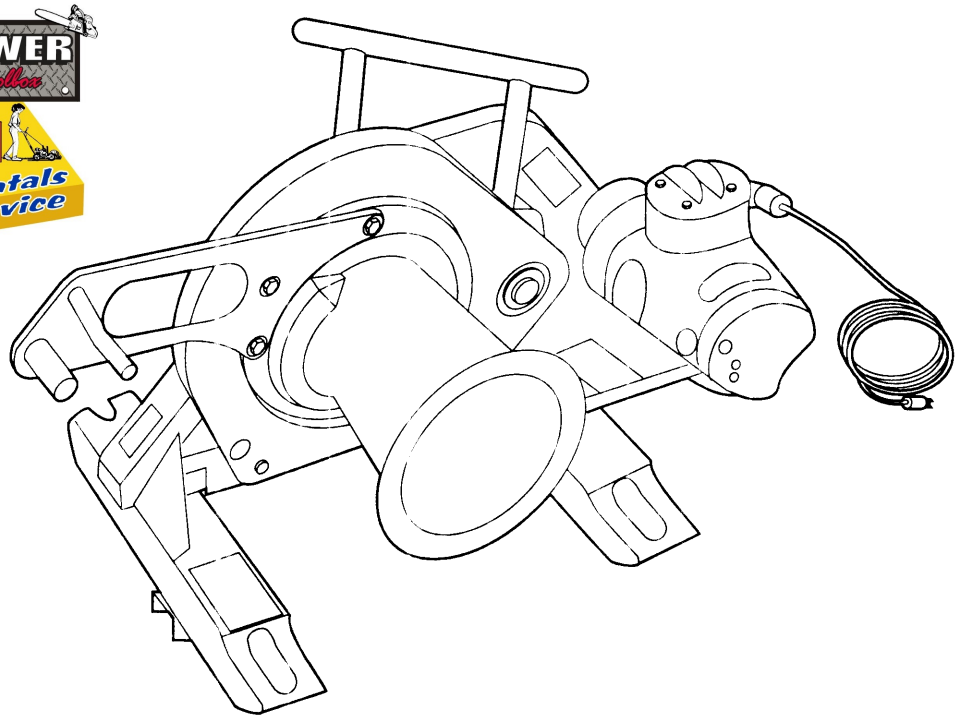
OPERATION, SERVICE AND PARTS INSTRUCTION MANUAL



GREENLEE® 640 TUGGER™

POWER CABLE PULLER

Read and **understand** this material before operating or servicing this puller. Failure to understand how to safely operate the puller could result in an accident causing serious injury or death. This tool should only be operated by qualified personnel.

FOR SERIAL NUMBERS BEGINNING AT: NZ-19000 EA

INSTALLATION OF 35336 Capstan Retrofit Kit Instructions begin on Page 27

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I. INTRODUCTION

- Greenlee has been recognized by the electrical industry as the leader in cable pulling. Over the decades, safety and operational instructions for all brands of pullers were provided to electricians by their trade groups. Recent changes in this traditional training role has created a need for this manual.
- This manual recognizes the fact that cable puller applications are unlimited in number and depend upon variables such as specific wiring layouts, the state of the surrounding structures, cable pull strategy, cable type and the cables or wires already present in the raceways. Because specific application instructions are not possible, this manual endeavors to provide general principles which will aid electricians in safely solving particular installation problems. Examples of puller applications received from our customers are included as a further guide to electricians.
- User experience provides the best feedback. We, at Greenlee Tool request input from experienced cable pullers concerning the contents of this manual and/or proposed additions to its contents. Send your comments and suggestions to the address below, attention advertising department #640 manual.
- Cable pulling involves a system. Such systems usually consist of cable reels, reel stands or dispensers, wire or cable grips, pulling rope, lubricant, a cable puller, sheaves and cable rollers. The cable puller, which is one component in the overall system, is the main focus of this manual.
- This manual is designed to make your job easier. However, there is nothing more important than the safety aids and instructions that are found throughout this document. The Safety Alert Symbol is used to identify topics of primary safety concern wherever they appear. Further, a separate section has been included, "Safe Operating Practices," which deals exclusively with accident prevention concepts.

II. PURPOSE OF THIS MANUAL

Greenlee has sold thousands of cable pullers over the years. We can not calculate the countless times these pullers have been used in the field. We feel that our record of safety has been very good. But accidents do occur, albeit infrequently. It is a fact that unsafe operation of this tool can cause serious injury, or even death (although we are unaware of any) under extreme circumstances. Therefore, it is important that users of the pullers operate the tool safely.

This instruction manual is intended to familiarize electricians and maintenance personnel with the operation, safety and servicing procedures associated with the Greenlee 640 Tugger™ Cable Puller. Your comments are welcome.

This manual should be kept available to operating and maintenance personnel. For additional copies at no charge order 999 9765.7.

⚠ DANGER:

A person who has not read and understood all operating and safety instructions is not qualified to operate the machine.

DO NOT OPERATE THE 640 TUGGER™ CABLE PULLER unless you understand how to use it safely.

SAFETY ALERT SYMBOL

The symbol above is used to call your attention to instructions concerning your personal safety. Watch for this symbol. It points out important safety precautions. It means "ATTENTION! Become alert! Your personal safety is involved!" Read the message that follows and be alert to the possibility of personal injury or death.

The use of any industrial tool may present hazards which can result in serious injury or death. The 640 Tugger™ Cable Puller is no exception.

⚠ DANGER:

Indicates a high probability that death, severe bodily injury or major property damage could result.

⚠ WARNING:

Is serious but less inevitable. There is some probability that death, severe bodily injury or major property damage could result.

⚠ CAUTION:

Is less serious but still demands attention. Indicates a hazard which may result in minor injury or property damage.

This section of the manual entitled "Safe Operating Practices" contains information for your protection, safety and quick reference. Always review this section, "Safe Operating Practices" before setting up and operating the #640 Tugger™ Cable Puller. We request your comments, suggestions and additions to this material.

Additional copies of this manual are available upon request at no charge.

III. SAFE OPERATING PRACTICES

SAVE THESE INSTRUCTIONS

This section has been designed to address many of the safe operating practices.

A. Safety First

- The information in this manual is essential for the safe operation of the Tugger™ Cable Puller. The manual must be read and understood before operating the puller or other equivalent training must be provided.
- The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury. Ref: 29 CFR 1926.21 (b) (2)
- It is understood that safety rules within individual companies vary. If a conflict exists between the material contained in this manual and the rules of a using company, the more stringent rules should take precedence.
- When using electric tools, such as a cable puller, basic safety precautions should always be followed to reduce the risk of fire, explosion from sparks, electric shock, and personal injury.

B. Tugger™ Safety Features

1. Anti-Reversing Capstan Mechanism
2. Guards on Drive System
3. Three-Prong Grounding Plug
4. Guarded On/Off Power Switch
5. Internal Force Limiting Drive Chain
6. Combination Handle/Cleat (rope tie-off)
7. Rope Overlap Prevention System
8. Tapered Capstan for Rope Tension Release

⚠ DANGER:

A person who has not read and understood all operating and safety instructions should not operate the 640 Tugger™ Cable Puller.

C. Planning The Pull

(Instructions on page 10)

⚠ WARNING:

Keep pulling rope confined to conduit wherever possible. Exposed rope can whip violently when broken.

⚠ WARNING:

Always operate in well lit areas.

⚠ DANGER:

Do not operate in hazardous or combustible environments as a fire or explosion could result from sparks or other means.

⚠ WARNING:

All components used in the pulling system must be able to withstand the maximum pull forces. Use only the properly rated components.

⚠ DANGER:

Never stand directly under a vertical pull. Keep that area clear of all personnel.

⚠ CAUTION:

Inspect all pulling system components before installation. Never use a worn, defective or incomplete component.

D. Tugger™ Installation

(Instructions on page 11 & 12)

Always recheck the security of the vise chain hold down devices prior to each pull, making sure the long vise chain pins are held deeply into the chain pockets. The use of cheaters, when mounting and tightening of the vise chains could cause the Tugger™ Cable Puller to break away under load causing serious injury or death.

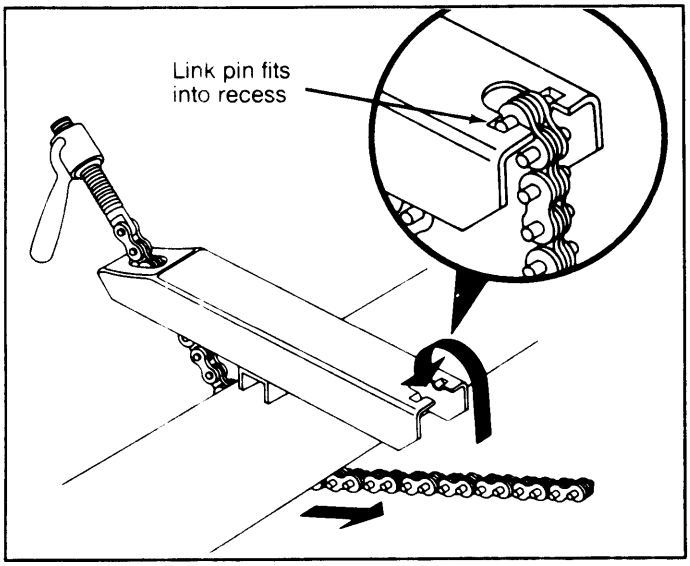


Figure 9 Chain Installation

⚠ WARNING:

Use caution when mounting vise chains around square corners. The vise chain must be uniformly tight at all points.

⚠ CAUTION:

Inspect all pulling system components before installation. Never use a worn, defective or incomplete component.

⚠ CAUTION:

It must always be possible to tighten the vise chain. Insufficient vise chain screw thread length will cause the handle nut to bottom out before the vise chain is tight.

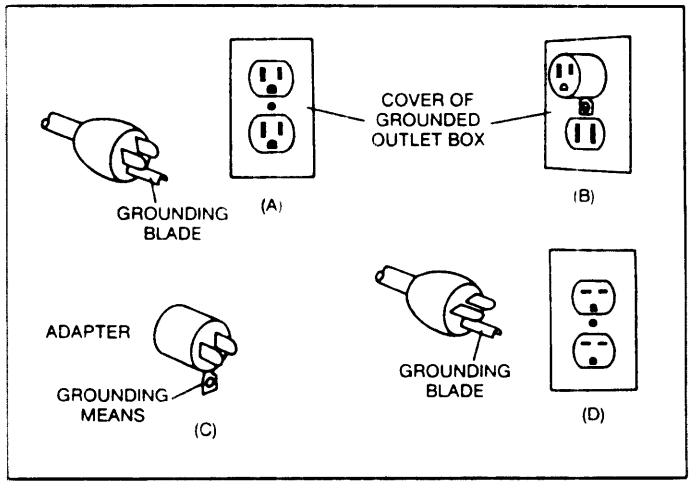
⚠ DANGER:

The mounting method which includes the vise chains, must be able to withstand the maximum pulling force. Components of a pulling system which break loose under load will fly violently and with great force. Never mount the puller onto an oversized fixed support.

E. Tugger™ Operation

(Instructions on page 12 & 13)

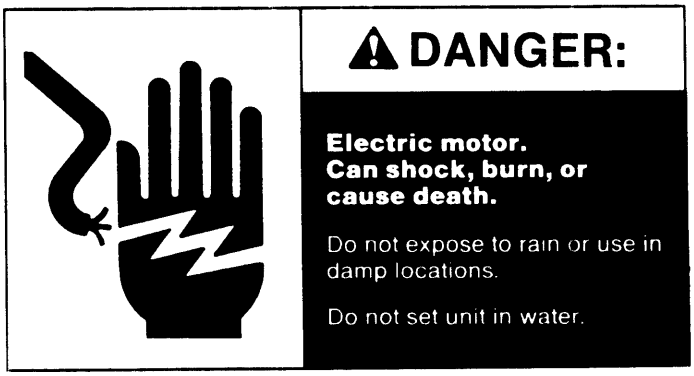
This tool should be grounded while in use to protect the operator from electric shock The tool is equipped with a 3-conductor cord and 3-prong grounding type plug to fit the proper grounding type receptacle. The green (or green and yellow) conductor in the cord is the grounding wire. Never connect the green (or green and yellow) wire to a live terminal. If your unit is for use on less than 150 V, it has a plug that looks like that shown in sketch (A) in Figure 10. If it is for use on 150 to 250 V, it has a plug that looks like that shown in sketch (D). An adapter, see sketches (B) and (C), is available for connecting sketch (A) type plugs to 2-prong receptacles. The green-colored rigid ear, lug, or the like, extending from the adapter must be connected to a permanent ground, such as a properly grounded outlet box. No adapter is available for a plug as shown in sketch (D).



Fgure 10 Grounding Methods

Use only 3-wire extension cords that have 3-prong grounding-type plugs and 3-pole receptacles that accept the tool's plug. Inspect periodically. Replace or repair damaged cords.

When tool is used outdoors, use only extension cords which are safe for outdoor use and are so marked.



⚠ WARNING:

Always stop the pull and tie off the tailing end of the rope to handle/cleat or fixed support if pull problems develop.

⚠ WARNING:

Rope at the capstan can crush a hand. Do not operate with loose clothing, hands and/or body on or near the rotating capstan.

⚠ WARNING:

Inrunning pinch point. Can cause crushing hand injury.

- Never operate with hands on capstan.
- Always stand with hands safe distance from capstan.
- Never add or remove wraps from rotating capstan.

⚠ WARNING:

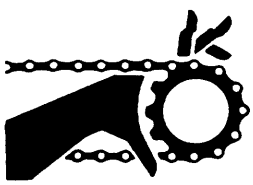
Do not operate the cable puller if the anti-reverse mechanism is not working. You must be able to hear the clicking of the anti-reversing pawl when the capstan is rotating.

⚠ DANGER:

This is an electrically operated tool — Never use in rain, damp locations, or where there are chemical materials or fumes. Disconnect power before servicing or repairing.

⚠ DANGER:

Do not operate without the chain guards in place.



⚠ WARNING:

Moving parts. Can cause severe injury.

Do not operate without chain guards in place.

⚠ WARNING:

The sudden failure of cable puller components can result in parts being thrown out at high speed.

⚠ WARNING:

Do not stand directly behind the load side of the rope. Position yourself and other personnel so that injury will not occur if any pulling system component would break loose during a pull.

⚠ WARNING:

Dropping hazard. Can cause severe injury or death.

Do not use Tugger as hoist. Use only for pulling cables.

F. Tugger™ Rope Handling

(Instructions on page 10 & 13)

⚠ CAUTION:

Use only rope rated for pulling force required, checking its condition frequently for damage. Damaged rope may break, causing eye injury, loss of balance and bodily injury.

⚠ CAUTION:

The rope should not approach the puller at an angle from the left or right of more than 5°.

⚠ WARNING:

Components other than rope contacting capstan could cause breakage resulting in eye injury, loss of balance and bodily injury.

⚠ WARNING:

Do not hold a load or maintain a stationary rope on the moving capstan. The heat generated may cause the rope to break suddenly.

⚠ WARNING:

Never allow the rope to wrap around your hands, arms or body. This could prevent quick release of the rope.

⚠ WARNING:

Keep pulling rope confined to conduit wherever possible. Exposed rope can whip violently when broken.

⚠ WARNING:

Inspect all pulling rope before using. Use of any defective (e.g. frayed, cut) or worn rope to complete a pull can result in a break, causing eye injury, loss of balance and bodily injury.

G. Tugger™ Maintenance

(Instructions on page 24)

⚠ CAUTION:

Keep tools clean for better and safer performance.

⚠ CAUTION:

Follow instructions for lubricating and changing accessories.

