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CONSIDERATIONS FOR MAINTENANCE FOR MOVABLE BRIDGES....WHY SHOULD I PROTECT MY INVESTMENT ?

by

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INTRODUCTION

During the past thirty years in Marketing with GE, I have been involved in some manner in selling a product to a user customer. I have found that service is probably the word I use most often, particularily in dealing with distributors throughout the United States and joint visits to industrial users. That service means having information available to users of our equipment and access to parts needed by them. You are one of those users.

DEFINITION

The dictionary defines renewal as "the act of being renewed" and renew as "to make new or as if new again; to restore". So a renewal part would be something you would use to make your bridge new again. It's hard to realize that a simple contact tip could make a bridge new again--but if that bridge is stuck in the up-position because power won't flow to the motor to allow it to lower, and the new contact completes the circuit and operates the motor once again, then it is a "new" bridge particuliarly to the motorist who has had to drive an additional 10-20 miles to the next bridge.

Another word definition for our topic is replacement--"the act of being replaced" or "to place again". You can replace the contactor that contained the tip referenced above, or you can replace the control panel or you can replace the whole bridge. Each has a correspondingly increasing dollar cost that is justified by the results obtained. By the same token, the lack of replacement or renewal brings on a headache that neither aspirin, Tylenol, nor Advil will cure.

NEEDS

Let's look at the needs for equipment renewal and how you might approach them. And, although it doesn't matter whether it's an electrical component, which will be the basis of my discussion, or a light bulb or a gear, it still provides the same results, or lack of them. Renewal or replacement can be done on either a routine or emergency basis. Most of the time the practice of routine maintenance will eliminate the need for emergency.

As I see it, you can either do it yourself or you can contract with an outside firm to handle your routine maintenance either on a schedule or on-call basis. I believe that many of you work both--internal and contract. Those of you that don't do either probably end up with lots of emergencies--not a very pleasant situation.

Emergencies of course can be made less painful if you have good supply of parts at your disposal.

In my dealings with steel mills, the maintenance engineer prided himself in that he had a minimum of one each of every electrical device in stock. Critical items were stocked in quantity. Unscheduled downtime in a steel mill can cost thousands of dollars in lost production. This on-hand stock cut that downtime to a minimum, with little or no lost production. This was only a portion of the mill. Other sections had the same or similar stock.

Other large industrials handle their parts needs similarily or have a central parts warehouse on the property. They all have several things in common: they have a physical product to sell, they have competition, and can pass on operating costs direct to their customers.

Most of you do not share that commonality--you don't have competition and you don't have a product to sell. But wait a minute...you do have competition! Florida competes with Mississippi, with Louisiana and so on. Each state competes for the tourist dollar, for the industrial complex dollar, for the retirement dollar. Each brings income into the state coffers to help maintain and sustain the state.

And, you do have a product to sell...SERVICE and the lack of that service can affect your securing the tourist, industrial, and retirement dollar. True, it's a little far fetched, but that little lack of service when a bridge is non-operational added to the pot-hole in the road, added to the need for improved thoroughfare, added to...can adversely affect your selling ability. Maybe I'm philosophizing a bit, but it's a point worth considering--a needed part can be costly. If you don't have it, how can you get it? Is it still available and if so, where can you get it? If it's not available, is there a substitute?

Most companies such as mine provide many sources of parts information. A little earlier, I mentioned how certain maintenance engineers in the steel industry handled their

renewal/replacement parts. As an example as to how a similar mass-production industry handles its renewal parts procurement, I would like to show you how we or any other Original Equipment Manufacturer or OEM can present the product renewal/replacement scheme to a paper producer that will allow him to secure information and become knowledgeable on what should be stocked. Let's look at the following examples:

A Renewal Parts Quotation and Training document such as this manual would be prepared. The size of the document would vary from 1/2 inch thick to numerous 1 - 2 inch books depending on the complexity of the system. One steel mill system recently required several pallet loads of manuals.

