FILING INFORMATION
For Insertion in Manual

Section No. 100.0 Item No. 15

FILL IN INFORMATION AT TIME OF DELIVERY

DATE: _____

ATTACHMENT:
Model No. _____
Serial No. _____

TRUCK:
Model No. _____
Serial No. _____

TRUCK MFG.:
Attach. Serial No. _____

OWNER:
Name: _____
Address: _____

OTHER INFORMATION:

User Manual

Installation • Service • Parts

REVOLVING CLAMPS

• Models C2R, C3R, C4R, C6R, C7R

WARRANTY

Cascade Corporation warrants all products manufactured by it for three (3) months after the date of shipment. In the case of products ordered for manufacturer's (dealer's) stock, the warranty is limited to one (1) year from date of shipment from Cascade for those products that remain in stock and are not installed on trucks, otherwise the 90-day period applies.

This warranty is limited to replacement at point of manufacture, or some other point designated by Cascade, of such parts as shall appear to Cascade upon inspection at, and f.o.b. such point, to have been defective in material or workmanship, but not including the cost of labor to replace such defective parts, and provided further that Cascade's use and/or installation instructions have been followed carefully and no parts other than those furnished by Cascade have been installed on Cascade's product. Except as shown in published catalogs or specifications, Cascade's products are not warranted to perform any particular task and Cascade assumes no responsibility for loss, damage or injury, either direct or consequential, resulting from or occasioned by possession or use of its products.

REVOLVING CLAMPS
This manual covers UNIT IDENTIFICATION numbers listed below.

634657 — 634752	635144 — 635164
634893 — 634896	635026 — 635071
634945	635386 — 635413
635072 — 635081	635492 — 635533

UNIT IDENTIFICATION numbers appear on attachment nameplate.

cascade®

Cascade Corporation
Portland, Oregon • Springfield, Ohio • Toronto, Canada • Amsterdam, Holland
Paris, France • Milan, Italy • Dusseldorf, West Germany • Newcastle, England
Johannesburg, South Africa • Sydney, Australia • Nagoya, Japan

FORM NO. 5032A

Index

How To Use This Manual

This User Manual describes the installation and maintenance procedure recommended for revolving clamps, and illustrates the assemblies and detail parts needed for service replacement.

If the number of a specific part is not known, determine the approximate location and application of the part required. Turn to the index immediately behind the most appropriate page. Proceed then to locate the part using the appropriate assembly drawing and parts listing.

The illustrations and the parts listings include part numbers, descriptions, quantities required, keys and footnotes to help in selecting the correct components. Quantities shown are for one complete assembly, unless otherwise indicated.

When ordering replacement parts, give the clamp serial number, User Manual form number, part number, name of part and quantity required. For further information on parts, maintenance or ordering, consult the lift truck dealer of your choice.

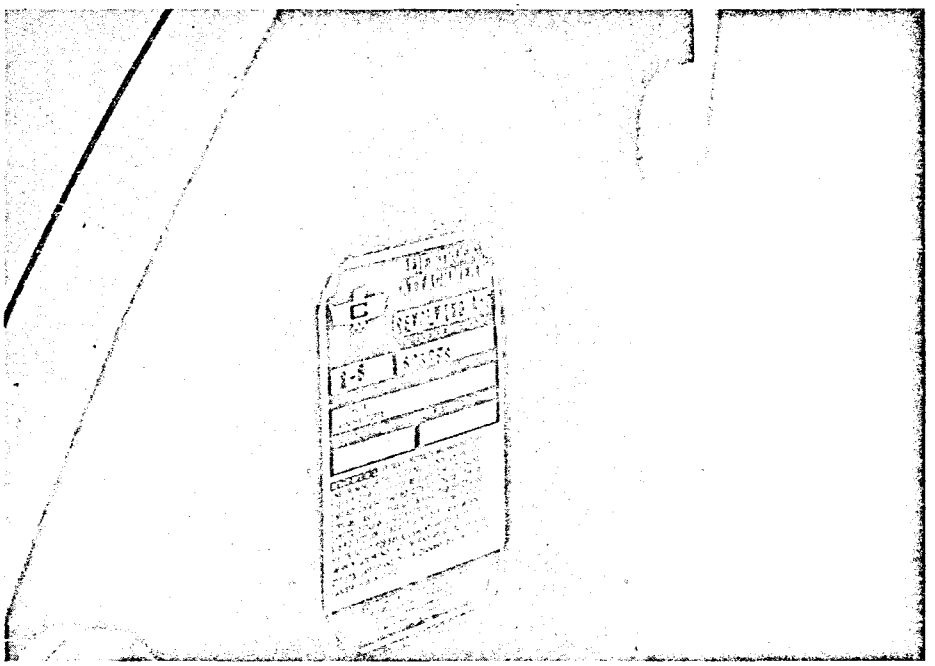
Attachment Serial Number Identification

Unit Serial Number

C6R	00000-PI
A	B

A. The first three letters denote the type and model of the load handler.

B. The digits identify each specific unit and the Cascade plant at which the load handler was manufactured.



The clamp serial number appears on the name plate which is located at a protected area on the attachment.