⚠ CAUTION:

Inspect tool cords periodically and if damaged, have repaired by authorized service facility.

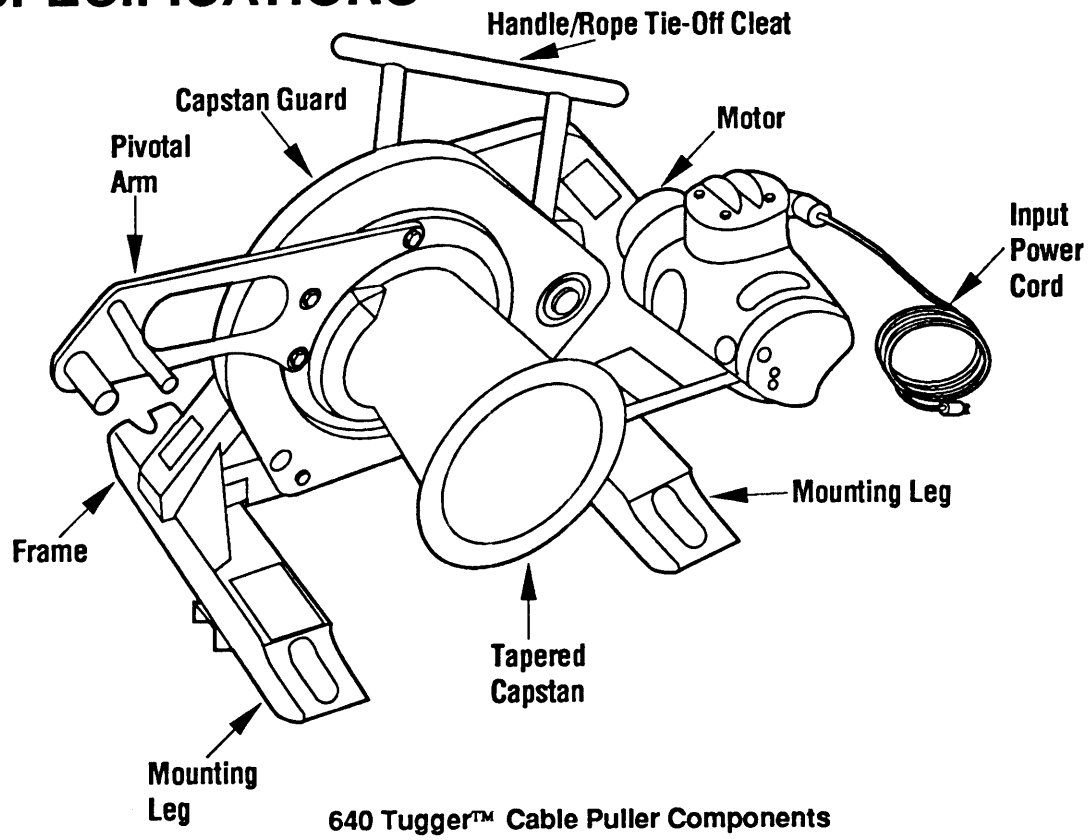
⚠ CAUTION:

Keep handles dry, clean, and free from oil and grease.

⚠ WARNING:

This is an electrically operated tool — do not dismantle or service the unit while puller is plugged into a power source. Hand injury, burns and electrical shock may result.

IV. PRODUCT SPECIFICATIONS



640 Tugger™ Cable Puller Components
Figure 1

640 TUGGER™ CABLE PULLER SPECIFICATIONS

Weight:
- Tugger: 68 lbs.
- Chains: 6 lbs.

Dimensions:
- Length: 22 in.
- Width: 14-1/4 in.
- Height: 17-3/4 in.

Drive Motor: One Horsepower

Power Source: 120V

Continuous Pull Force: 2,500 lbs.

Maximum Pull Force (7-10 minutes - motor may overheat): 4,000 lbs.

Speed (Feet Per Minute):
- No Load: 17 FPM
- 2,000 lbs: 13.5 FPM
- 4,000 lbs: 9 FPM

Required Rope:
- 9/16" Diameter; Double Braided Polyester Composite Average Breaking Strength: 16,000 lbs. (7258 kg)

OR

- 3/4" Diameter; Double Braided Polyester Composite Average Breaking Strength: 26,000 lbs. (11704 kg)

OR

- 7/8" Diameter; Double Braided Polyester Composite Average Breaking Strength: 32,000 lbs. (14515 kg)

V. PRINCIPLES OF CABLE PULLING

This section has been designed to help cable pulling personnel understand the high forces which can be encountered during a cable pull. Safe and efficient cable pulling requires a thorough understanding of the operation of the puller and accessories, and professional judgment. The demanding nature of the process is related to four characteristics:

1. Virtually every cable pulling application is unique with wide ranging differences. Therefore only trained experienced persons should be responsible for the setup and operation of a cable pulling system.
2. Forces as high as 16,000 **lbs.** may be developed at a point in the pulling system.
3. Enormous amounts of elastic energy are stored (rubber band effect) in the pulling rope. Stretched exposed rope, can whip violently when broken.
4. Control of cable pulling forces may be lost. Failure of any one of the system components, such as rope, chains, attachment structure, grips, sheaves, etc. could result in loss of control of cable pulling forces.

⚠ WARNING:

The sudden failure of cable puller components can result in parts being thrown out at high speed.

To aid operators in the management of these variables, this section on cable pulling principles has been incorporated into the manual.

A. CAPSTAN THEORY

The capstan is a "force multiplier". The resultant pull force produced by the operator's tailing force is dependent on the number of wraps of rope around the capstan as shown in the accompanying chart and formula. These figures are based on a coefficient of friction of .125 which is approximately the expected value for Greenlee recommended polyester multiplex and Double Braided Polyester ropes.

$$\text{PULL FORCE} = \text{Tailing Force} \times \underbrace{e^{0.0175\mu\Theta}}_{\text{(force multiplier)}}$$

where,

μ . . . coefficient of friction between rope and capstan

Θ . . . degrees of wrap of rope around capstan

e . . . is the number 2.7183.

No. of Wraps	Pull Force for Each 10 Lbs. of Tailing Force
1	21
2	48
3	106
4	233
5	512
6	1127

When a number of full wraps of rope around the capstan are used, for example, small operator tailing forces produce large pull forces. Only twenty pounds of operator tailing force will produce 1024 lbs. of pull force when five full wraps are used.

When five or six full wraps are used it is possible for an operator to "stall out" the motor if the wire or cable gets stuck. Approximately 50 lbs. of operator pull can develop the stall force with six wraps.

The operator's feel (tactile feedback) will be more sensitive with fewer wraps. This gives the operator control over the pull. The resistance of a cable changes during pulling for various reasons. The slip/stick behavior, frictional resistance, vertical and horizontal element and length of pull are principal reasons for the fluctuations. The operator continually adjusts his tailing force to account for these changes.

During normal pulling operations, when there is no operator tailing force, the slip/stick friction of the rope and the capstan will not be enough to allow any significant build up of pulling force. Therefore, no tailing force produces no pull force. This means that the operator is in complete control. The pull can be stopped by relaxing the tailing force. This is a safety feature unique to capstan pulling.

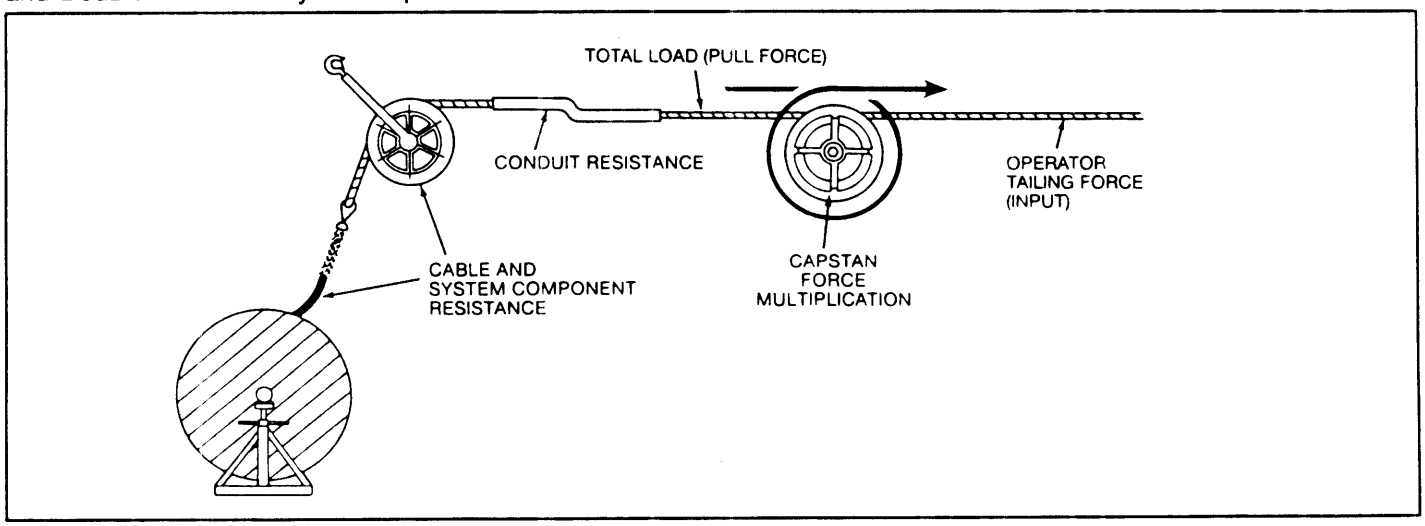


Figure 2 Typical Tugger™ Application

Either power failure or a broken internal drive chain will stop the cable pull. Because of the Anti-Reversing mechanism and the ability of a stationary capstan to resist large loads with a small holding force, complete control of the cable pulling system can be maintained by the operator.

If the capstan rotates while the rope is stationary both rope wear and increased temperature will occur. This could cause the rope to break

Do not hold a load or maintain a stationary rope on a rotating capstan. Switch off the motor and hold the tailing end of the rope or wrap the tailing rope around the combination cleat/handle or tie off the tailing end of the rope to an external structure:

⚠ WARNING:

Do not hold a load or maintain a stationary rope on the moving capstan. The heat generated could cause the rope to break suddenly.

Figure 2 shows two very different types of pulling resistance that must be overcome by the pulling force. The gravity resistance arises from the weight of the cables in a vertical run; it represents a constant force that is always ready to completely reverse the pull. On the other hand, the frictional forces in the trays or conduits merely resist movement —forward or backward. When the pulling force is relaxed, the friction tends to hold the cables in a fixed position.

B. ANCHORING THE PULLER

- Securing a puller requires that the vise chains and the object to which the puller is attached have sufficient strength to withstand the maximum pulling force.

⚠ DANGER:

The mounting method which includes the vise chains, must be able to withstand the maximum pulling force. Components of a pulling system which break loose under load will fly violently and with great force.

- The direction of the force on the fixed support follows **exactly** the direction of the pulling load rope. As shown in Fig. **3,** the pulling load rope may point in any direction of the clock.

As shown, the force on the support is both **up** and **toward the left.**

- The anchoring system on the Tugger™ cable puller consists of the frame, vise chains, clamps and the chain pocket. The frame resists the Tugger™ cable puller being pushed into the support surface as it would be when the pulling load rope pulls in the 6 o'clock direction. When the pulling load rope is in the 12 o'clock direction, which is not recommended, the chains resist the Tugger™ cable puller loads. In all other directions of the pulling load rope, there exists a force component parallel to the support surface that will tend to slide the puller. This sliding is resisted by friction between the support structure and both the frame and vise clamps. Tightening the chain clamps increases the sliding resistance.

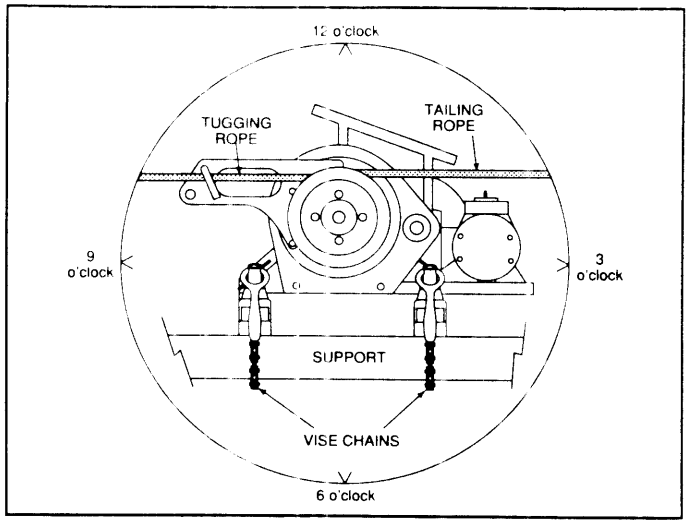


Figure 3 Pull Directions

⚠ CAUTION:

Use caution when mounting vise chains around square corners. The vise chain must be uniformly tight at all points.

- In addition the hardened edges of the vise chains dig into whatever they are attached to. This helps keep the puller securely in place.
- Effective chain clamping requires only that the chain pins be driven and held in the chain pockets using hand pressure on the vise chain handles. Reasonable uniform chain tension is sufficient. Do not substitute a different style or length of chain than originally supplied as it may not sit in the chain pocket correctly.

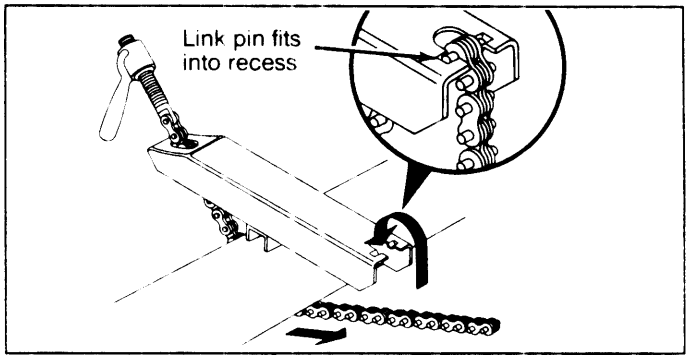


Figure 9 Chain Installation

C. ANCHORING SHEAVES

Sheaves are used to change the direction of the pull. The sheaves are hooked onto fixed supports which must resist the combined pull of both the entering and exiting forces from both sides of the sheave.

⚠ DANGER:

The mounting method which includes the vise chains, must be able to withstand the maximum pulling force. Components of a pulling system which break loose under load will fly violently and with great force.

Note: The structures supporting the sheaves may have to resist as much as twice the pulling force.

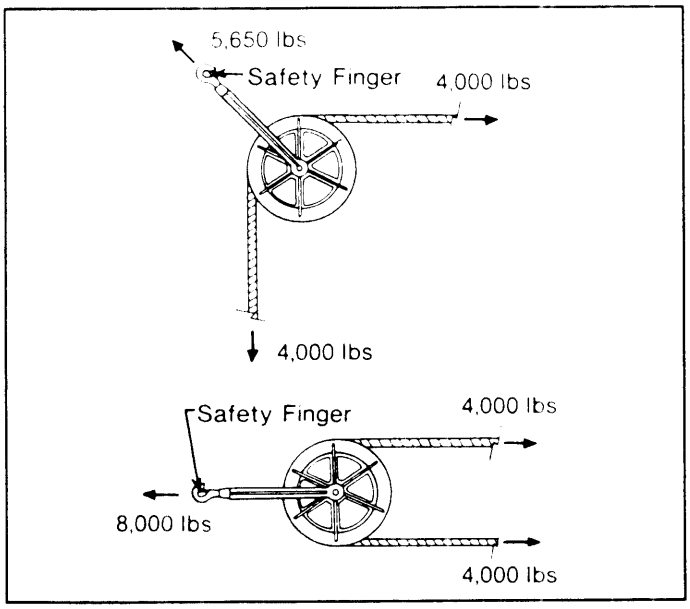


Figure 4 Sheave Forces

D. ENERGY

The product of a force moving through a distance is energy and may be measured in foot-lbs. Energy is stored in a rope when the load causes the rope to stretch. Failure of the rope or any other component of the pull can cause sudden, uncontrolled release of the energy stored in the rope. This could result in serious injury.

