (M-20G)

(continued) SECT.3
FIG. 1A
PAGE 8

PARTS

UNIT ITEM DESCRIPTION PART NUMBER PER ASSY. .NUT, LOCK HEX (attaching part) .ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 6 for Details) .PIN, STEERING CYLINDER ANCHOR .SCREW, H.H.C. (attaching part) .WASHER, LOCK SPLIT (attaching part) 486-A .BRACKET, CYLINDER MOUNTING KIT .SCREW, CAP (attaching part) .WASHER, FLAT (attaching part) .WASHER, LOCK (attaching part) .NUT, HEX (attaching part) .ASSEMBLY, FUEL TANK - GASOLINE (See Sect. 3, Fig. 7 for Details) .SCREW, CAP (attaching part) .WASHER, FLAT (attaching part) .WASHER, LOCK (attaching part) .NUT, HEX (attaching part) .SOLENOID 117-C -78.CONNECTING RING (attaching part) .SCREW, CAP (attaching part) .WASHER, SPLIT LOCK (attaching part) .ASSEMBLY, BELLY PAN (See Sect. 3, Fig. 8 for Details) .SCREW, H.H.C. (attaching part) .WASHER, FLAT (attaching part) .NUT, LOCK (attaching part)

ILLUSTRATED
PARTS CATALOG

FRAME ASSEMBLY (M-20G)

(continued)

PARTS SECT. 3 FIG. 1A PAGE 9

	S CATALUG L		PAGE 9
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
90	60343	.SCREW, CAP (attaching part)	4
92	63319	.WASHER, LOCK (attaching part)	4
94	60703	.NUT, HEX (attaching part)	4 .
96	131146	.COVER, ENGINE	1
98	60322	.SCREW, CAP (attaching part)	6
100	63302	.WASHER, SPLIT LOCK (attaching part)	6
102	63402	.WASHER, FLAT (attaching part)	6
104	130727	.COVER	1
106	60342	.SCREW, CAP (attaching part)	4
108	63301	.WASHER, SPLIT LOCK (attaching part)	4
110	63401	.WASHER, FLAT (attaching part)	4
112	131183	.KIT, DUAL FUEL (See Sect. 3, Fig. 9 for Details)	1
114	70137	.SWITCH, LIMIT	1
116	62615	.SCREW, RD. HD. SL. (attaching part)	2
118	63313	.WASHER, LOCK (attaching part)	2
120	70032	.LEVER, OPERATING	1
122	70288	.RELIEF, STRAIN	1
124	80032-05	.TEE, BULKHEAD	1
126	80056-01	.REDUCER, TUBE END	2
128	131164	.ASSEMBLY, EXHAUST 1 1/2" FLEX	1
-130	2728	.CLAMP, MUFFLER (attaching part)	1
132	131137	.BRACKET, MUFFLER	1
-134	60338	.SCREW, H.H.C. (attaching part)	2
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ILLUSTRATED
PARTS CATALOG

FRAME ASSEMBLY (M-20G)

(continued)

PARTS	S CATALOG L		PAGE 10
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-136	63302	.WASHER, SPLIT LOCK (attaching part)	2
-138	63402	.WASHER, FLAT (attaching part)	2
-140	60702	.NUT, HEX (ATTACHING PART)	2
142	65924	.MUFFLER	1
144	13133	.PLATE, SUPPORT	2
146	60343	.SCREW, CAP (attaching part)	4
148	63319	.WASHER, LOCK (attaching part)	4
150	60703	.NUT, HEX (attaching part)	4
152	· 782	.BOX, BATTERY	1
154	4030	BATTERY	1
156	131185	.KIT, BATTERY CABLE	1
158	65655	.CLAMP	3
160	765	.CLAMP	4
162	63654	.RIVET, POP (attaching part)	7
164	131077	.ASSEMBLY, TILT SWITCH (See Sect. 3, Fig. 10 for Details)	



FRAME ASSEMBLY (M-20GT)

PARTS SECT. 3 FIG. 1B PAGE 1

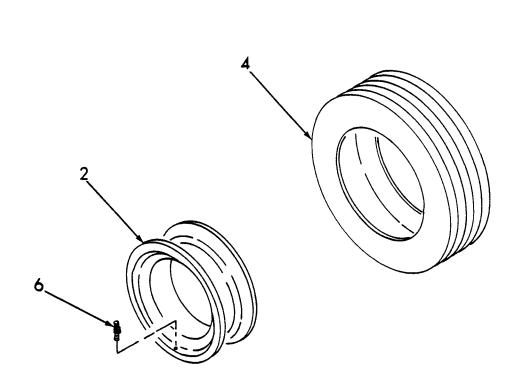
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PARTS CATALOG

TIRE AND WHEEL ASSEMBLY (M-20G)

PARTS SECT. 3

FIG. 2 PAGE 1

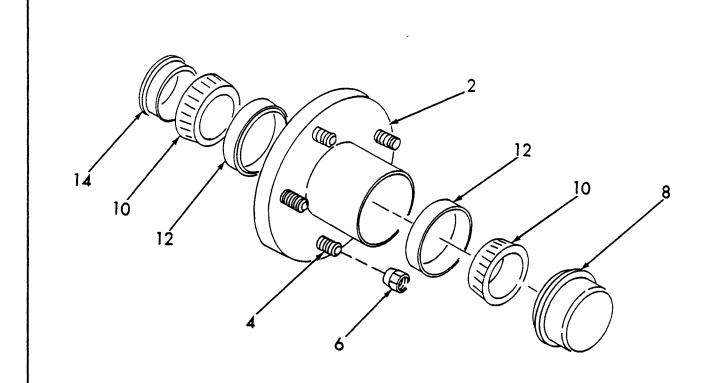


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131145	ASSEMBLY, TIRE AND WHEEL (See Sect. 3, Fig. lA for details)	REF
2	130662	.WHEEL, 13 INCH	1
4	30480	.TIRE, RADIAL	1
6	2252	.STEM, VALVE	1

HUB ASSEMBLY (M-20G)

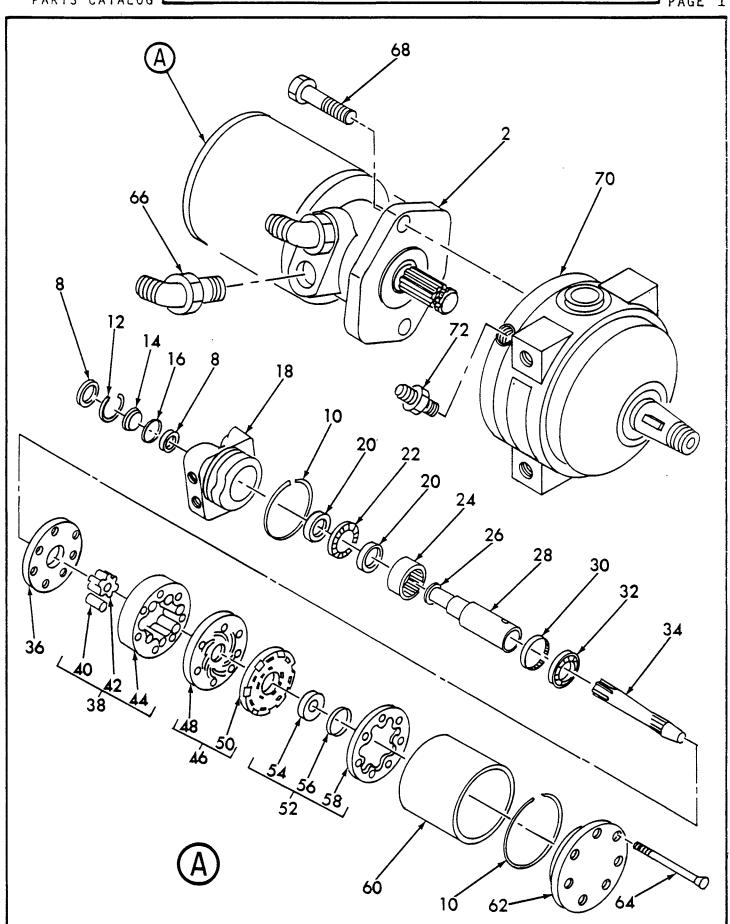
PARTS SECT.3

FIG. 3 PAGE 1



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	134	ASSEMBLY, HUB (See Sect. 3, Fig. 1A for NHA)	REF
2	65684	.HUB	1
4	65685	.BOLT, LUG (attaching part)	5
6	61316	.NUT, LUG (attaching part)	5
8	137	.CAP, DUST	1
10	65059	.BEARING	2
12	65686	.RACE, BEARING	2
14	66113	.SEAL	1

PARTS SECT.3 FIG. 4



ILLUSTRATED
PARTS CATALOG

DRIVE/MOTOR BRAKE ASSEMBLY-R.H. (M-20G)

(continued)

PARTS SECT. 3 FIG. 4 PAGE 2

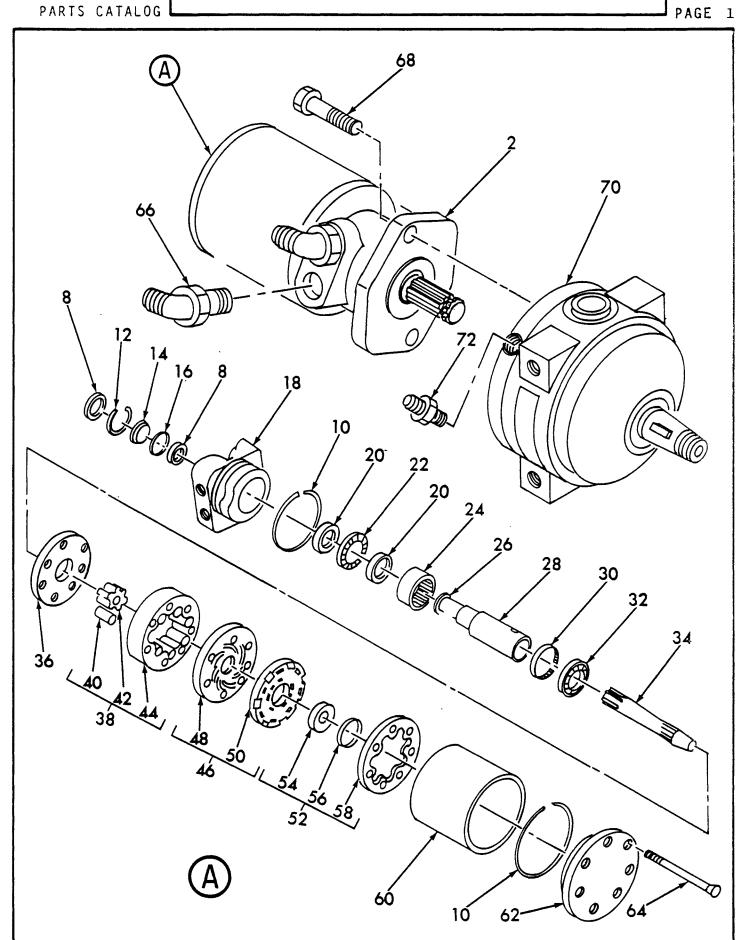
	CATALOG		PAGE 2
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130607	ASSEMBLY, DRIVE MOTOR/BRAKE (R.H.) (See Sect. 3, Fig. 1A for NHA)	REF
2	81018	.MOTOR, HYDRAULIC	1
-4		KIT, SEAL	1
6		SEAL	1
8		SEAL	1
10		RING, SEAL	2
12		RING, RETAINER	1
14		WASHER, BACKUP	1
16		WASHER	1
18		HOUSING	1
20		WASHER, THRUST	2
22		BEARING, THRUST	1
24		BEARING	1
26		WASHER	1
28		SHAFT, COUPLING	1
30		BEARING	1
32		BEARING, THRUST	1
34		LINK, DRIVE	1
36		PLATE, WEAR	1
38		SET, ROTOR	1
40		ROTOR	1
42		VALVE	7
44		STATOR	1
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ILLUSTRATED
PARTS CATALOG

DRIVE/MOTOR BRAKE ASSEMBLY-R.H. (M-20G)

(continued)

T	*************************************	T	PAGE
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY
46		SET, MANIFOLD (For MAB TOROMOTORS)	1
48		PLATE, MANIFOLD	1
50		MANIFOLD	1
52		SET, COMMUTATOR	1
54		COMMUTATOR	1
56		RING, SEAL	1
58		RING, COMMUTATOR	1
60		SLEEVE	1
62		ASSEMBLY, END COVER	1
64		BOLT, SPECIAL	7
66	80018-13	.ELBOW, 45° STRAIGHT THREAD	2
68	60622	.SCREW, CAP BOWMALOK	2
70	81019	.BRAKE, MULTIPLE DISC	1
72	80004-03	.CONNECTOR, STRAIGHT THREAD	Э.



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PARTS CATALOG

DRIVE/MOTOR BRAKE ASSEMBLY-L.H. (M-20G)

(continued)

PARTS SECT. 3 FIG. 4A PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130608	ASSEMBLY, DRIVE MOTOR/BRAKE (L.H.) (See Sect. 3, Fig. 1A for NHA)	REF
2	81018	.MOTOR, HYDRAULIC	1
-4		KIT, SEAL	1
6		SEAL	1
8		SEAL	1
10		RING, SEAL	2
12		RING, RETAINER	1
14		WASHER, BACKUP	1
16		WASHER	1
18		HOUSING	1
20		WASHER, THRUST	2
22		BEARING, THRUST	1
24		BEARING	1 ;
26		WASHER	1
28		SHAFT, COUPLING	1
30		BEARING	1
32		BEARING, THRUST	1
34		LINK, DRIVE	1
36		PLATE, WEAR	1
38		SET, ROTOR	1
40		ROTOR	1
42		VALVE	7
44		STATOR	1
			enge c'i wordsdaw wan

ILLUSTRATED
PARTS CATALOG

DRIVE/MOTOR BRAKE ASSEMBLY-L.H. (M-20G)

(continued)

PARTS SECT. 3 FIG. 4A PAGE 3

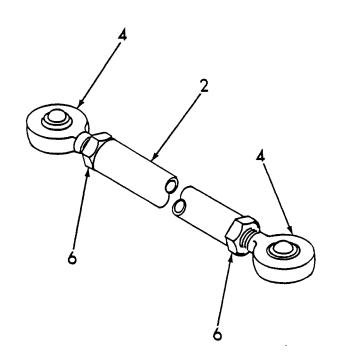
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46		SET, MANIFOLD (For MAB TOROMOTORS)	1
48		PLATE, MANIFOLD	1
50		MANIFOLD	1
52		SET, COMMUTATOR	1
54		COMMUTATOR	1
56		RING, SEAL	1
58		RING, COMMUTATOR	1
60		SLEEVE	1
62	·	ASSEMBLY, END COVER	1
64 .		BOLT, SPECIAL	7
66	80018-13	.ELBOW, 45° STRAIGHT THREAD	2
68	60622	.SCREW, CAP BOWMALOK	2
70	81019	.BRAKE, MULTIPLE DISC	1
72	80004-03	.CONNECTOR, STRAIGHT THREAD	1

PARTS CATALOG

TIE ROD ASSEMBLY (M-20G)

PARTS SECT. 3

FIG. 5 PAGE 1

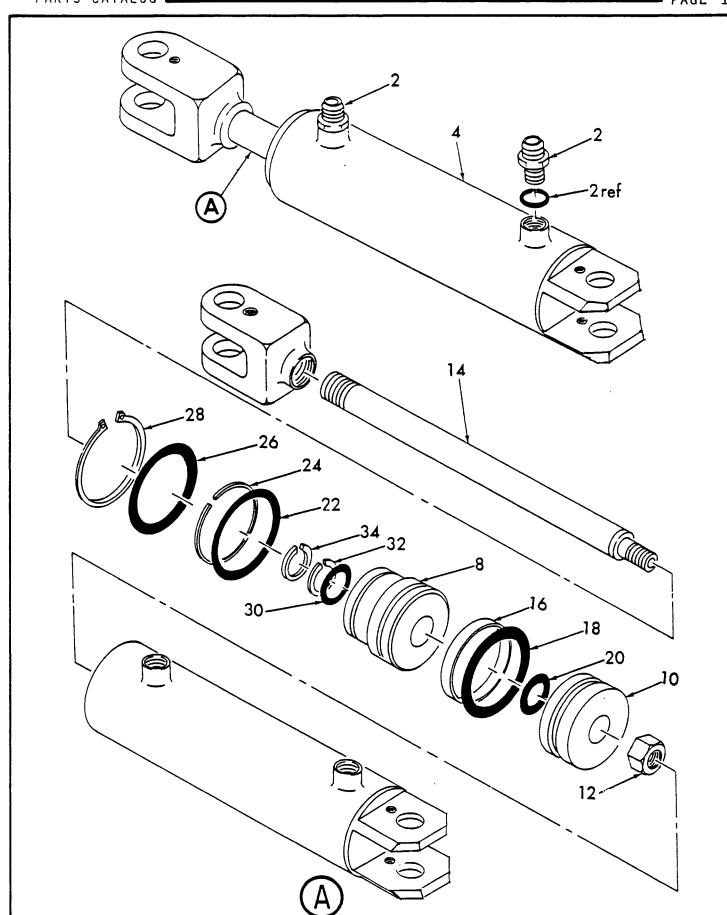


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130443	ASSEMBLY, TIE ROD (See Sect. 3, Fig. lA for NHA)	REF
2	130444	.TIE ROD	1
4	2274	.END, TIE ROD	2
6	60901	.NUT, JAM	2

STEERING CYLINDER ASSEMBLY (M-20G)

PARTS SECT. 3

FIG. 6



ILLUSTRATED
PARTS CATALOG

STEERING CYLINDER ASSEMBLY (M-20G)

(continued)

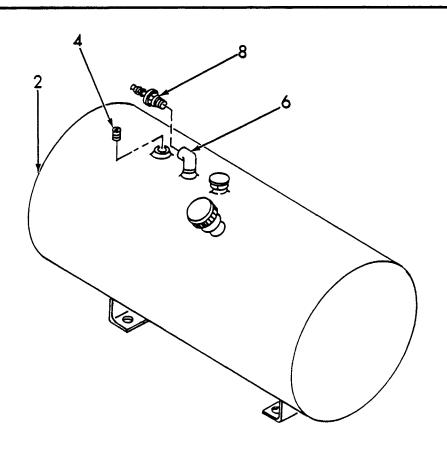
SECT. 3 FIG. 6

PARTS

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130237	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. lA for NHA)	REF
2	80004-03	.CONNECTOR, STRAIGHT THREAD	2
4	130165	.CYLINDER, STEERING	1
-6	66640	KIT, SEAL	1
8		BEARING	1
10		PISTON	1
12		NUT, LOCK	1
14		ROD, CHROME PLATED	1
16		RING, SLIPPER	1.
18		O'RING	1.
20		O'RING	1.
22		O'RING	1.
24		WASHER, BACKUP)
26		RING, LOCK	1
28		RING, RETAINING	1
30		O'RING	1
32		WASHER, BACKUP	1
34		SEAL, WIPER	1

FUEL TANK ASSEMBLY (M-20G)

PARTS SECT. 3 FIG. 7

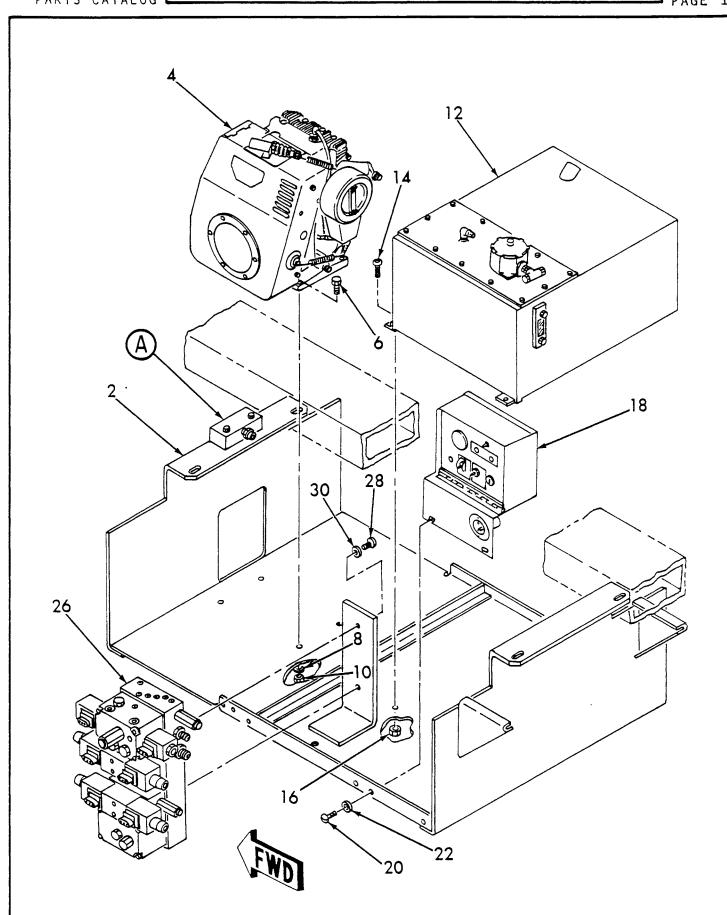


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131184	ASSEMBLY, FUEL TANK (See Sect. 3, Fig. lA for NHA)	REF
2	131139	.TANK, GAS	1
4	80049-03	.PLUG, HEX HEAD	1
6	80021-03	.ELBOW, STREET	1
8	2589	.FITTING, HOSE	1
	_		
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BELLYPAN ASSEMBLY (M-20G)

PARTS SECT.3

FIG. 8



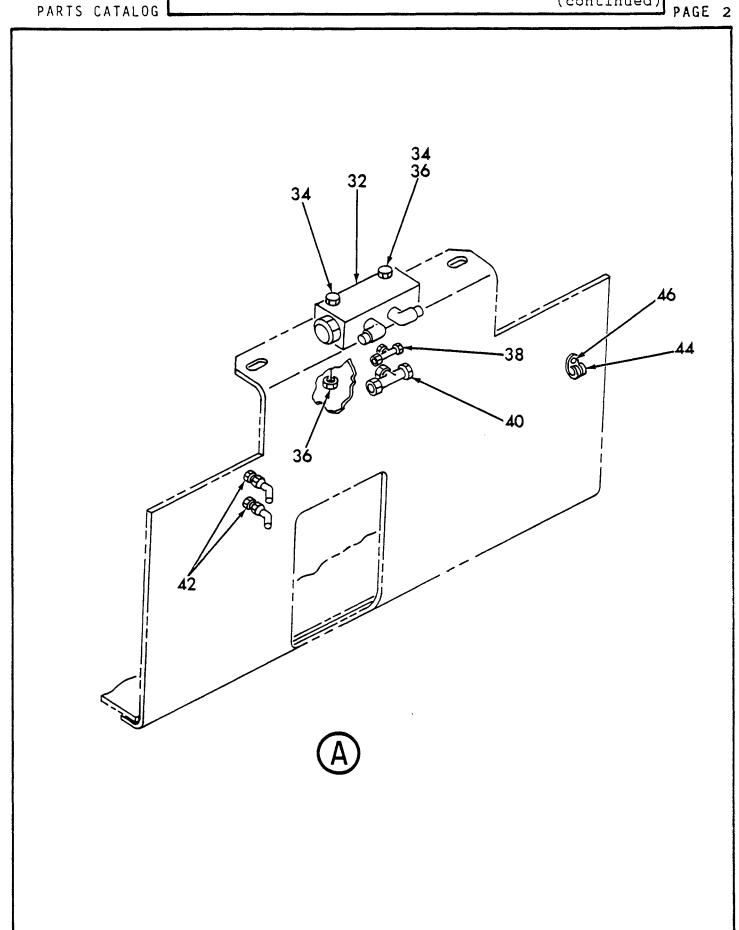
BELLYPAN ASSEMBLY (M-20G)

(continued)

FIG. 8

PARTS

SECT. 3



Mark Industries ILLUSTRATED

PARTS CATALOG

BELLYPAN ASSEMBLY (M-20G)

(continued)

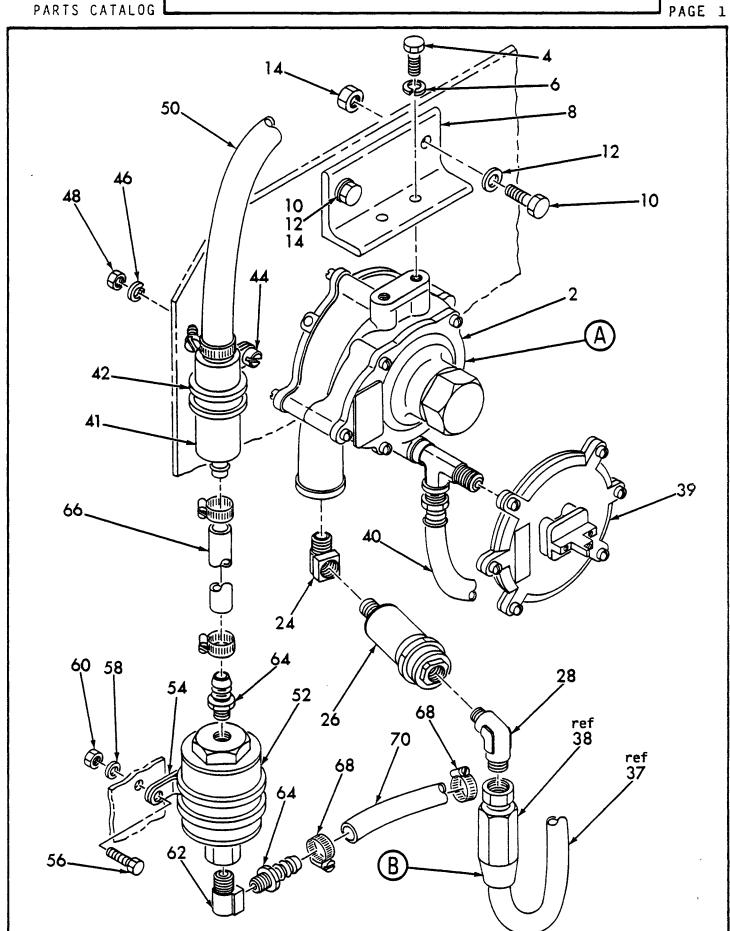
PARTS SECT. 3 FIG. 8 PAGE 3

	3 CATALOG		PAGE 3
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131142	ASSEMBLY, BELLY PAN (See Sect. 3, Fig. lA for NHA)	REF
2	131128	.WELDMENT, BELLY PAN	1
4	131156	.ASSEMBLY, ENGINE AND PUMP (See Sect. 3, Fig. 11 for Details)	1
6	60550	.SCREW, CAP (attaching part)	4
8	63506	.WASHER, FLAT (attaching part)	4
10	61326	.NUT, LOCK (attaching part)	4
12	131157	.ASSEMBLY, HYDRAULIC TANK (See Sect. 3, Fig. 12 for Details)	1
14	61944	.SCREW, BUTTON HEAD SOCKET (attaching part)	3
16	61318	.NUT, SELF LOCKING HEX (attaching part)	3
18	131147	.ASSEMBLY, GROUND CONTROL BOX (See Sect. 3, Fig. 13 for Details)	1.
20	63359	.SCREW, CAP (attaching part)	2
22	63301	.WASHER, LOCK (attaching part)	2
-24	130600-07	.CABLE, CONDUCTOR	1
26	131159	.ASSEMBLY, VALVE PACKAGE (See Sect. 3, Fig. 14 for Details)	1
28	60343	.SCREW, CAP (attaching part)	2
30	63319	.WASHER, LOCK (attaching part)	2
32	131187	.ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 15 for Details)	1
34	60340	.SCREW, CAP (attaching part)	2
36	61312	.NUT, SELF LOCKING HEX (attaching part)	2
38	80035-03	.TEE, UNIVERSAL BULKHEAD BRANCH	1
40	80035-06	.TEE, UNIVERSAL BULKHEAD BRANCH	1
42	80045-03	.UNION, BULKHEAD	2
44	16268	.CLAMP, HOSE	1
46	63654	.RIVET, POP	1

DUAL FUEL KIT (M-20G)

PARTS SECT. 3

FIG. 9

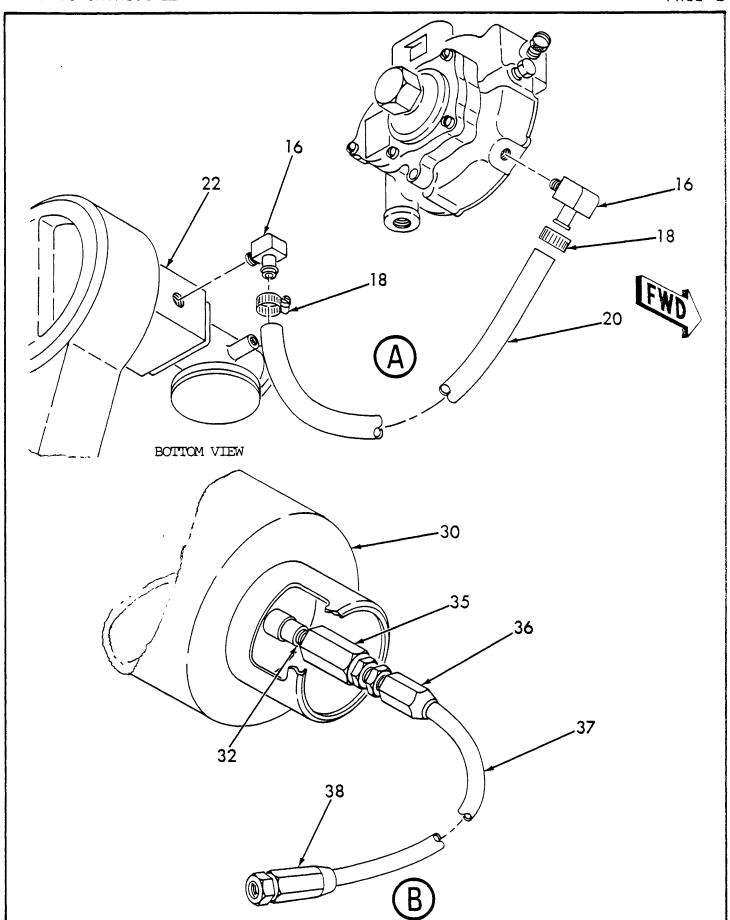


(continued)

FIG. 9

PARTS

SECT. 3



Mark Industries ILLUSTRATED

PARTS CATALOG

DUAL FUEL KIT (M-20G)