The number also is stamped by metal impression directly under the name plate to avoid problems in identification should the plate be removed or damaged.

Using Your Revolving Clamp

Cascade's revolving clamp combines a basic clamp and rotator. Pilot-operated check valves prevent accidental unclamping. Stopping the truck motor or even cutting hydraulic lines will not unclamp and release the load.

The integral rotator allows the operator to turn it 360 degrees for accurate, safe, fast positioning.

There are four standard arms for clamps to make them into a Bale Clamp, Drum Clamp, Multi-purpose Clamp or a Pallet (Fork) Clamp.

The Bale Clamp has ribbed arms on the clamp surface that "bite" the load for extra holding power. Loads involved are baled cotton, wool, rags, scrap paper, scrap metal, bulk or rubber.

The Multi-Purpose Clamp engages the load with flat rubber padded arms. This type is ideal for handling bins, tote boxes, rolls of fencing, bales and assorted other loads. The high friction arm surface will hold loads at pressures of about 400 psi above the minimum necessary to lift the load. The load does not have to be overclamped to be held securely.

Drum Clamps are available for handling one, two or four drums at a time. Contact pads on the arms are rubber-faced to provide better grip, and are designed to clamp between the drum chines or rolling rings on a standard drum.

With any of these standard arms, the load is held safely and securely during rotation and transport, around corners, up and down ramps, and this is accomplished without requiring an investment in pallets.

Pallet Forks Very Popular

By far the largest application for revolving clamps is as a pallet handler with forks plus the ability to clamp. A clamp with forks is very versatile. It can handle pallets, racks, irregular steel fabrications, assorted tubs and boxes by constantly repositioning the forks hydraulieally. Or the truck operator can hook a fork tip under the edge of a load and slide it out for proper pickup, or he can push a load sideways into position or out of his way.

Guidelines have been developed for proper revolving clamp operation. Each operator should familiarize himself with the following points.

(1) Do not operate a revolving clamp at pressures above 2000 psi. Install an auxiliary relief valve in the circuit to the clamp, particularly if the truck system is capable of pressures in excess of 2000 psi. Clamps with special cylinders for higher pressure systems above 2000 psi are available.

Limit the relief valve pressure at slightly above minimum load handling pressure requirement. This will eliminate pump, hose line and related service problems, and yields a longer, trouble-free clamp life. Limiting the relief valve pressure eliminates load damage resulting from overclamping. A pressure gauge in the clamping circuit is also useful in this regard.

(2) Fast and smooth clamp operations depend on the volume of hydraulic oil delivered to the clamp (volume is measured in gallons per minute). On Models C2R and C3R hoses and fittings with an inside diameter of $^{5}/_{16}$-inch (SAE No. 6) should be used on lines from the truck valve to the revolving connection and drive motor. The C4R unit requires hoses with a $^{13}/_{32}$-inch inside diameter (SAE No. 8). Use ½-inch inside diameter lines (SAE No. 10) on Models C6R and C7R.

The truck's pump volume must be sufficient to supply clamping and revolving circuits. A minimum pump capacity of 12 gallons per minute is recommended.

(3) All Cascade revolving clamps have a special revolving connection in the rotating mechanism center hub. A cam on the shaft of this connection blocks the hydraulic fluid flow to the cylinder operating the lower arm during "off the floor" (horizontal) load pick up. This arrangement speeds load handling.

Since the lower arm will not move, position the arms at half the load height prior to rotating the clamp for horizontal pickup. This keeps the load near the truck center when the load has been clamped and rotated.

(4) Torque output of each revolving clamp rotator is shown in the table below:

Clamp Model	Maximum Torque①
C2R	28,400 in. lb.
C3R	28,400 in. lb.
C4R	31,500 in. lb.
C4R②	45,400 in. lb.
C6R	70,000 in. lb.
C7R	112,500 in. lb.

①Based on a 1000 psi pressure differential at the hydraulic motor.
②Heavy-duty optional model.