This manual consists of the following:

(Exhibit 1)
A list of the equipment supplied on the order by item number, catalog number with a one line description of each.

(Exhibit 2)
A summary quotation of part catalog numbers used, usually in alpha-numeric assending order. It lists the total quantity in use and the quantity of maintenance spares recommended along with a price for each item. This quantity recommendation reflects historical experience on life-expectancy based on the number of operations, failure because of operator error and natural causes such as electrical storms.

Two things of note on this sheet are zero recommendations on complete assemblies (which will be covered next) and "*" critical spares. We used to quote critical or start-up spares as a separate item. These critical items were suggested as parts that should be on hand at start-up. They are now included with the regular maintenance spares since the start-up time is generally minimal with today's technology and computer simulated system operation during factory testing.

(Exhibit 3)
Here, we take a complete assembly or operational device and break it down into individual parts. These parts were listed in the recommended maintenance spares of the previous exhibit...for instance, the arc chute on the DS303 dc contactor.

(Exhibit 4)
A "where used list" takes all recommended parts, lists them in assending alpha-numeric order and tells you all locatons where they are used...sort of a reverse index.

Also included in the manual are complete material list of the systems, sections covering other GE components associated with this equipment that were supplied on this order with appropriate parts recommendations and instructions, as well as associated vendor items supplied including appropriate parts lists.

(Exhibit 5)
The last part of this manual contains standard-line parts bulletins. This bulletin contains a list of parts recommended for normal stock and a <u>complete</u> list of parts with a (Exhibit 6) three-dimensional construction sketch of these parts.

This paper mill maintenance department would undoubtedly purchase the recommended parts. Several avenues of purchase would be available to them:

1. With the purchase of the original equipment. This would allow them to include the cost with the initial outlay dollars, based on esitmates of similar equipment spares.

2. Later with the funds coming from the maintenance budget. This, however, would possibly eliminate having start-up spares available (depending on when purchased).

3. Have a local contract maintenance or distributor purchase and stock the parts.

The important thing is that they will have these parts on hand should the need arise.

A little closer to home, here are some drawings associated with the North Bridge at Ft. Pierce, Florida. The job was supplied in 1963 and is still operational. A look at the connection diagram would indicate that there are several areas where parts are important--main motor contactors, circuit breakers, overload relays, brake contactors, and so on. I'm sure that maintenance has been performed and parts replaced on that panel. If not, they have been fortunate because the number of ups and downs performed must run close to one million.

I have also been involved in the replacement of Thrustor mechanisms, the hydraulic actuator for brakes. Many of these date back to the 1930's. Although a few parts are still available for these 1930 vintage Thrustor actuators, they can be replaced in their entirety...and springs, brake shoes, and so forth are still available for the brakes.

It is important that you as bridge owners or maintenance engineers establish a similar stance on maintaining an adequate stock of parts for the continued zero downtime operation of your bridge. Decide if you want parts or assemblies. Often a replacement device can be less expensive than sets of parts, particularily when you consider manpower to perform the repair. Each of you must make arrangements to have parts available and/or make appropriate recommendatins to your management if you feel that your present method is inadequate and can be improved.

CONSIDERATIONS

Some important points to consider are

1. What is the value of the equipment you are trying to protect?

I would guess that you spend from one half to one million dollars in the installation of a new electrical/mechanical system for a bridge. It seems foolish to not protect that investment with an ample supply of spare parts.

2. What is the cost of downtime?

How can you put a dollar value on downtime? If you are a toll bridge owner, then this can be measured since all who normally pay that toll are taking alternate routes, although the lost value is relatively small in terms of dollars. But those who collect no tolls have to consider the points mentioned in my opening remarks. How much damage are you doing to user goodwill? That is a task for management or the govenor's office, but eventually it will affect you.

3. Is there a built-in time sequence delay in restarting the equipment that adds to the downtime?

This may add to aggravation for the individuals waiting to cross the bridge.

4. Where is the equipment located and how long will it take to get parts to it?

If it takes a helicopter trip to deliver parts to a remote location, time and money are added to the cost of doing business most of which cannot be recovered.