(continued)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131183	KIT, DUAL FUEL (See Sect. 3, Fig. 1A for NHA)	REF
2	16921	.REGULATOR	1
4	60353	.SCREW, CAP (attaching part)	1
6	63301	.WASHER, LOCK(attaching part)	1
8	32454	.BRACKET, DUAL FUEL	1
10	60312	.SCREW, CAP (attaching part)	2
12	63401	.WASHER, FLAT (attaching part)	2
14	61227	.NUT, SELF LOCKING (attaching part)	2
16	65332	.BARB, HOSE	2
18	2713	.CLAMP, HOSE	2
20	65485-32	.HOSE	1
22	65510	.ADAPTER, CARBURETOR	1.
24	16519	.ELBOW, STREET	1
26	16925	.LOCK, PROPANE FILTER	1
28	80008-08	.ELBOW, MALE	1
30	486-C	.TANK, PROPANE	1
32	65141	.NIPPLE	1
-34	131186	.ASSEMBLY, PROPANE HOSE	1
35	65142	SOCKET, QUICK DISCONNECT	1
36	16452	FITTING, MALE HOSE	1
37	2616	HOSE (5 Ft.)	1
38	16451	FITTING, MALE HOSE	1
39	16975	.KIT, MICROVAC	
40	65689	.HOSE	1
i		I and the second	1

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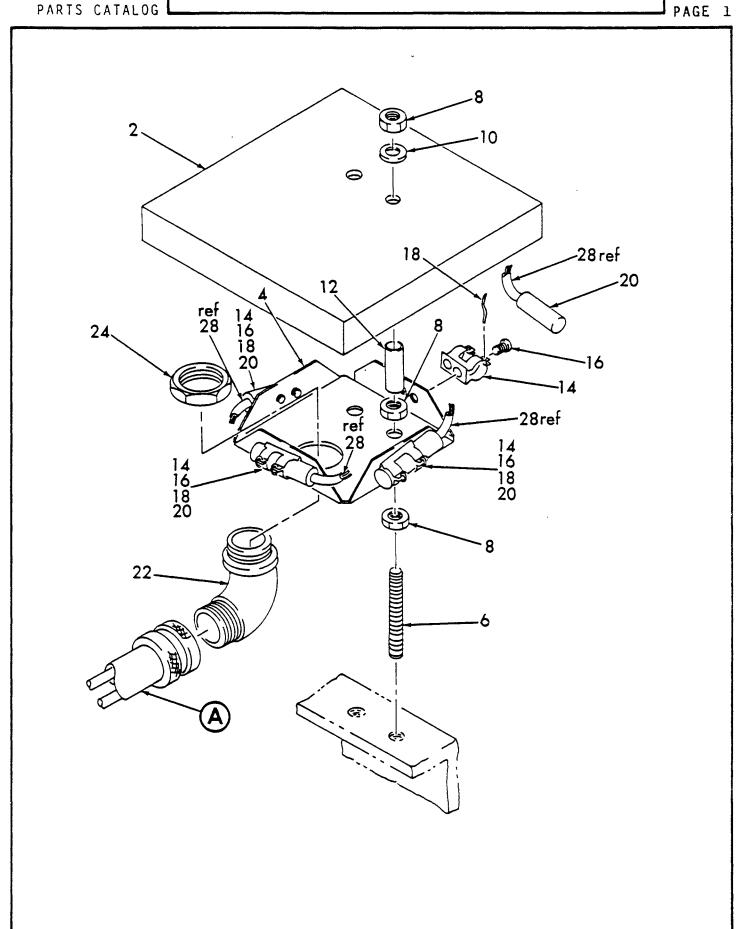
PARTS CATALOG

DUAL FUEL KIT (M-20G)

(continued)

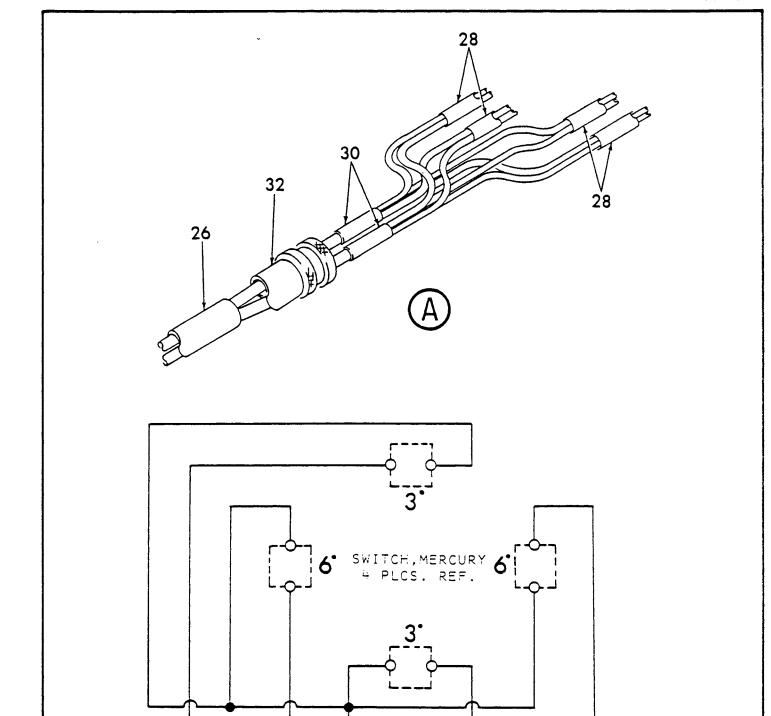
LWK12	CATALUG L		PAGE -
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
41	160	.FILTER, GAS	1
42	16268	.CLAMP	1
44	60309	.SCREW, CAP (attaching part)	1
46	63301	.WASHER, LOCK (attaching part)	1
48	60701	.NUT, HEX (attaching part)	1
50	160-B-0360	.HOSE, FUEL	1
52	20832	.VALVE, FUEL SHUT-OFF	1
54	65867	.CLAMP	1
56	60309	.SCREW, CAP (attaching part)	1
58	63301	.WASHER, LOCK (attaching part)	1
60	60701	.NUT, HEX (attaching part)	1
62	66196	.ELBOW, STREET	1.
64	240	.BARB, HOSE	2
66	160-B-0040	.HOSE	1
68	161-A	.CLAMP, HOSE	2
70	160-B-0360	.HOSE, FUEL	1
:			

TILT SWITCH ASSEMBLY (M-20G)



PARTS SECT. 3 FIG. 10

(continued) PAGE 2



WIRING DIAGRAM

WHT.

BLK.

ILLUSTRATED
PARTS CATALOG

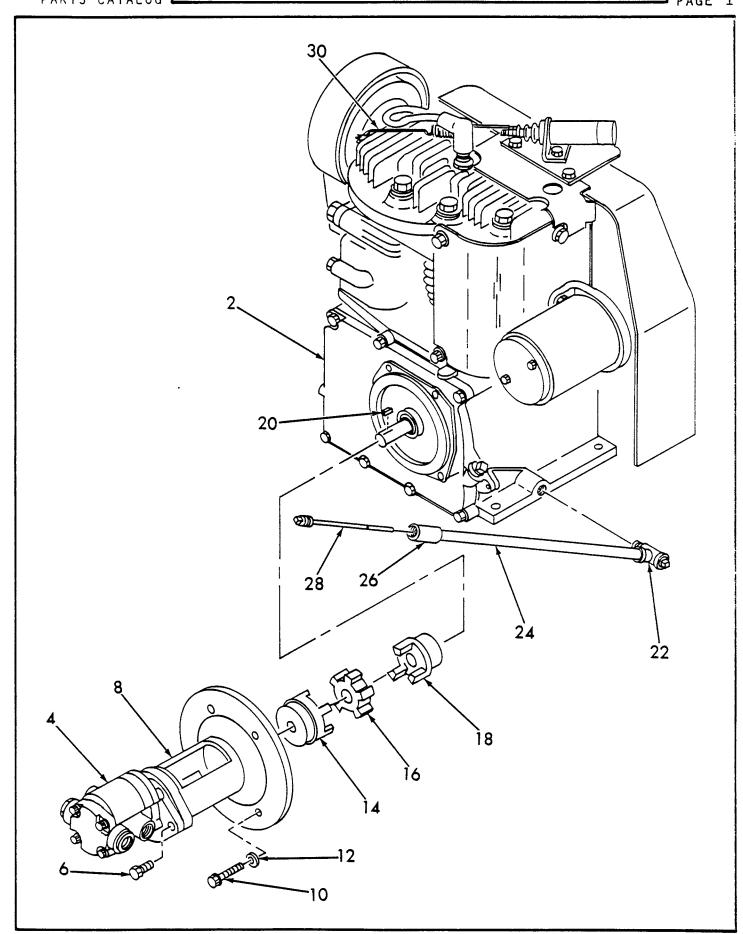
TILT SWITCH ASSEMBLY (M-20G)

(continued)

PARIS	CATALOG L	(Concernation)	
ITĘM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131077	ASSEMBLY, TILT SWITCH (See Sect. 3, Fig. 1A for NHA)	REF
2	30386	.COVER, TILT SWITCH	1
4	30385	.BRACKET, TILT SWITCH	1
6	63606	.ROD, THREADED (attaching part)	2
8	60701	.NUT (attaching part)	6
10	63301	.WASHER, LOCK (attaching part)	2
12	35715	.TUBE, ROUND (attaching part)	2
14	119-A	.BRACKET, SWITCH	4
16	62605	.SCREW, ROUND HEAD (attaching part)	8
18	70225	:WIRE, SAFETY	8
20	4014	.SWITCH, MERCURY	4
22	70226	.CONNECTOR, 90 DEGREE	1
24	61317	.NUT (attaching part)	3.
26	70036	.WIRE (9 Ft.)	AR
28	65898	.TUBE, HEAT SHRINK	4
30	117-D	.CONNECTOR, BUTT	2
32	65899	.TUBE, HEAT SHRINK).

ENGINE AND PUMP ASSEMBY (M-20G)

PARTS SECT.3 FIG.11 PAGE 1



Mark Industries
ILLUSTRATED PARTS CATALOG

ENGINE AND PUMP ASSEMBLY (M-20G)

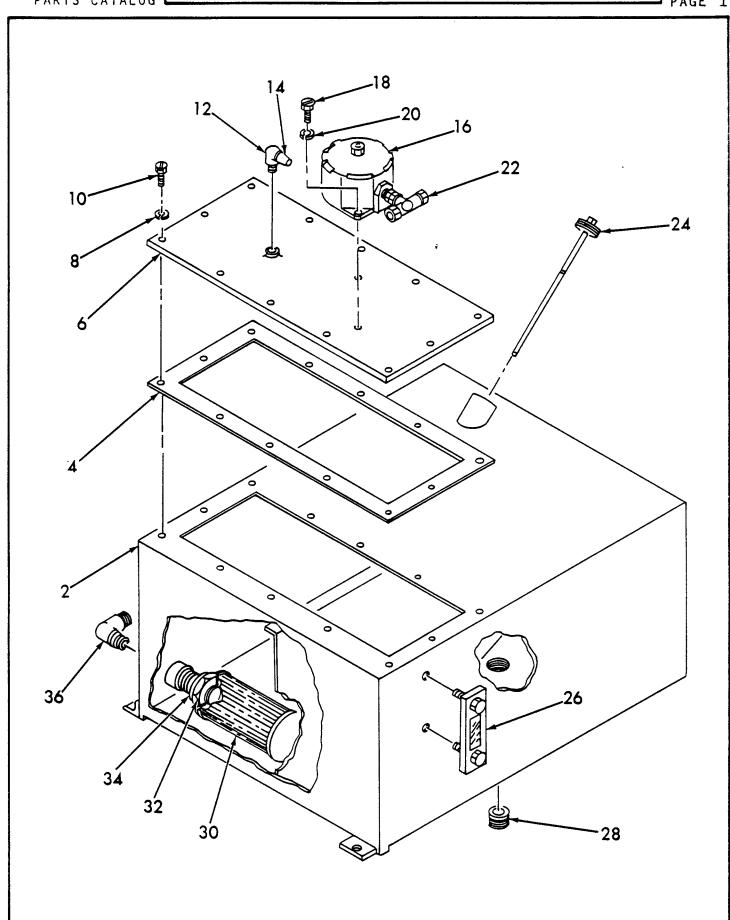
(continued)

PARTS SECT. 3 FIG. 11 PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131156	ASSEMBLY, ENGINE AND PUMP (See Sect. 3, Fig. 8 for NHA)	REF
2	131134	.ENGINE (See Vendor Section for More Information)	1
4	131168	.ASSEMBLY, PUMP (See Sect. 3, Fig. 16 for Details)	1
6	60618	.SCREW, CAP (attaching part)	2
8	81202	.ADAPTER, PUMP	1
10	60351	.SCREW, CAP (attaching part)	4
12	63304	.WASHER, LOCK (attaching part)	4
14	65922	.HUB, PUMP	1
16	65923	.SPIDER, RUBBER	1
18	65921	.HUB, ENGINE	1.
20	36386	.KEY, SQUARE	1
22	80041-06	.TEE, STREET	1
24	65977	.PIPE	1
26	54800	.COUPLING	1
28	131200	.DIPSTICK	1
30	65951	.SPRING, EXTENSION	1

HYDRAULIC TANK ASSEMBLY (M-20G)

PARTS SECT.3 FIG.12



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PARTS CATALOG

HYDRAULIC TANK ASSEMBLY (M-20G)

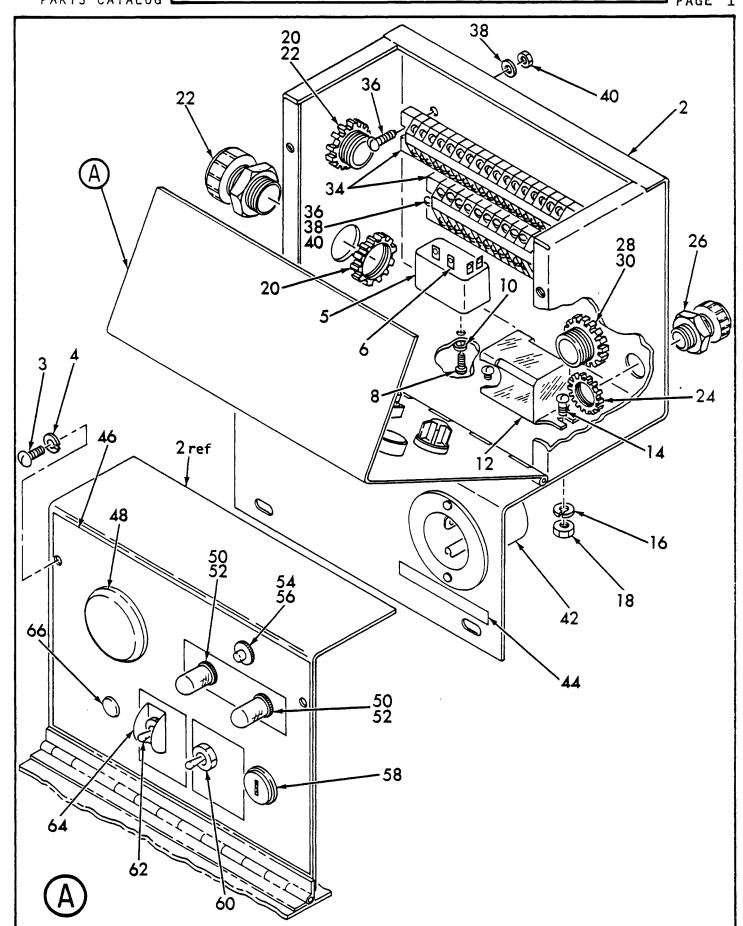
PARTS SECT. 3 FIG. 12

(continued)

TEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131157	ASSEMBLY, HYDRAULIC TANK (See Sect. 3, Fig. 8 for NHA)	REF
2	130639	.WELDMENT, HYDRAULIC TANK	1
4	130644	.GASKET	1
6	130641	.COVER, TANK	1
8	60342	.SCREW, CAP (attaching part)	12
10	63301	.WASHER, LOCK (attaching part)	12
12	80021-03	.ELBOW, STREET	1
14	65213	.BREATHER	1
16	81016	.FILTER	1
18	60342	.SCREW, CAP (attaching part)	2
20	63301	.WASHER, LOCK (attaching part)	2
22	80034-16	.TEE, MALE BRANCH	1
24	130230	.DIPSTICK	1
26	3018	.GAUGE, SIGHT	1
28	54200	.PLUG, MAGNETIC PIPE	1
30	81084	.STRAINER	1
32	80057-16	.REDUCER, PIPE THREAD	1
34	65749	.NIPPLE, CLOSE	
36	80008-20	.ELBOW, MALE	

GROUND CONTROL BOX ASSEMBLY (M-20G)

PARTS SECT. 3 FIG. 13 PAGE 1

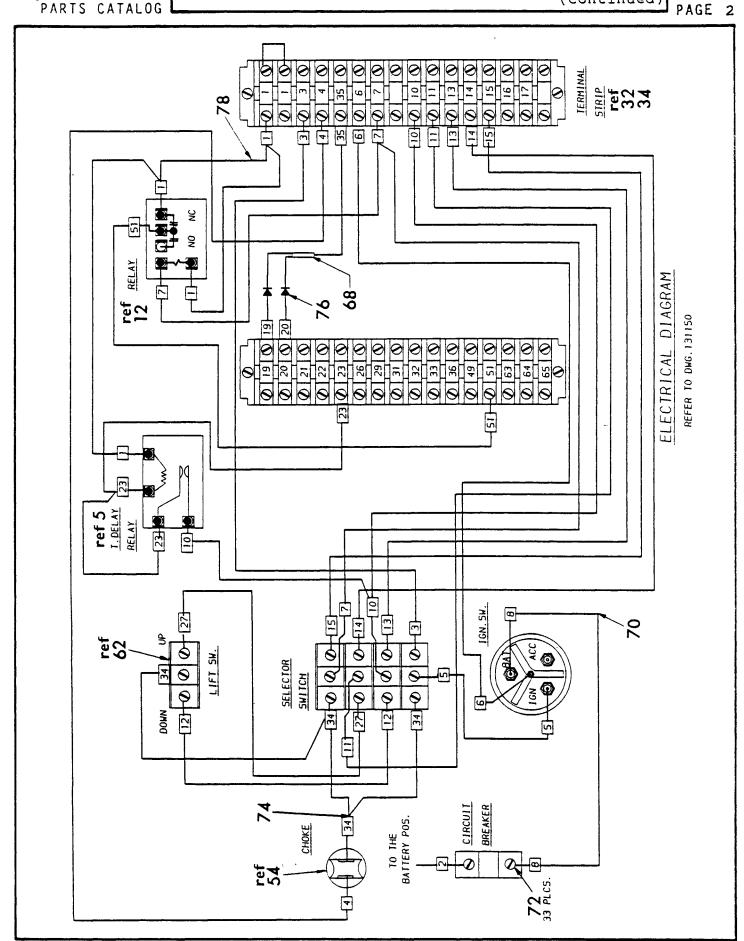


GROUND CONTROL BOX ASSEMBLY (M-20G)

(continued)

SECT.3 FIG.13

PARTS



ILLUSTRATED

PARTS CATALOG

GROUND CONTROL BOX ASSEMBLY (M-20G)

(continued)

PARTS SECT. 3 FIG. 13 PAGE 3

			PAGE 3
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131147	ASSEMBLY, GROUND CONTROL BOX (See Sect. 3, Fig. 8 for NHA)	REF
2	130390	.BOX, GROUND CONTROL	1
3	62612	.SCREW, CAP (attaching part)	2 .
4	63312	.WASHER, LOCK (attaching part)	2
5	70306	.RELAY, DELAY	1
6	496-A	.TERMINAL	4
8	61728	.SCREW (attaching part)	1
10	63322	.WASHER, LOCK (attaching part)	1
12	70371	RELAY	1
14	62612	.SCREW, CAP (attaching part)	2
16	63312	.WASHER, LOCK (attaching part)	2
18	61502	.NUT, HEX (attaching part)	2
20	2809	.NUT, LOCK	2
22	2807	.RELIEF, STRAIN	2
24	2809	.NUT, LOCK	1
26	2807	.RELIEF, STRAIN	1
28	2808	.NUT, LOCK	1
30	2806	.RELIEF, STRAIN	1
32	4027	.BLOCK, TERMINAL	32
34	117-A	.END, TERMINAL BLOCK	2
36	62612	.SCREW, CAP (attaching part)	4
38	63312	.WASHER, LOCK (attaching part)	4
40	61502	.NUT, HEX (attaching part)	4
42	70409	.INLET, FLANGE	1
44	185707	.DECAL, POWER TO PLATFORM	1
			1

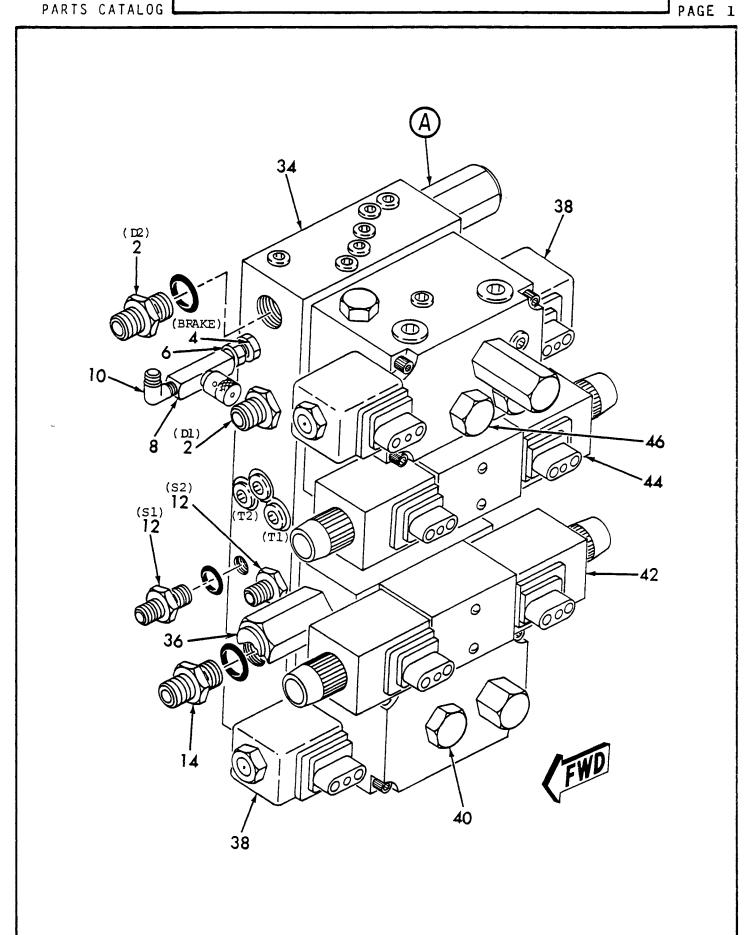
ILLUSTRATED
PARTS CATALOG

GROUND CONTROL BOX ASSEMBLY (M-20G)

(continued)

PARTS	S CATALOG L		PAGE 4
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	131154	.DECAL, GROUND CONTROL BOX	1
48	65244	.PLUG, HEYCO	1
50	20562	.BREAKER, CIRCUIT	2
52	65956	.WASHER, LOCK (attaching part)	4
54	4011	.SWITCH, PUSH BUTTON	1
56	117-E	.TERMINAL, PUSH-ON	2
58	2717	.SWITCH, IGNITION	1
60	16260	.SWITCH, TOGGLE	1
62	4021	.SWITCH, TOGGLE	1
64	20884	.GUARD, SWITCH	Ţ
66	771	.PLUG, WHITE	1.
68	70068	.CONNECTOR, BUTT	1
70	70232	.WIRE (15 Ft.)].
72	117-C	.CONNECTOR, RING	33
74	16213	.CONNECTOR	2
76	4045	.DIODE	2
78	70008	.WIRE (3 Ft.)	1

VALVE PACKAGE ASSEMBLY (M-20G)

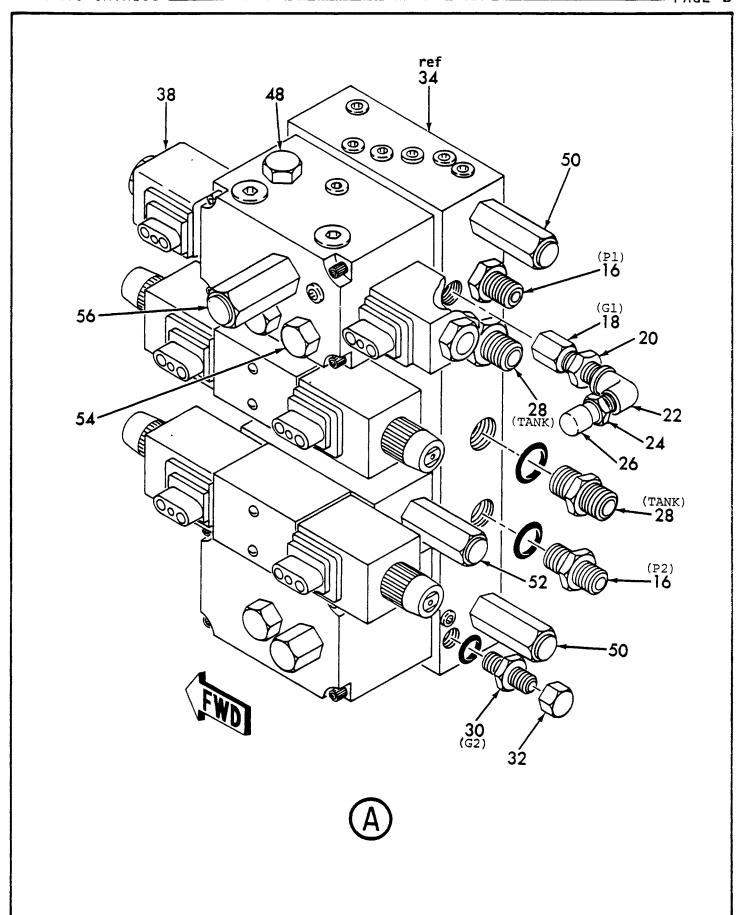


VALVE PACKAGE ASSEMBLY (M-20G)

(continued)

SECT.3 FIG.14 PAGE 2

PARTS



Mark Industries

ILLUSTRATED
PARTS CATALOG

VALVE PACKAGE ASSEMBLY (M-20G)

(continued)

PARTS SECT. 3 FIG. 14 PAGE 3

			UNIT
ITEM	PART NUMBER	DESCRIPTION 1234567	PER ASSY.
-1	131159	ASSEMBLY, VALVE PACKAGE (See Sect. 3, Fig. 8 for NHA)	REF
2	80004-11	.CONNECTOR, STRAIGHT THREAD (D1, D2)	2
4	51903	.ADAPTER, FEMALE PIPE (Brake)	1
6	80052-02	.NIPPLE, PIPE	1
8	30884	.VALVE, NEEDLE	1
10	80008-03	.ELBOW, MALE	1
12	80004-03	.CONNECTOR, STRAIGHT THREAD (S1, S2)	2
14	80004-08	.CONNECTOR, STRAIGHT THREAD (Lift)	1
16	80004-12	.CONNECTOR, STRAIGHT THREAD (P1, P2)	2
18	51903	.ADAPTER, FEMALE PIPE (G1)	1
20	80052-03	.NIPPLE, PIPE	1
22	80021-03	.ELBOW, 90° STREET	1
24	2527	.COUPLING, QUICK DISCONNECT	1
26	845	.CAP, QUICK DISCONNECT	1
28	80004-16	.CONNECTOR, STRAIGHT THREAD	2
30	80004-03	.CONNECTOR, STRAIGHT THREAD	1
32	80059-03	.CAP	1
34	81200	.PACKAGE, VALVE	1
36	66922	VALVE, RELIEF	1
38	66920	VALVE, 2 WAY N.O. SOLENOID	3
40	66677	REGULATOR, COMBINATION FLOW	1
42	66925	VALVE, DO1	1
44	67377	VALVE, DO1	1

Mark Industries ILLUSTRATED

PARTS CATALOG

VALVE PACKAGE ASSEMBLY (M-20G)

(continued)

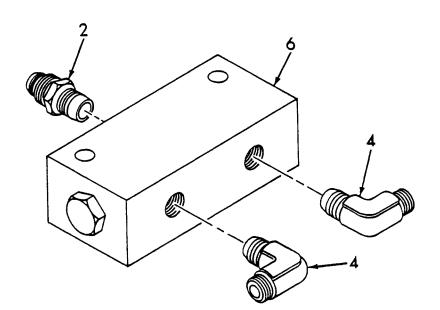
PARTS SECT. 3 FIG. 14

PARTS	CATALOG L	(00	PAGE 4
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	67376	VALVE, DIFFERENTIAL SENSING	1
48	66664	VALVE, SHUTTLE	1
50	66666	VALVE, RELIEF	2
52	66922	VALVE, RELIEF	1
54	66841	REGULATOR, FLOW	1
56	66680	VALVE, RELIEF	1
	·		

PARTS CATALOG

FLOW DIVIDER ASSEMBLY (M-20G)

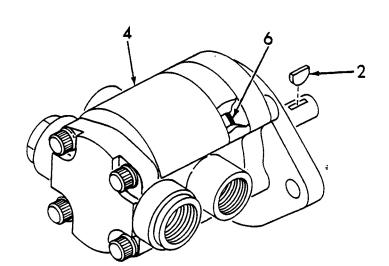
PARTS SECT. 3 FIG. 15 PAGE 1



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131187	ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 8 for NHA)	REF
2	80001-14	.CONNECTOR, MALE	1
4	80008-12	.ELBOW, MALE	2
6	81026	.DIVIDER, FLOW	1

PUMP ASSEMBLY (M-20G)

PARTS SECT. 3 FIG. 16 PAGE 1



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131168	ASSEMBLY, PUMP (See Sect. 3, Fig. 11 for NHA)	REF
2		.KEY	1
4	81201	.ASSEMBLY, DOUBLE GEAR PUMP	1
6		KIT, SEAL	1

4

Mark Industries ILLUSTRATED PARTS CATALOG

SCISSOR ASSEMBLY

THIS SECTION 4 IS ILLUSTRATED AS:

FIGURE 1 SCISSOR ASSEMBLY

FIGURE 2 LIFT CYLINDER ASSEMBLY

FIGURE 3 LIFT CYLINDER ASSEMBLY

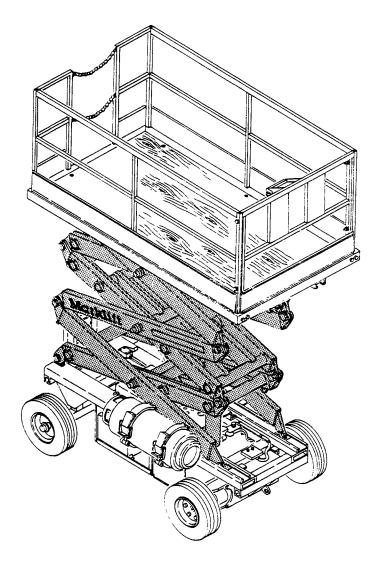
FIGURE 4 INNER ARM SUPPORT ASSEMBLY

FIGURE 5 OUTER ARM SUPPORT ASSEMBLY

FIGURE 6 INNER ARM ASSEMBLY (LOWER)