When uncertain whether the rotator is matched to a specific load, or when the rotator will not operate on a particular heavy load, a calculation of torque can be made as follows:

(a) Weigh the load.

(b) Measure the vertical "off center" position of the load. Measure vertically up or down the clamp bumper from the center point to a point which corresponds to the center (or midpoint) of the load when it is clamped.

(c) Measure the horizontal "off center" position of the load. Measure horizontally left or right along the clamp bumper from the center point to a point which corresponds to the center (or midpoint) of the load when it is clamped.

(d) Perform the following computation:

1. Square the vertical measurement.
2. Square the horizontal measurement.
3. Add these two figures together.
4. Determine the square root of this sum. This is the total "off center" position.

Example:
Vertical "off center": 3 inches (from Step B) Horizontal "off center": 4 inches (from Step C)
$(3)^2 = 9$ (from Step D-1)
$(4)^2 = 16$ (from Step D-2)
$9 + 16 = 25$ (from Step D-3)
(sq. root)
$25 = 5$ (from Step D-4)

(e) Multiply the figure just computed times the load weight (in pounds).

(f) Compare this figure with the maximum torque output of the rotator. If the

torque required is beyond the rated capacity of the rotator, do not attempt to handle the load.

Excessive "off center" loading should be avoided whenever possible, because it increases rotator and hydraulic system maintenance.

(5) Efficiency of the 360-degree drive mechanism in revolving clamps is directly related to the volume, working pressure and fluid temperature at the hydraulic motor. Back pressure in motor return lines decreases effective working pressure and reduces torque and rotating speed.

Cascade supplies SAE No. 8 ports on hydraulic motor fittings. Hoses and fittings with an inside diameter of $^{13}/_{32}$-inch should be provided on lines from the truck valve over the mast to the rotator for maximum efficiency.

Heating hydraulic fluid to temperatures over 170 degrees Fahrenheit seriously reduces drive motor efficiency. Flow restrictions in a hydraulic system generate heat. There should be few sharp hose bends and other restrictions in hydraulic circuits.

Installation Instructions

1. Before installing a new Cascade clamp, inspect the truck carriage to make sure that top edge locating notches are undamaged. Eliminate any obstructions on the face plate itself.

2. Position the clamp upright in preparation for mounting.

3. Remove the lower mounting hooks from the back of the rotator.

4. Remove the plastic caps from the two shaft fittings from the revolving connection projecting from the rotator back.

The revolving connections for clamp models C2R, C3R, C4R and C6R are equipped with SAE No. 8 fittings. However, the fittings have SAE No. 6 adapters on them. The C7P clamp has SAE No. 10 ports and fittings and SAE No. 8 adapters.

5. Attach the two jumper hoses securely to the revolving unit before connecting them to one of the two junction blocks on the truck carriage. The two lines should be plumbed into the connection as shown in the illustration.

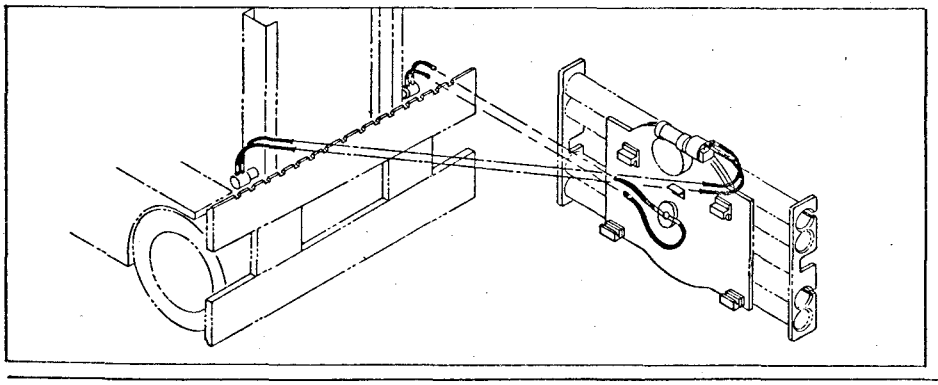
6. If the hose junction block is located on the *upper* truck carriage, do not connect jumper hoses to it until the clamp is mounted. Lay the hoses over the top of the frame. If the junction block is on the *lower* portion or in the center opening of the carriage, attach the jumper hoses securely *before* installing the unit.