5. Where was the equipment originally manufactured and how long will it take to secure a second set of parts?

Let's assume that you have a stock of parts at your disposal and use one of them. You now need to replace that part. Where is your nearest access point--a local (or distant) distributor; the manufacturer and if the manufacturer, where is he located--the next state, the US, overseas??? If you have veen involved with off-shore parts procurement, you know that valuable time can be lost in getting purchases through customs, not to mention delivery time.

6. What is the manufacturer's policy on supplying renewal or replacement parts after a product has become obsolete?

Information on this policy should be made known to you at the time the original equipment is purchased. But, most of you are not involved at that stage and unfortunately, a poor replacement policy can really hurt you 5-10, 20, 40 years later. Most reliable manufacturers will provide wearable parts for several years after obsolescence and even then, obsoleted products have been replaced with a more modern up-to-date version using new technologies. Earlier I mentioned replacing brake shoes on fifty year old GE Thrustor actuated brakes. Those brake shoes now have a new non-asbestos material brought on by a government decree to protect us from the dangers of asbestos. As you can see, many things affect the manufacturer's ability to suppy renewal parts.

A typical policy would provide wearing parts such as contact tips or brake shoes for fifteen to twenty years and non-wearing parts such as structures and bases from zero to three years. Electronic parts are usually supplied for four to five years. This can vary all over the lot, but at GE, we are still supplying some parts for devices manufactured in the early 1900's.

An alternate method for reparing equipment is Repair and Return or Exchange Plan. This is particularily prevalent for the newer electronic hardware being used today. Many domestic OEM's provide this service at their manufacturing location or at strategically located repair facilities.

It's also possible that your maintenacne personnel, including the bridge tender, can provide a repair and return function, provided they have the parts or have a spare to work with. Changeout can be accomplished during slack operation hours.

Another point often overlooked is that equipment replaced by a new bridge or more modern equipment will be useable on another bridge that was not as lucky. It's likely that there will be a large inventory of used equipment that will serve as spare parts for the existing bridge. An example is the North Bridge at Ft. Pierce that I referenced earlier. A duplicate of the supplied electrical equipment was installed at Road No. 789 at Nokomis at the same time and there are probably others that are the same or similar.

PLANNED OBSOLESENCE

No manufacturer, except the auto industry, has planned obsolesence. But, you, as a bridge owner, should go under the assumption that someday the equipment you have on your bridge will be obsolete.

All of you should have a site inventory on hand...what equipment do you have at each site, how is it similar to other bridges under your jurisdiction and what spare parts are available at that or other locations. If you feel that you have insufficient parts to sustain your bridge for another 5, 10, 20, or 40 years, prepare a request for money to purchase the needed spare parts. You or your successor will be glad you did.

REMEMBER, THAT BRIDGE WILL BE WITH YOU FOR A LONG TIME...TREAT IT WITH CARE.

LIST OF CONTROL EQUIPMENT

FURNISHED ON

REQUISITION NUMBER: 541-_____

ITEM NO.	ML/CAT. NO.	DESCRIPTION
201,202	0506X0462G01	TOP WIRE FORMER REBUILD
301A	0506X0462G30	TOP WIRE DROP-IN
301B	0506X0462G31	TOP WIRE READOUT
301C,D	0506X0462G32	TOP WIRE OPERATOR DEVICES