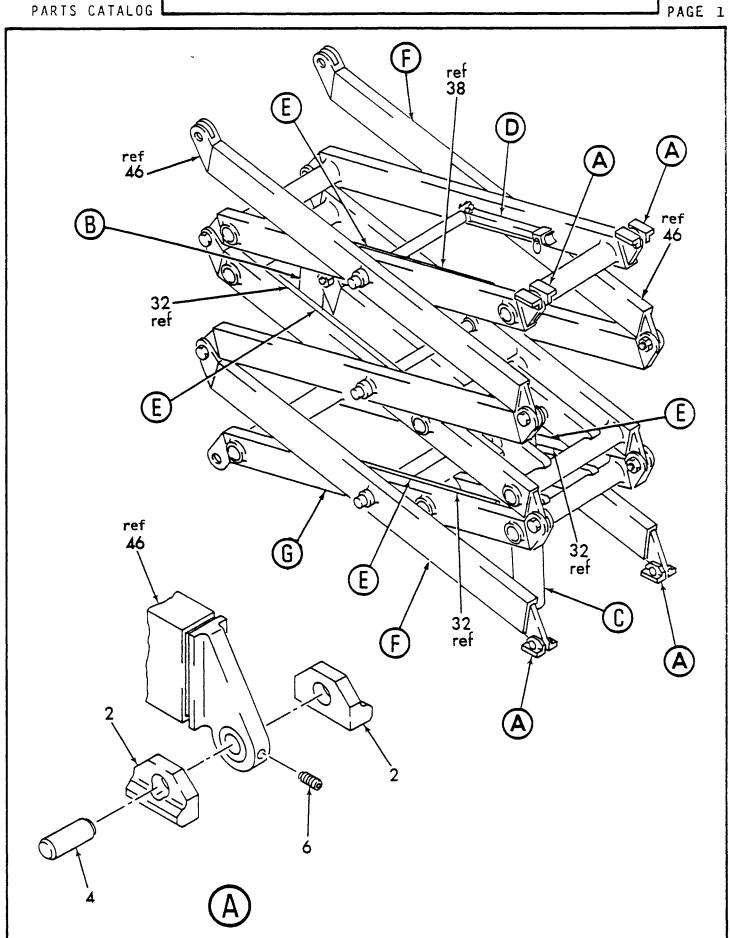
FIGURE 7 INNER ARM ASSEMBLY (MIDDLE)

FIGURE 8 INNER ARM ASSEMBLY (UPPER)



PARTS SECT.4

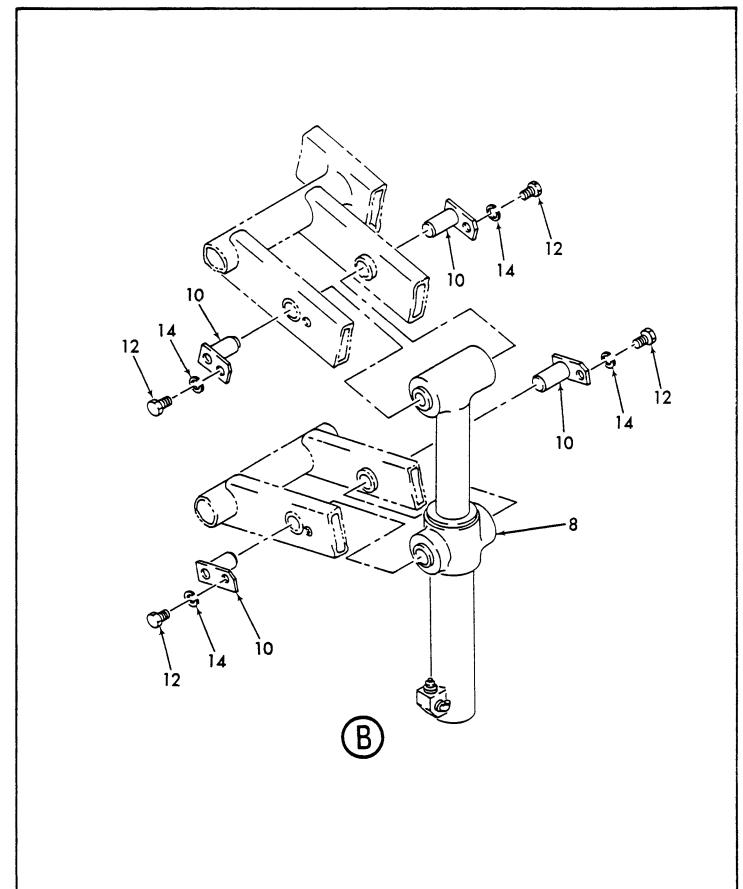
FIG. 1



PARTS SECT. 4

FIG. 1

(continued) PAGE 2

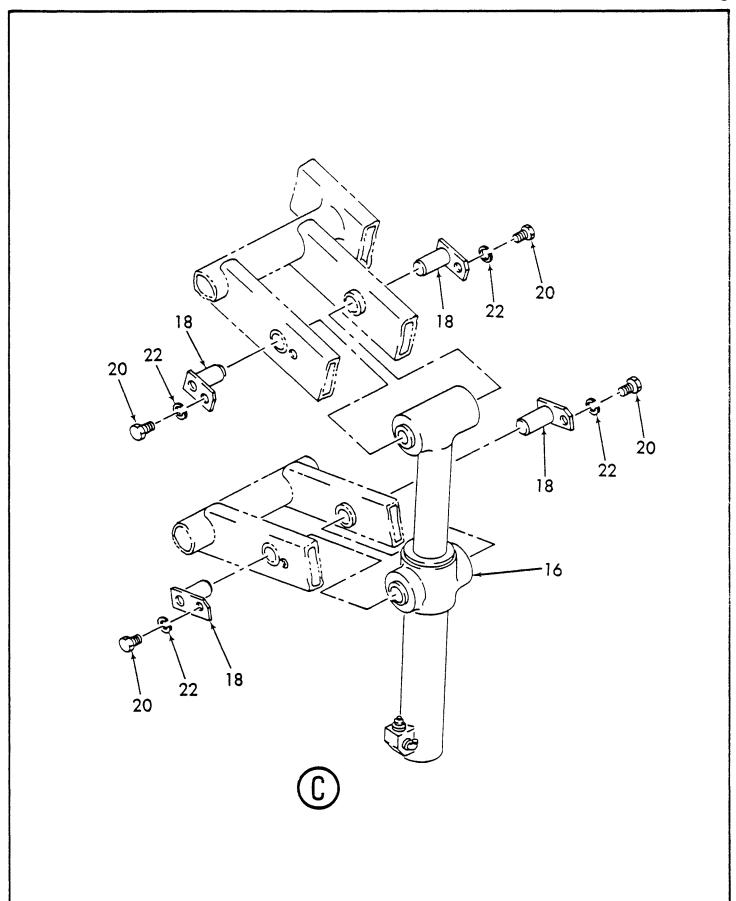


(continued)

FIG. 1

PARTS

SECT.4

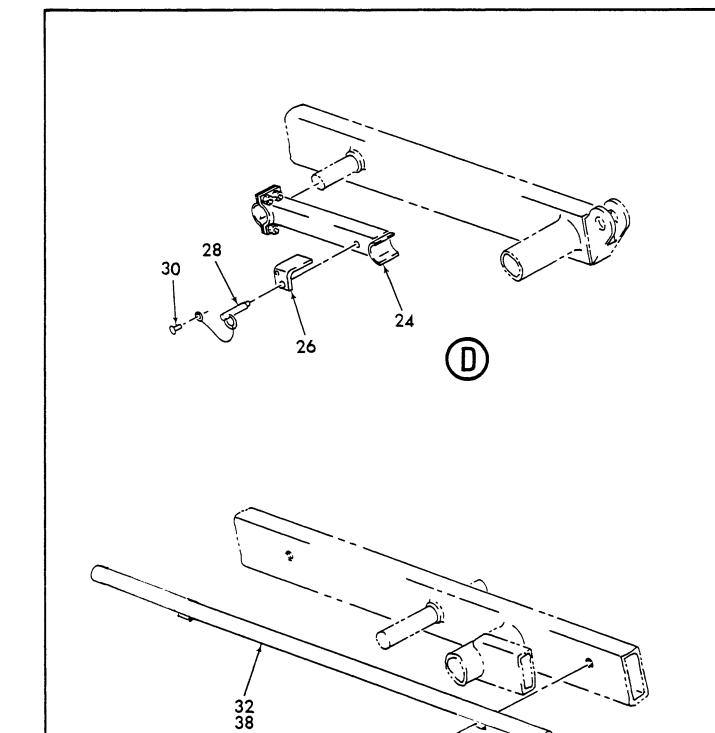


36 42

PARTS SECT. 4

FIG. 1

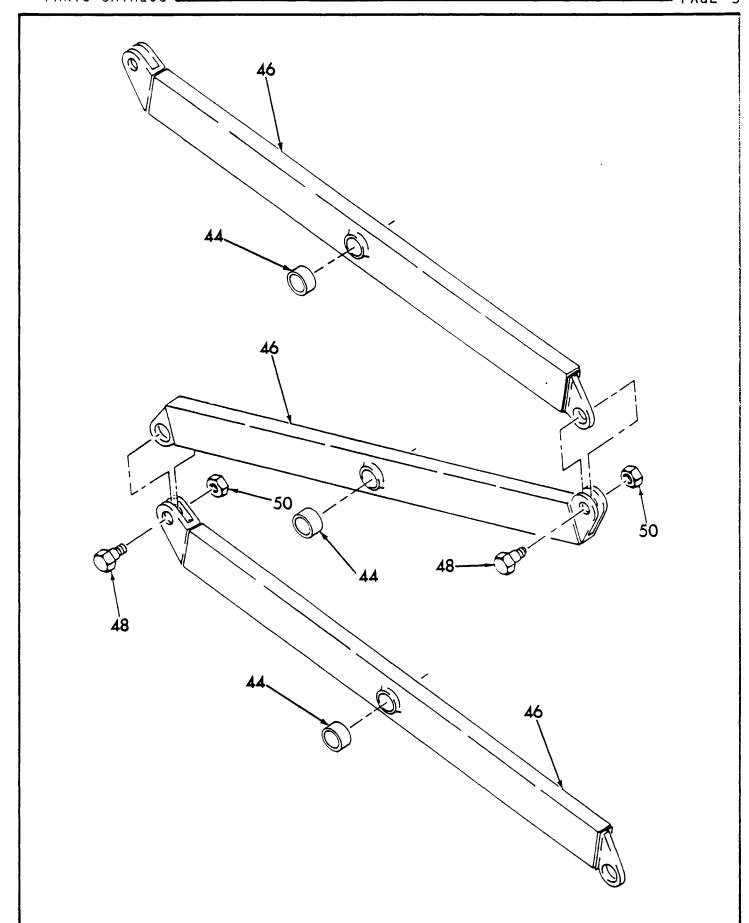
(continued) PAGE 4



(continued)

SECT. 4 FIG. 1

PARTS





(continued)

SECT. 4 FIG. 1

PARTS

FIG. 1 PAGE 6

Mark Industries ILLUSTRATED

PARTS CATALOG

SCISSOR ASSEMBLY

PARTS SECT. 4 FIG. 1

(continued) PAGE

-1 2	131188		
		ASSEMBLY, SCISSOR (See Sect. 2, Fig. 1A for NHA)	REF
i	130326	.PAD, WEAR	8
4	130327	.PIN, WEAR PAD	4
6	62201	.SCREW, SOCKET HEAD SET	4
8	131189	.ASSEMBLY, LIFT CYLINDER	1
10	130493	.PIN, TRUNNION	4
12	60533	.SCREW, HEX HEAD CAP (attaching part)	4
14	63302	.WASHER, SPLIT LOCK (attaching part)	4
16	131190	.ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 3 for Details)	1
18	130493	.PIN, TRUNNION	4
20	60533	.SCREW, HEX HEAD CAP (attaching part)	4
22	63302	.WASHER, SPLIT LOCK (attaching part)	4
24	130511	.ASSEMBLY, INNER ARM SUPPORT (See Sect. 4, Fig. 4 for Details)	1
26	130515	.BRACKET, ARM SUPPORT	1
28	12007	.PIN, BALL-LOC DETENT	1
30	375	.RIVET, (attaching part)	1
32	131106	.WELDMENT, TRANSFER TUBE	4
34	60325	.SCREW, HEX HEAD CAP (attaching part)	8
36	63319	.WASHER, LOCK (attaching part)	8
38	130611	.WELDMENT, TRANSFER TUBE	1
40	60342	.SCREW, HEX HEAD CAP (attaching part)	2
42	63301	.WASHER, LOCK (attaching part)	2
44	65577	.COLLAR, SHAFT	6

Mark Industries

ILLUSTRATED

PARTS CATALOG

SCISSOR ASSEMBLY

(continued)

PARTS SECT. 4 FIG. 1

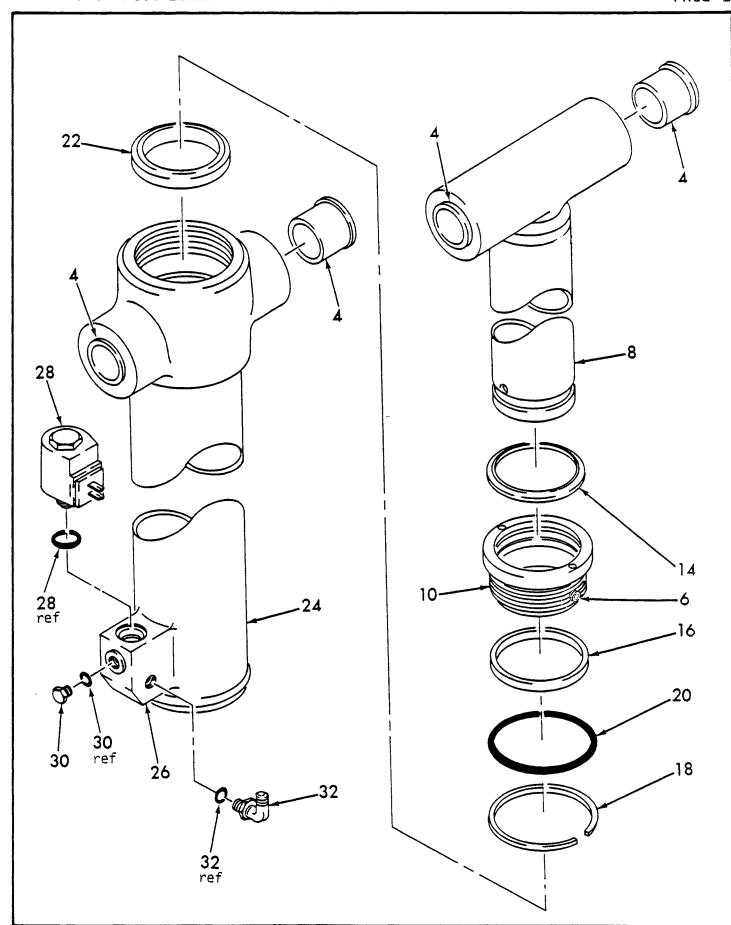
PARI	S CATALOG L	(continued)	PAGE 8
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	130254	.ASSEMBLY, OUTER ARM (See Sect. 4, Fig. 5 for Details)	6
48	130696	.BOLT, EAR PIVOT (attaching part)	4
50	61249	.NUT, HEX (attaching part)	4
52	130262	.ASSEMBLY, INNER ARM (See Sect. 4, Fig. 6 for Details)	1 ;
54	130268	.ASSEMBLY, INNER ARM (See Sect. 4, Fig. 7 for Details)	1
56	130272	.ASSEMBLY, INNER ARM (See Sect. 4, Fig. 8 for Details)	1
58	130696	.BOLT, EAR PIVOT (attaching part)	4
60	61249	.NUT, HEX (attaching part)	4



LIFT CYLINDER ASSEMBLY (single acting)

SECT.4 FIG. 2

PARTS



Mark Industries

ILLUSTRATED
PARTS CATALOG

LIFT CYLINDER ASSEMBLY (single acting)

(continued)

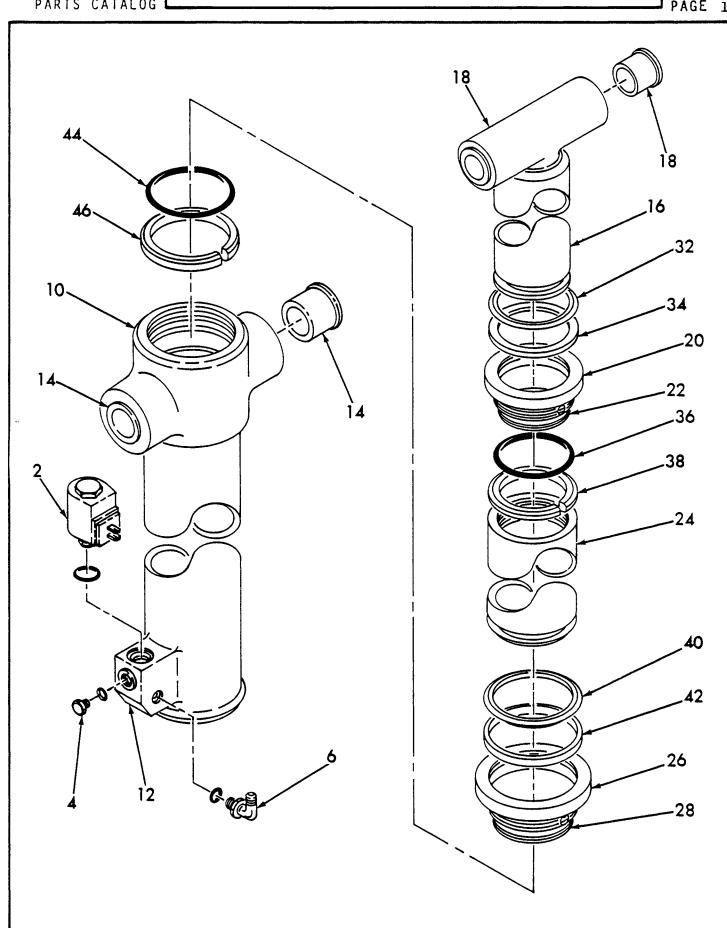
PARTS SECT. 4 FIG. 2

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131189	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
-2	130790	.CYLINDER, SINGLE ACTING LIFT	1
4	67036	BUSHING, FLANGED BRONZE	4
6	30010	PLUG, BLEED	1
8		ROD	1
10		NUT, ROD BEARING	1
-12	66822	KIT, SEAL	1
14	30163	WIPER, ROD	1
16	32127	O-RING	1
18	30066	RING, BACK-UP	1
20	30065 -	SEAL, STATIC	1
22		PISTON	1
24		BODY	1
26		VALVE, CHECK	1
28	66675	.VALVE, SOLENOID	1
30	80050-03	.PLUG, O-RING	1
32	80012-05	.ELBOW	1

LIFT CYLINDER ASSEMBLY (telescopic)

PARTS SECT.4

FIG. 3



Mark Industries

ILLUSTRATED
PARTS CATALOG

LIFT CYLINDER ASSEMBLY (telescopic)

(continued)

PARTS SECT. 4 FIG. 3

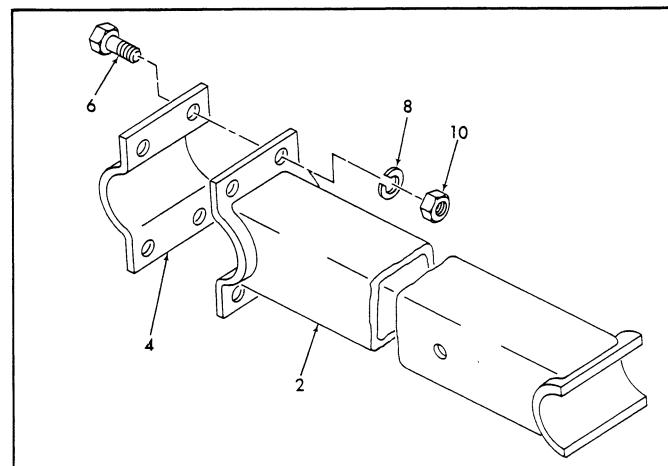
PARTS	S CATALOG	(continued)	PAGE 2
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131190	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. l for NHA)	REF
2	66675	.VALVE, SOLENOID	1
4	80050-03	.PLUG, O-RING	1
6	80012-05	.ELBOW	1
- 8	130788	.CYLINDER, TELESCOPIC LIFT	1
10		BODY	1
12		VALVE, CHECK	1
14		BUSHING, FLANGED BRONZE	2
16		ROD, (3.50 DIA.)	1
18	67036	BUSHING, FLANGED BRONZE	2
20		NUT, ROD BEARING	1
22	30010	PLUG, NYLON	1
24		ROD, (4.50 DIA.)	1
26		NUT, ROD BEARING	1
28		PLUG, NYLON	1
-30		KIT, SEAL	1
32	30163	WIPER, A.N.	1
34	32252	U-RING	1.
36	30065	O-RING	1
38		RING, BACKUP	1
40	30148	WIPER, A.N.	1
42	32128	U-RING	1
44	30065	O-RING	1
46		RING, BACKUP	1



INNER ARM SUPPORT ASSEMBLY

PARTS SECT.4

FIG. 4



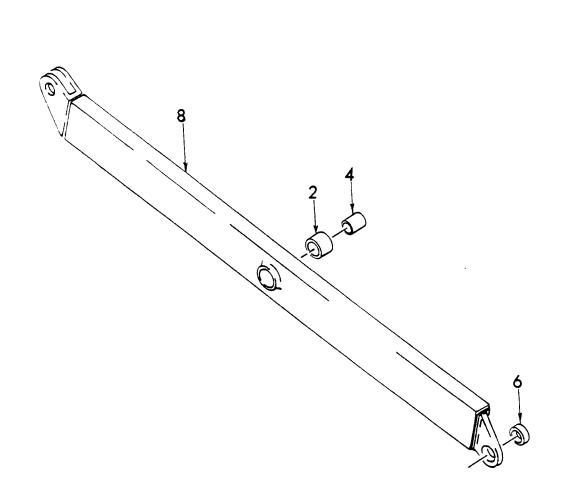
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130511	ASSEMBLY, INNER ARM SUPPORT (See Sect. 4, Fig. 1 for NHA)	REF
2	130512	.WELDMENT, INNER ARM SUPPORT	1
4	30693	.CLAMP, INNER ARM SUPPORT	1
6	60343	.SCREW, H.H.C. (attaching part)	4
8	63303	.WASHER, SLIT LOCK (attaching part)	4
10	60703	.NUT, HEX (attaching part)	4

PARTS CATALOG

OUTER ARM SUPPORT ASSEMBLY

PARTS SECT. 4

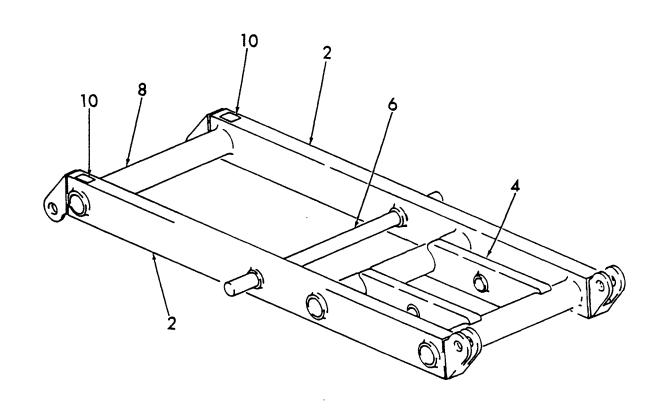
FIG. 5



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130254	ASSEMBLY, OUTER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130258	.SLEEVE	1
4	64922	.BUSHING	1
6	916	.BUSHING	1
8	130253	.MACHINING, ARM	1

INNER ARM ASSEMBLY (lower)

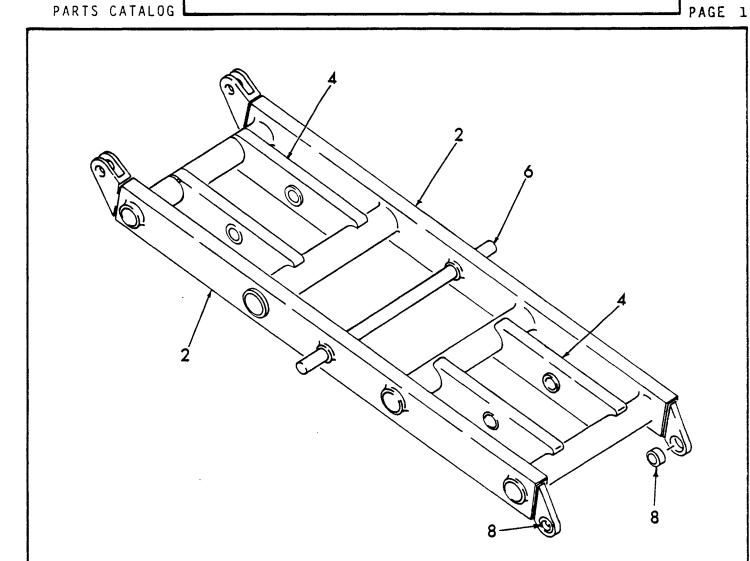
PARTS SECT. 4 FIG. 6



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130262	ASSEMBLY, INNER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130261	.SUB-ASSEMBLY, INNER ARM	2
4	130273	SUPPORT, TRUNNION CYLINDER	1
6	130274	SHAFT, CENTER	1
8	36046	PIPE	1
10	35994	BAR, FLAT	2

INNER ARM ASSEMBLY (middle)

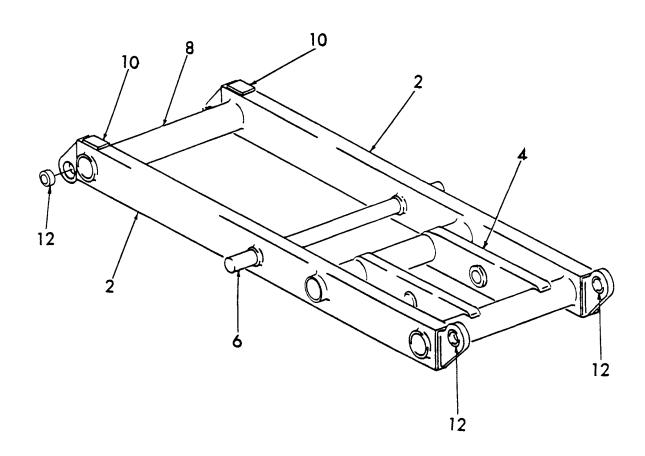
PARTS SECT.4 FIG. 7



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130268	ASSEMBLY, INNER ARM (See Sect. 4, Fig. l for NHA)	REF
2	130267	.SUB-ASSEMBLY, INNER ARM	2
4	130273	SUPPORT, TRUNNION CYLINDER	2
6	130274	SHAFT, CENTER	1
8	916	BUSHING	2

INNER ARM ASSEMBLY (upper)

PARTS SECT.4 FIG. 8 PAGE 1

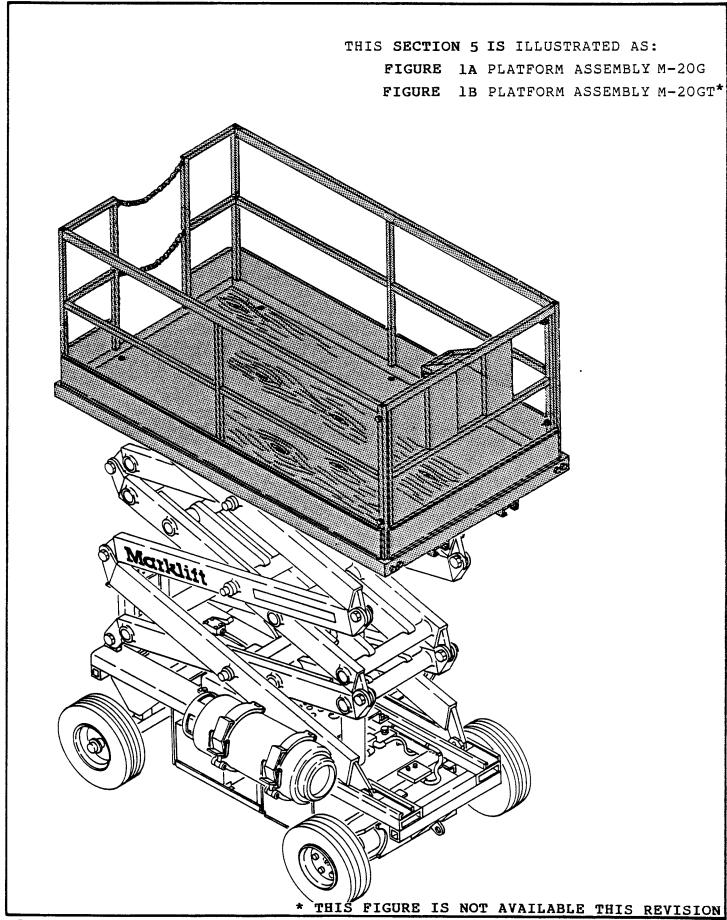


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130272	ASSEMBLY, INNER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130271	.SUB-ASSEMBLY, INNER ARM	2
4	130273	SUPPORT, TRUNNION CYLINDER	1
6	130274	SHAFT, CENTER	1
8	36046	PIPE	1
10	35994	BAR, FLAT	2
12	916	BUSHING	4

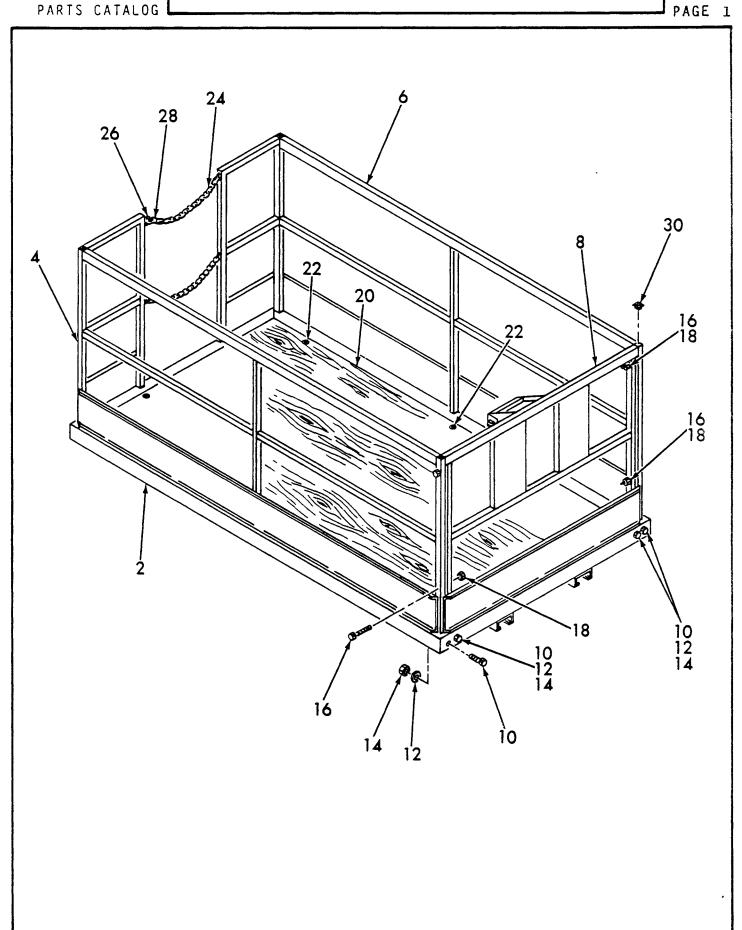
PLATFORM ASSEMBLIES

PARTS SECT.