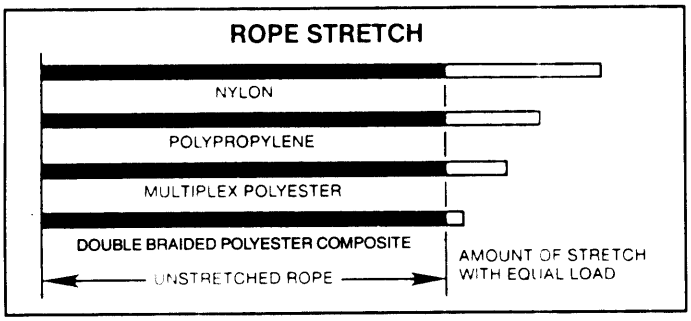


Figure 5 Load-Stretch Diagram

For example, think of a 100 foot length of nylon rope with a 10,000 lbs. breaking strength. Such ropes can stretch 40 ft. before breaking, releasing 200,000 ft-lbs of energy. This could throw an automobile seven stories into the air. Multiplex rope of equal strength to the above mentioned nylon rope will throw an automobile less than two stories high.

⚠ WARNING:

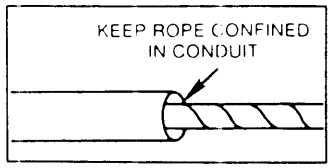
The sudden failure of cable puller components can result in parts being thrown out at high speed.

When rope is unconfined, a break or cut results in almost all of the resilience being converted into energy of motion (kinetic energy). This accounts for the whipping action commonly observed. Rope which is confined in conduits or trays will make contact upon unloading and drag itself against the constraining surfaces. The resulting friction converts the resilience into heat without the attendant whipping action.

Cautious cable pulling practices may dictate pulling cable in shorter segments to eliminate long spans of uncontrolled rope.

⚠ WARNING:

Keep pulling rope confined to conduit wherever possible. Exposed rope can whip violently when broken.



Summary

1. If the puller or its supporting structure break away, the stored rope energy may cause objects to fly
2. Energy can be better controlled where the pulling rope is confined in the conduit
3. Rope is a very critical link in the cable pulling system. Select a rope that has a PULLING LOAD RATING greater than the estimated forces required for the pull. Ropes which exhibit minimum stretch when loaded minimize the stored elastic energy.

The required ropes for 640 pulling applications are; 9/16", 3/4" or 7/8" Double Braided Polyester Composite Pulling Rope.

VI. OPERATIONAL INSTRUCTIONS

This section has been designed to address steps to be taken when operating the cable puller and accessories.

A. Planning the Pull

Pulling is a serious operation which makes preplanning very important. When designing the pulling system, these are some of the considerations:

- How long should each pull segment be?
- Which direction should you pull from and to?
- Is the rope and conductor contained by the raceway?
- Is the conduit or raceway sized properly to meet the NEC codes?
- Is there enough room for the puller operator, feeding end personnel and observers to work safely?
- Is there clear communication established between all members of the pulling crew?
- Do the components of the pulling system have the proper load rating?
- Do your pulling system components act as force multipliers?
- Are all the needed system components available and in safe operating condition?
- Are the structural elements to which the pulling systems components will be attached of sufficient strength?
- Is there enough manpower available to conduct a safe pull?

Each pulling situation is unique so that additional considerations may be required for a specific pull. Preplanning will assist in conducting a safe pull.

The Greenlee Cable Run Designer computer program can assist in this preplanning.

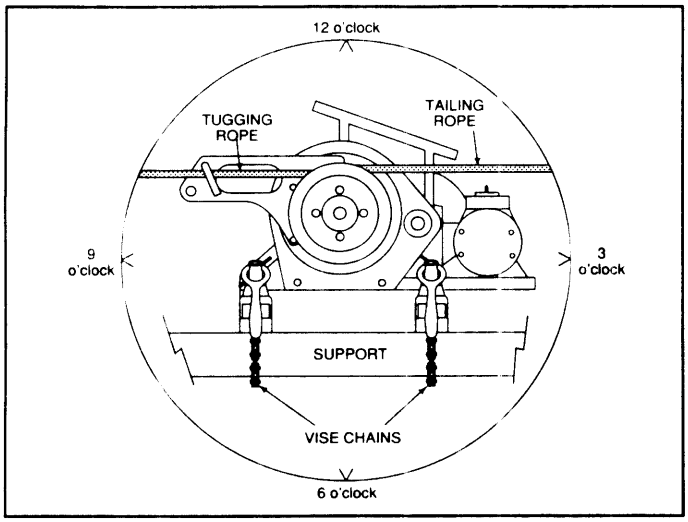
B. Installing The Tugger™ Cable Puller

⚠CAUTION:

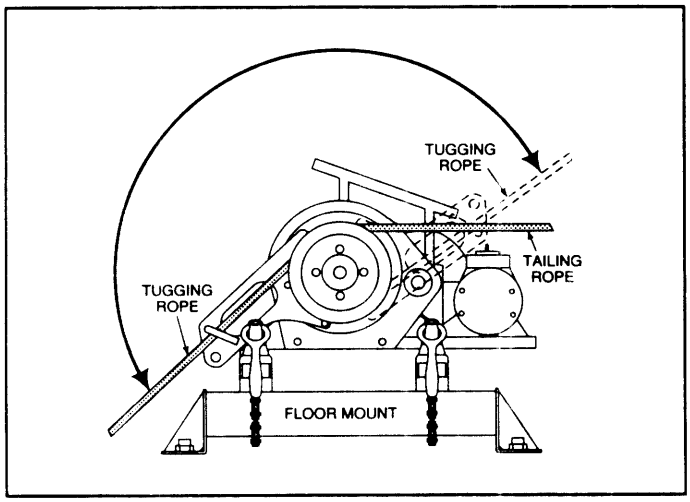
Inspect all pulling system components before installation. Never use a worn, defective or incomplete component.

Therefore before installation carefully inspect all pulling system components for damage, excessive wear, proper maintenance and proper operation. Replace any defective component.

1. Secure the Tugger™ Cable Puller to a fixed support that will withstand a force of 8000 lbs. in the direction of the load line on the capstan.

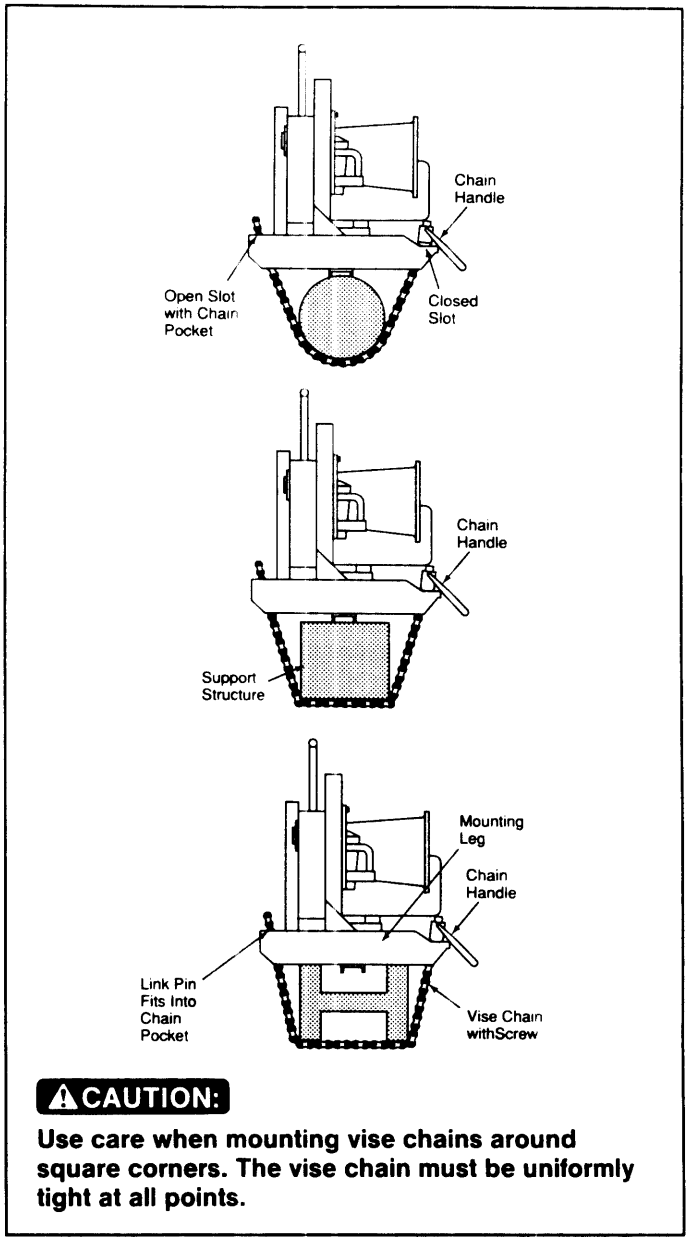


Always position the puller with a support structure that results in a line of pull parallel or into the support structure. NEVER pull directly against the mounting vise chains.



⚠DANGER:

The mounting method which includes the vise chains, must be able to withstand the maximum pulling force. Components of a pulling system which break loose under load will fly violently and with great force. Never mount the puller onto an oversized fixed support.



⚠CAUTION:

Use care when mounting vise chains around square corners. The vise chain must be uniformly tight at all points.

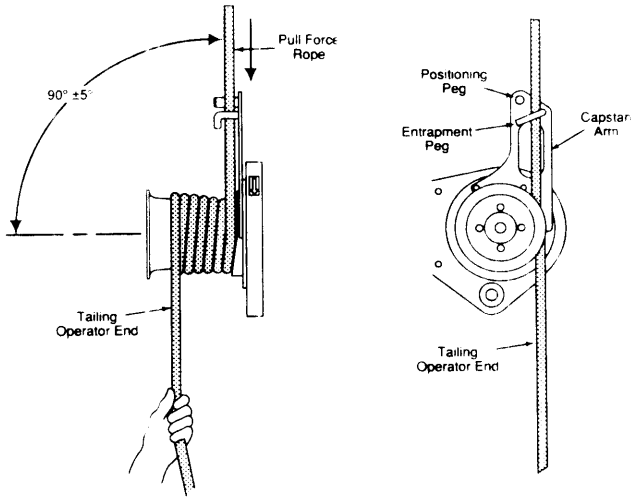
Figure 6 End Elevation/Typical Mounting Setups

2. Position the Tugger™ cable puller so that the rope from the pull run lines up with the capstan as shown in Fig. **7**.

3. Install chains as shown on page nine by first inserting the vise chain into the closed slot. The end of the chain, without the screw, is then inserted into the open slot so that the long chain pins fit into the chain pockets.

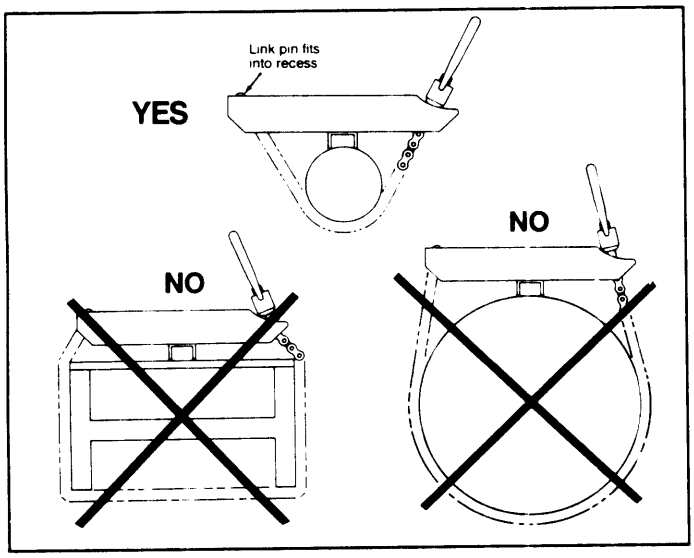
4. The spherical end of the handle nut must be seated fully in the closed slot and all threads in the handle nut must be engaged.

5. It must always be possible to tighten the chain.
   a. Be sure the handle nut has not bottomed out on the bottom of the vise chain screw —otherwise, you will not be able to tighten the chain sufficiently for secure attachment of the puller.
   b. Circular supporting structures must not be smaller than 2" or larger than 10" in diameter.



⚠ WARNING:

Inspect all pulling rope before using. Use of any defective (e.g. frayed, cut) or worn rope to complete a pull can result in a violent break, causing eye injury, loss of balance and bodily injury. Remember the rope is only as strong as its weakest point.



⚠ WARNING:

The vise chain pin must always be completely seated in the frame chain pocket.

6. Tighten the vise chain handle by hand. Do not use tools or "cheaters" to tighten.

7. Inspect the vise chain and associated hardware before each application. Do not use if there is any visible sign of damage.

8. Locate personnel out of the danger area as the puller, system components and/or supporting structure may break away. The travel will generally be in the direction of the pull force rope.

9. Whatever methods used to secure the Tugger™ Cable Puller, they must provide strength equal to the vise chain system. Particular concern should be exercised when cable pullers are mounted to concrete surfaces. The fastening variables are very difficult to control, such as the cure of the concrete, the type and size of the anchors and the effectiveness of the anchor installation.

C. Tugger™ Cable Puller Operation

Before operation inspect the pulling system setup for proper mounting to withstand the expected pulling force.

1. With the 640 Tugger™ Cable Puller motor off, the unit (and accessories) in place and secure, feed the rope over the positioning peg and through the L-shaped entrapment peg, along the capstan arm and wrap the rope around the capstan starting next to the rope positioning ramp as shown in Figure 7. Never pull cable with the rope wrapped from the outside end to the inside end of the capstan as this will defeat the rope anti-overlap system and can damage the puller. The arm and ramp incorporated to the capstan is designed to prevent the dangerous and costly phenomenon of rope overlap which would cause the pull to stop. The ramp forces the first wrap of rope outward on the capstan to allow an unobstructed path for the incoming rope, thus preventing it from crossing over the first wrap of rope. The arm assures that the rope will always feed onto the capstan at the proper angle. It is important that this system not be circumvented for any reason or the capstan will not operate properly. If the arm is not straight repair or replace before proceeding. Only approved pulling rope through the arm or onto the capstan.

Dual Pulling: some situations may require the use of two Greenlee Cable pullers operating in parallel. The pullers must be setup to operate in parallel, **not** in series. A proper parallel pull requires that each puller be attached to the cable using separate ropes, separate grips and possibly independent accessories in order to avoid overloads. Never exceed the pulling ranges of each individual puller.

3. Rope Tension: During the pull, the pulling force and speed can be reduced by decreasing the force exerted on the tailing end of the rope and allowing the rope to momentarily slip on the capstan. The pulling force and speed can be increased by increasing the tailing force exerted on the rope until the rope does not slip on the capstan. More wraps of rope on the capstan will allow greater pulling force with less operator effort; however, more wraps will make the puller less responsive to operator control. Use only as many wraps as required to comfortably make the pull.

⚠ CAUTION:

Be alert to how the rope enters the capstan. Do not allow it to lap or cross over itself.

NOTE: Allowing the rope to slip on the capstan may accelerate the rope wear. Check rope condition frequently.

⚠ WARNING:

Do not hold a load or maintain a stationary rope on the moving capstan. The heat generated could cause the rope to break suddenly.