DRIVE SYSTEMS OPERATIONS

1501 Roanoke Boulevard
Salem, Virginia 24153

EXHIBIT 1

QUOTE NO. LM9-D-870226-5 REQN. NO. 541-36979

ITEM NO.	PART CATALOG NUMBER		IN USE QTY	RECOMMENDED MAINT. SPARES QTY NET	TOTAL
A01	A25D100DA-TH RESISTOR		1	1	
A02	CR104PBG01R1 PUSHBUTTON		1	0	
A03	CR123C1.18A HEATER FOR OL RELAY		3	2	
A04	CR305X100A AUX CONTACT-1NO		4	4	
A05	CR306C002ZAAL AC STARTER NR	ASM	1	0	
A06	CR324C360F* OVERLOAD RELAY		1	0	
A07	DS303A5A01JXA003XM00 HEAVY DUTY DC CONTR	ASM	1	0	
A08	DS3800DDIB DB FOR NDIB		1	1	
A09	DS3800DPZA DB FOR NPZA		1	1	
A10	DS3800HACA ADDRESS CUSTOMIZE CD		1	1	
A11	DS3800HADA L-ADR DECODE CD		1	1	
A12	DS3800HPIE CARD		1	1	
A13	DS3800HPRC PULSE-RATE		1	1	
A14	DS3800HRRB RELAY OUTPUT DIG I/O		1	1	
A15	DS3800HSCD HIGH LEV NON-ISOL.		1	1	
A16	DS3800HSHB CPL SLAVE		1	1	
A17	DS3800NDID DRIVE INTERFACE		1	1	

EXHIBIT 2

ASSEMBLY EXPLOSIONS

CATALOG NUMBER	DESCRIPTION	QTY
CR306C00ZZAAL	AC STARTER NR	1
CR305X100A	AUX CONTACT-1NO	4
CR324C360F	OVERLOAD RELAY	1
15D21G2	COIL	1
187D350P1	MOV CONTACT SUPPORT	1
541A278P1	SPRING	1
546A301G53	CONTACT KIT	1
DS3820D0SD	DROP IN OP STA	1
DS3800DPZA	DB FOR NPZA	1
DS3800HPIE	CARD	1
DS3800HSHB	CPL SLAVE	1
DS3800NPZA	DOIS P.S.	1
305A4177P1	SWITCH	30
DS3828BA3DEEDGAAAGDD	MED HP PWR CONV	1
A25D100DA-TH	RESISTOR	1
DS303A5A01JXA003XM00	HEAVY DUTY DC CONTR	1
195B6285G2	ARC CHUTE	1
22D101G3A	COIL	1
259A5658G1	STAT-CONTACT TIP ASM	2
259A5663G1	MOVABLE CONTACT	2
259A5664G1	SHUNT ASSEMBLY	1
259A5676P1	SPRING	2
259A5677P1	SPRING	1
6960053G3	CONTACT KIT	2

EXHIBIT 3

WHERE USED LIST

CATALOG NUMBER	DESCRIPTION	WHERE USED
A25D100DA-TH	RESISTOR	
	MED HP PWR CONV	DS3828BA3DEEDGAAAGDD
CR104PBG01R1	OIL TIGHT UNIT	
	TOP WIRE OP DEVICES	506X0462G32000011
CR123C1.18A	HEATER FOR OL RELAY	
	TOP WIRE FORMER RBLD	506X0462G01F02181
CR305X100A	AUX CONTACT-1NO	
	AC STARTER NR	CR306C002ZAAL
CR306C002ZAAL	AC STARTER NR	
	TOP WIRE FORMER RBLD	506X0462G01F02180
CR324C360F	OVERLOAD RELAY	
	AC STARTER NR	CR306C002ZAAL
DS303A5A01JXA003XM00	HEAVY DUTY DC CONTR	
	MED HP PWR CONV	DS3828BA3DEEDGAAAGDD
DS3800DDIB	DB FOR NDIB	
	ELECTRONIC MODE	DS3828ME32Z21PA1ZA5L
DS3800DPZA	DB FOR NPZA	

EXHIBIT 4

RENEWAL PARTS

IC2800-Y100 CONTACTORS

Forms A, B, D, E, F, R, Y, AD, AE, and AF

NOTE:—When ordering parts for a form of the contactor not covered by this bulletin, give reference number, description of part, complete nameplate reading, and above bulletin (GEF) number. *Do not use catalog number when form for which the parts are needed is not covered by the bulletin.*