5



PARTS SECT.5 FIG.1A



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PARTS CATALOG

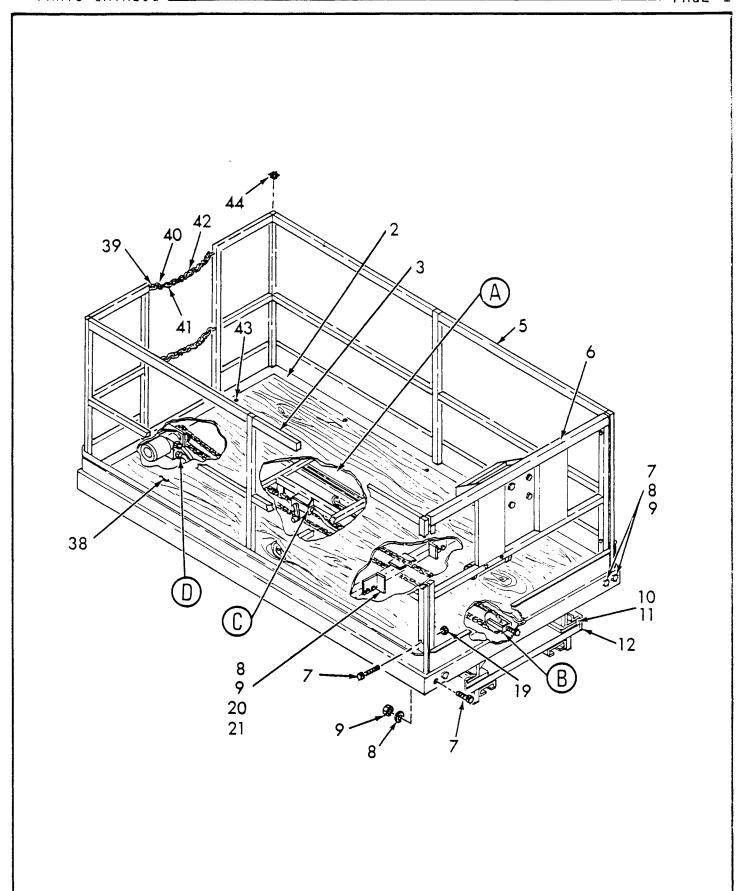
PLATFORM ASSEMBLY (M-20G)

PARTS SECT. 5 FIG. 1A PAGE 2

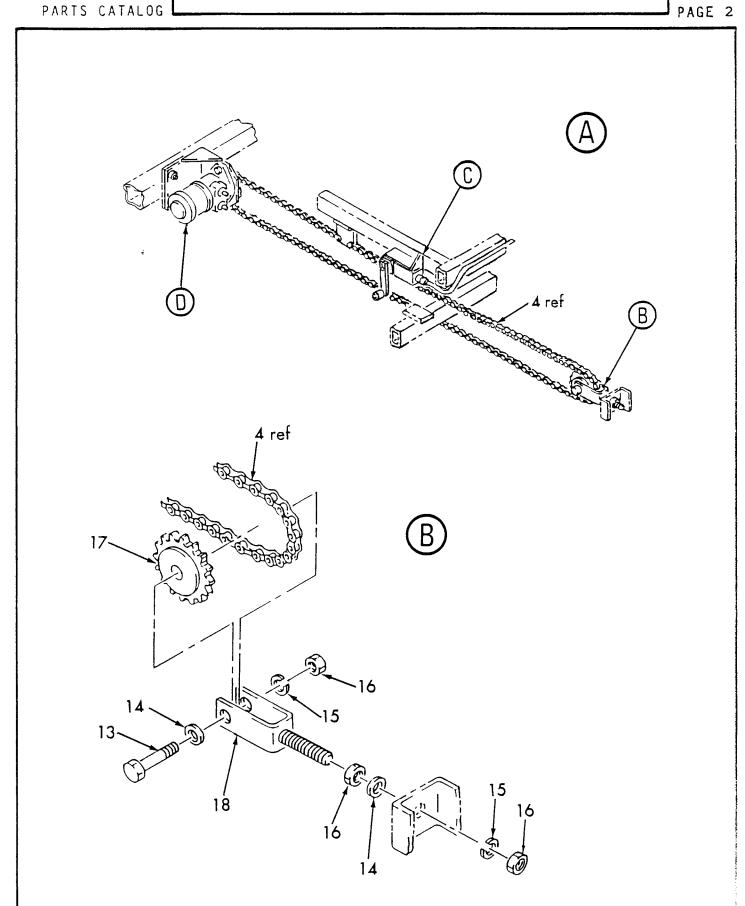
(continued)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130347	ASSEMBLY, STANDARD PLATFORM (See Sect. 2, Fig. lA for NHA)	REF
2	130344	.WELDMENT, PLATFORM	
4	130354	.RAIL, GUARD - R.H. SIDE	1
6	130355	.RAIL, GUARD - L.H. SIDE	1
8	130356	.RAIL, GUARD - FRONT	1
10	60337	.SCREW, CAP (attaching part)	8
12	60331	.WASHER, SPLIT LOCK (attaching part)	8
14	60701	.NUT, HEX (attaching part)	8
16	60337	.SCREW, CAP (attaching part)	4
18	61227	.NUT, HEX LOCK (attaching part)	4
20	130398	.FLOOR, PLYWOOD	1
22	61713	.SCREW, FHL FH SELF TAPPING (attaching part)	10
24	65794	.CHAIN, LINK	2
26	65636	.CHAIN, LINK	2
28	65637	.SNAP, OPEN END BOLT	2
30	91541	.PLUG, CAP	4

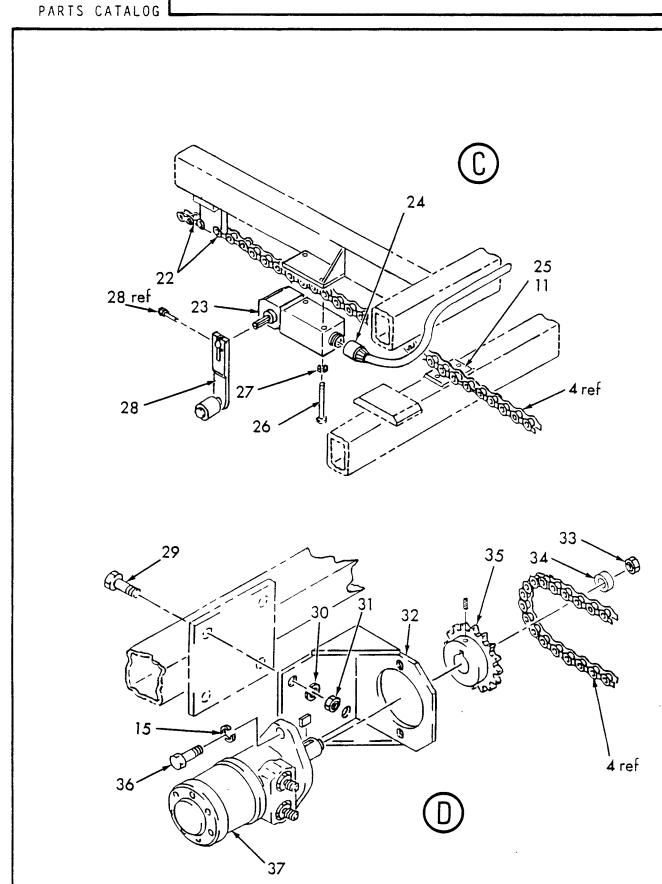
PARTS SECT.5 FIG.1B PAGE 1



PARTS SECT. 5 FIG. 1B



PARTS SECT. 5 FIG. 1B PAGE 3



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PARTS CATALOG

PLATFORM ASSEMBLY (M-20GT)

PARTS SECT.5 FIG.1B PAGE 4

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130348	ASSEMBLY, EXTENDABLE PLATFORM (See Sect. 1, Fig. 1 for NHA)	REF
2	130349	.WELDMENT, PLATFORM	1
3	130355	.RAIL, GUARD - L. H. SIDE	1
4	65579	.CHAIN, SELF LUBRICATING	1
5	130354	.RAIL, GUARD - R.H. SIDE	1
6	130356	.RAIL, GUARD - FRONT	1
7	60337	.SCREW, CAP HEX HEAD (attaching part)	14
8	63301	.WASHER, LOCK SPLIT (attaching part)	16
9	60701	.NUT, HEX (attaching part)	14
10	31058	.WEAR, PAD	2
11	16217	.RIVET, POP (attaching part)	20
12	130363	.WELDMENT, FRAME TOP	1
13	60370	.SCREW, CAP HEX HEAD (attaching part)	1.
14	63415	.WASHER, FLAT (attaching part)	2
15	63305	.WASHER, LOCK SPLIT (attaching part)	2
16	61242	.NUT, LOCK (attaching part)	3
17	65585	.IDLER, SPROCKET	1
18	130320	.WELDMENT, CLEVIS	1
19	61227	.NUT, HEX LOCK (attaching part)	4
20	60318	.SCREW, CAP HEX HEAD (attaching part)	4
21	130371	.STOP	2
22	65580	.MASTER, LINK	2
23	70173	.SWITCH, LIMIT	1
24	2806	.RELIEF, STRAIN	1
25	130399	.PAD, WEAR	4

PARTS SECT.5 FIG.1B PAGE 5

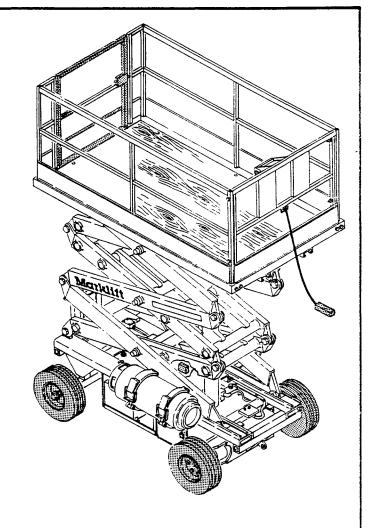
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	62615	.SCREW, MACHINE ROUND HEAD SLOTTED (Attaching part)	2
27	63313	.WASHER, LOCK SPLIT (attaching part)	2
28	70169	.LEVER, LIMIT SWITCH	1
29	60307	.SCREW, CAP HEX HEAD (attaching part)	4
30	63319	.WASHER, LOCK SPLIT 3/8" (attaching part)	4
31	60703	.NUT, HEX HEAD (attaching part)	4
32	130319	.WELDMENT, BRACKET HYDRAULIC	1
33	60342	.SCREW, CAP HEX HEAD (attaching part)	1
34	31061	.WASHER, DRUM	1
35	65578	.SPROCKET, STEEL 5/8 PITCH	1
36	60326	.SCREW, CAP HEX HEAD (attaching part)	2
37	130341	.ASSEMBLY, HYDRAULIC MOTOR	1
38	130398	.FLOOR, PLYWOOD	1
39	65636	.CHAIN, LINK	2
40	65990	.SNAP, SWIVEL WIRE SPRING	2
41	65991	.CONNECTOR, CHAIN THREADED	2
42	160000	.CHAIN, LINK	2
43	61713	.SCREW, SELF-TAPPING (attaching part)	10
44	91541	.CAP., PLUG	4

PARTS CATALOG

OPTIONAL ASSEMBLIES

PARTS SECT.

6



THIS SECTION 6 IS ILLUSTRATED AS:

FIGURE	1	OPTIONAL	ASSEMBLIES
--------	---	----------	------------

FIGURE 2 REMOTE DRIVE KIT

FIGURE 3 2500 WATT GENERATOR

FIGURE 4 HOURMETER

FIGURE 5 P.Q. SLOPE SENSOR

FIGURE 6 TRAVEL WARNING HORN *

FIGURE 7 ALL MOTION ALARM *

FIGURE 8 12 VOLT PLATFORM WORK LIGHT *

FIGURE 9 ROTATING AMBER BEACON *

FIGURE 10 FEMALE REMOTE DRIVE PLUG *

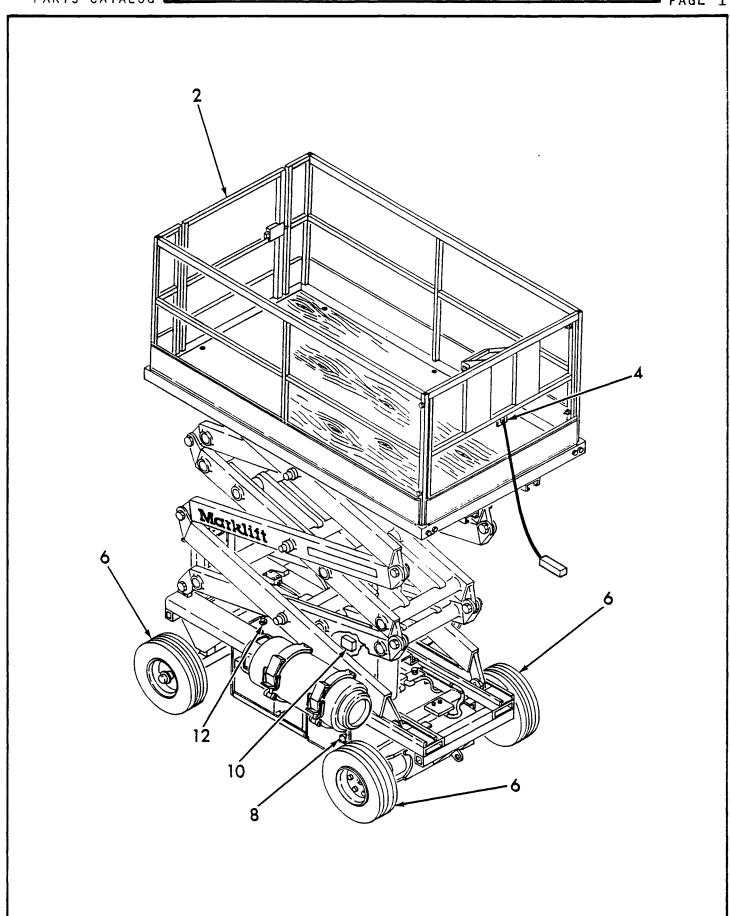
FIGURE 11 PROPORTIONAL DRIVE CONTROLS *

FIGURE 12 TUV PACKAGE*

OPTINAL ASSEMBLIES

PARTS SECT.6

FIG. 1



Mark Industries

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PARTS CATALOG

OPTIONAL ASSEMBLIES

(continued) FI

SECT.6 FIG. 1

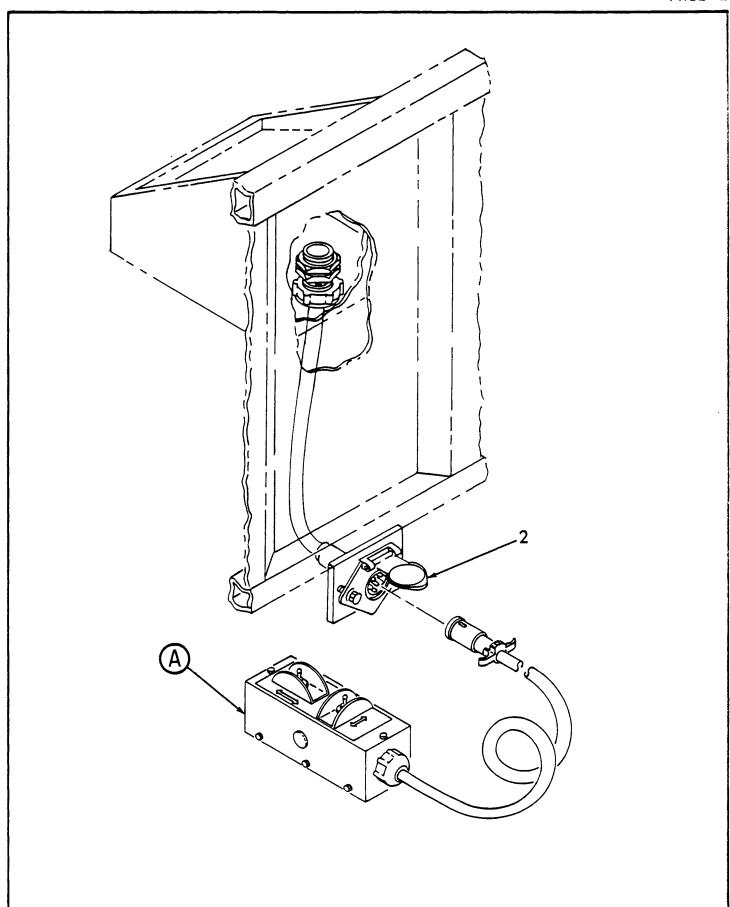
PARTS

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
2	131063	GATE, SWING	1
4	131916	KIT, REMOTE DRIVE (See Sect. 6, Fig. 2 for Details)	1
6	130663	TIRES, A70 X 13	4
8	131941	GENERATOR, 2500 WATT (See Sect. 6, Fig. 3 for Details)	1
10	131065	HOURMETER (See Sect. 6, Fig. 4 for Details)	1
12	131942	SENSOR, P.Q. SLOPE (See Sect. 6, Fig. 5 for Details)	1
-14	· 131901	HORN, TRAVEL WARNING (See Sect. 6, Fig. 6 for Details)	1
- 16	131900	ALARM, ALL MOTION (See Sect. 6, Fig. 7 for Details)	1
-18	131928	LIGHT, 12 VOLT PLATFORM WORK (See Sect. 6, Fig. 8 for Details)	1
-20	131927	BEACON, ROTATING AMBER (See Sect. 6, Fig. 9 for Details)	1
-22	131956	PLUG, FEMALE FOR REMOTE DRIVE (See Sect. 6, Fig. 10 for Details)	1
-24	131933	CONTROLS, PROPORTIONAL DRIVE (See Sect. 6, Fig. 11 for Details)	1
-26	131926	PACKAGE, TUV (See Sect. 6, Fig. 12 for Details)	1

REMOTE DRIVE KIT

PARTS SECT. 6

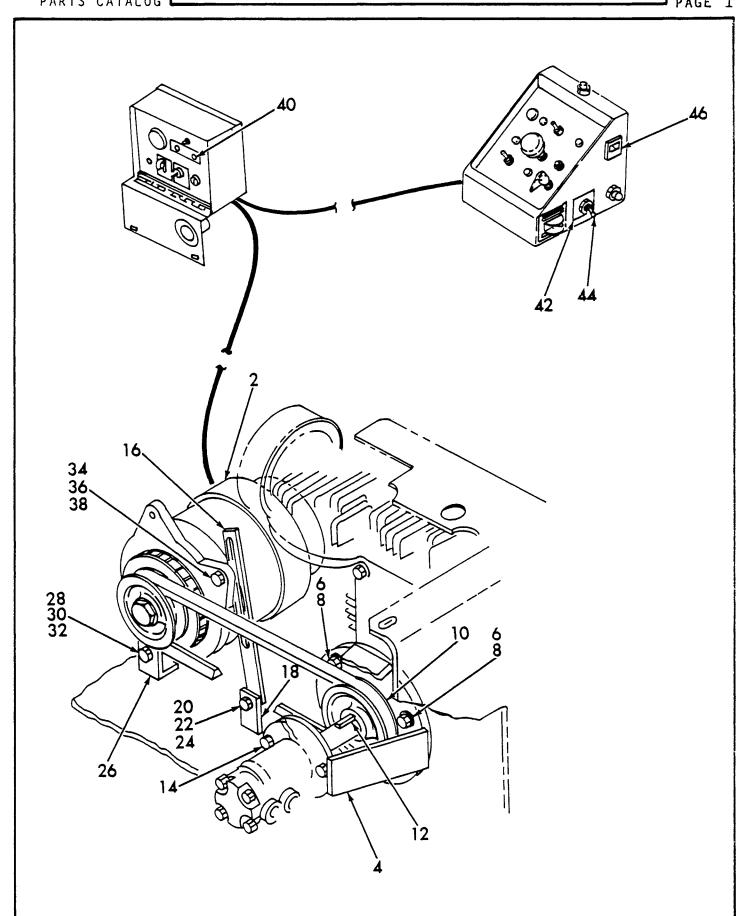
FIG. 2



2500 WATT GENERATOR

PARTS SECT.6

FIG. 3

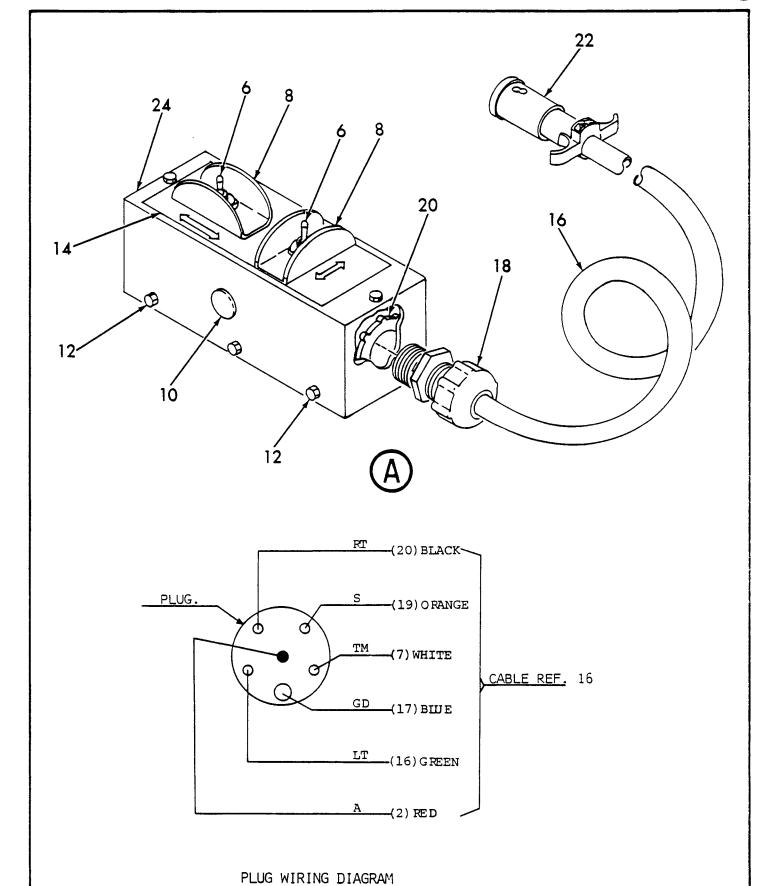


REMOTE DRIVE KIT

(continued)

SECT. 6 FIG. 2

PARTS



Mark Industries

ILLUSTRATED
PARTS CATALOG

REMOTE DRIVE KIT

(continued)

PARTS SECT. 6 FIG. 2 PAGE 3

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131916	KIT, REMOTE DRIVE (See Sect. 6, Fig. l for NHA)	REF
2	131940	.PLUG, FEMALE REMOTE DRIVE & STEER	1
-4	130911	.ASSEMBLY, REMOTE DRIVE LANYARD/CONTROL	1
6	20481	SWITCH, TOGGLE	2
8	20884	GUARD, SWITCH	2
10	771	PLUG, WHITE	1
12	61726	SCREW, SELF TAPPING	8
14	130906	DECAL, R. CONTROL DRIVE & STEER	1
16	130902-08	CABLE, CONDUCTOR	1
18	70281	RELIEF, STRAIN	1
20	2808	NUT, LOCK	1
22	70266	PLUG, (6-POLE)	1
24	130901	ASSEMBLY, ELECTRICAL	1.

Mark Industries

ILLUSTRATED

PARTS CATALOG

2500 WATT GENERATOR

(continued)

PARTS SECT. 6 FIG. 3

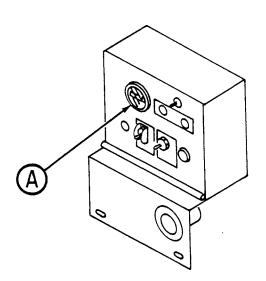
PARTS	S CATALOG L	(continued)	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
ITEM	PART NUMBER	DESCRIPTION . 1234567	UNIT PER ASSY.
18	131938	.BRACKET, BELT TENSIONER MOUNT	1
20	60343	.SCREW, CAP (attaching part)	1
22	63303	.WASHER, LOCK (attaching part)	1
24	60703	.NUT, HEX (attaching part)	ĺ.
26	131939	BRACKET, GENERATOR MOUNT	1
28	60347	.SCREW, CAP (attaching part)	1
30	63303	.WASHER, LOCK (attaching part)	1
32	60703	.NUT, HEX (attaching part)	1
34	60338	.SCREW, CAP	1
36	63302	.WASHER, LOCK	1
38	63402	.WASHER, FLAT	1
40	20562	.BREAKER, CIRCUIT	1
42	20494	.DECAL, 110 VAC	1
43	20482	.SWITCH, TOGGLE	1
46	288	.COVER, SNAP	1
48	117-D	.CONNECTOR, BUTT	2
50	70126	.RECEPTACLE	1

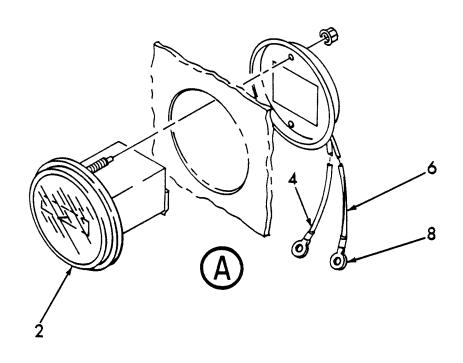
HOURMETER

PARTS

SECT. 6 FIG. 4

PAGE 1





Mark Industries

ILLUSTRATED
PARTS CATALOG

HOURMETER

PARTS SECT. 6

(continued)

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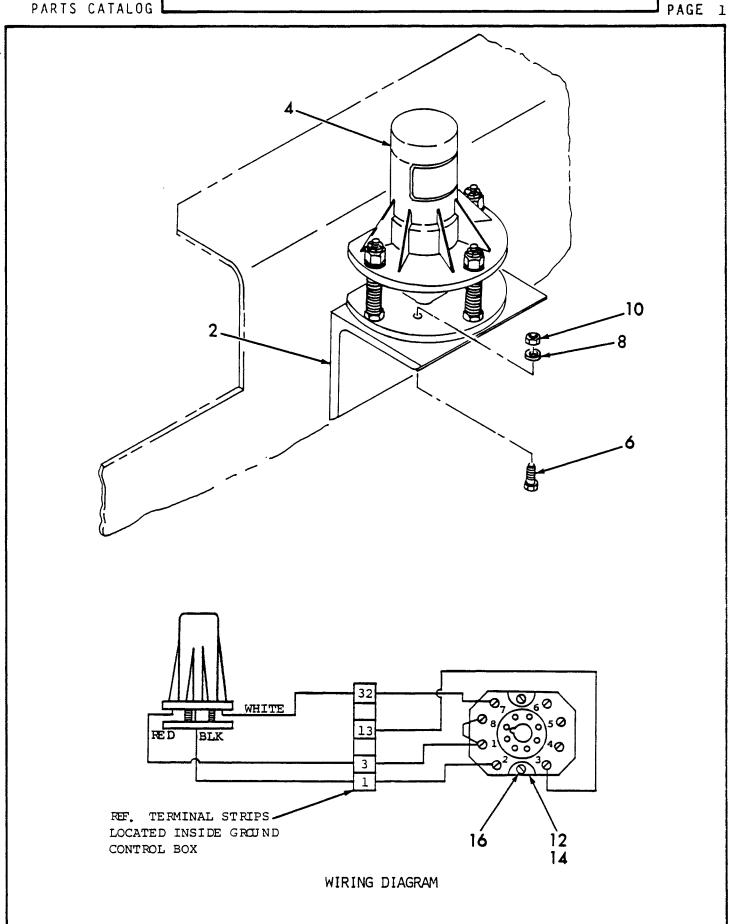
TEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY
-1	131065	HOURMETER (See Sect. 6, Fig. 1 for NHA)	REF
2	20571	- HOURMETER	1
4	70232	.WIRE, WHITE 1.5 FEET	AR
6	70008	.WIRE, YELLOW/GREEN 1.5 FEET	AR
8	117-C	.RING, CONNECTOR	2
	·		
			·
			demander of the state of the st
			entachturio VV ca. A

P.Q. SLOPE SENSOR

PARTS SECT. 6

FIG. 5

PAGE 1



Mark Industries

ILLUSTRATED PARTS CATALOG

P.Q. SLOPE SENSOR

SECT. 6 FIG.

PARTS

(continued)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY							
-1	131942	SENSOR, P.Q. SLOPE (See Sect. 6, Fig. 1 for NHA)								
2	130793	.BRACKET	1							
4	31074	.SENSOR, SLOPE	1							
6	60309	.SCREW, CAP	2							
8	63301	.WASHER, LOCK	2							
10	60701	.NUT, HEX	2							
12	70170	.RELAY	1							
14	70239	SOCKET	1							
16	62623	.SCREW, CAP	2							

TRAVEL WARNING HORN

PARTS SECT.6 FIG. 6

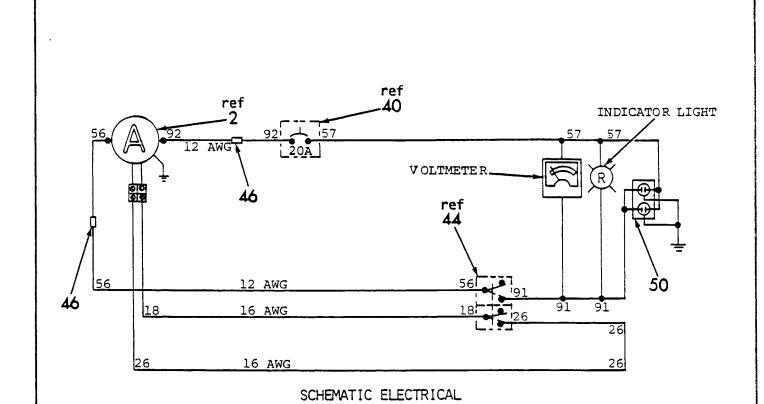
PAGE 1

THIS SECT. 6, FIG. 6 PART NUMBER 131901
TRAVEL WARNING HORN DRAWINGS
ARE NOT AVAILABLE THIS REVISION

2500 WATT GENERATOR

(continued) PAGE 2

PARTS SECT. 6 FIG. 3



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131941	GENERATOR, 2500 WATT (See Sect. 6, Fig. 1 for NHA)	REF
2	20907	.GENERATOR	1
4	131191	.ADAPTER, ENGINE PUMP	1
6	60351	.SCREW, CAP (attaching part)	
8	63304	.WASHER, LOCK (attaching part)	4
10	65964	.PULLEY	1
12	37148	.KEY, SQUARE	1
14	60618	.SCREW, CAP	2
16	131937	.TENSIONER, GENERATOR BELT	1
	1		Į.