4. The clicking noise heard accompanying capstan rotation comes from the anti-reversing mechanism which keeps the capstan from reversing in the event of a power failure or breaking of the drive chain.

⚠ WARNING:

Do not operate the cable puller if the anti-reverse mechanism is not working. You must be able to hear the clicking of the anti-reversing pawl when the capstan is rotating or the capstan can reverse.

5. Do not allow anything other than rope to contact the capstan. Do not use wire rope on the capstan, because it causes excessive wear and capstan grooving.

6. Always observe the rope winding onto the capstan. Do not allow the rope to climb up or cross over itself.

7. Do not pull cable grips or clevises over the capstan of the puller. Tangling may result and damage to the soft aluminum capstan may occur.

⚠ CAUTION:

Rope at the capstan can crush a hand. Do not operate with hands or body near the rotating capstan.

8. There is a pinching hazard at the pinch point formed where the tugging line first engages the capstan. To control this hazard,

a. Never operate the puller with loose clothing and/or hands on or near the capstan.

b. Always stand so that hands are a safe distance from the capstan.

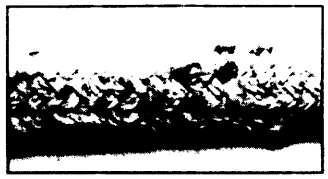
c. Never add or remove wraps from a rotating capstan.

9. If any problem develops with the pull, always stop the motor and tie off the tailing rope to the **handle/cleat** on the Tugger™ Cable Puller or to a fixed support.

10. Check the condition of the rope frequently. Never use a rope which shows visual signs of damage.

INSPECT ROPE

Cut Rope



Worn, Frayed Rope

⚠ WARNING:

Inspect all pulling rope before using. Use of any defective, frayed, cut or worn rope to pull can result in serious injury or death.

D. The Tailing Rope

1. The rope that is pulled off of the capstan is known as the tailing rope.

2. When the tailing rope is relaxed, rope stretch will pull the rope in the opposite direction. This will cause the tailing rope to be pulled toward the capstan with forces sometimes equal to or greater than the load. In pulls where a large part of the run is vertical all of the tailing rope could be pulled back.

⚠ WARNING:

Never allow the rope to wrap around your hands, arms or body. This could prevent quick release of the rope.

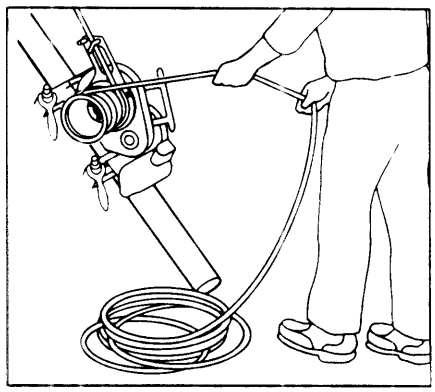
3. Personnel entangled in the tailing rope may be pulled rapidly into the capstan.

a. Therefore never wrap the tailing end of the pulling rope around arms, waist or any other part of the body during the pull. This can restrict the safe release of the rope.

b. Do not allow personnel or objects to become entangled in the tailing rope accumulated in the area.

c. Hardware attached or close to the tailing rope, such as takeup reels, may strike personnel.

d. Tailing rope should be coiled in an area in front of the operator. If the coil is pulled toward the capstan, it will not strike the operator.



4. Rope off the area beneath a vertical pull. Falling cable from a vertical run could cause injury to anyone in the area beneath the vertical run.

⚠ WARNING:

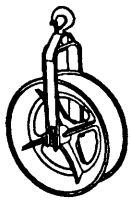
Never stand directly under a vertical pull. Keep that area clear of all personnel and equipment.

VII. ACCESSORIES FOR THE 640 TUGGER™ CABLE PULLER

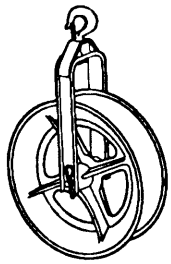
Accessories used with the 640 Tugger™ Cable Puller should have a rating suitable for the application.

Hook Type Cable Sheaves

Greenlee Number 651 12" Hook-Type Cable Sheave



Greenlee Number 652 18" Hook-Type Cable Sheave

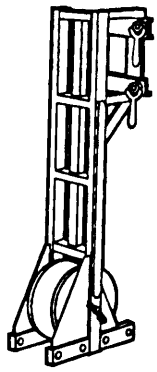


Greenlee Number 653 24" Hook-Type Cable Sheave

Hook-type sheaves can be used to change direction of cable under pull, to suspend cable on long spans or to keep cables bunched together for overhead pulls.

Pipe Adapter Sheave

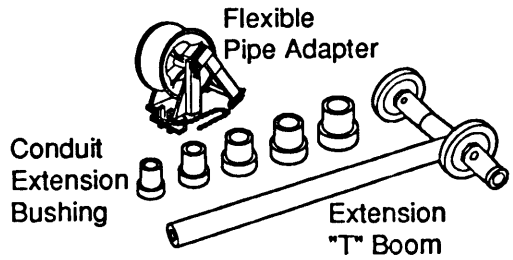
Pipe Adapter Sheaves allow the 640 Tugger™ Cable Puller to be rapidly attached to conduit for pulling and feeding cable or wire into conduit. The sheave guides the cable and keeps it straight.



Greenlee Number 649

Extension Boom Kit

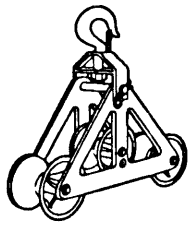
Greenlee Number 682



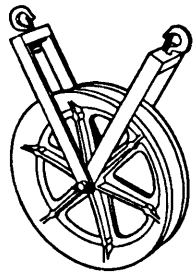
(Includes the 685 Flexible Pipe Adapter and Extension Bushings)

Flexible Pipe Adapters and Mobile "T" Boom keep pulling force in line with the conduit and reduces strain on hangers or boxes. They are applicable for both vertical and horizontal pulls.

Triple Sheave Cable Guide



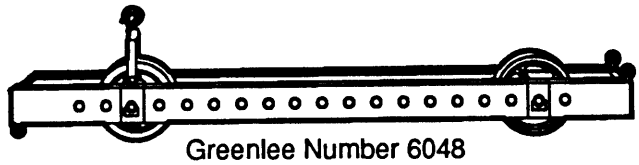
Greenlee Number 6036 Triple Sheave Cable Guide



Greenlee Number 639 Right Angle Twin-Yoke

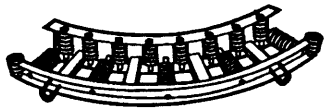
The right angle twin-yoke and triple sheave guides cable around bends in trays and protects trays and hangers from heavy pulling forces.

Manhole Sheaves

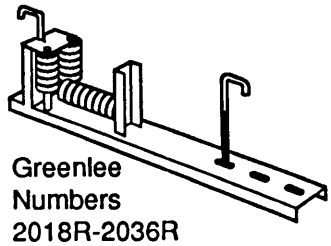


Greenlee Number 6048

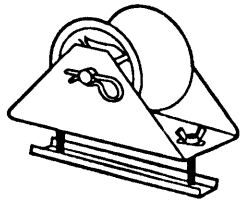
Cable Roller and Tray-Type Sheaves



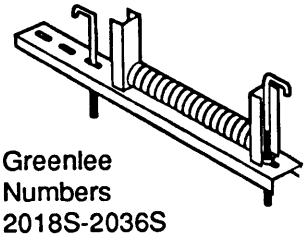
Greenlee Numbers 20249R and 20369R



Greenlee Numbers 2018R-2036R



Greenlee Numbers 658 and 659

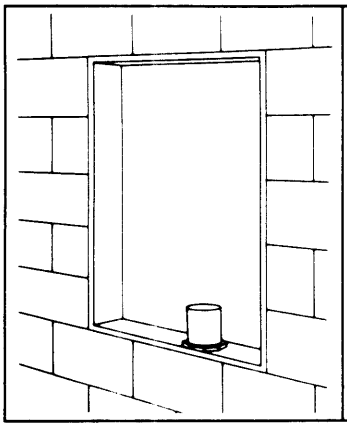


Greenlee Numbers 2018S-2036S

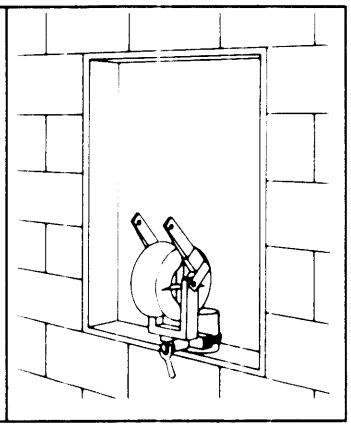
VIII. TYPICAL APPLICATIONS

Illustrations of typical setups are shown in this section. Proper set up in actual applications may require variations from these examples. All accessories used in conjunction with the 640 Tugger™ Cable Puller should have a rating suitable for the application.

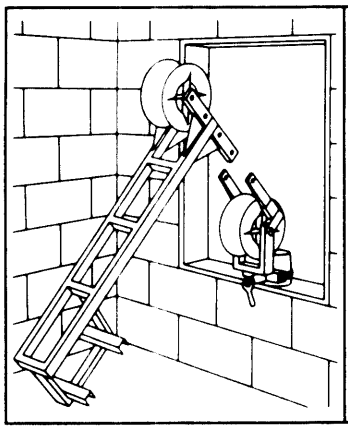
"Up" Pull Through Concealed Conduit



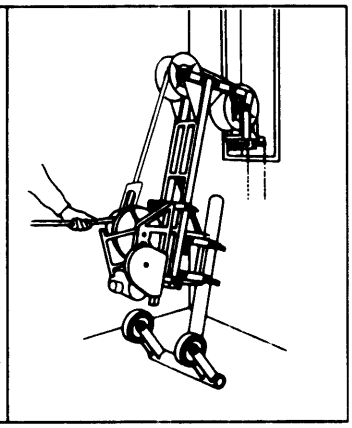
"Up" Pull through concealed conduit with 640 Tugger™ Cable Puller System.



Attach Pipe Adapter with proper extension bushing to end of conduit (before attaching extension bushing, remove nut from end of conduit).

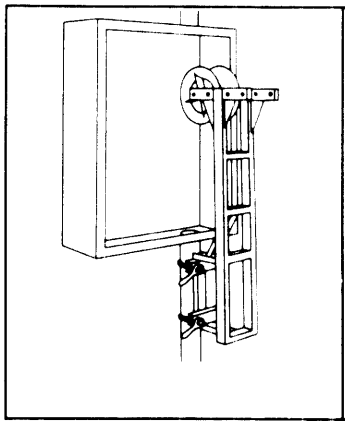


Attach Pipe Adapter Sheave to Flexible Pipe Adapter.

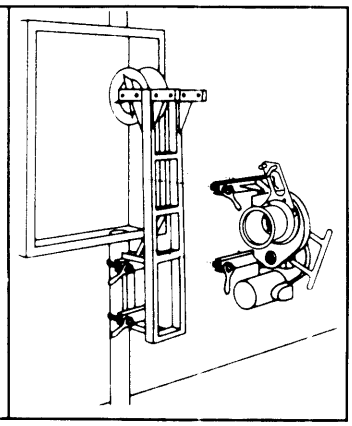


Add Mobile "T" Boom and 640 Tugger™ Cable Puller for flush mounted pull — resting extension boom on floor.

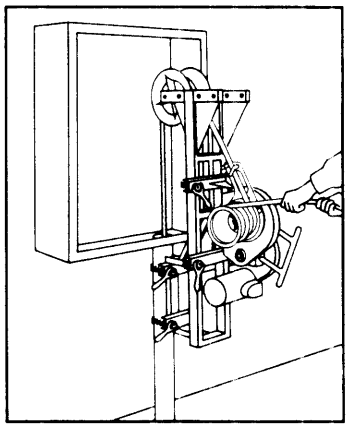
"Up" Pull Through Exposed Conduit



"Up" Pull through exposed conduit with 640 Tugger™ Cable Puller and Pipe Adapter attached to exposed conduit.

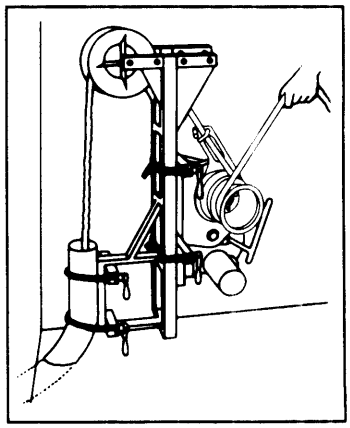


Attach No. 640 Tugger™ Cable Puller to Pipe Adapter.



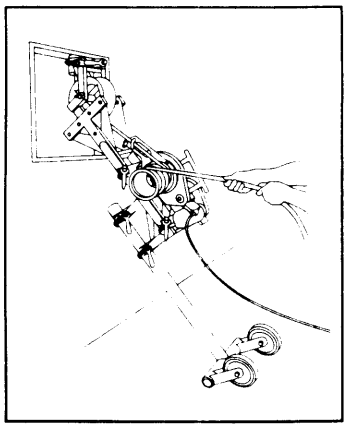
"Up" Pull-in exposed conduit.

"Up" Pull Through Pipe



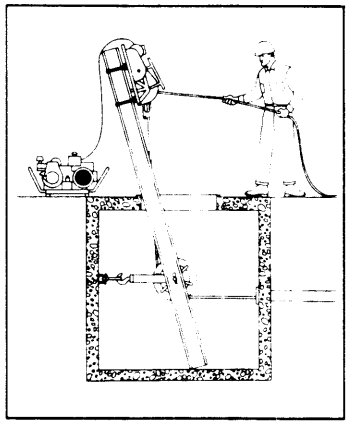
"Up" Pull using Pipe Adapter Sheave.

"Down" Pull Through Concealed Conduit



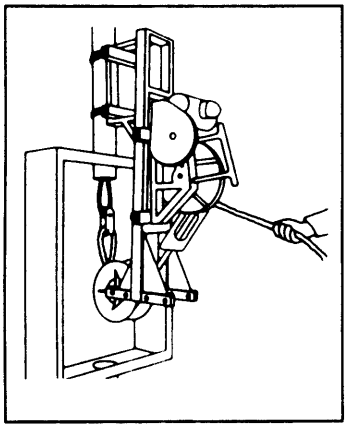
"Down" Pull -- in concealed conduit using mobile boom extension Flexible Pipe Adapter and Pipe Adapter Sheave.

Pulls Through Manholes

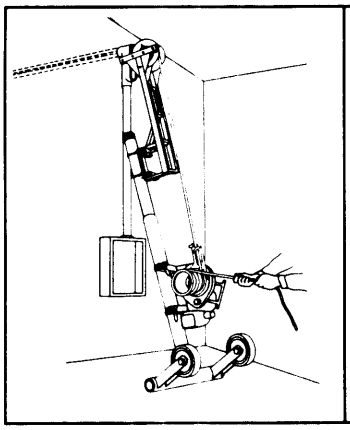


Pulling from manhole — Puller mounted on manhole sheave Power is supplied by portable generator.