PARTS RECOMMENDED FOR NORMAL STOCK

Fig. No.	Ref. No.	Number Required for IC2800-Y100										Catalog Number	Description
		A	B	D	E	F	R	Y	AD	AE	AF		
1	1	1	1	1	1	1	1	1	1	1	1	----------	Operating coil (see table below)
	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	----------	Set of interlock contacts (see table page 2)
1	21	1	1	1	1	1	1	1	1	-	1	5354901	Movable contact
1	21	-	-	-	-	-	-	-	-	1	-	5904068G1	Movable contact
2	26	1	1	1	1	1	1	1	1	-	1	5352149P1	Stationary contact
2	26	-	-	-	-	-	-	-	-	1	-	5306170G1	Stationary contact
1	24	1	1	1	1	1	1	1	1	1	1	147A6193P1	Compression spring for movable contact
1	22	1	1	1	1	1	1	1	1	1	1	5304778G1	Shunt for movable contact
2	35	1	-	1	-	1	-	1	-	1	1	5195148	Arc chute side, right-hand
2	36	1	-	1	-	1	-	1	-	1	1	5195149	Arc chute side, left-hand

Δ If interlock is used, a quantity of one set is required for each interlock switch unit.

OPERATING COILS, PICK-UP RESISTORS, RECTIFIERS AND AUXILIARY CONTACTORS FOR IC2800-Y100 CONTACTORS

NOTE: The number following the form letters in the IC designation identifies the operating coils, pick-up resistors, rectifiers and auxiliary contactors. Each must be ordered separately from the table below.

EXAMPLE: IC2800-Y100A14 requires coil No. 14, Cat. No. 22D85G214A, pick-up resistor A50E250DA-TH, rectifier IC3500A403B3, and auxiliary contactor CR2810A14AC4.

Coil No.	Coil Catalog No.	No. Req'd	Pick-up Resistor	No. Req'd	Rectifier	No. Req'd	†Auxiliary Contactor	No. Req'd
2	22D85G201A	1	--------	-	------	-	------	-
2	22D85G201A	1	A50E1500DA/X103AE	1	6RS22PD12AHD1	2	CR2810A14AC4	1
2	22D85G201A	1	A50E2700DA/X103AE	1	6RS22PD12AHD1	2	CR2810A14AC5	1
2	22D85G201A	1	A50E3300DA/X103AE	1	6RS22PD12AHD1	2	CR2810A14AC6	1
3	22D85G202A	1	--------	-	------	-	------	-
3	22D85G202A	1	A50E375DA/X103AE	1	6RS22PB6AHD1	1	CR2810A14AC3	1
3	22D85G202A	1	A50E400DA-TH	1	IC3500A403B1	1	CR2810A14AC3	1
4	22D85G203A	1	--------	-	------	-	------	-
4	22D85G203A	1	A50E100DA/X103AE	1	6RS22PB3AHD1	1	CR2810A14AC2	1
4	22D85G203A	1	A50E100DA-TH	1	IC3500A403B1	1	CR2810A14AC2	1

† For auxiliary contactor parts refer to GEF-4210.