ALL MOTION ALARM

PARTS SECT.6 FIG. 7

PAGE 1

THIS SECT. 6, FIG. 7 PART NUMBER 131900 ALL MOTION ALARM DRAWINGS ARE NOT AVAILABLE THIS REVISION

12 VOLT PLATFORM WORK LIGHT

PARTS SECT. 6

FIG. 8

PAGE 1

THIS SECT. 6, FIG. 8 PART NUMBER 131928
12 VOLT PLATFORM WORK LIGHT DRAWING
IS NOT AVAILABLE THIS REVISION

ROTATING AMBER BEACON

PARTS SECT. 6 FIG. 9

PAGE 1

THIS SECT. 6, FIG. 9 PART NUMBER 131927
ROTATING AMBER BEACON DRAWING
IS NOT AVAILABLE THIS REVISION

FEMALE PLUG FOR REMOTE DRIVE

PARTS SECT.6 FIG.10 PAGE 1

THIS SECT. 6, FIG. 10 PART NUMBER 131956 FEMALE PLUG FOR REMOTE DRIVE DRAWING IS NOT AVAILABLE THIS REVISION.

PROPORTIONAL DRIVE CONTROLS

PARTS SECT.6 FIG.11 PAGE 1

THIS SECT. 6, FIG. 11 PART NUMBER 131933
PROPORTIONAL DRIVE CONTROLS DRAWINGS
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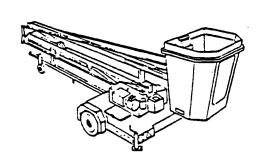


TUV PACKAGE

PARTS SECT.6 FIG.12 PAGE 1

THIS SECT. 6, FIG. 12 PART NUMBER 131926
TUV PACKAGE DRAWINGS
ARE NOT AVAILABLE THIS REVISION





THIS VENDOR CHAPTER IS DESIGNED AS:

SECTION 1 WISCONSIN ENGINE

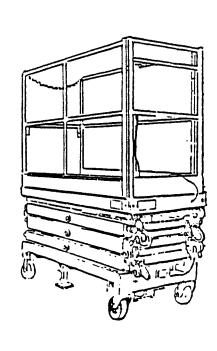
SECTION 2 DICO HUB

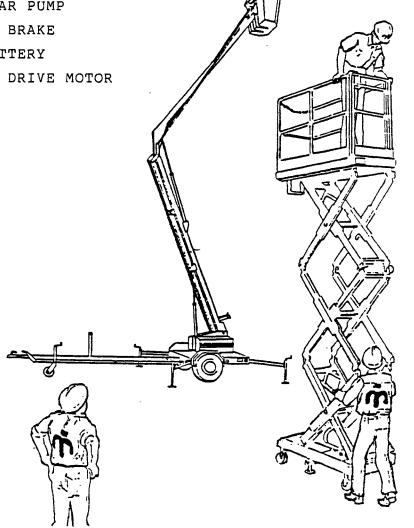
SECTION 3 CESSNA GEAR PUMP

SECTION 4 MICO DISC BRAKE

SECTION 5 TROJAN BATTERY

SECTION 6 ROSS GEAR DRIVE MOTOR





VENDOR

SECT. 1

PAGE

REPAIR MANUAL



WISCONSIN Workhorse W1—588 Gasoline **Engine**

TELEDYNE TOTAL POWER

MEMPHIS, TENNESSEE 38181-1160

TTP00043 June 1985

(continued)

SECT. 1 PAGE 2

IMPORTANT

READ THESE INSTRUCTIONS CAREFULLY

All points of operation and maintenance have been covered as carefully as possible but if further information is required, inquiries sent to the factory will receive prompt attention.

When writing the factory ALWAYS GIVE THE MODEL, SPECIFICATION AND SERIAL NUMBER of engine referred to.

STARTING AND OPERATING OF NEW ENGINES

Careful breaking in of a new engine will greatly increase its life and result in trouble-free operation. A factory test is not sufficient to establish the polished bearing surfaces, which are so necessary to the proper performance and long life of an engine. Neither is there a quick way to force the establishment of good bearing surfaces. These can only be obtained by running a new engine carefully and under reduced speeds and loads for a short time, as follows:

First, be sure the engine is filled to the proper level with a good quality of engine oil, see "Grade of Oil" chart.

For the proper procedures to follow when breaking in a new engine, see page 12 "Break-in Procedure" of this manual.

The various bearing surfaces in a new engine have not been glazed, as they will be with continued operation, and it is in this period of "running in," that special care must be exercised, otherwise the highly desired glaze will never be obtained. A new bearing surface that has once been damaged by carelessness will be ruined forever.

Our engine warranty is printed on the inside back cover of this manual. Read it carefully.

For Your Own Record

THIS MANUAL IS FOR MY WISCONSIN MODEL ENGINE SPEC. No. SERIAL No.

THE ABOVE INFORMATION, WHICH WILL BE FOUND ON PAGE 6 OF THIS MANUAL, SHOULD BE FILLED IN. YOUR PROMPT ATTENTION TO THIS MATTER WILL MAKE IT CONVENIENT FOR YOU IN THE FUTURE, AS THIS INFORMATION MUST BE GIVEN WHEN ORDERING ENGINE REPAIR PARTS.

WISCONSIN ENGINE

VENDOR

(continued)

SECT. 1

PAGE

1

Contents Contents

AWARNING

Read and observe all individual safety warnings as you use this manual to operate, service or repair your engine.

FOREWARD

Good operation and a planned maintenance program as outlined in this manual are of vital importance in obtaining maximum engine performance, and long engine life. The instructions on the following pages have been written with this in mind, to give the operator a better understanding of the various problems which may arise, and the manner in which these problems can best be solved or avoided.

Procedures in the Engine Maintenance Section must be set up and followed by the owner and operator to obtain dependable service and long life from the engine. Owners and operators are expected to perform these maintenance procedures as outlined under the daily schedule as well as 50-hr., 250 hr., and 500 hr. periods WHILE IN THE WARRANTY PERIOD AS WELL AS DURING THE LIFE OF THE ENGINE.

Warranty service does not include tune-up of the engine such as replacing spark plugs, tappet settings, ignition timing, ignition wiring, air cleaner service and lubrication and filter maintenance.

The operator is cautioned against the use of any parts, other than **Genuine Teledyne Total Power** for replacement or repair. These parts have been engineered and tested for their particular job, and the use of any other parts may result in unsatisfactory performance and short engine life. Likewise, Teledyne Total Power distributors and dealers, because of their close factory relations, can render the best and most efficient service.

THE LIFE OF YOUR ENGINE DEPENDS ON THE CARE IT RECEIVES.

Comene

WORKHORSE ENGINES

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SECT. 1

VENDOR

PAGE 4

IMPORTANT SAFETY NOTICE

Proper repair is important to the safe and reliable operation of an engine. This Repair Manual outlines basic recommended procedures, some of which require special tools, devices or work methods.

Improper repair procedures can be dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE PERFORMING REPAIRS ON THIS ENGINE

Warning labels have also been put on the engines to provide instructions and identify specific hazards which if not heeded could cause bodily injury or death to you or other persons. These labels identify hazards which may not be apparent to a trained mechanic. There are many potential hazards for an untrained mechanic and there is no way to label the engine against all such hazards. These warnings in the Repair Manual and on the engine are identified by this symbol:



Operations that may result only in engine damage are identified in the Repair Manual by this system:

Teledyne Total Power cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this manual are therefore not all inclusive. If a procedure, tool, device or work method not specifically recommended by Teledyne Total Power, Industrial Products Division is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the engine will not be damaged or made unsafe by the procedures you choose.

IMPORTANT: The information, specifications and illustrations in this book are on the basis of information available at the time it was written. The specifications, torques, pressures of operation, measurements, adjustments, illustrations and other items can change at any time. These changes can effect the service given to the product. Get the complete and most current information before you start any job. For parts, service, or information, contact Teledyne Total Power, Memphis, TN.

WISCONSIN ENGINE

VENDOR

SECT.

(continued) PAGE

↑ WARNING

Most sub-systems used in conjunction with Teledyne Total Power industrial engines including, but not limited to, radiators, hoses, fans, fuel tanks, fuel lines or other fuel system components, batteries, electrical connections or other electrical components, clutches, transmissions, hydraulic pumps and generators, are not supplied by Teledyne Total Power, but are provided by the manufacturer of the end item in which the engine is used.

Some of the dangers associated with servicing such items are generally mentioned in this manual; however, the appropriate handbooks and safety instructions provided by the manufacturer of the end item should always be consulted prior to undertaking any work on sub-systems attached to the engine, to avoid any hazards inherent to these sub-systems.

MARNING

Read and observe all individual safety warnings as you use this manual to operate, service or repair your engine.

Always exercise caution whenever working with an engine or any associated system.

Injuries may be caused by lack of care when working with, or near, moving parts, hot parts, pressurized systems, electrical equipment, or fuel systems.

Always wear eye and hearing protection when working on or near engines.

Improper attire such as loose clothing, ties, rings, soft shoes or bare feet could be hazardous and should be avoided when servicing engines.

Use or service of the engine (including the use of modified parts or materials) not in accordance with manufacturer's specifications could damage your engine or cause personal injury.

MARNING

Some equipment and materials used in the overhaul or maintenance of an engine such as machine tools, electrical equipment, compressed air, solvents, gasoline or other fuels may be dangerous and can cause injury. Always observe safety precautions associated with these items.

WISCONSIN ENGINE

(continued)

SECT. 1

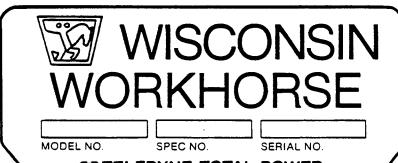
VENDOR

PAGE (

INFORMATION FOR ORDERING PARTS

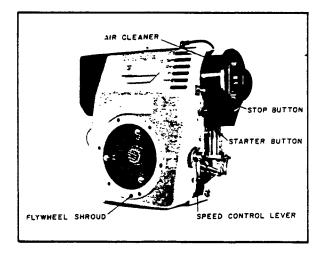
When ordering parts, refer to the engine name plate attached to the side of the cylinder block, which lists the model, serial number and a specifica-

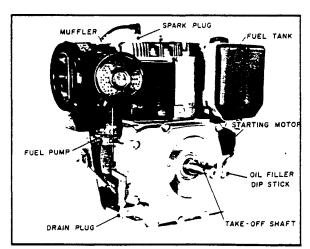
tion number. This data is of vital importance in obtaining the correct parts: always include this information on your parts order.



MEMPHIS TENNESSEE U.S.A. ASSEMBLED IN MEXICO

BASIC PARTS ILLUSTRATION







(continued) PAGE

Workhorse Industrial Engines

SPECIFICATIONS

MODEL	W1-588
No. of Cylinders	1
Bore	3.75" (95.2mm)
Stroke	3.25" (82.6mm)
Piston Displacement	35.88 cubic inches (588 cc)
Compression Ratio	6.5:1
Oil Capacity in Crankcase	1.75 qts.
Fuel Capacity	1.4 gal.
Valve Clearance	
Intake	.007
Exhaust	.021
Spark Plug	14mm
Gap	.030
Weight	
Net	141.0 lbs. (63kg)
Crated	151.0 lbs. (72kg)

POWER OUTPUT

RPM	НР	KW
2000	8.9	6.6
2200	10.2	7.6
2400	11.2	8.4
2600	12.3	9.2
2800	13.2	9.8
3000	14.0	10.4
3200	14.7	11.4
3400	15.4	11.5
3600	16.0	11.9

(continued)

SECT. 1 PAGE

GENERAL INFORMATION

WISCONSIN Work-Horse Engines are of the four stroke cycle type in which each of the four operations of intake, compression, power and exhaust constitutes a complete stroke. This produces one power stroke for each two revolutions of the crankshaft.

COMPRESSION RELEASE

A component part of the camshaft that operates automatically. It permits fast and effortless starting with no dangerous "Kickback."

COOLING

Cooling of the engine is accomplished by a flow of air circulated over the cylinder and head of the engine, by a combination fan-flywheel encased in a sheet metal shroud. The air is divided and directed by ducts and baffle plates to insure proper cooling for all engine parts.

- 1. NEVER operate an engine with any part of the shrouding removed. This will reduce proper cooling.
- 2. Keep the cylinder and head fins clean, free of dirt and chaff. This could also cause improper circulation of cooling air, and will cause the engine to overheat.

CARBURETOR

The proper combustible mixture of gasoline and air is furnished by a balanced carburetor. This gives the correct fuel-to-air ratios for all speeds and loads.

TIMING

This engine was a self-contained solid state ignition system. Timing is therefore not adjustable.

LUBRICATION SYSTEM

An oil dipper attached to the connecting rod provides a splash type system. The motion of the dipper, provides ample lubrication for all internal parts of the engine.

SERVICE CLASSIFICATION OF OIL

In addition to the S.A.E. Viscosity grades, oils are also classified according to the severity of engine service. Use oils classified by the American Petroleum Institute as Service SE and SF. This type of oil is for engines performing under unfavorable or severe operating conditions such as high speeds. constant starting and stopping, operating in extreme high or low temperatures, and excessive idling. In gasoline engines it is recommended that you not use oils classified as CC or CD. These are dieseldesignated oils.

GRADE OF OIL

SEASON OR TEMPERATURE	GRADE OF OIL
Spring, Summer or Fall + 120°F to + 40°F	SAE 30
Winter + 40°F to + 15°F	SAE 20-20W
+ 15°F to 0°F	SAE 10W SAE 5W-20
Below Zero Use oils classified as Ser	
Use oils classified as ser	VICE MJ, JD OF JE
Crankcase Capacity	1.75 Quarts

Fig. 1-1

Follow recommendations for summer oil use in the winter if the engine is housed in a warm building.

- 1. Check oil level every eight hours of operation.
- 2. The old oil should be drained and new oil added after every fifty hours of operation.

To drain oil, remove drain plug at either side of crankcase base. Oil should be drained while the engine is still hot, so it will flow more freely.

(continued)

PAGE

DRY ELEMENT AIR CLEANER

Dry element air cleaners are standard equipment on this engine model. DO NOT oil this element or DO NOT use gasoline, kerosene, or solvent for cleaning. Excessive smoke or loss of power are good indications that the air cleaner requires attention.

ROTATION

The rotation of the crankshaft is clockwise when viewing from the flywheel or starting end of the engine. This gives a counter clockwise rotation at the power take off end of the crankshaft.

The horsepower, which is specified in a chart on page four is for an atmospheric temperature of 60° and a barometer pressure of 29.92 inches of mercury (sea level).

For each inch lower the barometric pressure drops, there will be a loss in horsepower of 31/2%.

For each 10° temperature rise there will be a reduction in horsepower of 1%.

For each 1000 ft, altitude above sea level there will be a reduction in horsepower of 31/2%.

The friction in new engines cannot be reduced to the ultimate minimum during the regular block testing but the engines are guaranteed to develop at least 85% of maximum power when shipped from the factory. The power will increase as friction is reduced during the first few days of operation. The engine will develop at least 95% of maximum horsepower when the friction is reduced to a minimum.

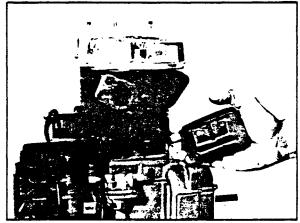
For continuous operation, do not operate at moré than 80% of horsepower shown at any speed.

SOLID STATE IGNITION — DESCRIPTION

The pointless ignition system, called Solid State Ignition, is a circuit breaker type ignition device. utilizing the power transistor as an element for controlling electric current. As a result, no timing adjustment or breaker point setting is necessary.

CRANKCASE BREATHER

A reed type breather valve is an integral part of the valve tappet inspection cover, as illustrated in Fig. 1-2. The valve maintains a partial vacuum in the crankcase, and thus eliminates internal crankcase pressure that would cause oil leaks at the seals, gaskets and breather box. Keep complete breather system free from dirt. Clean breather valve by washing in solvent, and reassemble mount with drain hole facing down.



SPARK PLUG

The spark plug should be removed periodically, cleaned and re-gapped. The width of the gap between the points of the two electrodes must be very carefully checked to prevent an adverse affect on engine operation. Check spark plug gap with a wire type gauge and regap as shown in Fig. 1-3. Use a new spark plug at the beginning of a new season. Replacement plug must be of the correct heat range, like Champion L90. The thread size is 14mm.



Fig. 1-3

Use a new gasket when mounting either old or new plug and thoroughly clean threads in cylinder head before installation. Tighten spark plug twentyeight to thirty foot-pounds torque. If torque wrench is not available, tighten plug until it begins to seat on the gasket, then turn 1/2 to 3/4 of a turn more.

PAGE 10

OPERATING INSTRUCTIONS

BEFORE STARTING

Inspect for damage and loose hardware. Make sure all fuel connections, wiring and mounting are correct and secure.

IMPORTANT

Engine is shipped without oil in crankcase. Fill crankcase base with the proper grade of engine oil as specified in "grade of oil chart." Fill thru the oil dipstick opening (Fig. 1-4) to level mark indicated on (Fig. 1-5). The oil level is indicated by a groove on the dipstick, check oil level by setting bottom of plug on the top of oil filler opening on gear cover. (Do not thread in place to check oil level). The crankcase capacity for new engine oil is 1.75 qts.

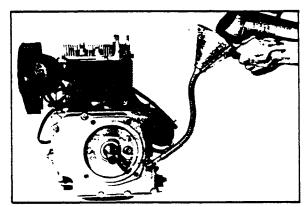


Fig. 1-4

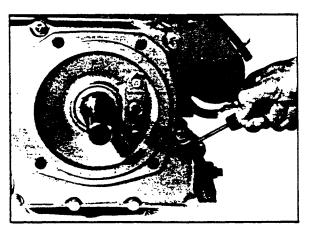


Fig. 1-5

For breaking-in of new or reconditioned engine, use same grade oil as recommended in "grade of oil chart."



Be sure there is plenty of ventilation. Do not start engine unless it is safe to do so. Maintain a safe distance from moving parts.

CAUTION: Know how to stop engine quickly in case of emergency. Refer to "To Stop Engine" paragraph. page 13

STARTING

- 1. Check crankcase oil level and gasoline supply. Open fuel shut off valve.
- 2. The carburetor main jet is preset at the factory. No carburetor main jet adjustment should be required for starting the engine.
- 3. Set throttle about 1/2 open if variable speed governor control is furnished. With a fixed speed governor, spring will hold throttle open for
- 4. Pull stop switch to Run position.
- 5. Close carburetor choke completely by turning choke lever in direction of pointer. Prime engine by turning engine over.
- 6. Open choke half-way (one notch in lever). Pull engine over against compression and let rope rewind slowly and completely into starter.
- 7. Brace left hand against engine, pull firmly and rapidly to start engine. Repeat if necessary. With starting motor, pull out stop switch (tag reads "To stop-push in," and depress starter button.
- 8. After engine starts, open choke fully. Less choking is necessary in warm weather or when engine is warm, than when cold. Should flooding occur, open choke fully and continue cranking.

If all condtions are right, engine will start promptly in one or two attempts. After engine starts, allow it to warm up a few minutes before applying load. DO NOT race or gun engine to hurry warm up.

New engines should be run in gradually to insure trouble-free service. Refer to Operation Manual for correct "break in" procedure.

VENDOR

ILLUSTRATED PARTS CATALOG

WARM UP

Allow the engine to warm up by running the engine at 1/2 speed or lower, for about five minutes without load. DO NOT run the engine at high speeds to decrease warm-up time, as the proper oil film on various surfaces of the piston cylinders, bearings, etc., cannot be established until the oil has warmed up and become sufficiently fluid.

Increase engine speed to the required R.P.M. by moving the control lever, Fig. 1-6, after the warm-up

This is especially important on new engines and in cool weather.

Racing an engine by disconnecting the governor. or by doing anything to interfere with the governed control engine speed, is extremely dangerous and also voids the engine's warranty. The governor is provided as a means for controlling the engine speed to suit the load applied, and also as a safety measure to guard against excessive speeds, which not only overstrain all working parts, but which might wreck the engine and possibly injure bystanders. All parts of the engine are designed to safely withstand any speeds which might normally be required, but it must be remembered that the stresses set up in rotating parts increase with the square of the speed. That means that if the speed is doubled, the stresses will be quadrupled, and if the speeds are tripled, the stresses will be nine times as great.

Strict adherence to the above instructions cannot be too strongly urged, and greatly increased engine life will result as a reward for these easily applied recommendations.

IMPORTANT

Whenever high speed operation is not required. slow engine down to idle. This practice will result in increased fuel economy and increased engine life.

BREAK-IN PROCEDURE

Proper break-in will lead to trouble-free operation and increased engine life. The factory test given to a new engine is not sufficient to establish the polished bearing surfaces which are so necessary for good performance and long engine life. There is no quick way to force the establishment of good bearing surfaces; these can only be obtained by running a new engine carefully and under reduced speeds and loads for a short period of time.

Run the engine the first fifteen minutes without load at low idle speed (1500 to 1800 R.P.M.).

Gradually increase the speed to engine operating R.P.M. (3600 max.) for two additional hours. During that time, increase the load in 25% increments up to 75% of maximum rated power.

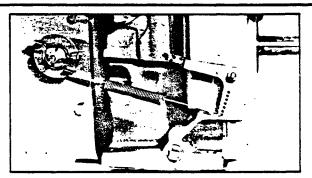


Fig. 1-6

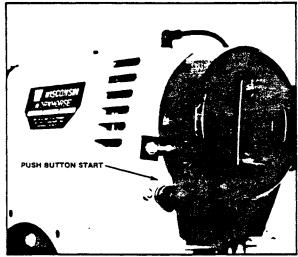


Fig. 1-7

Do not operate engine continuously at more than 75% of maximum power during the first twenty-five hour period.

TO STOP ENGINE

To stop engine, allow it to cool down for 3-5 minutes. Then rotate the control lever, Fig. 1-6, to STOP position and push stop button to shut off engine.



FUELING

Refuel slowly to avoid spillage. Do not smoke while filling fuel tank.

Fill tank to about 1-1/4 inch (32mm) from top of filler neck with gasoline only. Use only clean, high quality gasoline. Tank capacity is 1.4 gallons (5.3 Liters).

Use regular grade leaded or unleaded. We don't recommend fuels with more than a 10% alcohol content

WISCONSIN ENGINE

VENDOR SECT. 1

(continued) PAGE 12

MAINTENANCE

ENGINE MAINTENANCE SCHEDULE

NEW OR REBUILT ENGINE — FIRST 25 HOURS

- Change crankcase oil.
- Tighten hardware air cleaner mounting, muffler, fuel lines, etc.
- · Check valve tappet clearance.

MAINTENANCE	Daily or 8 hrs.	Weekly or 50 hrs.	100 hrs.	200 hrs.	See notes below
ADD FUEL to fuel tank	•				
CHECK OIL LEVEL. Add to full mark. Do not over fill.	•				
CHECK AIR CLEANER. Shake out accumulated dirt from dry element cleaner - Maintain oil level in oil tight type cleaner.	•				*
CLEAN AIR INTAKE SCREEN Clean cooling fins if necessary	•		6		*
CLEAN AIR FILTER ELEMENT		•			*
CHANGE CRANKCASE OIL			•		*
INSPECT STARTING MOTOR.Check for loose mounting and cable connections.				•	
CHECK VALVE TAPPET CLEARNCE. Adjust if necessary.				•	
REPLACE FUEL FILTER CARTERIDGES.				•	*
INSPECT COOLING SYSTEM. Remove shrouding and scrape off from, between fins, around cylinder head and from shrouding	g				PAGE 8

* Under severe environmental conditions these items may need to be maintained more frequently.

ENGINE STORAGE

If not properly protected, temperature and humidity changes can cause corrosion of piston rings, cylinder walls and bearing surfaces in a stored engine. For maximum protection, prepare the engine for storage as follows:

- Run the engine until it reaches operating temperature, then stop the engine and drain the oil from crankcase while engine is still warm.
- Air cleaner and exhaust openings should be taped or otherwise sealed off for the duration of the storage period.
- 3. Remove all dirt and chaff from the cooling fins.
- 4. Store in a clean, dry place.

5. Store the battery in a clean, dry place away from rubber materials. Check the battery charge once a month during storage. Recharge when required.

To protect the cylinder, piston, rings, and valves, and keep them from rusting and sticking, a half and half mixture of kerosene and good engine oil (same grade as used in the engine crankcase) should be injected into the carburetor air intake. Do this while the engine is warm and running at moderate speed. Use enough of the mixture (about 1/4 pint) so that a heavy, bluish smoke appears at the exhaust. This "fogging" operation will leave a coating of oil on the above mentioned parts, protecting them from the atmosphere. After stopping the engine, turn it over slowly, until the flywheel key or take-off shaft keyway is up, or in the 12 o'clock position and on the

PAGE 13

PARTS CATALOG

(continued)

1001100T00 10 1110T1151T

compression stroke. Both valves will then be closed and the piston will be on top in the cylinder bore. This will minimize rusting of the cylinder bore and help retain the oil fog previously injected into the engine.

While the engine is warm, drain oil from the crankcase. Also drain fuel lines, carburetor, fuel pump and tank, to prevent lead and gum sediment from interfering with future operation. Gasoline fumes from gradual evaporation are a dangerous fire hazard.

The air cleaner and filter element should be thoroughly cleaned. Tape or otherwise seal off the exhaust air cleaner openings for the duration of the storage period.

The outside of the engine, including the cooling fins on the cylinder and head, should be thoroughly cleaned of all dirt and other deposits. All exposed unpainted metal parts should be coated with grease or heavy oil.

Before adding new crankcase oil the next season, drain engine of condensation which may have accumulated in the crankcase during the storage period.

Fill crankcase with a good quality of oil to the high level point, before starting engine. DO NOT use any oil heavier than S.A.E. No. 30.

Use a new spark plug at the beginning of a new season, especially if the engine has given considerable service.

It is highly recommended that machines be stored inside a building through the winter. If this is not possible, the engine should be protected from snow and ice by a proper covering.

CARBURETOR ADJUSTMENT

The carburetor main jet adjustment needle valve should be opened approximately 1½ turns. After the engine is started and warmed up, adjust the needle valve for best operation under full load, if possible. In cold weather, starting may be facilitated by opening the needle valve slightly more, then readjust to normal running position after engine is started. The correct amount of throttle plate opening for the proper low idle speed is obtained by means of the throttle stop screw. The idle mixture adjustment must be made with the carburetor throttle lever closed. Initial setting is approximately one full turn open from seat. Idle speed should be 1200 R.P.M. or above.

CRANKCASE BREATHER

Oil in breather box may be the result of faulty breather action caused by dirt stuck between reed and seat. This condition can be remedied in the following manner.

- With engine running at operating speed, pinch neoprene breather line so that it is completely shut off.
- 2. Hold tubing closed, for a period of not more than twenty seconds, then release.
- If oil leaks continue, repeat procedure after a five minute interval. If this does not remedy the condition; stop engine, take off inspection cover breather assembly and wash in solvent.

WISCONSIN ENGINE

VENDOR

SECT. 1

(continued) PAGE 14

TROUBLESHOOTING CHART

										_				!			
TO USE CHART		art															
1. Find problem under problem listing. 2. Follow down column to a black dot. 3. Refer to left of dot for probable cause. 4. If first probable cause does not solve problem, go to next black dot. 5. Refer to section(s) of Repair Manual, under sec. column for additional information.	PROBLEM	Engine will not start, or hard to start	Engine starts but will not run	Erratic engine operation	Too much black smoke	Too much blue smoke	Fuel consumption too high	Engine uses too much oil	Engine has low compression	Engine runs hot	Stop switch does not stop engine	Engine noise (knocks)	Engine noise (clicking)	Starter does not turn	Stator output incorrect		
		_		-							-						
PROBABLE CAUSE	Sec.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
No Fuel		•															
Low Cranking Speed		•			L												
Improper or Contaminated Fuel		•	•	•	<u> </u>					<u> </u>		ļ					
Restricted Air Cleaner	ļ	•	<u> </u>	•	•		•		•								
Loose Fittings or Defective Fuel Lines		•	•	•	ļ											<u> </u>	
Air in Fuel System		•	•	•	<u> </u>												
Clogged Fuel Filters or Duty Lines		•	•	•									<u> </u>				
Incorrect Valve Tappet Adjustment	<u> </u>	•	<u> </u>	•	<u> </u>		<u> </u>		•				•				
Defective Valve Components	<u> </u>	•							•		<u> </u>	•	•				
Defective Speed Control or Governor		•	•	•							•						
Low Compression		•			•												
Incorrect Oil Grade or Level				<u> </u>		•		•		•		•				<u> </u>	
Worn Crankfhsaft Bearings												•					
Worn Valve Guides, Piston or Rings						•		•	•		1					-	
External Leaks (Fuel or Oil)							•	•									
Loose Cylinder Head										•							
Scored or Worn Cylinder Walls									•								
Cooling Air Restrictions										•							
Weak or Shorted Battery														•	•		
Loose or Corroded Electrical Connections														•	•		
Defective Starter Switch														•			
Defective Voltage Regulator or Starter															•		
Defective Starter or Solenoid														•			

(continued)

SECT. 1 PAGE 15

TROUBLESHOOTING

TROUBLE CAUSES AND REMEDIES

The main requirement for starting, and maintaining satisfactory operation of a gasoline engine are:

- 1) A proper fuel mixture in the cylinder.
- 2). Good compression in the cylinder.
- 3) Good spark, properly timed, to ignite the mixture.

If all three of these conditions do not exist, the engine cannot be started; too heavy a load for the engine to turn over at a proper speed, a long exhaust pipe with high back pressure, etc. may affect starting, but do not necessarily mean the engine is improperly adjusted.