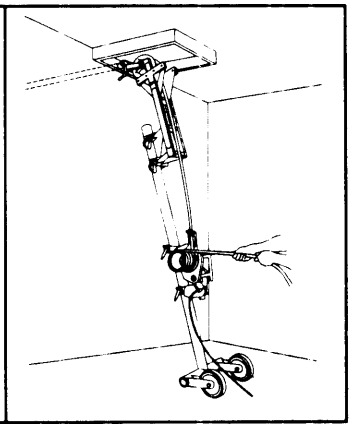
"Down" Pull Through Exposed Conduit



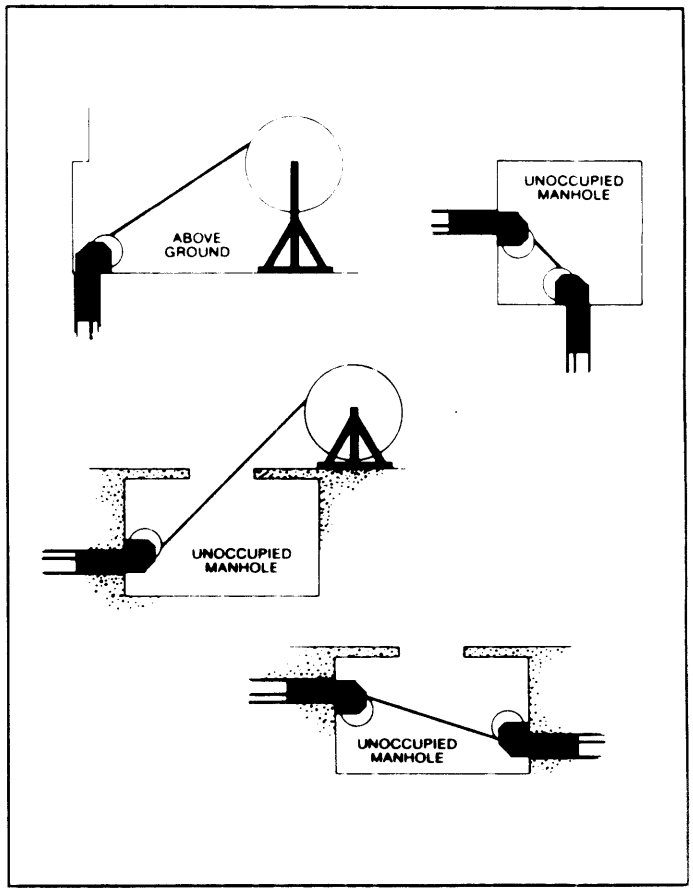
"Down" Pull -- using exposed conduit with 640 Tugger™ Cable Puller and Pipe Adapter Sheave.



Pulling through "LB" Connector — with sufficient cable to complete run and service panel.

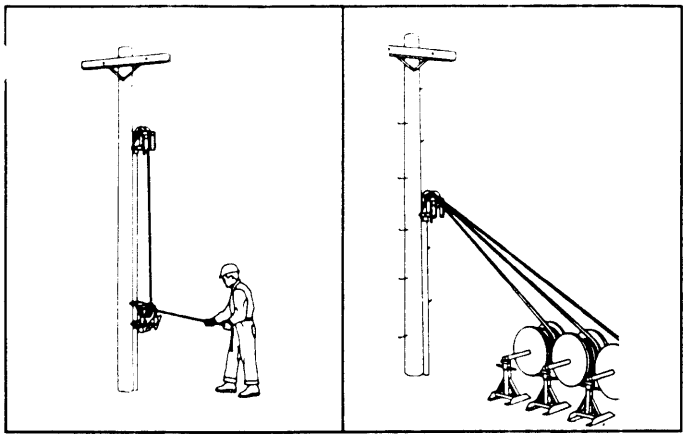


Overhead pull using Flexible Pipe Adapter, Pipe Adapter Sheave and mobile "T" Boom.



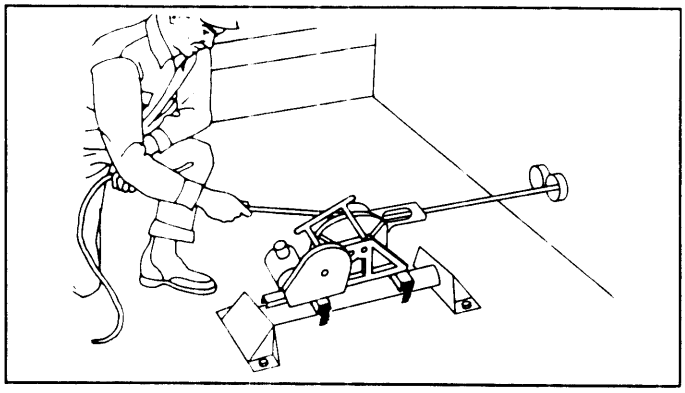
Feeding sheaves used in conjunction with Puller.

Typical Pulls Through Powerlines

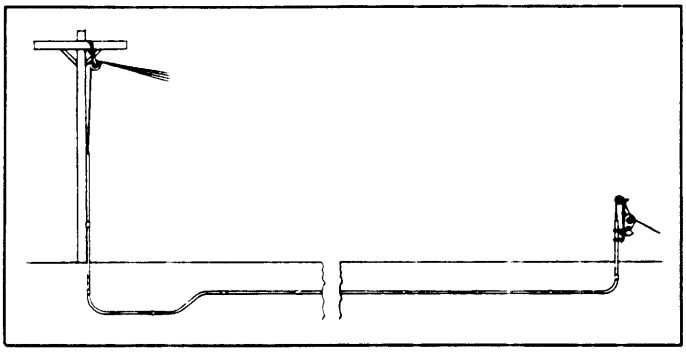


Pulling to Utility Pole.

Feeding to Utility Pole.



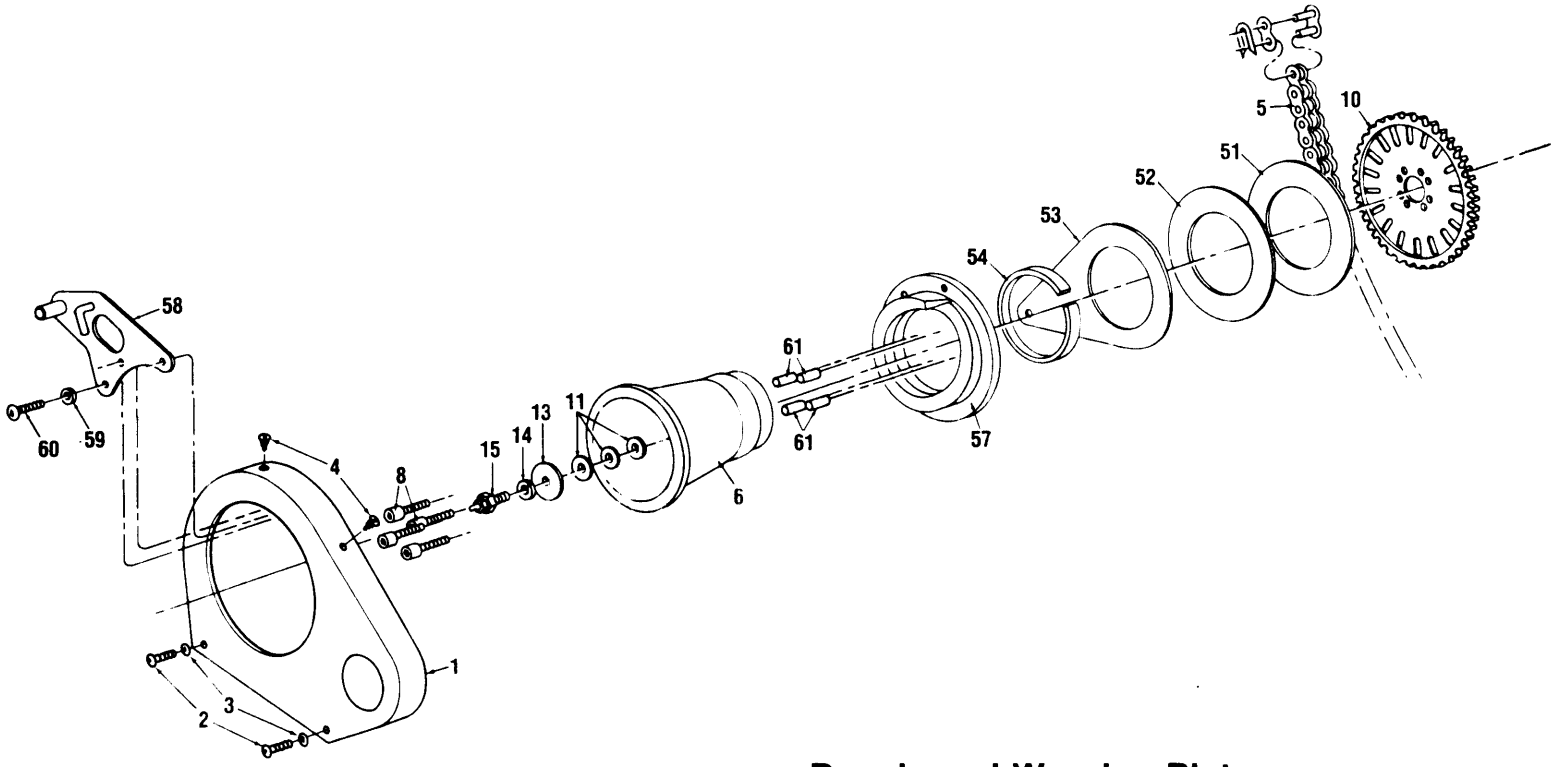
Pulling from Concrete floor using 6037 Floor Mount



Pull from power line.

IX. EXPLODED VIEW

640 TUGGER™ CABLE PULLER

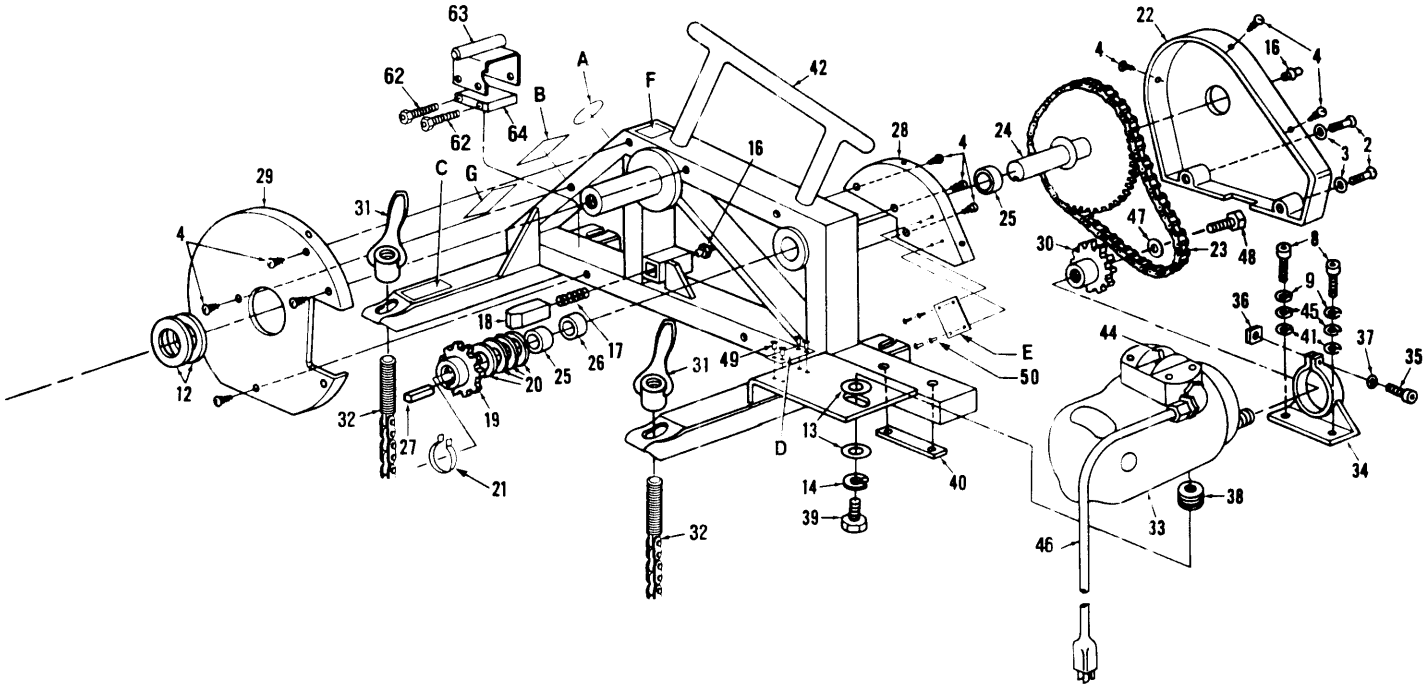


Decals and Warning Plates

KEY NO.	PART NO.	DESCRIPTION	QTY.
A	**503 0392.9**	Damp Warning Decal	1
B	**502 9936.0**	Capstan Rotation Decal	1
C	**501 2121.9**	Greenlee Decal	1
D	**502 3481.1**	Nameplate for 115V model	1
	502 3830.2	Nameplate for 220V model	1
E	**503 1810.1**	Warning Plate	1
F	**503 4316.5**	Read Instruction Manual Decal	1
G	**503 5664.0**	Rope Path Decal	1

Authorized Service Stations

Greenlee Tool Company has numerous factory authorized repair parts service stations located throughout the United States and Canada. These service stations are prepared to service and repair your Greenlee tools to keep them in proper and safe operating condition. For the location of your nearest Greenlee Authorized Repair Parts Service Station call Greenlee's toll free service number 800/435-2932.



X. PARTS LIST

NO. 640 TUGGER™ CABLE PULLER

KEY NO.	PART NO.	DESCRIPTION	QTY.
1	**503 5342.0**	Capstan Guard	1
2	**905 1264.2**	Screw, 10-32	4
3	**905 2647.3**	Washer, Lock #10 Cadmium Plated	4
4	**905 1460.2**	Screw, Philips Head 10 x 3/8 Type B, Cad. Pltd.	14
5	**501 5739.6**	No. 40 Chain, 66 pitch	1
6	**503 5541.4**	Capstan, Aluminum	1
8	**905 0597.2**	Screw, Socket Head Cap, 3/8-16NC x 1"	6
9	**905 0506.9**	Washer, Lock 3/8" (Split)	6
10	**905 2355.5**	Sprocket, #40, 60 tooth	1
11	***905 2644.9**	Washer, 5/8" I.D. x 1 " O.D. x 1/32" Thick	1
	***905 2645.7**	Washer, 5/8" I.D. x 1" O.D. x 1/16" Thick	1
12	**502 5896.6**	Fiber Washer, 1-3/4" O.D. x 1-1/4" I.D. x 1/8" Thick	2
13	**905 2675.9**	Washer, Plain 1-5/16" x 21/32" I.D. x 3/32"	2
14	**905 1603.9**	Washer, Lock 5/8" (Split)	2
15	**502 5521.5**	Cap Screw with Zerk Fitting Key #16	1

*During assembly, clearance between capstan and frame is adjusted to a maximum of .030 inch by using either the .031 (1/32") or the .062 (1/16") shim washer. (Keys 55 and 56)

PARTS LIST (continued)