IC2800-Y100 CONTACTORS

COMPLETE LIST OF PARTS

Fig. No.	Ref. No.	Number Required for IC2800-Y100 A	B	D	E	F	R	Y	AD	AE	AF	Catalog Number	Description
1	2	2	2	2	2	2	2	2	-	2	2	N57P16008B	Connection screw for coil lead (10-32, 1 2 in. pan. hd. pro. fin.)
1	3	2	2	2	2	2	2	2	2	2	2	5956358	Terminal clamp for coil lead
1	4	1	1	1	1	1	1	1	1	1	1	8626009P2	Retaining washer for operating coil
1	5	1	1	1	1	1	1	1	1	1	1	5304780G1	Magnet core
1	6	1	1	1	1	1	1	1	1	1	1	N22P25012B	Screw fastening magnet core to magnet frame (3 8 in.-16, 3 4 in. hex hd. pro. fin.)
1	7	1	1	1	1	1	1	1	1	1	1	8650146G3	Magnet frame
1	7	-	-	-	-	1	-	-	-	-	-	8650146G4	Magnet frame
1	8	1	1	1	1	1	1	1	1	1	1	117A7300P1	Terminal for shunt connection
1	9	1	1	1	1	1	1	1	1	1	1	N62P25014B	Carriage bolt fastening terminal to magnet frame (3 8 in.-16, 7 8 in. pro. fin.)
1	10	1	-	1	-	1	-	1	1	1	1	5304773	Arcing horn
1	11	1	-	1	-	1	-	1	1	1	1	279A541P2	Screw fastening arcing horn to magnet frame
1	12	1	1	1	1	1	1	1	-	1	1	8067092P1	Stop plate for armature
		-	-	-	-	-	-	-	1	-	-	8067092P6	
1	13	2	2	2	2	2	2	2	2	2	2	N144P16010C	Screw with lockwasher fastening stop plate to magnet frame (10-32, 5 8 in. pan hd. pro. fin.)
1	14	1	1	1	1	1	1	1	1	1	1	8650024P4	Fulcrum plate for armature, stationary
1	15	2	2	2	2	2	2	2	2	2	2	N144P16010C	Screw with lockwasher fastening stationary fulcrum plate to magnet frame (10-32, 5 8 in. pan hd. pro. fin.)
1	16	2	2	2	2	2	2	2	2	2	2	8690535P2	Fulcrum retainer for movable fulcrum plate
1	17	4	4	4	4	4	4	4	4	4	4	N144P16008C	Screw with lockwasher fastening fulcrum retainer to magnet frame (10-32, 1 2 in. pan hd. pro. fin.)
1	18	1	1	1	1	1	1	1	1	1	1	6926385G2	Armature with support for movable contact
1	19	1	1	1	1	1	1	1	1	1	1	8650148P1	Fulcrum plate for armature, movable
1	20	4	4	4	4	4	4	4	4	4	4	N144P16008C	Screw fastening movable fulcrum plate to armature (10-32, 1 2 in. pan hd. pro. fin.)
1	21	1	1	1	1	1	1	1	1	-	1	5354901	Movable contact
		-	-	-	-	-	-	-	-	1	-	5904068G1	
1	22	1	1	1	1	1	1	1	1	1	1	5304778G1	Shunt for movable contact
1	23	1	-	1	-	1	-	1	1	1	1	279A541P2	Screw fastening shunt to movable contact
1	24	1	1	1	1	1	1	1	1	1	1	147A6193P1	Compression spring for movable contact
2	25	1	-	1	-	1	-	1	1	-	1	5306102G3	Blowout coil with support for stationary contact
2	25	-	-	-	-	-	-	-	-	1	-	117A7302G1	Blowout coil with support for stationary contact
2	26	1	1	1	1	1	1	1	1	-	1	5352149P1	Stationary contact
2	26	-	-	-	-	-	-	-	-	1	-	5306170G1	Stationary contact
2	27	-	1	-	1	-	1	-	-	-	-	9107563P2	Screw fastening stationary contact to support
2	27	1	-	1	-	1	-	1	1	1	1	N22P23012B6	
2	28	1	-	1	-	1	-	1	1	1	1	5354913	Magnet core for blowout coil
2	29	1	-	1	-	1	-	1	-	1	1	5354916	Insulation sleeve for magnet core
		-	-	-	-	-	-	-	1	-	-	5354916P2	
2	30	2	-	2	-	2	-	2	-	2	2	5354912	Insulation washer for blowout coil
		-	-	-	-	-	-	-	2	-	-	5354912P2	
2	31	1	-	1	-	1	-	1	1	1	1	5308781G2	Pole piece with stud, left-hand
2	32	1	-	1	-	1	-	1	1	1	1	5354915P2	Pole piece, right-hand
		-	1	-	1	-	1	-	-	-	-	5359172P2	Supporting block for stationary contact
		-	1	-	1	-	1	-	-	-	-	N22P25020B	Screw fastening supporting block to base (3 8 in.-16, 1 1 4 in. hex. hd. pro. fin.)
2	33	1	-	1	-	1	-	1	1	1	1	N26P23056B	Screw fastening pole pieces together (5 16 in.-18, 3 1 2 in. hex. hd. pro. fin.)
2	34	1	-	1	-	1	-	1	1	1	1	117A7149G1	Support for blowout coil lead
		1	-	1	-	1	-	1	-	1	1	117A7148G1	Arc chute, complete, with screws, nuts, and washers
2	35	1	-	1	-	1	-	1	-	1	1	5195148	Arc chute side, right-hand
2	36	1	-	1	-	1	-	1	-	1	1	5195149	Arc chute side, left-hand
2	37	2	-	2	-	2	-	2	-	2	2	N144P16024B	Screw with lockwasher fastening arc chute sides together
		1	-	-	-	-	-	1	-	1	-	728B3561P3	Base for contactor
		-	-	1	-	-	-	-	1	-	1	728B3561P4	Base for contactor
		-	-	-	-	1	-	-	-	-	-	728B3561P5	Base for contactor
		-	1	-	-	-	-	-	-	-	-	119A5423P1	Base for contactor
		-	-	-	1	-	-	-	-	-	-	119A5423P2	Base for contactor
		-	-	-	-	-	1	-	-	-	-	119A5423P3	Base for contactor
		1	1	1	1	1	1	1	-	1	1	728B536P2	Insulation for back of base
		-	-	-	-	-	-	-	1	-	-	728B536P6	Insulation for back of base