As a guide to locating starting difficulties, the following causes are listed under the three headings: Fuel Mixture, Compression, and Ignition. In each case the causes of trouble are given in the order in which they are most apt to occur.

NOTE: For a quick reference guide, see "Troubleshooting Chart", page 14

STARTING DIFFICULTIES

FUEL MIXTURE

No fuel in tank or fuel shut-off valve closed.

Fuel pump diaphragm worn out or damaged.

Carburetor not choked sufficiently, especially if engine is cold. See "Starting", page 10

Water, dirt, or gum in gasoline interfering with free flow or fuel to carburetor.

Poor grade or stale gasoline that will not vaporize sufficiently to form the proper fuel mixture.

Carburetor flooded, caused by too much choking, especially if engine is hot. See "Starting", page 10

Dirt or gum holding float needle valve in carburetor open. This condition should be indicated if fuel continues to drip from carburetor with engine standing idle. Often tapping the float chamber of the carburetor very lightly with the handle of a screwdriver or similar tool will remedy this trouble. Do not strike carburetor with any metal tool.

If due to flooding, too much fuel entered the cylinder in attempting to start the engine, the mixture will most likely be too rich to burn. In that case the spark plug should be removed and the engine turned over several times with the starting sheave, so the rich mixture will be blown out through the spark plug hole. The choke must be left open during this procedure. Spark plug should be fired off, assembled, and starting tried again.

COMPRESSION

The W1-588, workhorse engine is provided with an automatic compression release, so that the normal method of detecting faulty compression, by the resistance encountered when turning the engine over on the compression stroke, no longer holds true.

Check the following for suspected loss of compression, if the fuel and ignition systems are not the cause of starting difficulties and loss of power.

- 1. Cylinder dry due to engine having been out of use. Pour one fluid ounce of crankcase oil through spark plug hole.
- Loose or broken spark plug. In this case a hissing noise will be heard in cranking engine due to escaping gas mixture on compression stroke.
- Damaged cylinder head gasket or loose cylinder. head. This will likewise cause a hissing noise on compression stroke.
- 4. Valve tappets with insufficient clearance under valve stem. See "Camshaft and Valve Tappet. Timing Mark", page 28

If correcting the above conditions does not remedy the situation, it will be necessary to partially dismantle the engine and check for:

- 1. Valve stuck open due to carbon or gum on valve stem. To clean valve stems, see "Valve and Seat Inserts", page 24
- 2. Piston rings stuck in piston due to carbon accumulation. This will require removing piston and connecting rod assembly, and cleaning parts. See "Connecting Rod and Piston", page 27
- 3. Scored cylinder. This will require reboring the cylinder and fitting with a new piston and rings. If scored too severely, an entirely new cylinder block may be necessary.

(continu

SECT. 1 (continued) PAGE 16

IGNITION

If difficulty is experienced in starting the engine or if the engine miss-fires, the strength of the ignition spark should be checked. Remove spark plug from cylinder head and connect ignition wire to it. Turn the engine over several times using the rope starter sheave. Ground spark plug to the engine. Observe the spark at the plug gap. If a good strong spark occurs, the ignition system can be eliminated as the source of trouble. If there is a weak spark, or no spark at all, check the following:

See "Timing" paragraph, page 28

Also check ignition wires, spark plug, and coil. No spark may also be attributed to the following:

Ignition wires disconnected from magnets, coil, or spark plug.

Faulty starter switch.

Spark plug cable wet or oil soaked.

Spark plug insulator broken. Plug wet or dirty.

Spark plug gap wrong. See page 9

ENGINE MISSES

Spark plug gap incorrect.

Worn and leaking ignition cable.

Weak spark. See "Solid State Ignition — Description", page 9

Loose connections at ignition wires.

Water in gasoline.

Poor compression. See "Compression", page 15

ENGINE SURGES

Carburetor flooding.

Governor spring hooked into wrong hole in lever or governor rod incorrectly adjusted.

ENGINE STOPS

Fuel tank empty. Water, dirt or gum in gasoline.

Gasoline vaporized in fuel lines due to excessive heat around engine (Vapor lock). See "To Stop Engine", page 11

Vapor lock in fuel lines or carburetor due to using winter gas (too volatile) in hot weather or gasoline with too much alcohol.

Remote tank more than 34" below fuel pump.

Air vent hole in fuel tank cap plugged.

Engine scored or stuck due to lack of oil.

Ignition troubles. See "Solid State Ignition — Description", page 9

ENGINE OVERHEATS

Crankcase oil supply low. Replenish immediately.

Low grade of gasoline. Carbon in engine.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins on cylinder head.

Engine operated in confined space where cooling air is continually recirculated.

Dirty or incorrect grade of crankcase oil.

Restricted exhaust.

Engine operated while detonating due to low octane gasoline or heavy load at low speed.

ENGINE KNOCKS

Water or dirt in gasoline, or poor grade of gasoline.

Poor grade of gasoline or of low octane rating.

Engine operating under heavy load at low speed.

Carbon or lead deposits in cylinder head.

Loose or burnt out connecting rod bearing.

Engine overheated. See previous heading.

Worn or loose piston pin or connecting rod bolts loose.

ENGINE BACKFIRES THROUGH CARBURETOR

Sticky inlet valves. See "Valves and Seat Insert", page 24

Overheated valves, or hot carbon particles in engine.

Engine cold.

(continued) PAGE 17

FUEL SYSTEM AND GOVERNOR

FUEL SYSTEM

The fuel tank should be filled with a high quality, well-known brand of regular or unleaded gasoline. The capacity of the standard tank is 1.4 gallons. Some of the poorer grades of gasoline contain gum which will deposit on valve stems, piston rings, and in the various small passages in the carburetor. This can cause serious trouble in operating and might prevent the engine from operating at all.

The gasoline used should have an octane rating of at least 90. Fuel with a low octane rating will cause detonation, and if operation is continued under this condition, severe damage will result to the engine. The cylinder and piston will be scored, head gasket blown out, bearings will be damaged, etc.

Be sure that the air vent in the fuel tank cap is not plugged with dirt, as this would prevent fuel from flowing to the carburetor.

FUEL TANK

Close fuel valve at bottom of tank and disconnect fuel lines. Remove two bolts at the bottom of the tank, which holds the bracket to the cylinder head studs. The fuel tank and bracket can now be removed as a complete unit.

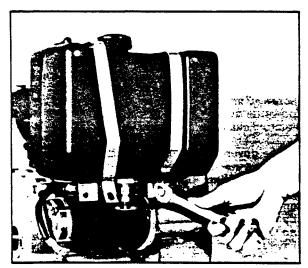


Fig. 1-8

GOVERNOR

The governor, which is a centrifugal flyweight type, maintains the engine speed by varying the throttle opening to suit the load imposed upon the engine. The engines are equipped with either a fixed speed or variable speed control, to regulate the governed speed of the engine.

GOVERNOR OPERATION

Two flyweights are hinged to lugs on the governor gear. Hardened fingers on the flyweights bear against a thrust sleeve, moving it against the yoke. The flyweights move out. The motion of the thrust sleeve is transmitted through a yoke connected to the carburetor throttle. A spring connected to the governor lever tends to hold the governor flyweights to their inner position, also to hold the carburetor throttle open. As the engine speed increases, centrifugal force from the flyweights acts against the spring and closes the throttle to a point where the engine speed will be maintained constant relative to the governor spring tension.

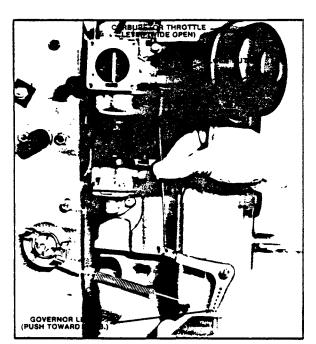


Fig. 1-9

GOVERNOR ADJUSTMENT

The control rod between the governor and carburetor must be adjusted to the proper length, otherwise, the governor action will be faulty. With the engine at rest, the governor spring will hold the flyweight in, and the control rod must be of such length as to hold the carburetor throttle wide open at that point.

(continued) PAGE 18

With the control rod disconnected from the governor lever, push the rod toward the carburetor as far as it will go. This position will put the carburetor throttle lever in a wide open position. The governor lever should then be moved as far as possible in the same direction. Holding both parts in the above position, the rod should be screwed in or out of the swivel block on the carburetor, until the bent end of the rod will register with hole in lever, then screw the rod in one more turn. The extra turn will shorten the linkage slightly and will enable the carburetor throttle lever to bounce back from the stop pin rather than jam against the pin, when a load is suddenly applied to an idling engine. This will eliminate excessive wear on the threads in the carburetor throttle swivel block.

Snap control clip in place and tighten lock nut against swivel block on carburetor throttle lever.

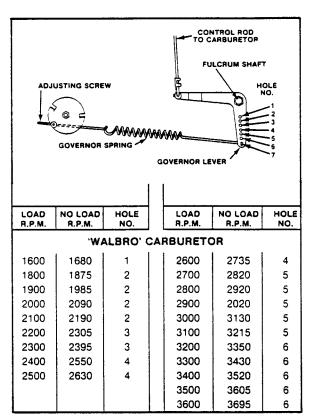
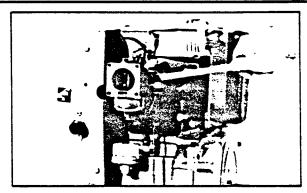


Fig. 1-10

CARBURETOR AND AIR CLEANER

The carburetor and air cleaner should be removed both to facilitate work on the engine and to prevent damage to these parts. Unscrew wing nuts and remove cleaner. Disconnect breather line at inspection cover, throttle rod clip at governor lever and fuel line. Take out the two nuts holding carburetor flange to cylinder, and remove carburetor-air cleaner bracket as a complete unit.



IN REASSEMBLY: when attaching air cleaner bracket to flange on carburetor air horn, use a new gasket and tighten the three mounting screws to 34 in.-lbs. torque (minimum).

PULSE PUMP

All W1-588 engines are equipped with a pulse pump. When starting for the first time, or when the engine has been out of operation a few days, prime the engine to prevent hard starting. When priming the pump, push the start button in five or six times. just enough to turn the engine over without starting. This allows the carburetor float bowl to fill up with gasoline, which enables easier starting.

ADJUST ENGINE SPEED

Engine speed is adjusted by hooking governor spring in correct hole of governor lever, and then regulating spring tension by means of an adjusting screw. The governor lever has 7 holes for the governor spring, with the No. 1 hole closest to the fulcrum shaft.

The governor lever chart in Fig. 1-10, shows the load and no load speeds and the corresponding governor spring hole. After hooking spring into the lever hole relative to the desired load speed, run the engine without load and regulate the spring tension by means of the adjusting screw until the required no load speed is obtained. The governor spring will have to be disconnected from governor lever each time screw is turned in or out.

A tachometer or revolution counter should be used against the crankshaft to check speed while adjusting the governor spring tension. The engine speed without load will vary from 75 to 180 revolutions per minute higher than the speed with load. For instance; if the engine is to operate at 3400 R.P.M. under full load, the speed with no load will be 3520 R.P.M. Refer to the governor lever chart, Fig. 1-10 for the variation between load speed and no load (high idle) speed.

VENDOR

(continued)

STARTING AND CHARGING

ELECTRICAL SYSTEM

A 12 volt, 15 amp flywheel alternator consisting of a flywheel with magnet rotor, stator and regulatorrectifier module is standard equipment on Model W1-588. Battery ignition engines are wired in accordance with Fig. 1-11A. The type of connectors used prevent incorrect wiring from the stator to the rectifier and regulator modules. To disconnect plugs, squeeze outer ends of receptical and pull apart.

The regulator-rectifier module should not be removed and mounted at some remote location. This is a negative ground circuit. Connect ground strap from negative post of battery to starting motor flange, or good clean grounding surface on engine. A battery is **not** furnished by Teledyne Total Power.

The air gap between the ignition unit and the flywheel ignition magnet should be maintained at 0.010" to 0.015". This should be checked with a non-metallic feeler gauge.

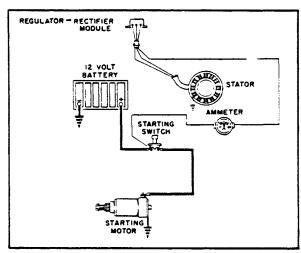


Fig. 1-11A

FLYWHEEL ALTNERATOR

Prior to electrical testing, a thorough visual inspection should be made to eliminate conditions that might seem to be a defective alternator. First. examine lead wires for broken or loose connections. and make sure the module is securely mounted. The regulator-rectifier module must be securely mounted to a metal surface for grounding purposes. as well as for heat dissipation. Mounting surfaces must be clean and free of contaminants - oil, grease, etc. When assured that the problem is with the alternator, run the following tests.

BATTERY OVERCHARGE

With the engine running at full RPM, check battery voltage with DC voltameter:

If voltage is over 15.0, regulator is not functioning properly. Replace module.

If voltage is under 15.0, alternator is functioning properly. Check battery condition.

A fully charged battery should be 13-15 volts. If the battery is over 15 volts, check the voltage regulator.

BATTERY LOW/NO CHARGE

With engine running at full RPM, check battery voltage with DC voltameter:

If voltage is greater than 14 volts, place load on battery to reduce voltage below 14 volts - if the charge increases: Alternator functioning properly. Battery was fully charged.

If the charge rate does not increase — Perform the same procedure as in "Battery Overcharge" Section, except disconnect the regulator module.

If the charge rate increases - Regulator was at fault. Replace regulator module.

If the charge rate does not increase — Regulator was not at fault. Continue with the next test.

Perform the same procedure as in the "Battery Overcharge" Section, except with new rectifier module plugged in.

If the charge rate does increase - Rectifier module at fault. Permanently install new rectifier module.

If the charge rate does not increase - continue with the next test.

With engine stopped, unplug all connectors between modules and stator. Start engine and run at 2400 RPM. With AC Voltameter, check voltage between each of the black stator leads and grounds:

If one of the two voltages is zero or they are over 10% apart - the stator is faulty and should be replaced.

ILLUSTRATED
PARTS CATALOG

WISCONSIN ENGINE

SECT. 1 (continued) PAGE 20

VENDOR

REWIND (Recoil) STARTER

For Wisconsin Engine Model-W1-588

Operating Instructions — Repair — Parts List

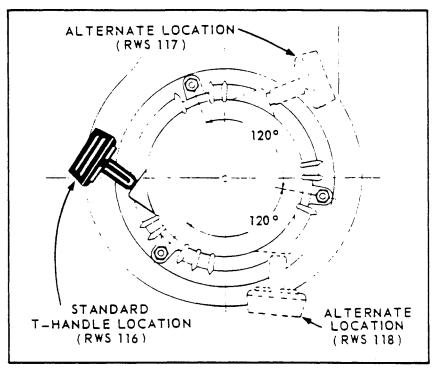


Fig. 1-12

PRINCIPLES OF OPERATION

A recoil spring, connecting the pulley to the housing, provides tension for actuating the starter, and it rewinds the rope on to the pulley whether the engine starts or not.

Three dogs (pawls) are mounted in a cluster to the starting pulley, around a dog carn attached to a shaft in the housing. As the rope handle is pulled to start the engine, the dogs are forced outward as they act against the contour of the stationary mounted carn. In this outward action the dogs engage with teeth in a flywheel mounted drive hub to turn the engine over.

When the engine starts and the 'T' handle returns, the dogs back out of the drive hub teeth, as the pulley rewinds in the opposite direction, and they revert back to an inactive position by means of the cam and individual dog return springs.

'T' HANDLE LOCATION, Fig. 1-12

The starting handle can be located in any of three locations with the standard location being toward the left side of the engine, pulling from an approximate 10 o'clock position.

Either of the two optional locations can be obtained by simply removing the three mounting nuts and rotating the housing 120° in either direction. Caution: Before tightening the mounting nuts the starter will have to be centered with the drive hub per Fig. 1-17 paragraph H on page 22

OPERATING INSTRUCTIONS

- To start engine; open fuel valve and close carburetor choke. Pull engine over against compression. Let rope rewind into starter slowly. Pull firmly and rapidly to start engine. (Repeat procedure if necessary). After engine starts, open choke fully.
- Always maintain your hold on the starter handle and allow it to return slowly.
- Pull the starter handle so that the rope remains in a straight line through the handle and guide.
- 4. **Do not** jerk the cord out to its very end in an unnecessary rough manner. Use a smooth but forceful pull.
- Do not let go of starter handle allowing it to snap back against the starter.
- Do not attempt to pre-load starter spring unnecessarily.
 Units are properly adjusted at the factory so that the outward pull of the starter is stopped by the end of the cable, not the spring.

MAINTENANCE AND REPAIR

Oil and dirt, if allowed to accumulate in and around the starter, will cause wear and eventual failure of not only the starter parts, but engine parts as well.

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Do not allow internal rotating screen and housing fins to become "clogged up" with dirt. Brush clean to allow proper air flow to reach the engine.

Inspect rope for wear - replace before it breaks at a critical time.

If engine does not turn over as rope is pulled out, starter dogs are not engaging with drive hub teeth.

if rope does not rewind; rope or pulley may be binding insufficient spring tension — spring disengaged or broken.

To overhaul the rewind starter, follow the disassembly and assembly procedures in the following 'Repair Instructions'. Rope replacement can be accomplished without completely disassembling the starter. See paragraph D.

REPAIR INSTRUCTIONS

In order to do any repair work on the rewind starter, it is advisable to secure the starter housing either in a vise, or to a workbench by means of a 'C' clamp.

DISASSEMBLY

A. REMOVE HANDLE and ROPE, Fig. 1-15

Pull rope out about two feet and tie knot to prevent rope from rewinding into pulley. Extract metal handle reinforcement from handle and until or cut off end knot. Remove handle and reinforcement from rope, and until knot that kept the rope from rewinding into the pulley. PULL rope all the way out (about 6 feet) and at the same time hold the starter housing, with thumb pressing against pulley assembly to prevent rewinding. Pull the rope knot (visable thru square opening in pulley) and the rope will slide out through rope bushing in housing and hole in the pulley.

Carefully release thumb pressure and the pulley will completely unwind. At this point the main recoil spring is in a relaxed position.

B. REMOVE PULLEY and SPRING, Fig. 1-13

Remove cam center screw, dog cam, brake spring and washer.

Prevent recoil spring from escaping from housing by carefully lifting pulley about 1/2 inch and then detaching inside spring hook from oulley, with a screw driver. Note: If spring should escape, it can easily be replaced into cover by coiling in the turns. See Fig. 1-16 for proper direction of spring coiling. If it is necessary to remove spring, start with the inside loop and carefully pull out one loop at a time while holding back rest of turns. When replacing spring, note the position of spring hooks in Fig. 1-16. Engine rotation is clockwise. viewed from starter end.

C. REMOVAL of DOGS, Fig. 1-13

Remove dog retainer clips using a screw driver or other pointed tool. The dogs and springs can then be lifted off the axis pins.

Dogs and springs can be removed and replaced without removing rope, recoil spring or cam retainer screw.

D. ROPE REPLACEMENT, Fig. 1-14

If it is only necessary to replace the rope, the starter need not be completely disassembled.

Assuming the rope has broken, remove what ever remains of the rope from the starter. Tie knot at end of new rope. Turn the pulley in starter counter clockwise until it stops (about 6-7 turns). Allow the pulley to rotate slightly in the opposite direction (clockwise) until the hole in the pulley is in line with the rope bushing in the housing. Lock sheave in this position by placing a screw driver between two of the housing support ribs and wedging the end of the screw driver under the dog cam and against the dog, see Fig. 1-14. Thread rope through hole in pulley and through rope bushing in housing. Pull rope completely through until the knot in end of rope (previously tied) can be tucked

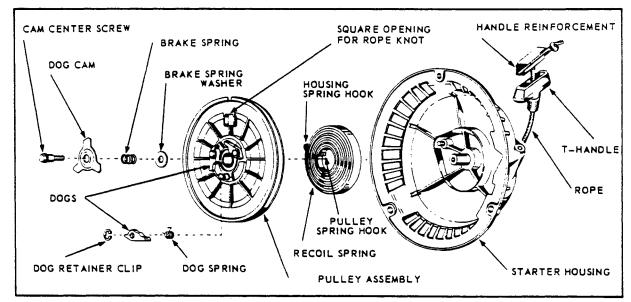


Fig. 1-13

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PARTS CATALOG

WISCONSIN ENGINE

(continued)

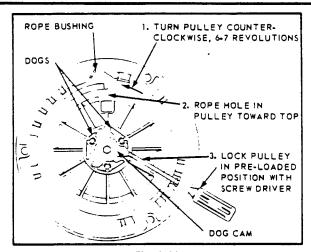


Fig. 1-14

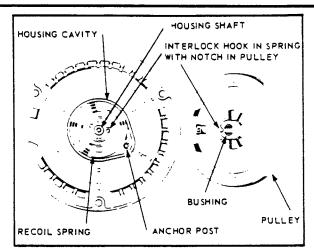


Fig. 1-16

into the square pocket in the pulley, see Fig. 1-13. Allow the rope to recoil into the pulley about 2 feet, then tie a retaining knot in the rope to prevent it from being completely rewound into the pulley. Install the 'T' handle on the rope, then the handle insert. Tie a knot at end of rope and tuck it into the handle insert, then assemble insert into the rubber 'T' handle. Remove the retaining knot and allow the rope to recoil completely

E. RECOIL SPRING REPLACEMENT, Fig. 1-16

Spring holders furnished with replacement springs simplify the assembly procedure. Place recoil spring in proper position as shown in Fig. 1-16 with the outside loop hooked around the anchor post. Then press spring into housing cavity thus releasing the spring holder. A few drops of SAE 20 or 30 oil should be applied to spring and light grease on housing shaft.

REASSEMBLY

F. ASSEMBLY of PULLEY, Fig. 1-16

After recoil spring has been installed in housing, mount pulley. Push housing and pulley together with a twisting motion so that the hook on end of spring engages the notch in pulley. When this occurs, the pulley will seat properly in the housing.

G. ASSEMBLY of DOG GROUP, Fig. 1-13

Assemble brake washer, brake spring, dog cam, cam and center screw. Torque center screw 115-130 inch pounds. Install three dog springs over the axis pins on the pulley and seat in the pockets. Mount the three dogs on the same pins on pulley. Make sure that the dog springs are actuated as the dogs are positioned to insure that the dogs are held in against the cam plate. Install three dog retainers. Note: Whenever the dog retainers are removed they should be replaced with new parts.

H. REWIND STARTER ALIGNMENT, Fig. 1-17

Mount rewind starter to support ring studs with 'T' handle in required starting position. Place the three plain washers, lockwashers and nuts on studs and hand tighten only — for alignment purposes.

Proper alignment of the starter is obtained by pulling out the 'T' handle until a substantial resistance, indicating starter engagement, is obtained. This automatically centers the starter to the drive hub. Hold starter in this position and securely tighten the three mounting nuts. The starter will become damaged if it is not centered properly. The engine is now ready to start.

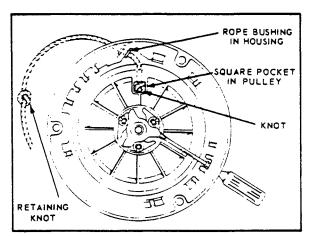


Fig. 1-15

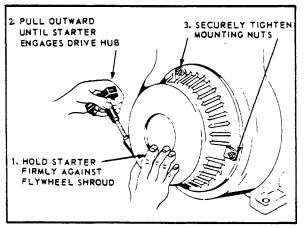


Fig. 1-17

VENDOR

ENGINE REPAIR AND OVERHAUL

DISASSEMBLY AND REASSEMBLY OF ENGINE

Engine repairs should be made by an experienced mechanic. When disassembling the engine it is advisable to have several boxes available so that parts belonging to certain groups can be kept together. Capscrews of various lengths are used in the engine, therefore, great care must be exercised in reassembly so that the correct screws are used in the proper places.

Tighten the capscrews of the cylinder head, gear cover, connecting rod, stator plate and the spark plug to the specified torque readings indicated in the paragraphs of reassembly, relative to these parts.

While the engine is partially or fully dismantled all parts should be thoroughly cleaned. USE ALL NEW GASKETS in reassembly and lubricate all bearings surfaces.

The following procedure is for complete disassembly of an engine. Instructions on reassembling are also given, as often it will not be necessary to disassemble the entire engine. As disassembly progresses, the order may be altered somewhat, as will be self-evident to the Mechanic.

TESTING OF A REBUILT ENGINE

An engine that has been completely overhauled such as having the cylinder rebored and fitted with new pistons, rings and valves, should go through a thorough "run-in" period before any load is applied to it.

The engine should be started and allowed to run for about one-half hour, at about 1600 to 1800 R.P.M. without load. The R.P.M. should then be increased to engine operating speed, still without load, for an additional three and one-half to four hours.

The proper "running-in" of the engine will help to establish polished bearing surfaces and proper clearances between the various operating parts.

DRAIN OIL FROM CRANKCASE BEFORE DISASSEMBLING

Remove muffler and disconnect ignition wire from spark plug. If engine is to be completely overhauled, remove all accessories.

RECOIL STARTER SHEAVE AND FLYWHEEL SHROUD

Remove starter sheave and screen by taking out the three screws and washer that mount to the flywheel.

Take off top cover and cylinder side shroud. Unhook governor spring and remove the four screws holding flywheel shroud to back plate if it is necessary to remove the shroud backing plate the flywheel must first be removed.

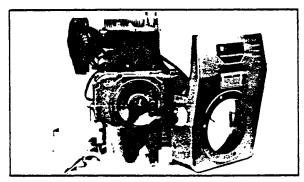


Fig. 1-18

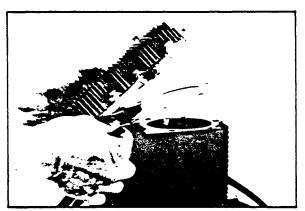


Fig. 1-19

CYLINDER HEAD AND SPARK PLUG

Remove spark plug and take off the three cylinder head nuts and five capscrews. After removal of cylinder head and gasket, clean out all carbon deposits from combustion chamber and dirt from between cooling fins.

In reassembly, use new cylinder head and spark plug gaskets. NOTE: Internal contour of cylinder head gaskets at inlet and exhaust valves are not the same. Mount gasket to cylinder block with the larger internal radius located at the inlet valve.

Apply a mixture of graphite and oil to the threads of the cylinder head studs and capscrews. Torque to 32 ft.-lbs. in three alternate stages: 16 ft.-lbs., 24 ft.-lbs., and finally, 32 ft.-lbs.

Leave spark plug out temporarily, for ease in turning engine over remainder of assembly and for timing adjustments. When mounting spark plug, tighten 28 to 39 ft.-lbs. torque.

VALVE AND SEAT INSERTS

Take off the combination valve inspection cover and breather assembly. By means of a standard automotive valve spring compression, remove retainer locks and take out valves from top of cylinder block. (Fig. 1-20)

Clean out carbon and gum deposits from the valves' seats, ports and guides. Replace valves that are badly burned, pitted or warped.

The exhaust valve face and exhaust seat insert are of steel material. A positive type valve rotator is furnished as standard equipment on the exhaust valve only. Clean and inspect operation of rotator.

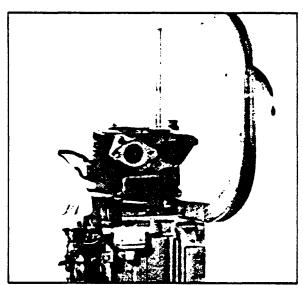


Fig. 1-20

The inlet and exhaust seat inserts can be removed, when replacement becomes necessary, by means of insert puller, 40010501. To install new seat use insert driver, 40010500.

Grinding of valves and seats should be done by an authorized Wisconsin service station. Before grinding valves, inspect valve guides for possible replacement. Refer to Fig. 1-21 for proper method of driving out guides and see chart (Fig. 1-23) for valve, seat and guide specifications.

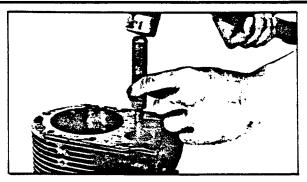


Fig. 1-21

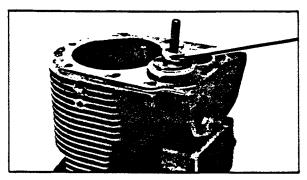


Fig. 1-22

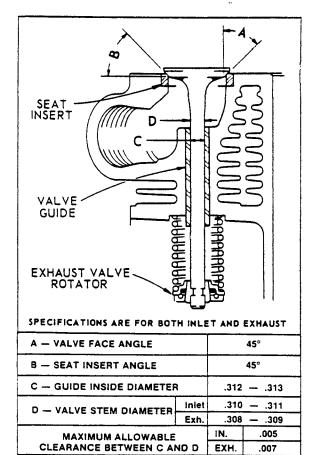


Fig. 1-23

(continued)

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After grinding, lap valves in place until a uniform ring will show entirely around the face of the valves. Clean valves and wash block thoroughly with a hot solution of soap and water. Wipe cylinder walls with clean, lint-free rags and light engine oil, especially if honing operation was also performed.

VALVE GUIDE

When valve stem clearance becomes excessive. the valve guides should be driven out, as illustrated in (Fig. 1-21) and new guides pressed in place. Use valve guide driver 40010502. In reassembly, press guides into valve ports using the same driver tool. Refer to (Fig. 1-23) for clearance specification and proper assembly.

FLYWHEEL

Caution: If flywheel is to be removed it must be loosened at this time. DO NOT attempt to loosen flywheel after gear cover is removed. Striking the crankshaft, without support from gear cover, would inflict damages to the crankshaft, rod and piston.

Straighten tab of star lockwasher that is bent over on flat of flywheel nut. Place a 1-11/16" box or socket wrench on to flywheel nut and give the wrench a sharp blow with a soft hammer. Do not remove nut, simply unscrew it flush with end of shaft.

The flywheel is mounted to a taper on the crankshaft. Take a firm hold on the flywheel fins, pull outward and at the same time strike the end of the crankshaft with a babbit hammer. The flywheel will slide off the taper of the crankshaft. Do not use a hard hammer as it may ruin the crankshaft and bearings.

Loosen flywheel but do not remove. It is necessary that the flywheel be left on to support crankshaft during removal of gear cover and connecting rod, and prevent damaging oil seal in stator plate. Take flywheel off after piston and connecting rod are removed.

In reassembly, mount flywheel immediately after crankshaft is mounted; be sure woodruff key is in position on crankshaft and is properly lined up with keyway in flywheel hub. Do not drive flywheel on to taper of crankshaft. Place a short piece of pipe against hub of flywheel and tap end of pipe with a soft hammer to seat flywheel on to taper. Mount start washer with tab inserted in flywheel keyway. Assemble nut and tighten only enough to hold in place. After end play is set, tighten flywheel nut.