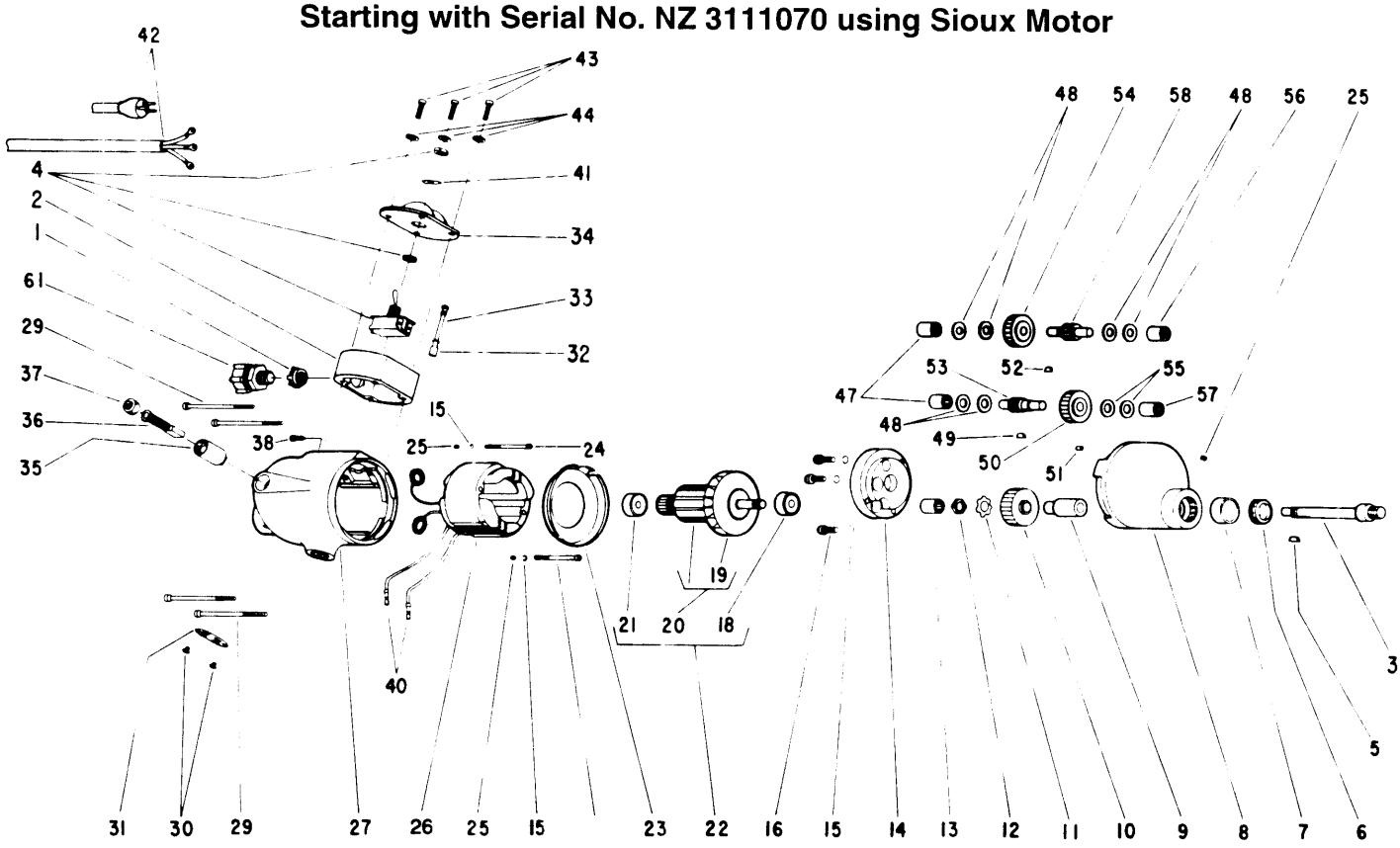
For Serial Numbers beginning at: NZ-19000 EA

KEY	GREENLEE PART NO.	DESCRIPTION	QTY.
16	905 1271.5	Fitting, Zerk Alemite #1743-B	1
17	501 6309.4	Spring, Rec Pin	1
18	501 6310.8	Stop Pin Rect.	1
19	503 1811.0	Sprocket, with 1/4" Keyway	1
20	501 7916.0	Fiber Washer, 1-1/2" O.D. x I.D. x 1/32" Thick	5
21	905 1301.0	Ring, Tru-Arc #5160.98 Retaining	1
22	501 5747.7	Primary Drive Guard	1
23	501 5745.0	No. 35 Chain, 68 pitch	1
24	502 5609.2	Sprocket & Shaft	1
25	905 1459.9	Bearing	2
26	501 7904.7	Spacer, Bearing	1
27	502 5617.3	Key	1
28	501 7914.4	Guard, Small Internal	1
29	501 7915.2	Guard, Large Internal	1
30	501 5746.9	Sprocket, (tapped 5/8-16)	1
	502 7834.7	Vise, Chain Unit Complete (includes Keys 31 and 32)	2
31	502 3178.2	Handle, chain	2
32	502 7833.9	Vise Chain with Screw	2
33	502 9500.4	Drive motor–115 Volt (for units with Serial Numbers NZ 3111070 & up)	1
	502 9501.2	Drive Motor–230 Volt	1
34	503 2793.3	Motor Bracket Unit	1
35	905 0176.4	Screw, 1/4-20 x 3/4" Socket Head Cad. Pltd.	1
36	905 1669.9	Nylok Nut, 1/4-20 NC	1
37	905 2707.0	Flat Washer 1/4-9/32 I.D. x 1/2"	2
38	501 7912.8	Threaded Bushing	1
39	905 2364.4	Screw, 5/8"-11" NC x 1" Hex Head Cap	1
40	501 5750.7	Motor Clamp Bar	1
41	905 1515.3	Flat Washer, 3/8 SAE	2
42	501 5758.2	Cable Puller Frame	1
44	918 5337.0	Motor Switch	1
45	905 1364.9	Flat Washer, 5/16"	2
46	502 9592.6	Power Cord (Sioux)	1
47	905 2339.3	Flat Washer 1/4"-9/32 x 47/64 3/4" OD x 5/16 ID x 1/16 THK (for Sioux Motor)	1
48	503 1357.6	Screw, 1/4-20 UNC x 3/4" L.H. Hex Head (for Sioux Motor)	1
49	905 2192.7	Drive Rivet	4
50	905 3001.2	Rivet 1/8" x 1/8 Dome Head "Pop"	4
	501 9017.2	Brush Retainer Screw (Not Shown) for units with Serial Numbers up thru 319-17250 with Milwaukee Motors)	1
	501 9016.4	Motor Brush (for Milwaukee Motors up thru Serial Numbers 319-17250)	2
	918 6038.5	Motor Brush (for Milwaukee Motors with Serial Numbers 319-17251 and after)	2
	502 9496.2	Adapter, collar (for Sioux Motor 502 9500.4)	1
	502 9586.1	Switch (for Sioux Motor)	1
	502 9588.8	Armature with Fan (for Sioux Motor)	1
	502 9589.6	Field, Motor (for Sioux Motor)	1
	502 9591.8	Brush, Motor (for Sioux Motor)	2
	503 0136.5	Cap, Brush (for Milwaukee Motors with Serial Numbers 319-1725, and after)	2
	501 9102.0	Repair Kit, No. 40 Chain (Not Shown)	Optional
	501 9101.2	Repair Kit, No. 35 Chain (Not Shown)	Optional
	905 1797.0	Connecting Link, No. 35 Chain	Optional
	905 2787.9	Connecting Link, No. 40 Chain	Optional
51	503 5320.9	Backing Washer	1
52	503 5310.1	Thrust Washer	1
53	503 5341.1	Anti-Rotation Plate	1
54	503 5322.5	Ramp Bearing	1
57	503 5291.1	Ramp	1
58	503 5305.0	Capstan Arm	1
59	905 1602.8	Lock Washer 5/16"	3
60	905 2587.6	Screw 5/16"-18 x 7/8" Button Head	3
61	905 0134.9	Dowel Pin 3/8" x 2"	4
62	905 1265.0	Cap Screws 1/4"-20 x 3/4"	4
63	503 5338.1	Anti-Rotation Bracket	1
64	503 5339.0	Block	1

EXPLODED VIEW

1560GT MOTOR

Starting with Serial No. NZ 3111070 using Sioux Motor



PARTS LIST (Motor Only)

1560GT DRILL MOTOR STARTING WITH SERIAL NO. NZ 3111070 USING SIOUX MOTOR

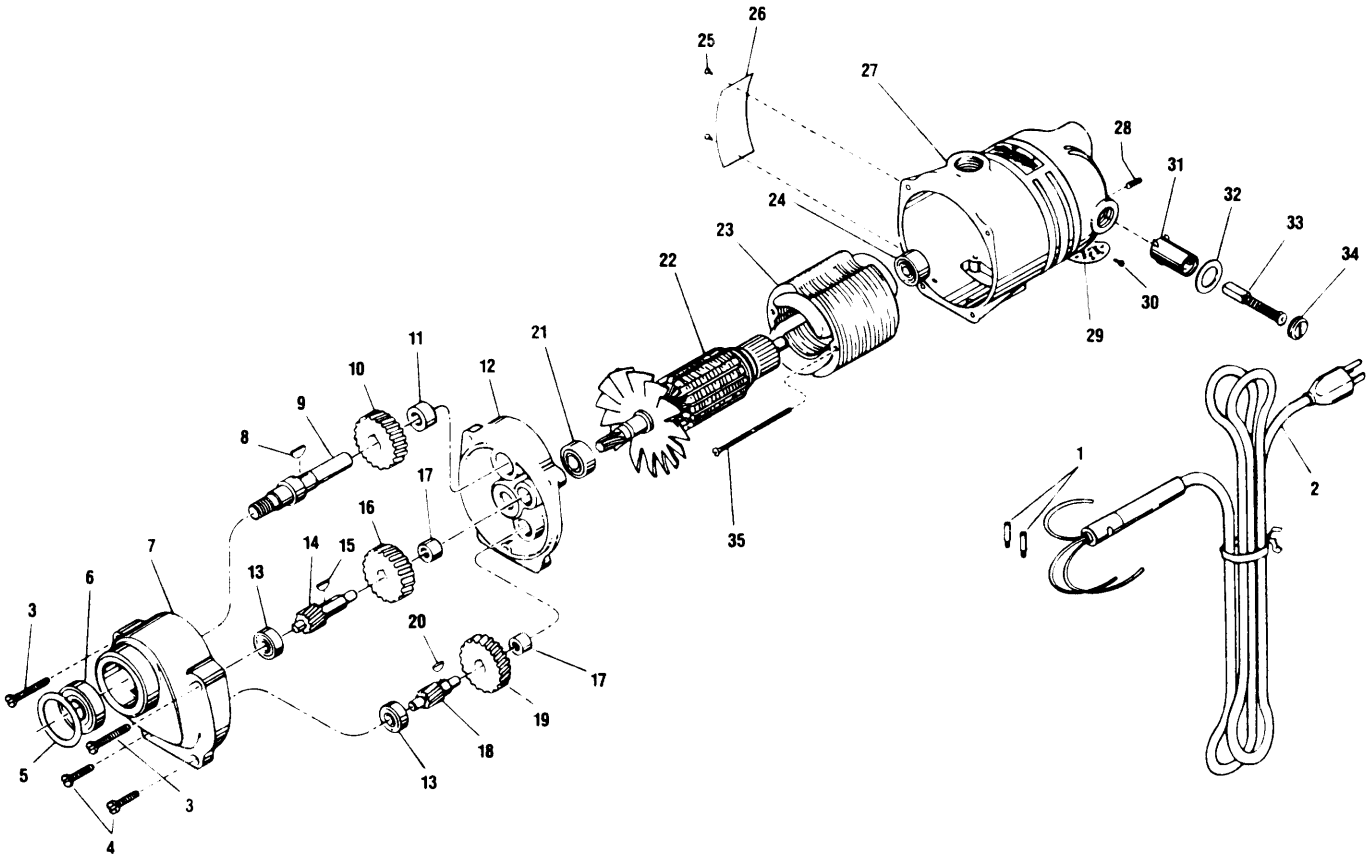
Furnish Catalog, Serial and Model Number When Ordering Parts

KEY NO.	PART NO.	DESCRIPTION	QTY
1	18658	Locknut	1
2	12395A	Switch, Adaptor for	1
3	22512	Spindle-Chuck (1560)	1
4	18161	Switch	1
5	30014	Key-#404 Woodruff	1
6	23042	Seal-Oil	1
7	10131	Bearing-Ball	1
8	12049	Case-Gear	1
9	24057	Spacer-Gear	1
10	19036	Gear-Chuck Spindle	1
11	25073	Washer-Lock	1
12	24062	Nut-Tool Spindle	1
13	10008	Bearing-Needle	1
14	12040	Cover-Gear Case (includes Key 47)	1
15	09724	Washer-Lock #10	5
16	07119	Screw-Phil. #10-24 x 1	3
18	10251	Bearing-Ball	1
19	21569A	Fan	1
20	65293	Armature	1
21	10210	Bearing-Ball	1
22	65330	Assembly-Armature, Fan & Bearing	1
23	25079	Plate-Baffle	1
24	07136	Screw-#10-24 x 2-1/8	2
25	07000	Screw-#10-24 x 3/16	3
26	28938	Field-Motor	1
27	12773	Housing	1
29	07130	Screw-#10-24 x 5-11/16	4
30	06090	Screw-#4 x 1/2	6
31	23000	Assembly-Cap inspection Hole	1
32	28084	Terminal-Female	1
33	28129	Assembly-Lead Wire	1
34	63105	Assembly-Switch Guard & Plate	1
35	18087	Holder-Brush	1
36	18031	Brushes-Motor	2
37	18120	Cap-Holder Brush	1
38	07204	Screw-Ground #10-24 x 5/16	1
40	28083	Plug-Bullet (Male)	2
41	28130	Plate (On/Off)	1
42	18430	Assembly-Cord & Terminals	1
43	07240	Screw-#10-24	4
44	09723	Washer-Shakeproof #10	4
47	10003	Bearing-Needle	2
48	25075	Spacer	6
49	30010	Key-#304 Woodruff	1
50	19038	Gear-2nd Compound	1
51	24009	Pin-Dowel	1
52	30001	Key-Woodruff	1
53	19408	Pinion-2nd Compound	1
54	19035	Gear-1st Compound	1
55	25074	Washer-Thrust	2
56	10005	Bearing-Needle	1
57	10007	Bearing-Needle	1
58	19410	Pinion-1st Compound	1
61	28164	Relief Strain	1

MOTOR FOR NO. 640 POWER CABLE PULLER

For Motor Serial Nos. 319-1001 thru 319-17249

In the event that service parts or repair is necessary on the motor of this unit, please contact the nearest Milwaukee electric service station. Greenlee Textron Inc. does not stock parts or repair these motors.