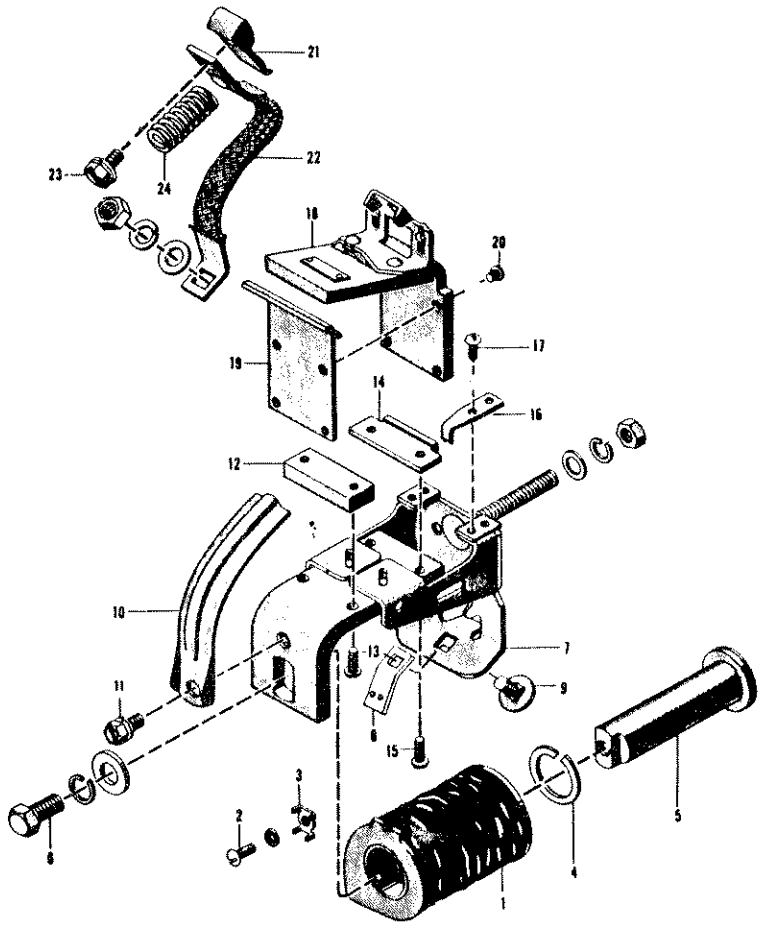

Fig. 1

EXHIBIT 6