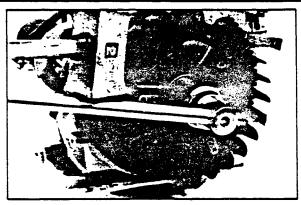


Fig. 1-24

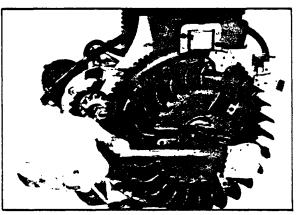


Fig. 1-25

GEAR COVER - DISASSEMBLY AND REASSEMBLY PROCEDURE

- 1. Drain Oil.
- 2. Remove governor lever from gear cover.
- 3. Place 1" x 2" board under gear cover end of the crankcase tilting engine toward flywheel end.
- 4. If crankshaft does not have a keyslot, locate piston top center and mark vertical location on crankshaft. Rotate crankshaft to 4:00 o'clock position for keyslot or mark.
- 5. Drive locating pins from gear cover.
- 6. Remove gear cover attaching bolts.

PARTS CATALOG

VENDOR

(continued) PAGE 26

- 7. Pry gear cover from crankcase about 1/2 inch.
- 8. Observe interior of crankcase. Camshaft must come away from its bearing in the gear cover before dis-assembly can continue. If necessary, use a screwdriver blade to move camshaft from gear cover, being careful not to damage the thrust surface of camshaft bearing.
- 9. When the camshaft is clear, work gear cover back and forth with twisting motion while pulling gear cover away from crankcase.

When re-assembling, install a new gasket and proceed as follows:

- 1. Looking at the engine from the P.T.O. side, set the crankshaft keyway at the 12 o'clock position.
- 2. Remove the 3/8 hex plug from the inspection opening on the gear cover.
- 3. Insert seal sleeve into seal through gear cover, if available.
- 4. Hold the gear cover in its normal position (governor arm to left side).
- 5. Balance gears should swing down and come to rest with timing marks visible through sight hole aligned with each other.
- 6. Check position of governor arm. (Fork should be down.)
- 7. Slide gear cover into position, exercising care not to swing balance gears or damage oil seal. Be sure that the camshaft is mated into the gear cover and the balance gears have splined with the crankshaft gears.
- 8. Start one gear cover capscrew on each side and turn crankshaft either direction approximately 10 degrees.
- 9. Turn the crankshaft keyway back to TDC or 12 o'clock position and make sure the timing marks are lined up thru the sight hole.

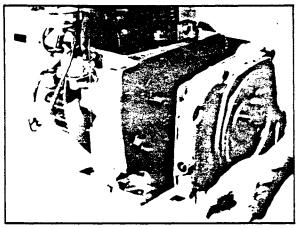


Fig. 1-26

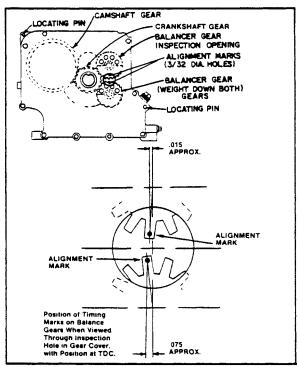


Fig. 1-27

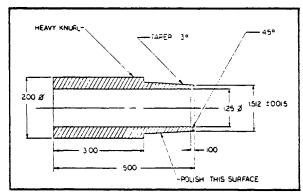


Fig. 1-28

(continued) PAGE 27

Be sure that the camshaft is mated into the gear cover and the balance gears have splined with the crankshaft gears. Start one gear cover capscrew on each side and turn crankshaft either direction approximately ten degrees. Now rotate the crankshaft key to the twelve o'clock position, making sure the timing marks are lined up thru the sight hole. NOTE: Governor yoke must straddle governor shaft extension and bear against thrust sleeve.

Tighten gear cover capscrews to 21 ft.-lbs. torque.

GOVERNOR FLYWEIGHT ASSEMBLY

The governor gear and flyweight assembly rotates on a stationary pin pressed into the crankcase and is held in place with a snap ring.

To disassemble: spread flyweight apart and remove governor thrust sleeve, by means of snap ring pliers. Snap ring can be removed and gear-flyweights slipped off the end of the shaft.

Reassembly is done in reverse order. Maintain a clearance of .003 to .005" between gear hub and face of governor shaft boss in crankcase (Fig. 1-29). This end play can be adjusted by tapping the governor shaft in other direction. Clearance between shaft and gear is .005 to .002". When clearance exceeds .005", replace worn parts.

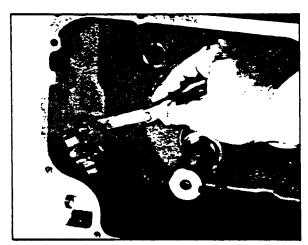


Fig. 1-29

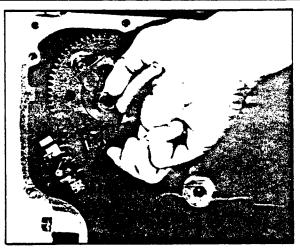


Fig. 1-30

CONNECTING ROD AND PISTON

By means of 1/2" socket wrench, loosen and remove hex nuts from connecting rod bolts. Oil slinger will come off when nuts are removed. Then, by tapping the ends of the bolts lightly, the connecting rod cap will break free from the bolts.

Scrape off all carbon deposits that might interfere with tour. Clearance between the piston and cylinder must be measured at the bottom on the piston skirt thrust face. Refer to chart, (Fig. 1-31) for proper clearance. The thrust faces on the piston skirt are 90° from the axis of the piston pin hole.

PISTON TO CYLINDER AT PISTON SKIRT THRUST FACES	.0025 .0035	
PISTON RING GAP		.010 to .020°
PISTON RING	TOP RING	.002 to .004°
SIDE CLEARANCE		.002 to .004*
IN ONOGYES		.0015 to .0035"
Connecting Rod to Crank Pin - Side Clearanc	•	.004 to .013*
Connecting Rod Shell Bearing to Crank Pin		.0005 to .0015°
PISTON PIN TO CONNECTING ROD BUSHIN	.0005 to .0011°	
PISTON PIN TO PISTO	*8000, ot 0000. tight	
1.255 1.250 STANDARD CRANK F	1.4994 1.4984 WID DIMENSI	TH.

Fig. 1-31

PISTON RING

If a ring expander tool, as shown in Fig. 1-32, is not available, install rings by placing the open end of the ring on piston first. Install bottom ring first and work up to the head of piston, installing top ring last. Spread ring only far enough to slip over piston into correct groove, being careful not to distort ring. A pit mark, or the word 'top' is stamped on the rings, to indicate the correct placement of the rings on the pistons. Scraper ring must be mounted with scraper edge down, otherwise, oil pumping and excessive oil consumption will result.

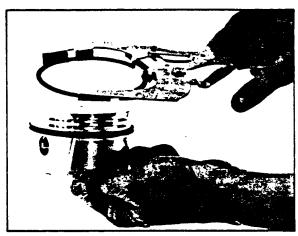
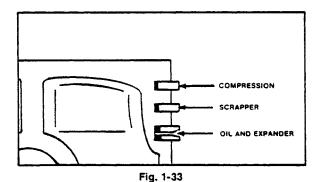


Fig. 1-32



CYLINDER BLOCK

Clean all dirt and foreign deposits from between the cylinder block fins.

The block does not have to be removed unless the cylinder bore is worn more than .005 inch oversize. The block should then be bored and fitted with oversize piston and rings. This work should be done by an authorized Teledyne Total Power dealer. In reassembly: tighten the four cylinder block mounting nut to 40 to 45 ft.-lbs. torque. The capscrew in valve spring compartment should be tightened to 32 ft.lbs. torque.

CAMSHAFT AND VALVE TAPPET, TIMING MARKS

To prevent tappets from falling out and becoming damaged when the camshaft is removed, turn the crankcase over on its side. Push tappets inward to clear camlobes and remove camshaft.

Remove tappets: check face for scuffing and inspect body for wear. The body diameter should be .6245/.6235" and have a clearance of .0005 to .0025" in quide hole.

In reassembly: Tappets must be inserted in crankcase before camshaft is assembled. Mount camshaft so that timing mark on campear matches up with marked gear tooth on crankshaft gear. See (Fig. 1-35). If valve timing is off, engine will not function properly or may not run at all. Be sure thrust spring is in place in end of camshaft, before mounting gear cover.

in reassembly: use a ring compressor and stagger the piston ring gaps 90° apart around the piston. Oil the piston, rings, wrist pin, rod bearings and cylinder walls before assembly.

Note: Mount piston and rod assembly with the stamped number on the connecting rod bolt boss facing toward the open end of the crankcase. Assemble connecting rod cap in like manner so that

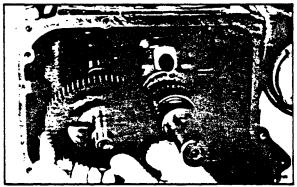


Fig. 1-34

the two numbers are of the identical side. Turn crankshaft to lower end of stroke and tap piston down until rod contacts crank pin. Mount dipper so that cap nuts are accessible from open end of crankcase. Tighten connecting rod nuts to 22 ft.-lbs.

(continued) PAGE 29

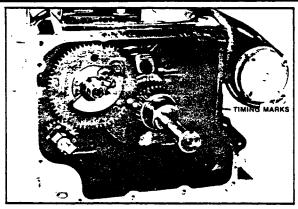
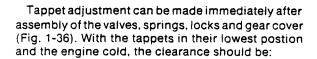


Fig. 1-35



inlet - .007 inch exhaust - .021 inch

Caution: Be sure exhaust tappet is not riding on compression release spoilercam.

To check tappet clearance on an assembled engine, turn crankshaft so that take off or flywheel keys are in a twelve o'clock position, and on compression stroke. Observe position of valve stems in the inspection compartment. Both valves should be in their lowest position (closed); proceed to check clearance.

The automatic compression release is incorporated with the engine camshaft and with proper engine maintenance should operate trouble-free with a minimum of wear.

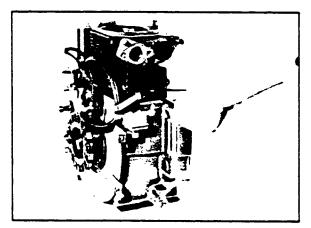


Fig. 1-36

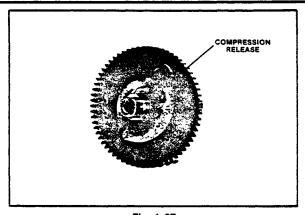


Fig. 1-37

COMPRESSION RELEASE

While cranking engine, a spoiler cam holds the exhaust valve slightly open thru a portion of the compression stroke. This condition reduces the compression pressure, allowing the engine to be turned over faster and with less effort. After the engine starts and the speed reaches 650 R.P.M., the spoiler cam moves to an inoperative position and normal compression is returned to combustion chamber.

CRANKSHAFT

Remove flywheel woodruff key.

Pull crankshaft out from open end of crankcase and take care not to damage the oil seal. If necessary, loosen shaft by tapping lightly at flywheel end with a soft hammer.

In reassembly, inspect crankcase oil seal and main bearing for possible replacement. Mount crankshaft with extreme care so as not to damage lips of the oil seal. Use an oil seal sleeve if available. Mount the flywheel after the crankshaft is assembled, and tighten the flywheel nut until the flywheel is firmly seated to the crankshaft taper. Flywheel will support the crankshaft for mounting of the connecting rod and piston.

(Do not torque flywheel nut, until crankshaft end play has been properly set.)

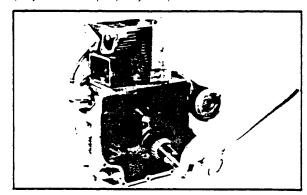


Fig. 1-38



WISCONSIN ENGINE

(continued) PAGE 30

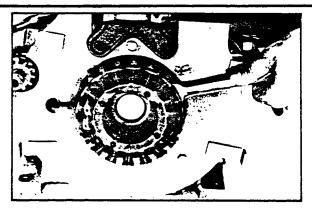


Fig. 1-39

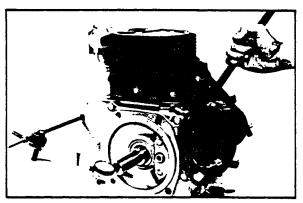


Fig. 1-40

The stator plate functions as an adapter for the magneto coil as well as a front bearing support. Since the crankshaft end play is adjusted by means of the stator plate gasket unless replacement is necessary.

To remove stator plate, take out four capscrews and tap plate from inside crankcase with a wooden hammer handle. In reassembly: use new gaskets having the same total thickness as those removed. Torque stator plate capscrews to 18 ft.-lbs.

End play is checked after crankshaft, gear cover and flywheel are mounted. The end play should be .001 to .004 inch with engine cold, and can be determined as illustrated in (Fig. 1-40). Wedge a lever between the flywheel and crankcase and move the crankshaft forward and backward against a dial indicator. If there is too much end play a corresponding thickness of gasket will have to be removed from behind stator plate. If not enough end play, a gasket will have to be added.

If new tapered crankshaft main bearings are installed, seat bearing by alternately striking each end of the crankshaft several sharp blows with a lead hammer. Then proceed to check crankshaft end play.

After end play is set: refer to flywheel reassembly paragraphs, for final instructions on tightening of flywheel nut.

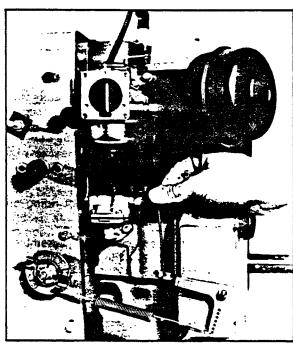


Fig. 1-41

(continued) PAGE 31

SECT. 1

TORQUE SPECIFICATIONS WEAR LIMITS AND CLEARANCE DATA

DESCRIPTION	Tolerance	Wear Limit		
Flatness of cylinder head	i		.005	
Cylinder Bore	Ĺ	' —	3.7495 3.7500	.005
	Ε	<u> </u>	3.7501 3.7505	
Bore — out of round			.0005	
PISTON DIAMETER AT SKIRT Thurst faces (standard size		A—	3.7470 3.7465	.002
· ·		8—	3.7475 3.7471	.502
Piston to cylinder cleara at skirt thurst faces	.0025 .0035	.003		
Ring groove width (top a 2nd ring	.0965 .0956			
Ring groove width (oil ri	.1895 .1885			
Ring width (top ring)	Ring width (top ring)			
Ring width (2nd ring)			.0925 .0935	
Ring width (oil ring)			.187 .186	
Piston rings side clearance	Тор			.002
in groove	2	Ind	.002 .004	.002
		Oil	.0015 .0035	.002
Ring gap (at cylinder ski)	.010 .020	.005	
Pin hole in piston	Pin hole in piston			
Piston pin diameter	.7500 .7497	.001		
Piston pin to Piston fit	.0000 .0008 tight			
Connecting rod (crank p	oin	end)	1.6245 1.6250	.002

		i	
DESCRIPTION	Tolerance	Wear Limit	
Connecting rod side clea	.009 .013	.005	
Piston pin to connecting bushing clearance	rod	.0005 .0011	.004
Connecting rod — large small bore centers	and	6.877 6.873	
Connecting rod — large small bore alignment (pa		.002	.004
Crank pin (parallel)		.0005	
Crank shaft journal diam (take-off end)		1.4974 1.4968	
Crankshaft journal (flywhend)	neel	1.4974 1.4968	
Crankshaft end play	.001 .004	ADJ.	
Camshaft (journal diame	.7495 .7490		
Valve spring (free spring)	1.188	
Valve stem diameter	IN.	.310 .311	
	EX.	.308 .309	
Valve stem clearance to	IN.	.005	.002
guide (maximum)	EX.	.007	
Valve — length from groove to	IN.	.306	
stem end	EX.	.308	
Valve — tappet clearance	IN. EX.	.007	ADJ.
	E.A.	.021	
Valve guide bore	.0005		
Tappet — stem to guide clearance	.0005 .0025	.004	
Ignition timing		13°	ADJ.
Spark plug gap		.030	ADJ.
Spark plug — 14mm -	- Cham	pion L90	

WISCONSIN ENGINE

VENDOR SECT. 1

(continued) PAGE 32

TORQUE SPECIFICATIONS FOR MACHINE HARDWARE For Engine Model W1-588 Torque Values — Maximum Foot Pounds (Dry)

PART Number	SIZE CAPSCREW UNLESS SPECIFIED	QTY.	APPLICATION	FT. LBS.
10P01-4026	5/16 - 18 nut	3	Recoil Starter Mounting	24
10P01-4048	1/4 - 28 nut	1	Disc Assy Mounting	
10T01-4018	1/4 - 28 nut	1	Governor Control Level	10
10T01-4017	1/4 - 20 nut	1	Governor Control Disc	10
10X01-4013	10 - 32 x 3/4	4	Alternator Stator to Gear Cover	1.5
10X01-4006	1/4 - 20 x 1/2	2	Cylinder Lead Inspection Cover	9
10X01-4018	3/8 - 16 x 1	2	Starting Motor Bracket	30
10Y01-4016	1/4 - 20 x 7	2	Starting Motor Bracket & Starting Motor Stud	9
10X01-4046	5/16 - 18 x 1 3/4	9	Fuel Pump to Crankcase	9
10X01-4003	5/16 - 18 x 7/8	4	Carburetor to Cylinder Head	18
10X01-4007	5/16 - 18 x 1	4	Bearing Plate to Crankcase	24
10X01-4019	3/8 - 16 x 1/2	4	Cylinder Head Mounting to Crankcase	36
10P01-4002	5/16 - 24 (NUT)	2	Connecting Rod	24
10X01-4021	3/8 x 3/4	2	Fuel Tank Mounting Bracket to Cylinder Head	30
10X01-4011	1/4 - 20 x 1/2	2	Fuel Tank Strap to Mounting Bracket	
10X01-4042	8 - 32 x 1/4	2	Ignition Module to Bracket	2
10X01-4015	$1/4 - 20 \times 3/4$	2	Mount Ignition Module Bracket	9
10Y01-4020	1/4 - 20 x 1 1/4	1	Magnet Insert to Flywheel	9
10X01-4006	1/4 - 20 x 1/2	3	Backplate Mounting to CrankcaSe	9
10X01-4006	1/4 - 10 x 1/2	6	Blower Housing to Backplate	9
10P01-4049	#10 Self Tapping	1	Bendix Cover to Shroud	3
10X01-4006	1/4 - 20 x 1/2	3	Cylinder Shroud to Cylinder	9
10X01-4010	3/8 - 16 x 1 3/4	5	Cylinder Head to Cylinder	
10P01-4029	3/8 - 16 (STUD)	3	Cylinder Head Studs to Cylinder	31
10X01-4014	5/16 - 18 x 3/4	2	Exhaust Flange	18
10X01-4016	1/4 - 20 x 1	3	FLywheel Screen to Bearing Plate	9

WISCONSIN ENGINE

VENDOR

SECT. 1

(continued) PAGE 33

NUMBER	SIZE CAPSCREW UNLESS SPECIFIED	QTY.	APPLICATIONS	FT. LBS.
10P01-4035	1/4 - 20 x 5/8	2	Starting Switch Mounting	9
10P01-4036	1/4 - 20 x 1 1/8	1	Regulator Rectifier Mounting	9
10X01-4016	1/4 - 20 x 1	3	Drive Hub to Flywheel Mounting	9
10P01-4010	7/16 - 20 (NUT)	4	Cylinder Block Mounting	47
10X01-4002	#10 - 32 x 3/8	4	Adapter Plate Air Cleaner	1.5
10X01-4006	1/4 - 10 x 1/2	3	Cylinder Head Shroud to Blower Housing Shroud	9

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SECT. 1 PAGE 35

Limited Engine Warranted

TELEDYNE TOTAL POWER, a division of Teledyne Industries, Inc. (herein "Teledyne") warrants that each new engine or service engine assembly sold by it will be free, under normal use and service, from defects in material and workmanship for a period of one (1) year after the date of delivery to the original retail purchaser, or 2000 hours of operation, whichever shall first occur.

Teledyne's obligation under this Limited Warranty shall be limited to the repair or replacement, at Teledyne's option, of any part or parts which upon examination is/are found, in Teledyne's sole judgement, to have been defective in material or workmanship. It shall be a condition of Teledyne's obligation under this Limited Warranty that Teledyne, directly or through one of its Distributors or Warranty Stations authorized to service the particular engine involved, receive prompt notice of any warranty claim and that the engine or the part or parts claimed to be defective be promptly delivered, transportation prepaid, to such Distributor or Warranty Station for inspection and repair. All repairs qualifying under this Limited Warranty must be performed by Teledyne or one of its authorized Distributors or Warranty Stations. The labor necessary for removal and reinstallation of an engine in connection with a covered warranty repair shall be included only to the extent allowed in the particular case by Teledyne, in its sole discretion. The Customer shall be responsible for the remainder of the labor charges incurred in the removal and reinstallation of the engine.

The repair or replacement of any part or parts under this Limited Warranty shall not extend the term of the engine warranty beyond the original term as set forth above.

LIMITATIONS AND EXCLUSIONS: This Limited Warranty shall not apply to:

- A. Any engine which shall have been subject to negligence, misuse, accident, misapplication or over-speeding.
- B. Any engine that has been installed, repaired, or altered by anyone in a manner which in Teledyne's sole judgement adversely affects its performance or reliability.
- C. Any engine which has been fitted with or repaired with parts or components not manufactured or approved by Teledyne which in Teledyne's sole judgement adversely affects its performance or reliability.
- D. Engine tune-ups and normal maintenance service including, but not limited to, valve adjustment, normal replacement of service items, fuel and lubricating oil, fan belts, antifreeze, etc.
- E. Damages caused by prolonged or improper storage of the engine.

The customer is responsible for all transportation charges in connection with any warranty work.

Teledyne reserves the right to modify, alter or improve any engine or parts without incurring any obligation to modify or replace any engine or parts previously sold without such modification, alteration or improvement.

No person is authorized to give any other warranty or to assume any additional obligation on Teledyne's behalf unless made in writing and signed by an officer of Teledyne.

THIS WARRANTY, AND TELEDYNE'S OBLIGATIONS HEREUNDER, ARE IN LIEU OF ANY OTHER WARRANTIES OR OBLIGATIONS OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. TELEDYNE SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES.

TELEDYNE TOTAL POWER

MEMPHIS, TENNESSEE 38118

TTP00007 June 1985 Printed in U.S.A.



DICO HUB

VENDOR

SECT. 2

FIG. 1

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CESSNA GEAR PUMP

VENDOR

SECT. 3

FIG. 1

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Mark Industries ILLUSTRATED PARTS CATALOG

MICO DISC BRAKE

VENDOR

SECT. 4 PAGE

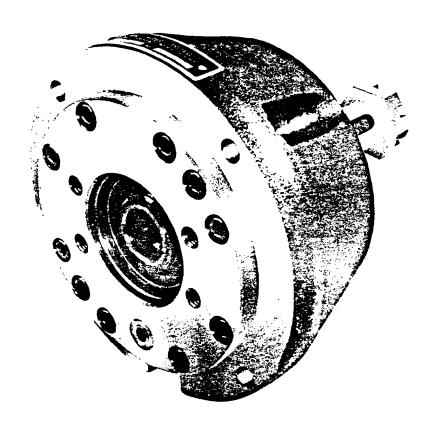
SY-TEC SERIES

MULTIPLE DISC BRAKE

(wheel mount)

SERVICE MANUAL







MICO, INC.

1911 Lee Blvd., P.O. Box 2118, No. Mankato, MN U.S.A. 56002-2118 Phone. (507) 625-6426 / TELEX 910-565-2444

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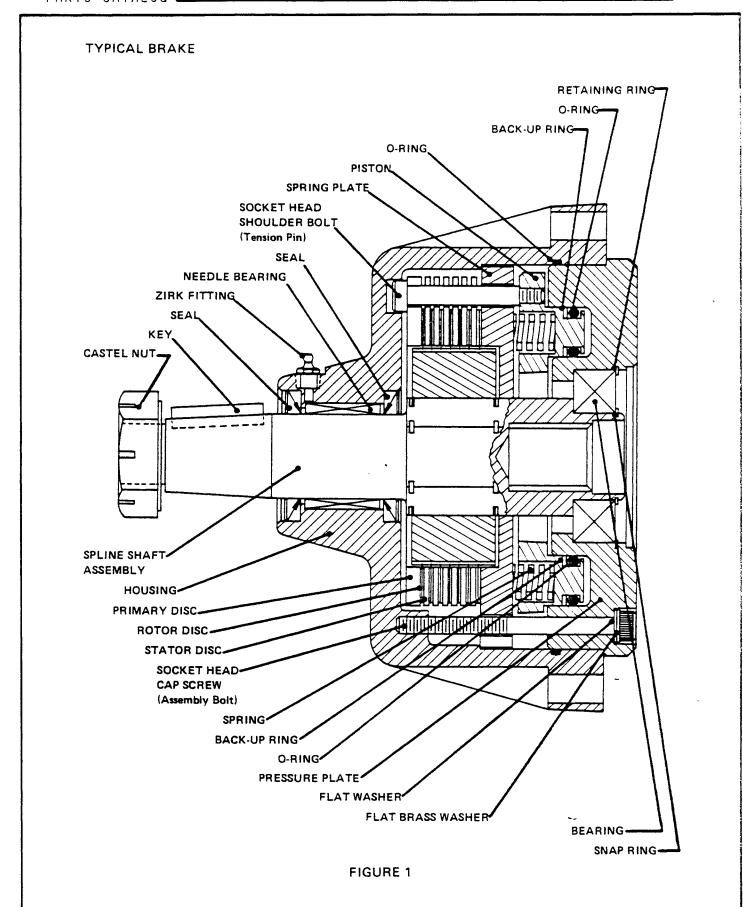
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MICO DISC BRAKE

(continued)

VENDOR SECT. 4

PAGE 2



PARTS CATALOG

(continued)

PAGE

PRINCIPLES OF OPERATION

These brakes are spring-set, hydraulically released, multi-disc brakes. They are used primarily for holding loads, vehicles, conveyors, etc. in place when the hydraulic drive system is shut down or fails. Although the brakes are rated at 3,000 psi, they only require from 100 psi to 220 psi to make them function normally. The exact pressure required for operation is dependent upon the number of springs used to generate the torque necessary to hold the designed load. Thus, a brake with a full compliment of springs, will generate the highest level of torque and require approximately 220 psi to fully release the brake and provide adequate running clearance for the individual discs. A brake with 1/2 of the full spring compliment will have 1/2 as much torque and will require only 100 psi

to fully release the brake. Consult catalog to choose the torque which best suits your design parameters.

It is very important to remember that any pressure on the brake's release piston will directly effect the level of torque.

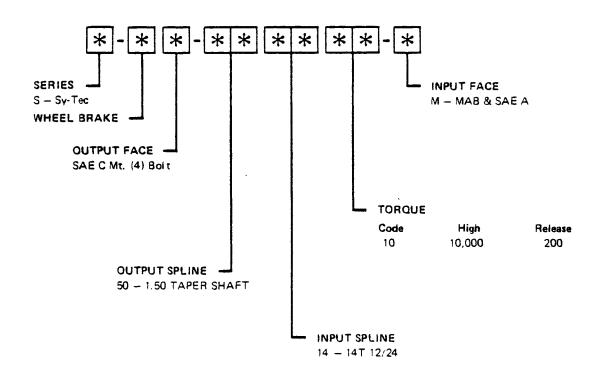
Two application examples:

1. The brake has a release pressure of 200 psi. The actuation pressure is provided by a charge pump. During certain phases of the machine's operation, the charge pump pressure dips from 200 psi to 100 psi. At 200 psi, the brake runs free (zero torque) but at 100 psi the brake will generate slightly less than half of its rated torque. The brake will drag - failure may occur. In this case, a brake should be

- selected which has a lower release pressure.
- 2. A brake has a release pressure of 200 psi. The system is set up to hold a load when a variable pump is shifted into neutral. Everything is running fine until the filter clogs, causing a buildup of back pressure in the return line to the tank. At a pressure of 60 psi, the brake will lose 25% of its holding torque; thus the load may slip. The situation can be corrected by replacing the filter or adding an extra margin of safety to your required brake torque in the initial design.

These brakes are designed to give thousands of trouble-free hours of service when set up correctly in the hydraulic circuit.

DESCRIPTION OF MODEL NUMBERS



DISASSEMBLY

- Remove castle nut (item 26) and key (item 20) from output end of spline shaft assembly (item 19).
- Remove 10 socket head assembly bolts (item 4) and flat washers (items 5 & 6).
 Washers (item 5) are brass.
 A suitable holding fixture is useful to keep brake in position.
- Tap output end of spline shaft assembly (item 19) with a soft mallet to separate housing (item 22) from internal parts assembly.
- 4. Remove o-ring (item 21) from housing (item 22).
- Needle bearing (item 24) and seals (items 23 & 25) will remain in housing (item 22). Inspect parts for wear and remove only if necessary.
- 6. Remove snap ring (item 1) from input end of spine shaft aassembly (item 19).
- Tap input end of spline shaft assembly (item 19) with a soft mallet to separate spline shaft from internal parts assembly.
- 8. Bearing (item 3) and retaining ring (item 2) will remain in pressure plate (item 7). Remove both and inspect for wear.
- Remove four socket head shoulder bolts (item 18). A suitable holding fixture is useful to hold brake in position.

CAUTION: Do not remove shoulder bolts without pressurization of brake (approx. 200 psi) or damage may result.

- Remove primary disc (item 17), seven rotor discs (items 16) and six stator discs (items 15).
- 11. Remove spring plate (item 14).
- Before removing springs (items 13), note pattern for reassembly purposes.
- 13. Separate piston (item 12) and pressure plate (item 7) by carefully exerting hydraulic pressure through brake release port on pressure plate.
- Remove outside and inside o-rings (items 8 & 10) and out-

side and inside back-up rings (items 9 & 11) from piston (item 12).

CAUTION: Care must be taken so as not to scratch or mar piston.

ASSEMBLY

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN SYSTEM.

- 1. Use an alkaline wash to clean parts before assembly.
- Install back-up rings (items 9 & 11) on piston (item 12) toward spring pockets.
- Install o-rings (items 8 & 10) on piston (item 12). Be sure o-rings are flat and all twists removed.

CAUTION. Care must be taken so as not to scratch or mar piston.

- 4. Lubricate piston (item 12) with type fluid found in the system. Carefully press piston into pressure plate (item 7). Be sure piston is aligned correctly at all times and that there are no extrusions. Press piston until it bottoms on pressure plate (item 7).
- Install springs (item 13) according to pattern noted during disassembly. Different colored springs must be alternated.
- 6. Place. spring plate (item 14) over springs (item 13).
- Install stator discs (item 15) and rotor discs (item 16).
 Begin with a rotor disc (item 16) and alternate with stator discs (item 15).
- 8. Install primary disc (item 17).
- Align discs and partially screw in four socket head shoulder bolts (item 18).