KEY NO.	PART NO.	DESCRIPTION	QTY.
1	**45-04-0100**	Cord Retaining Screw	2
2	**22-64-0080**	Cord Set	1
3	**06-81-7950**	1/4-20 x 1-3/4 Fil. Hd. Sem	2
4	**06-81-7850**	1/4-20 x 1 Fil. Hd. Sem	2
5	**34-80-3450**	Retaining Ring	1
6	**02-04-1780**	Ball Bearing	1
7	**28-14-0401**	Gear Case	1
8	**06-42-2400**	Woodruff Key	1
9	**38-50-1201**	Spindle	1
10	**32-75-1001**	Spindle Gear	1
11	**02-50-4040**	Needle Bearing	1
12	**28-28-0102**	Diaphragm (Incl. 06-65-1205 Pin)	1
13	**02-04-0910**	Ball Bearing	2
14	**36-66-0501**	Intermediate Pinion Shaft	1
15	**06-42-1600**	Woodruff Key	1
16	**32-44-1181**	Intermediate Gear	1
17	**02-50-2450**	Needle Bearing	2
18	**36-66-2601**	Intermediate Pinion Shaft	1
19	**32-40-1001**	Intermediate Gear	1
20	**06-42-1200**	Woodruff Key	1
21	**02-04-1260**	Ball Bearing	1
22	**16-82-1430**	115 Volt Armature	1
23	**18-82-1110**	115 Volt Field	1

KEY NO.	PART NO.	DESCRIPTION	QTY.
24	**02-04-1070**	Ball Bearing	1
25	**06-85-0200**	Nameplate Screw	2
26	**12-99-0040**	Nameplate Blank	1
27	**28-50-4761**	Motor Housing	1
28	**06-83-2670**	1/4-20 x 1/2 Knrl. Set Screw	2
29	**44-66-0180**	Cover Plate	1
30	**06-81-8650**	6-32 x 1/4 Rd. Hd. Sem	4
31	**22-22-0100**	Brush Holder Assembly	2
32	**23-86-0130**	Insulating Washer	2
33	**22-18-0115**	Carbon Brush Assembly	2
34	**23-44-0081**	Brush Retaining Screw	2
35	**06-81-8950**	8-32 x 2-1/4 Rd Hd. Sem	2
		PARTS NOT SHOWN	
	28-50-8621	Switch Housing	
	23-66-0100	Switch	
	06-81-1925	1/4-20 x 2 Fil. Hd. Screw (For Switch Housing)	2
	06-81-1800	1/4-20 x 1/2 Fil. Hd. Screw (For Switch Housing)	2

115V. MOTOR CONVERSION KIT

INSTRUCTIONS FOR INSTALLATION OF 502 9500.4
DRIVE MOTOR, AS A REPLACEMENT FOR 501 5748.5 OR
502 1972.3 DRIVE MOTOR, EFFECTIVE S/N 210001 to NZ 23101

502 3371.8 MOTOR CONVERSION KIT

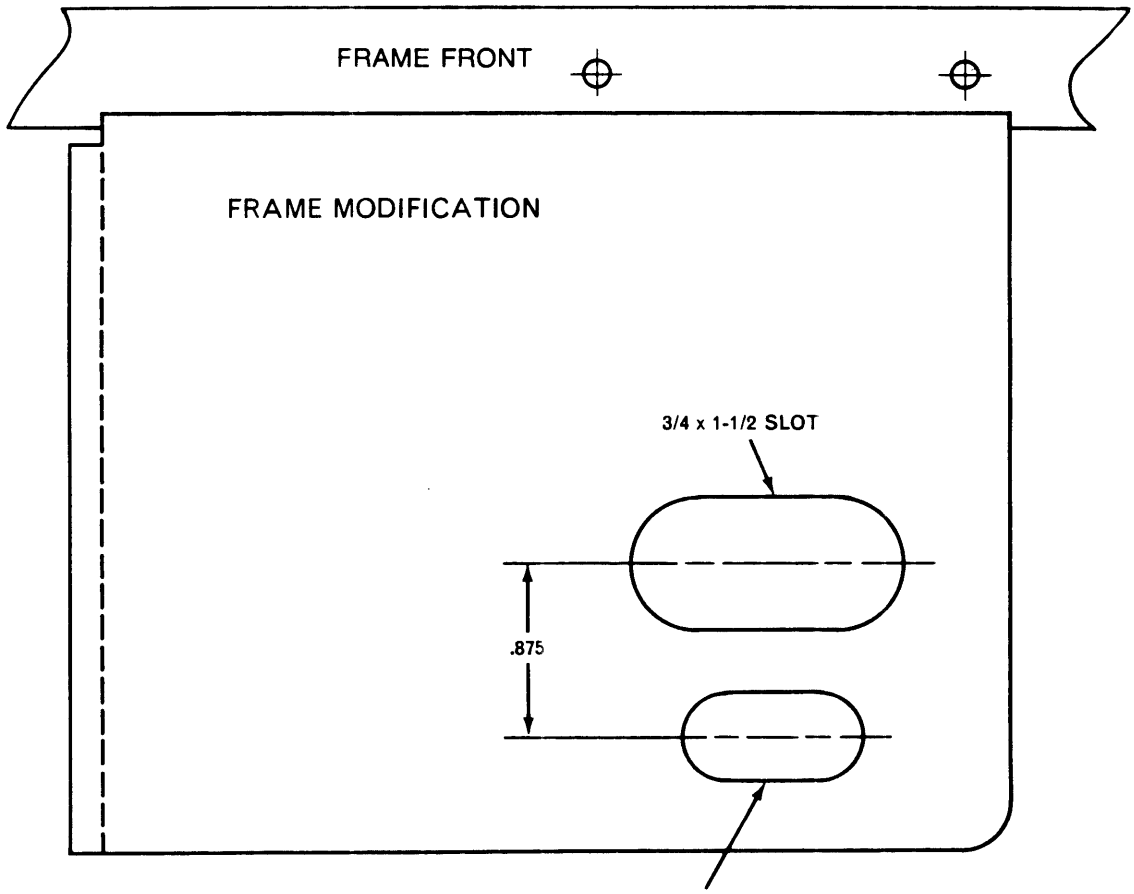
(Consists of Following Items)

HARDWARE REQUIRED

CONTROL NO.	DESCRIPTION	QTY.
905 0067.9	Screw, Hex Hd 5/8 x 11 x 1	1
905 0176.4	Screw, Skt Hd, 1/4–20 x 3/4	1
905 0905.6	Washer, Lock 5/8 x .109	1
905 1669.9	Nut Hex, 1/4–20 Nylon Insert	1
905 2675.9	Washer, Type B 2-1/32 x 1-3/4 x 3/32	2
905 2707.0	Washer, Type B 9/32 x 1/2 x 1/16	1
502 5892.3	Washer, Fibre	2

PARTS REQUIRED

503 2793.3	Bracket Unit, Motor	1
501 7912.8	Bushing, Threaded	1
502 9500.4	Motor, Drive	1



TEMPLATE FOR LOCATING 3/4 x 1-1/2 SLOT ON MOTOR BASE

XI. 640 TUGGER™ CABLE PULLER MAINTENANCE

⚠ DANGER:

SHUT OFF MOTOR AND UNPLUG UNIT BEFORE DISMANTLING OR SERVICING.

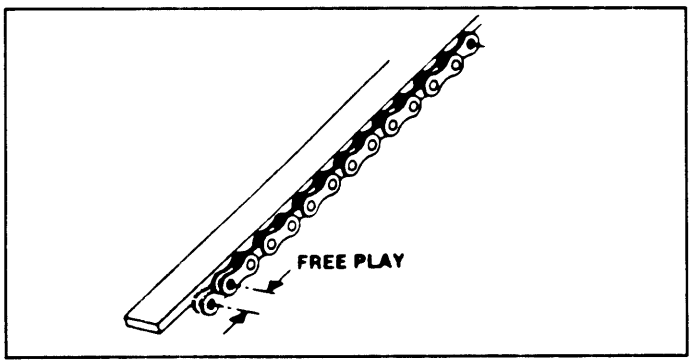
A. Lubricating Drive Chains

Lubricate puller drive chains after every 20 hours of operation. Remove the primary drive guard by removing the small screws. Lubricate the inside of the chains with 80W - 90W gear oil, then replace the primary drive guard and screws.

B. Check the condition of the chain drive after every 40 hours of Puller operation.

1. Disassemble the chain guards by removing the screws. Remove the retaining rings securing the small and intermediate drive sprockets. Pull drive and intermediate driven sprockets (with #35 chain) off motor shaft and out of frame unit. Remove the capstan retaining screw and the capstan complete with both sprockets and #40 chain.

2. Clean the chains thoroughly with solvent. Lay the chains against a straight edge. Slide one end of the chain back and forth to check free play (Figure below). If free play is greater than 3/8", replace the chain. Replace the chain if any links bind.



3. Lubricate the chains with 80W-90W gear oil.

4. Assemble in reverse order of B1 above.

C. Greasing Drive Train Shafts

Apply a multipurpose NLGI Grade 2 grease, (Mobil HP; Amoco Permalub), to the grease fittings after every 20 hours of puller operation. The grease fittings are located on the capstan and intermediate sprocket shafts.

D. Greasing Ratchet Pawl (Anti-Reversing Mechanism)

Apply a multipurpose NLGI Grade 2 grease (Mobile HP; Amoco Permalub) to the grease fitting after every 40 hours of puller operation. The grease fitting is located on the lower portion of the frame on the opposite side of the capstan.

NOTE: If the clicking noise is not evident follow steps 1 through 4 below.

1. Remove drive sprocket and chain as described in B1 to the left.

2. Remove ratchet pawl.

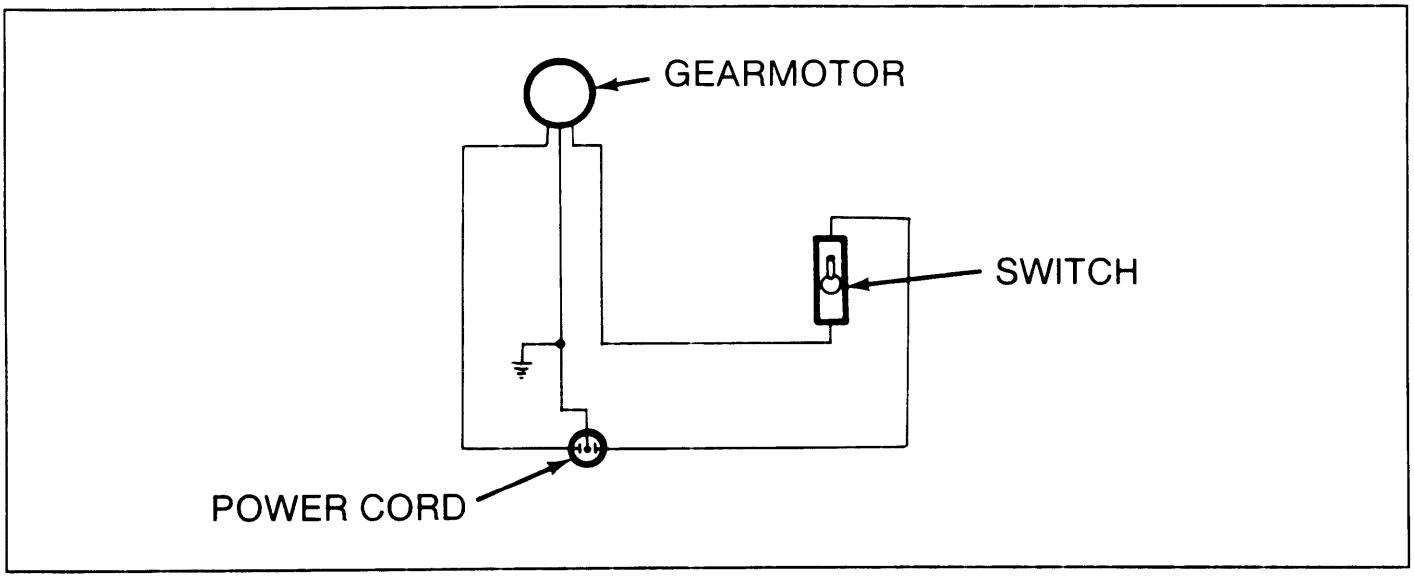
3. Apply axle grease to all working surfaces. Then reassemble by reversing steps A and B.

4. Be sure that the ratchet pawl is functional upon reassembly. A clicking noise indicates the pawl is engaging. **Do not** operate the puller if this clicking noise is not evident.

E. Commutator Brushes

Check the brushes after every 40 hours of operation. Remove motor brush caps and brushes. Measure the brush lengths. If length of brush is less than 3/8", replace both brushes, or return to Greenlee service center for replacement.

ELECTRICAL SCHEMATIC OF 640 TUGGER™ CABLE PULLER



640/640-22 TUGGER™ CABLE PULLER

TROUBLESHOOTING/REPAIR GUIDE

PROBLEM	CAUSE	SOLUTION
Motor Will Not Run	A. Not plugged into proper receptacle B. Non-functional switch C. Non-functional motor D. Main Power Supply interrupted	A. Check plug connection B. Replace switch C. Replace non-functional part D. Check main power supply circuit.
Capstan will not rotate while motor is running	A. Broken #35 chain B. Broken #40 chain C. Non-functional gear in motor or gear box	A. Replace #35 chain B. Replace #40 chain C. Replace non-functional part

Motor will not run. To replace motor:

DO NOT WORK ON UNIT WHILE PLUGGED INTO POWER SUPPLY

1. Remove Primary Drive Guard (22, 2, 3, 4)
2. Remove screw and washer at end of motor shaft. (Caution: This screw has left hand threads, these parts are not shown.)
3. Remove screw and washers from under the motor (33, 39, 14, 13).
4. Remove screws and washers on the motor bracket unit (34, 35, 36, 37, 8, 9, 41, 45, 40).
5. Slip chain off motor sprocket and pull motor out of bracket (33, 34, 23).
6. Remove small sprocket from motor and reinstall it on the new motor (30, 33). (This sprocket has right hand threads in it.)
7. Install new threaded bushing in the new motor (33, 38). (Note: Make sure it is screwed in flush with bottom of motor.)
8. Slide motor into motor bracket unit and set it in position on the frame. (Also, slip chain back into the sprocket.) (33, 34, 30, 23)
9. Install and tighten screw, washers, and lock-nut at the top of the motor bracket unit (34, 35, 36, 37).
10. Install but do not tighten the three screws and washers (8, 39, 13, 14, 9, 45, 41).
11. Adjust chain tension by pulling motor unit away from frame as far as it will go. Also, make sure the sprockets are in line with each other. While holding motor unit in position, retighten the three screws (8, 39) to secure the motor in place.
12. Reinstall the primary drive guard and tighten the 5 screws (22, 2, 3, 4).

If the switch is non-functional:

Motor does not require removal to replace defective switch.

1. Remove defective switch by removing mounting screws, locknuts, switch cover and disconnect wiring joints from motor.
2. Hook wiring connections to new switch and mount switch onto motor with switch cover, locknuts and mounting screws.
3. Plug in unit and test run.

Capstan will not rotate while motor is running:

This is usually caused by one of three things: a broken gear in the gear box of the motor, which requires motor unit replacement; a broken #35 chain; or a broken #40 chain.

To replace the #35 chain:

1. Follow steps 1 through 5 on motor replacement.
2. Then install new #35 chain (23). Note: When installing new #35 chain make sure the open end of the master link retaining clip is facing the opposite direction of the rotation of its mating sprocket and on the outside face of the sprocket.
3. Follow steps 9 through 13 on motor replacement to reinstall motor.

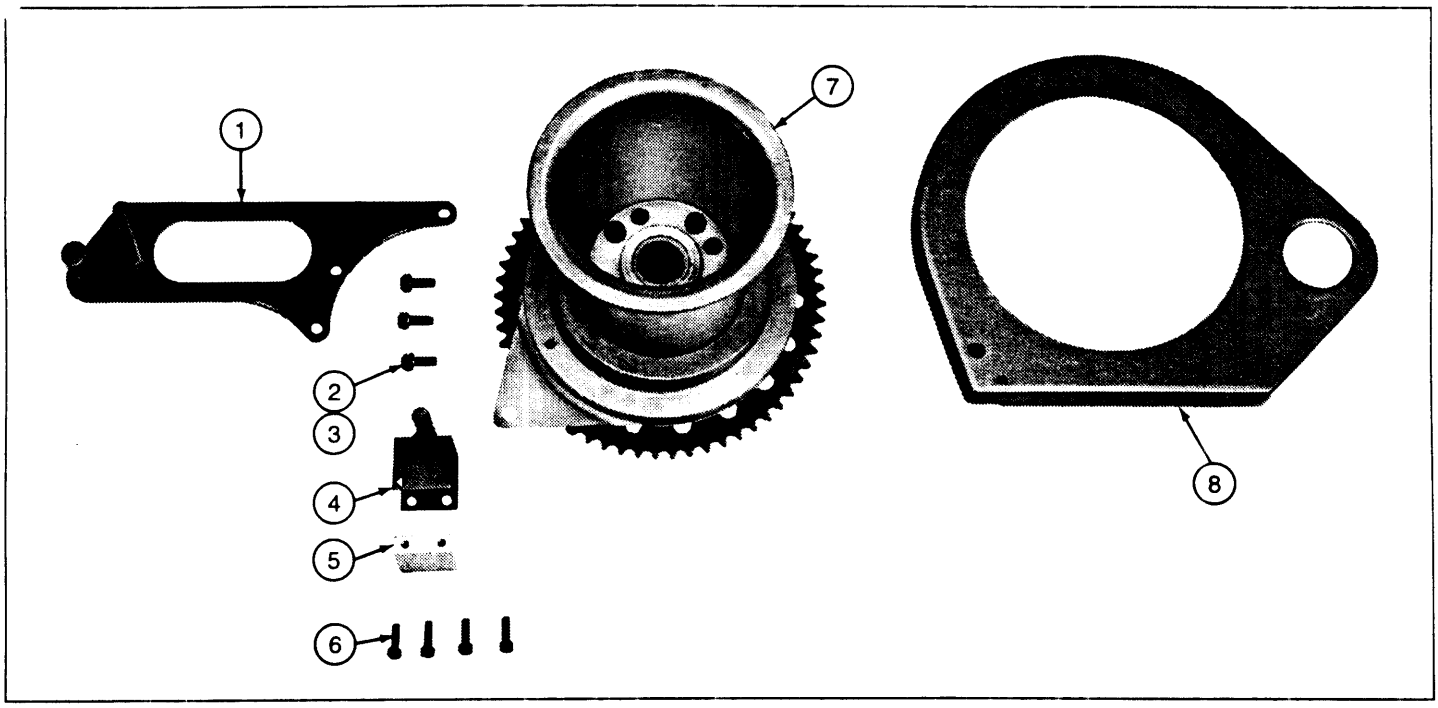
To replace a damaged #40 chain:

1. Remove capstan arm.
2. Remove capstan guard. (1, 2, 3, 4)
3. Remove screw and washers from capstan shaft. (11, 13, 14, 15)
4. Remove retaining ring from end of sprocket shaft unit. (24)
5. Slide capstan, capstan sprocket, chain, and keyway sprocket off at the same time. This must be done evenly as they will bind onto the shaft. (5, 6, 10, 19) Note: Assemble the master link retaining clip on the inside face of its mating sprocket with the open end of it facing the opposite direction of the sprocket rotation.
6. Now replace bad chain and reassemble by reversing steps 1 through 5.
7. Plug in unit and test run.

To replace damaged frame:

1. Follow steps 1-3 on #35 chain replacement.
2. Follow steps 1-5 on #40 chain replacement.
3. Remove key, sprocket shaft unit, fiber washers, stop pin, sprocket and spring.
4. Install 2 new bearings, spacer, and zerk fitting into new frame. These bearings and zerk fitting are pressed into frame.
5. Reinstall 2 fiber washers, capstan and sprocket screw, and washers. Now shim if needed, to allow not more than .030 free end play. Then remove screw and washers. Then, slide capstan and sprocket about half-way off shaft.
6. Reinstall stop pin and spring. (Note: Be sure tapered side of stop pin faces motor unit.)
7. Reinstall sprocket shaft unit, 5 fiber washers, and key.
8. Now, reverse steps 1 through 3 on #35 and 1 through 4 on #40 chain replacement.
9. Reinstall motor by following steps 3 and 4 on motor replacement.
10. Plug in unit and test run.

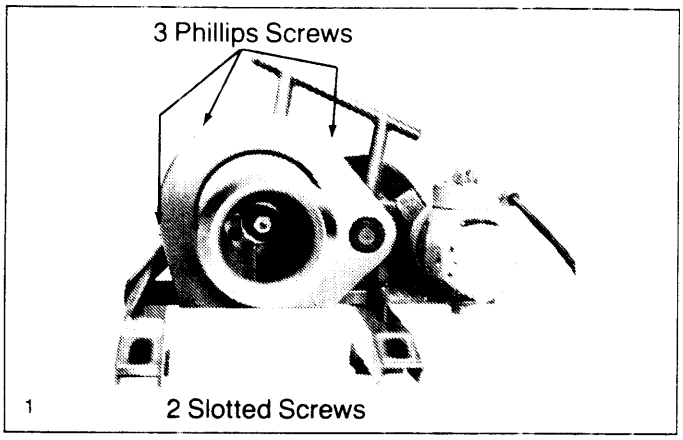
Installation Instructions for 35336 Capstan Retrofit Kit



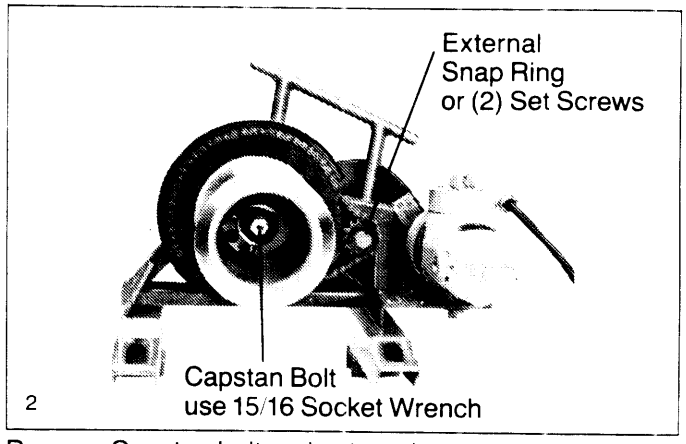
CONSIST OF:

KEY NO.	PART NO.	DESCRIPTION	QTY.
1	503 5305.5	Rope Guide Arm	1
2	905 2587.6	5/16"-18 x 7/8" Button Head Screw	3
3	905 5320.9	5/16" Lock Washer	3
4	503 5338.1	Anti-Rotation Bracket	1
5	503 5339.0	Block	1
6	905 1265.0	1/4"-20 x 3/4" Cap Screw	4
7		Capstan Assembly consists of	
	503 5541.4	Capstan	1
	503 5291.1	Ramp	1
	503 5322.5	Ramp Bearing	1
	503 5341.1	Anti-Rotation Plate	1
	503 5310.1	Thrust Washer	1
	503 5320.9	Backing Washer	1
	905 0134.9	Dowel Pins 3/8" x 2"	4
	503 5362.4	Sprocket #40, 60 tooth	1
	905 3922.2	3/8"-16 x 2 3/4" Cap Screw	4
8	503 5342.0	Capstan Guard	1

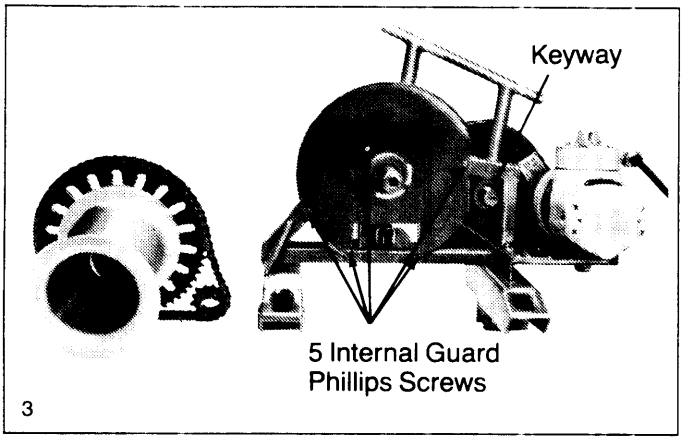
Installation Instructions for 35362 Capstan Retrofit Kit



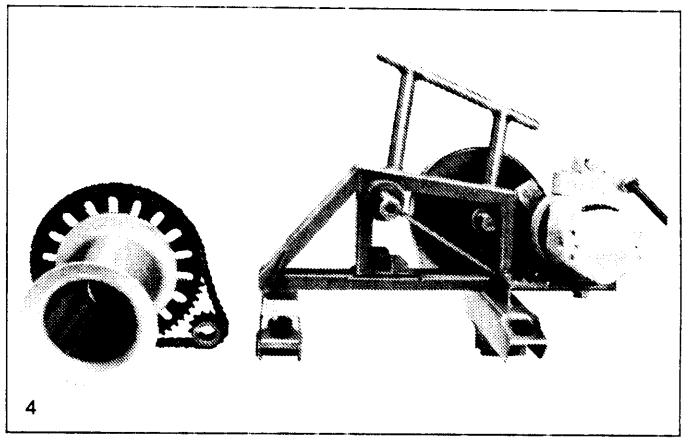
Remove capstan guard screws. Remove capstan guard.



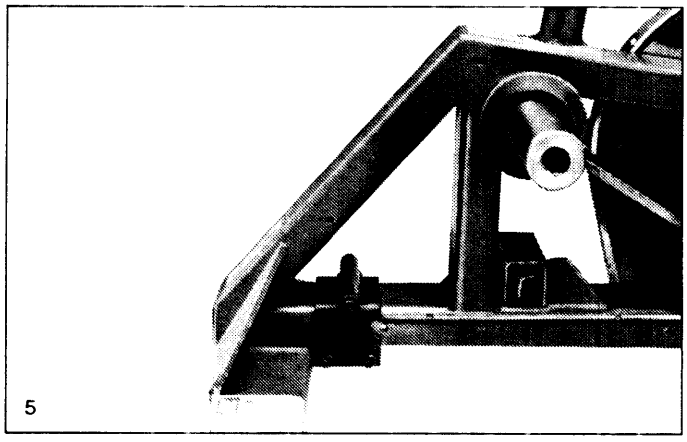
Remove Capstan bolt and external snap ring or loosen 2 set screws on small sprocket shaft.



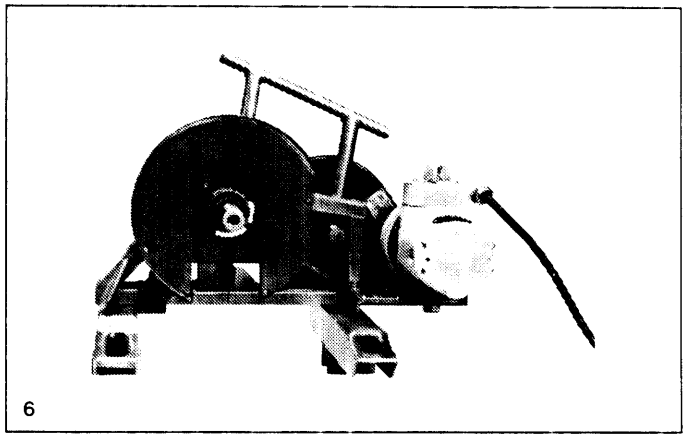
Remove Capstan, capstan sprocket, chain and small sprocket together. Replace all spacers on capstan shaft. Make sure the small sprocket shaft keyway is up, if not plug in unit and run and stop to locate keyway at top, unplug unit. Remove internal guard screws.



Remove internal guard.

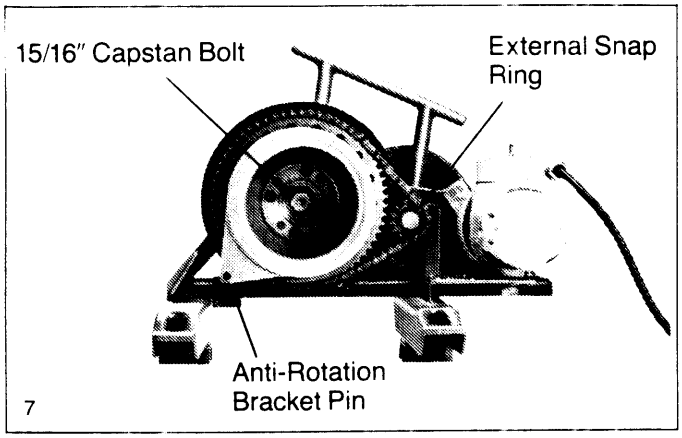


Attach the anti-rotation bracket to frame as shown with pin extending on capstan side of frame. Place block under frame between sides of bracket. Line up holes then fasten with 1/4" socket head Allen screws.

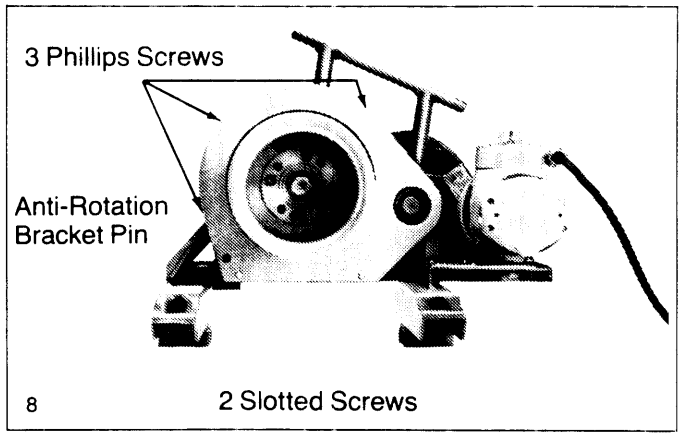


Replace internal chain guard with 5 Phillips screws. Start all 5 screws then tighten. Before reassembling unit see maintenance section for information on chain and ratchet pawl lubrication.

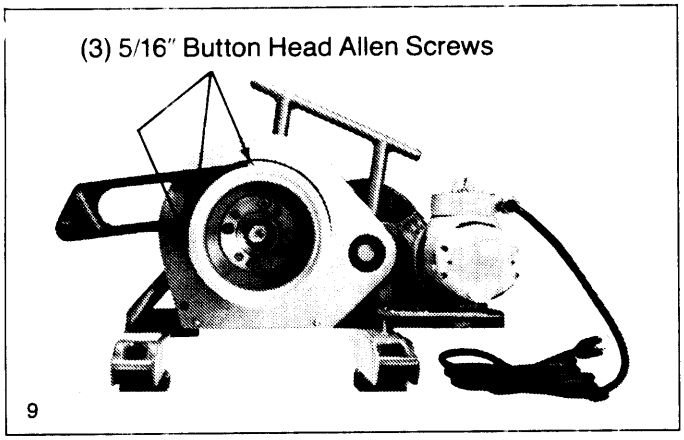
Installation Instructions for 35362 Capstan Retrofit Kit



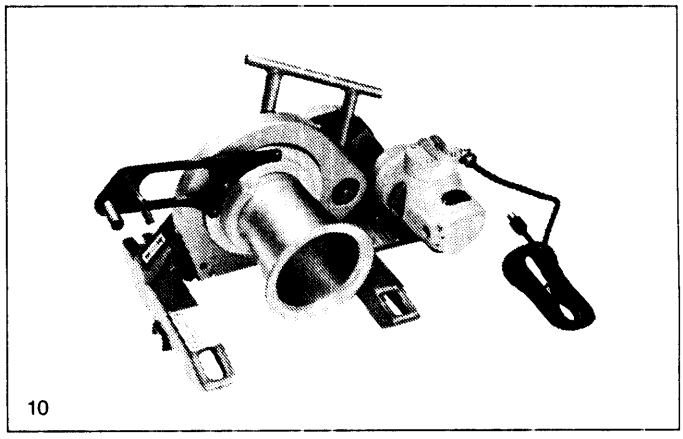
Assemble new capstan unit with chain and small sprocket. Slide capstan and small sprocket as a unit onto their shafts as shown. Turn capstan unit to align small sprocket keyway. Make sure anti-rotation plate hole is trapped by anti-rotation bracket pin. If necessary place a short wooden block over end of capstan and tap with a hammer to seat capstan. Place washers on capstan bolt and install and tighten to 70 ft lbs. with a torque wrench. Install external snap-ring or tighten set screws on small sprocket shaft, if the snap ring groove is not visible push the shaft from the other side of the puller.



Install new capstan guard start all 5 screws first then tighten. Make sure anti-rotation bracket pin lines-up with the hole in the guard.



Attach tape guide with (3) 5/16" Button head Allen screws and lock washers.



Completed conversion.

NOTES

NOTES

GREENLEE FAIRMONT TEXTRON

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Printed in U.S.A.