NOTE: Socket head shoulder bolts (items 18) should have loctite applied. Place one or two drops

of loctite to the threads.

Inspect for free movement of stack and check to see if spline shaft assembly (item 19) lines up with discs so it can fit through stack. Pressurize brake release port (approx. 200 psi) to release discs. Torque shoulder bolts to 20 ft. lbs. and release pressure. A suitable holding fixture is useful to hold brake in position.

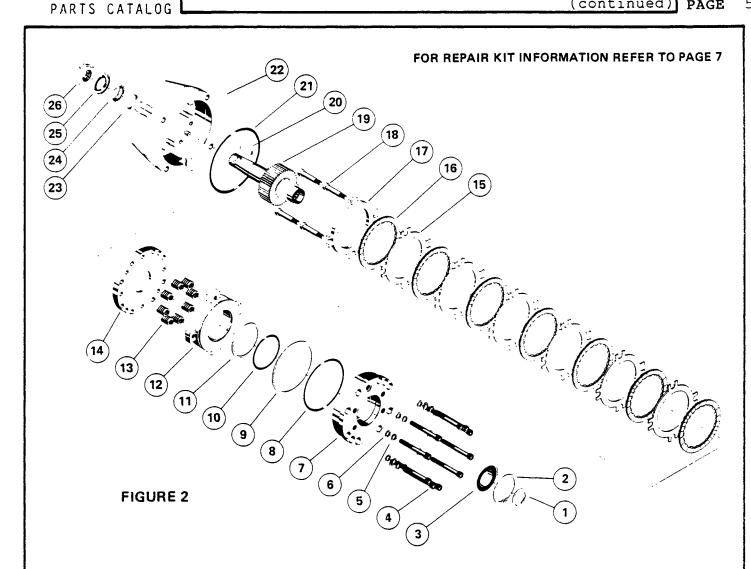
- Install spline shaft assembly (item 19) through stack input end first and out pressure plate (item 7).
- 11. Install bearing (item 3) and retaining ring (item 2) in pressure plate (item 7).
- 12. Install snap ring (item 1) on input end of spline shaft assembly (item 19).
- 13. If seals (items 23 & 25) and needle bearing (item 24) were removed from housing (item 22) they must be installed. Note direction of both seals.
- 14. Install o-ring (item 21) in housing (item 22).
- Install housing (item 22) with the internal parts assembly using 10 socket head assembly bolts (item 4) and flat washers (items 5 & 6).

NOTE: The ten socket head assembly bolts (item 4) should have loctite applied. Place one or two drops of loctite to the threads.

Washers (item 5) are brass and should be first on the bolts. Torque bolts to 45 ft. lbs.

 Install castle nut (item 26) and key (item 20) on output end of spline shaft assembly (item 19).

(continued)



PARTS LIST

ITEM DESCRIPTION

- 1 SNAP RING
- 2 RETAINING RING
- 3 BEARING
- 4 SOCKET HEAD CAP SCREWS (10) (Assembly Bolts)
- 5 FLAT BRASS WASHERS (10)
- 6 FLAT WASHERS (10)
- 7 PRESSURE PLATE
- 8 O-RING
- 9 BACK-UP RING
- 10 O-RING
- 11 BACK-UP RING
- 12 PISTON
- 13 SPRINGS (8)

ITEM DESCRIPTION

- 14 SPRING PLATE
- 15 STATOR DISCS (6)
- 16 ROTOR DISCS (7)
- 17 PRIMARY DISC
- 18 SOCKET HEAD SHOULDER BOLTS (4) (Tension Pins)
- 19 SPLINE SHAFT ASSEMBLY
- 20 KEY
- 21 O-RING
- 22 HOUSING
- 23 SEAL
- 24 NEEDLE BEARING
- 25 SEAL
- 26 CASTLE NUT

MICO DISC BRAKE

(continued) PAGE

VENDOR SECT. 4

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BLEEDING

- 1 Install brake in system and connect pressure lines.
- 2 Bleed pressure release section of brake by pressurizing side inlet

port and allowing air to escape from top port. Pressure should not exceed 100 psi during bleeding. 3 Apply sufficient pressure to release brake and check for proper operation in system.

SERVICE DIAGNOSIS

PROBLEM	CAUSE CEL	EXPLANATION	ACTION
Brake slips	A. Excessive pressure in hydraulic system	If there is back pressure in the brakes actuation line, the holding torque of the brakes is reduced.	Check filters, hose size, restrictions in other hydraulic components.
	B. Oil in brake if designed for dry use	Dry linings generate 66% more torque than linings saturated with oil. If the brake has oil in it, check the type of oil hydraulic or gearbox.	
		1. Gearbox oil 2. Hydraulic oil	Replace oil seal in brake Check motor seal Check piston seals Note: Internal compon- ents will need to be in- spected, cleaned and re- placed as required.
	C. Disc plates worn	The thickness of the disc stack sets the torque level. A thin stack reduces torque.	Check disc thickness
	D. Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - a rare occurrence	Check release pressure
Brake drags or runs hot	A. Low actuation pressure	The brake should be pressurized to minimum of 20 psi over the specified release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system or
	B. Bearing failure	If the bearing should fail, a large amount of drag can be generated	Replace bearing
	C. Oil in brake	Excess fill of oil in sump condition thru wet brakes can cause the unit to run hot. Also excessive rpm in sump condition.	Drain oil and refill as specified for brakes Switch to flow thru cooling.
Brake will not release	A. Stuck valve or clogged	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure - Replace defective line or component
	B. Bad o-rings	If release piston will not hold pressure, brake will not release.	<u> </u>
	C. Discs frozen	Sy-Tec brakes are designed for only limited dynamic braking. A severe emergency stop or prolonged reduced release pressure operation may result in this type of damage.	Replace disc stack

MICO DISC BRAKE

SECT. 4

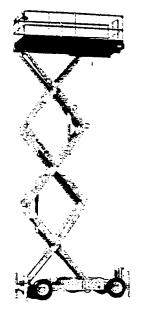
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VENDOR

REPAIR KITS

(Refer to Page 5 for item numbers)

NUMBER	DESCRIPTION	INCLUDES
12-501-026	O-ring and Back-up Ring Kit	Flat Brass Washers (items 5) Seals (items 23 & 25) O-rings (items 8, 10 & 21) Back-up Rings (items 9 & 11) Loctite
12-501-106	Lining Kit	Flat Brass Washers (items 5) O-ring (item 21) Primary Disc (item 17) Stator Discs (items 15) Rotor Discs (items 16) Loctite
12-501-108	Bearing Kit	Flat Brass Washers (items 5) O-ring (item 21) Seals (items 23 & 25) Bearings (items 3 & 24) Loctite
12-501-110	Spring Kit	Flat Brass Washers (items 5) O-ring (item 21) Springs (items 13) Loctite



Making your work easier to reach.

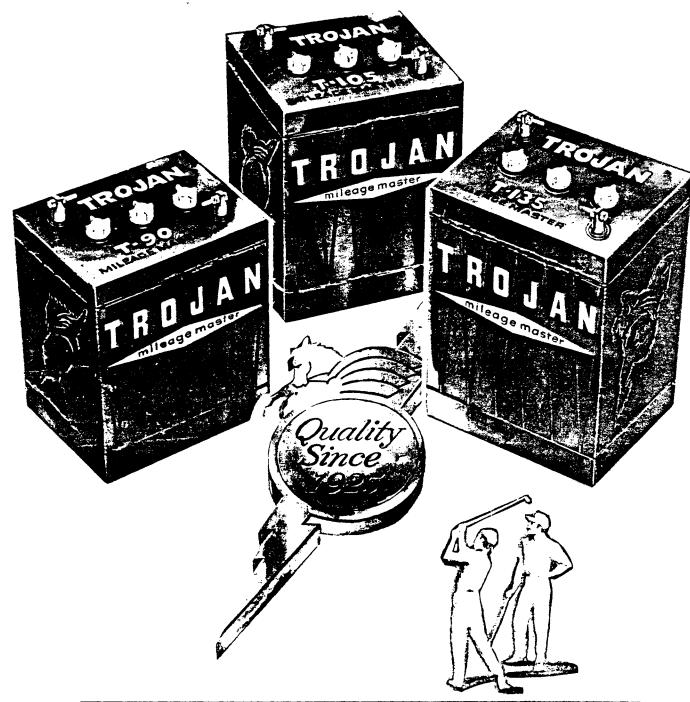


VENDOR

SECT. 5

PAGE

TROJAN MILEAGE MASTER BATTERIES:



(213) 946-8381 • (714) 521-8215 Toll Free (Outside Calif.) (800) 423-6569 (Excluding Alaska and Hawaii)⊁

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SECT.

PAGE

oper care and maintenance of electric ve



Look for and pay particular attention for damage to or well spots on the shipping cartons, examine those batteries for signs of breakage. Always inspect incoming shipments of batteries for damage.

If damaged batteries are found secure acknowledgment of the damage from the carrier's representative and tile a claim secure the transportation company. Contact your supplier for battery replacement.

If batteries are received wet and not immediately placed in service, they must be charged at regular intervals as follows: Storage Temperature Below 40° F 40° F to 60° F 60° F and above

None required Every 2 months Once a month : Charge

damage and/or contains damage can occur from Improper stacking. If batterias are stored individually, place supporting backs between layers. Do not stack layers more than three (3) high and rotate stock so that the oldest batteries can be Never stack one battery directly on top of another. Post ÷

manufacturer's instructions. Connections should be made tight enabling good contact between connector lugs and bettery terminals. Always charge sets of batteries imme-Batteries should be installed in accordance with the vehicle diately after installation into the car.

- 1. Water batteries at least once a week
- Add only approved water to the cells. Distilled water is recommended, high mineral content water must not be used. Maximum allowable impurities in percent-tron (.003), chioride (.004), fixed residue (.076).

Remove vent caps and water batteries preferably after charging to prevent over flow of acid due to expansion.

Fill all cells to the proper level. Do not overfill cells, Fill to level indicator or ½ inch over the top of the separators if there is no level indicator. Do not use a hose to water batterles.

electrolyte is above separators. Excass water usage indi-cates the presence of any one or all of the following conditions which should be checked. Spot check cells between weekly waterings to assure

High temperature operation Overcharging

2. High temperature operation 3. Nearing end of service life

Do not allow the electrolyte level to drop below the top of the separators since this will lead to shortened battery life.

 Wash the tops of the batteries making sure the vent caps are in place. Do not allow water or other foreign matter Clean batteries after weekly watering or when washing cars.

to enter the cells.

Use a solution of bicarbonate of soda and water to wash inspection to insura good conditions which will give better batteries if there is an accumulation of acid.

- Dry charge batteries should be activated in accordance with instructions of the battery manufacturer. used first.
- When watering batteries inspect battery and other terminal connections for:

Corroston — If any exists, clean connection and apply a non-metallic grease or protective spray to retard Loose Connections — Be sure all connections are lurther corrosion.

3. Broken or Frayed Cables — Be sure all cable connections are good and that no loose or broken wires are exposed. Replace any which look suspicious. light and that good contact is made between terminals.

Check charger to Insure that proper charge is being returned to the batteries. Once a weak after the batteries have been charged, spot check two (2) or more cells for specific gravity reading Gravity should be 1.250 - 1.280. If low readings are noted

Check connections as specified under inspection Sa.

Check all cells to determine if batteries are near the and of life. This should be done to the same procedure as called for under Section IV covering "Trouble Shooting" of batteries.

On a regular interval, check car as outlined in the instruc-tion manual for:

1. Brake drag

Proper tire pressure

Proper lubrication

Proper operation of electrical system Proper operation of drive and transmission system Condition of charger plug and receptacle in car Any of these conditions which are detrimental to car operation will shorten battery life.

> battery service. ei ei

SECT.

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3

install batteries in car being sure that they are properly held down, firm but not too tight.

Replace cables, being sure terminals and clean and connections are tight.

Clean and recondition buttery trays, holddowns and cables. Inspect new batteries for broken containers and proper electrolyte tevel before installing in the car.

Remove old set of batteries.

Apply a light coating of non-metallic grease or protective coating.

USTRATED PARTS CATALOG

- Become familiar with instructions issued with the charger or car manual
- Batterles are to be charged after each day's use as soon as play has been completed. Charging between rounds is permissible if it is determined feasible to do so.
- ē Do not allow batteries to sit in discharged condition for longed periods of time. Do not charge balleries if car was not used that day. mi
- Always be sure batteries are fully charged each day prior to starting play.
- Connect a load tester to the set of batterles and discharge the batterles at 75 Amps and record the time to a terminal voltage of 31.5 votts. Testers are now available having an amomatic Shut-Off at this voltage. New batteries should run a minimum of 75 minutes on this test. • When a car falls to operate properly performing less than one round of gotf, the car is to be brought into the shop and the batteries examined as follows:
- If batteries run 40-50 minutes they have lost capacity and may be nearing the end of their useful Ille. In golf car service one round of golf may be expected on an If the batterles run less than 40 minutes they have either reached the end of life or a defective battery is in the circuit. Battery replacement is then necessary.

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If batteries run more than '50 minutes, they are in good condition and satisfactory for continued service. Prior to putting the car back in survice it should be checked for the extelence of other trouble as outlined in the instruction manual. average golf course. j

If terminal connections appear to be in good condition, check all cells with a hydrometer for variation in specific gravity among cells. A variation of .030 points or more between cells of a battery is cause for suspect. Mark the Read all gravitles again after recharge. Be sure that batteries are fully charged at gravilles of 1.250 to 1.280. If cells vary by .030 points or more it is an indication of possible trouble within that battery. 1. Check terminal connections for corrosion, loose connections Recharge the batteries as recommended by the manufacturer. and broken or frayed cables. low cells. ÷ ÷

Defective Batteries (Premeture Fallures)

- Defective battery can be determined either by observation of gravity variance at the end of the 76 Amp discharge (.030 or more points between cells of a battery) or by turning the discharge tester back on and determining the battery or cell which is determining the battery or cell 1. Defective battery can be determined either by which is defective by use of a voltmeter.
- Mark the defective battery.
- Recharge the batteries with the defective battery in the circuit.
- Remove the defective battery and replace with new battery or battery of comparable age which is fully charged.
- storage trouble of the Check batteries after car has been removed from and before service begins. Follow inspection and shooting procedures to determine the condition batteries. **~**i

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Prior to storing car, batteries should be cleaned, fully charged and properly leveled. While in storage the batteries should be recharged to charge at time intervals shown below: Charge None required Every 2 months Once a month Storage Temperature Below 40° F 40° F to 60° F 60° F and above



PARTS CATALOG

VENDOR SECT. 5

SECT. 5

(continued) PAGE

TROJAN MILEAGE MASTER BATTERIES

REF. Group 20 Hour			75 AMPS TO 5.25 VOLTS		OVERALL DIMENSIONS			
NUMBER	TYPE	VOLTS	RATE A.H.	AT 80° F MINUTES	LENGTH	WIDTH	*HEIGHT	WEIGHT
G C-2	T-90	6	185	90	10-3/8	7-1/8	10-3/4	56
GC-2H	T-105	6	217	105	10-3/8	7-1/8	10-3/4	61
GC-2H	T-135	6	244	135	10-3/8	7-1/16	11-1/2	72

OTHER SPECIAL BATTERIES AVAILABLE FOR ELECTRIC VEHICLES.

*TYPE OR TERMINAL WILL VARY HEIGHT SLIGHTLY

TROJAN "MILEAGE MASTER" TYPES FEATURE QUARTER-TURN VENT CAPS



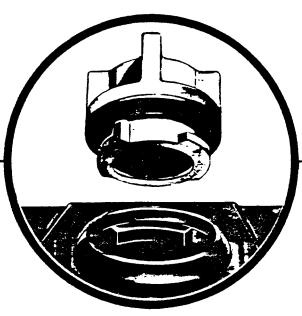
TYPE AP

STRAIGHT POST

TYPE LT

ANGLE TERMINAL % Lead coated boit





ALL BATTERIES COME WITH UNIVERSAL TERMINALS
UNLESS OTHERWISE SPECIFIED



WING NUT TERMINAL 3/16 or 5/16 Stud

TYPE UT

UNIVERSAL TERMINAL



DISTRIBUTED BY



TROJAN BATTERY COMPANY

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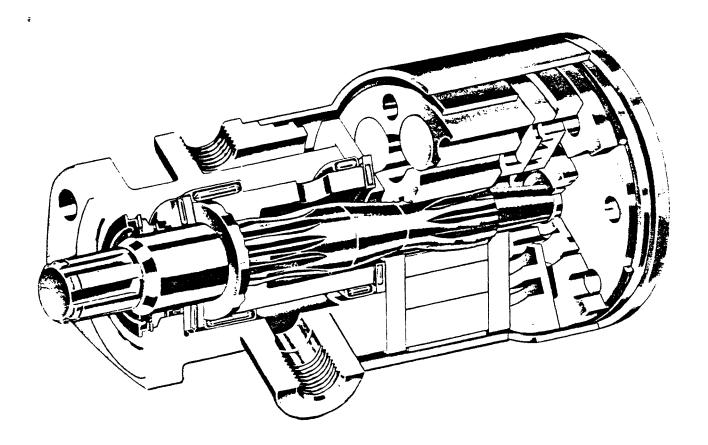
VENDOR

SECT. 6 PAGE

TORQMOTOR®

SERVICE PROCEDURE

MAB SERIES





The MAB TORQMOTOR

- Low Speed,
 - High Torque
 - Hydraulic Motor.

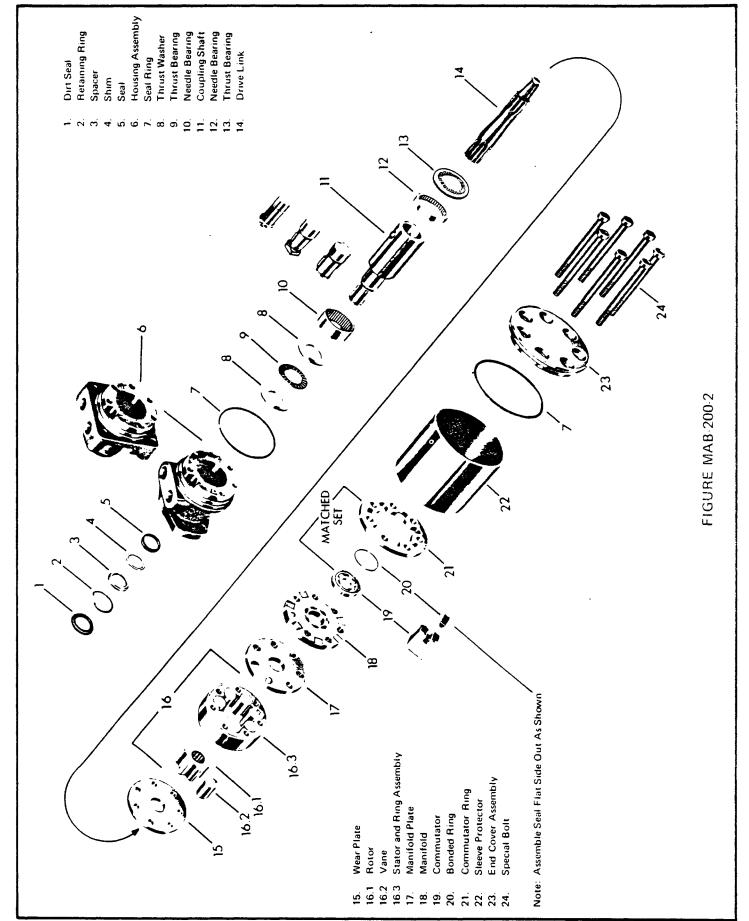
ROSS GEAR DRIVE MOTOR

VENDOR

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(continued)



VENDOR SECT. 6

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(continued)

SERVICE PROCEDURE

Preparation Before Disassembly

PARTS CATALOG

Remove port hole plugs before attempting to rotate shaft. Drain the motor assembly by turning the output shaft. Wash the complete motor in solvent and remove all particles of dirt from the exterior and blow dry before placing on work bench.

Clean Work Conditions

If it is necessary to disassemble the TORQMOTOR, make certain to use a clean work bench (a piece of clean wrapping paper makes an excellent and disposable top). The hands and tools of the repairman should be clean, and the operation should be carried out in a sheltered area free from drafts that may carry foreign material into the disassembled pieces. (Precision fits in the TORQMOTOR needs "white room" type care.)

<u>Caution</u>: Avoid wiping parts with a cloth, as lint and foreign particles may adhere to the working parts of the TOROMOTOR.

Handling

Care must be taken in handling the close fitting parts, as nicks and mutilations will result in serious damage.

REPLACEMENT OF HIGH PRESSURE SEAL (5) IN TOROMOTOR

(Reference Figure MAB-200-2)

- Remove dirt seal (1) and retaining ring (2), if burr exists on retaining ring groove, remove with a scraping tool.
- Set the motor with coupling shaft (11) down in a suitable clean can. Plug "A" port and connect "B" port to 120 psi air hose, or use a piston type hydraulic hand pump. Note: The air connection should be made with provisions for quick shut-off after the spacer (3), shim (4) and seal (5) have been ejected.
- 3. Apply clean grease to new seal (5) and assemble into housing assembly (6) with lip side inward.
- 4. Assemble shim (4), spacer (3) and retaining ring (2), be sure the rounded edge of the retaining ring is faced inward. Apply a small amount of clean grease to the back side of new dirt seal (1) and assemble into housing assembly (6).

TOROMOTOR DISASSEMBLY

(Reference Figure MAB-200-2)

- In a vise, clamp down on the housing assembly (6) port bosses with the coupling shaft (11) pointed down.
- Using wrench with a 12 point 9/16" socket, remove the seven special bolts (24) and place them on the work bench.

- 3. Remove the end cover assembly (23) and seal ring (7) by inserting screw driver between end cover assembly (23) and sleeve protector (22). Pry up end cover assembly (23) and lift from unit with seal ring (7) attached.
- 4. Remove seal ring (7) from end cover assembly (23) and discard.
- 5. Remove the commutator ring (21), commutator (19), bonded ring (20) and manifold (18) by using two of the special bolts (24) as a lifting tool, insert the two special bolts (24) into two holes and lift out the previously mentioned parts.
- 6. Remove bonded ring (20) from commutator (19) by using an air hose, blow air down into ring groove until bonded ring (20) is lifted out and discard.
- 7. Inspect manifold (18) for cracks and replace with new manifold if cracks are visible.
- 8. Remove manifold plate (17) by using the two special bolts (24) and method previously mentioned.
- 9. Remove rotor assembly (16), wear plate (15) and drive link (14) by using the two special bolts (24) and method previously mentioned.
- Remove vanes (16.2) and rotor (16.1) from rotor assembly (16). Use caution not to drop these parts when handling.
- 11. Inspect rotor (16.1) outside lobes for pits and marks. If pits or wear marks are visible, discard rotor (16.1) and replace complete rotor assembly (16) with a new rotor assembly.
- 12. Remove thrust bearing (13).
- 13. Remove coupling shaft (11).
- 14. Remove sleeve protector (22) by inserting screw driver between sleeve protector (22) and housing assembly (6) and pry up. If rust exists on ends of sleeve protector (22), remove by sanding lightly.
- Remove seal ring (7) from housing assembly (6) and discard.
- 16. Remove housing assembly (6) from vise, turn over and reclamp housing assembly in vise so that dirt seal (1) is pointed upward.
- 17. Remove dirt seal (1), retaining ring (2), spacer (3), shim (4) and seal (5) from housing assembly (6). Discard dirt seal (1) and seal (5). If burr exists on retaining ring groove, remove with a scraping tool.

PARTS CATALOG

ROSS GEAR DRIVE MOTOR

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VENDOR

(continued) PAGE

18. Do not remove thrust washers (8), thrust bearing (9) and needle bearings (10) and (12) unless there is absolute evidence of damage. Needle bearings should be free to rotate and not show signs of surface breakdown. If needle bearing (10) requires replacement, use a 1.490 maximum diameter shaft and press out thrust washers (8), thrust bearing (9) and needle bearings (10) and (12). The housing assembly face should be placed on a block of wood during the pressing operation to protect it. Discard thrust washers, thrust bearing and needle bearings and replace with new parts as parts may have been damaged when being pressed out.

If needle bearing (12) needs replacement use a bearing puller to remove needle bearing, care should be taken to not damage the housing assembly (6) face with the bearing puller.

TOROMOTOR ASSEMBLY

(Reference Figure MAB-200-2)

Important: Before starting assembly, clean all parts with a clean petroleum base solvent and air dry. Do not wipe dry with rags. Be sure all dried paint lips have been removed from edges of lapped surfaces. Unless otherwise indicated, do not oil or grease parts before assembly. Note: Lubricate All Seals before assembly with SAE 10W-40 SD oil or clean grease.

- In a vise, clamp down on the housing assembly (6) port bosses with the small bore end pointed up.
 Assemble new seal (5) with lip side inward, assemble shim (4), spacer (3) and retaining ring (2). Be sure the rounded edge of the retaining ring (2) is faced inward.
- 2. Apply a small amount of clean grease to the back side of new dirt seal (1) and assemble into housing assembly (6).
- Remove housing assembly (6) from vise, turn over and reclamp in vise with large bore end up.
 *** See Note.)
- 4. Apply "Scotch" tape around splines or keyway on coupling shaft (11) to prevent damaging seal (5). Assemble coupling shaft (11).
- 5. Assemble thrust bearing (13).
- 6. Assemble drive link (14).
- 7. Assemble wear plate (15).
- 8. Assemble rotor assembly (16) with counterbore in rotor (16.1) down.
- 9. Assemble manifold plate (17), manifold (18) and commutator ring (21).

- 10. Assemble commutator (19) and new bonded ring (20).
- 11. Assemble <u>new</u> seal rings (7) on housing assembly (6) and end cover assembly (23).
- 12. Apply a generous amount of "STP" to both ends on sleeve protector (22) and assemble over unit and onto unit and onto housing assembly (6). Make sure sleeve protector is setting in a non-cocked position.
- 13. Assemble end cover assembly (23) onto sleeve protector (22) in a non-cocked position.
- 14. Assemble seven special bolts (24) and screw in finger tight. Alternately and progressively tighten the seven special bolts to pull end cover assembly (23) and sleeve protector (22) down into place. (Torque the seven special bolts to 50 ± 5 ft. lbs.)

*** NOTE

If it was necessary to remove thrust washers (8), thrust bearing (9), needle bearing (10) and needle bearing (12), the following assembly procedure must be followed.

- 1. Assemble <u>new</u> thrust washer (8), <u>new</u> thrust bearing (9), <u>new</u> thrust washer (8) in this order into housing assembly (6).
- Press in new needle bearing (10) with suitable tools to a 2.365 ± .030 dimension into housing assembly (6). Note: Bearing should indicate which side to press against.
- 3. Press in new needle bearing (12) with suitable tools to a .18 ± .03 dimension into housing assembly (6).

 Note: Bearing should indicate which side to press against.

ROSS GEAR DRIVE MOTOR

VENDOR

(continued)

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TROUBLE SHOOTING

Trouble		Cause		Remedy	
Oil leakage	1.	Hose fittings leaking	(a)	Tighten fittings	
			(b)	Replace O ring in 7/8", 14 thread fitting	
	2.	Seal ring leak	(a)	Replace seal ring by disassembling motor	
	3.	Special bolt leakage	(a)	Tighten single bolt to 50 foot lbs.	
	4.	Faulty high pressure seal	Remove dirt seal, retaining ring Blow out seal. Replace seal.		
	5.	Coupling shaft and high pressure seal		lace coupling shaft and seal cage.	
High loss of speed,	1.	Lack of sufficient oil supply	(a)	Adjust faulty pressure relief	
under load.		suppry	(b)	Repair worn pump.	
			(c)	Use correct oil for temperature of operation.	
	2.	High internal motor leakage.	(a)	Replace worn rotor set with new rotor assembly	
			(b)	Replace worn commutator ring	
			(c)	Replace worn manifold	
			(d)	Replace worn wear plate.	
Low mechanical	1.	Line blockage	(a)	Replace blocked line.	
efficiency or undue high pressure required to operate TORQMOTOR	2.	Internal Interference.	(a)	Correct clearance of rotor set. (Replace rotor set)	

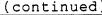
PARTS CATALOG

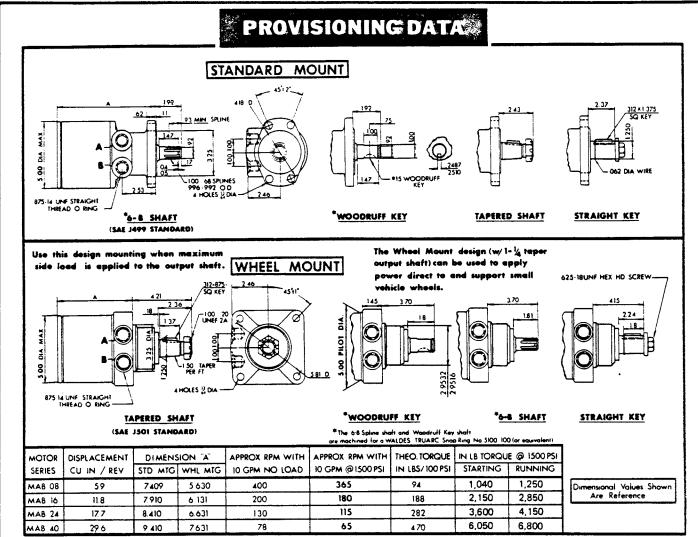
VENDOR

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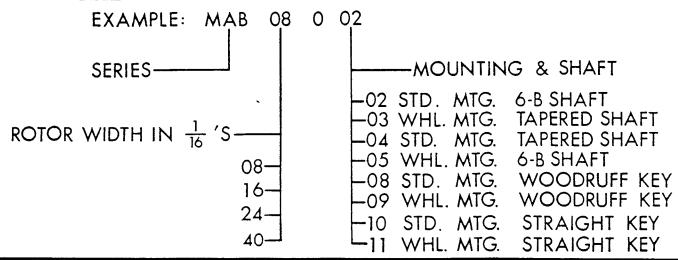




MAB TORQMOTOR

NOTE System Relief Valve Setting from 2,000-3,000 PSI Require Prototyping and Evaluation by Sales Engineer.

SPECIFICATION & IDENTIFICATION TAG GUIDE





SERVICE BULLETINS

As we make improvements to the MARKLIFTS, we like to supply you, the customer, with updated information which applies to your machine.

This section is provided as a place to store Service Bulletins as you receive them from MARK INDUSTRIES.