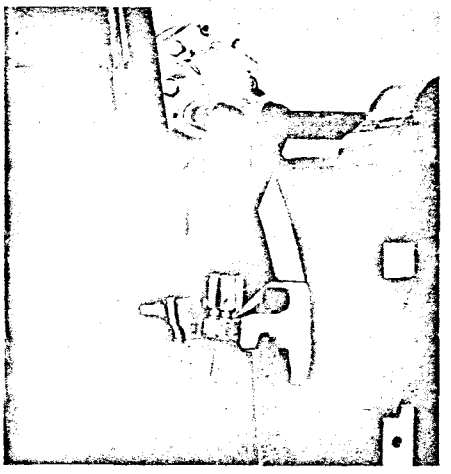
7. Install the clamp on the truck. It may be lifted onto the truck or simply positioned on the floor or on a pallet so the truck carriage moves under the upper mounting hooks. Line up the clamping locating lug with the truck carriage center notch. Be careful not to pinch, twist or damage jumper hoses while mounting.

After the unit has been placed on the truck, bolt the lower mounting hooks into position on the back of the rotator to firmly secure it to the carriage.

8. Attach jumper hoses from the revolving connection to the carriage junction blocks. The hydraulic lines which operate the closing and opening movement must be aligned together over the mast and through the same truck valve.

9. Remove the two protective plastic caps from the hydraulic fittings on the rotator drive motor end.





10. Attach the two jumper hose lines from the second carriage junction block to the drive motor.

11. At this point recheck the hoses from the truck valve to the clamp. Make sure hoses are routed correctly, and that all connections are tight. There should be few 90-degree bends and other similar flow restrictions in hydraulic circuits. Check mounting hooks to be certain the clamp is solidly mounted on the truck carriage.

12. Start the truck. Operate the clamping and rotating functions several times to remove any air trapped in the system. Check for hydraulic leaks and mechanical interference during rotation.

Before proceeding to the next step, check to make sure that the retaining nuts on the anchor and rod ends of each clamp cylinder are tight. They should be tightened with a torque wrench set at the following:

Model	Torque①
C3P	90
C4P	150
C6P	300
C7P	300

①*Figure shown is minimum (lubricated) in foot pounds.*

13. All Cascade revolving clamps provide continuous rotation in either direction. In certain applications, however, it may be necessary to restrict rotation to 180 degrees. For this purpose, there's an optional rotation limiting kit. If the clamp is equipped with this positive stop arrangement, the following information applies:

(a) The rotation limiting kit consists of two identical rectangular steel blocks, one bolted to each of the upper corners on the front side of the rotator's stationary base plate. Each of these two fixed blocks contain a large, adjustable, self-locking capscrew. A third steel block is bolted to the back side of the revolving face plate. This block is faced, top and bottom, with resilient pads. (The clamping portion of the unit bolts to the revolving face plate, front side.)

(b) As the face plate rotates through a 180 degree arc, the block contacts the head of one or the other adjustable capscrews projecting from the fixed blocks on the base plate.

(c) By loosening the fixed blocks and turning the two projecting capscrews in or backing them out the rotating mechanism and clamp may be adjusted to 180 degrees, and to a true horizontal position. These capscrews are most accessible when the clamp frame is turned 90 degrees from the horizontal.

(d) Tapped holes in the face plate have been provided for mounting the moving block on either edge of the plate. This allows the selection of clockwise or counterclockwise rotation depending upon the specific handling problem.

(e) No adjustments or modifications to the 360 degree drive gears, bearing, hydraulic motor, or clamping unit are required.

14. Adjust the rate of arm travel. Although the clamp was tested and arm speed carefully adjusted before it was shipped, each lift truck has its own particular hydraulic system characteristics, and arm movement should be readjusted as necessary.

Start the truck. Hold the engine speed on gas powered trucks well above idle so that a normal operating volume of oil is being pumped through the hydraulic lines to the clamp cylinder.

When the clamp is correctly adjusted both arms should close together from full extension at the fastest possible speed and reach their minimum range at the same moment. The arm closing speed is controlled by two restrictor fittings, one located on each cylinder at the rod end.

To equalize arm travel:

(a) Open both restrictor fittings completely by loosening the lock nut and backing out the threaded shaft. The restrictor is wide open when a half-inch of the shaft is exposed above the tightened lock nut. Open the valves completely *before* making the adjustment because clamp speed is directly affected by restriction in the lines. The fittings should be as wide open as possible with both arms operating at the same speed.

(b) Close the arms from their full extension, watching to see which one is closing most rapidly.

(c) Close the restrictor fitting on the cylinder controlling the faster arm until both arms travel at the same rate. The clamp will probably have to be opened and closed several times to make this adjustment accurately.

15. To complete installation, insert a hydraulic pressure gauge into the truck system's test port and adjust the pressure relief setting per the lift truck manufacturer's recommendations for this attachment and load. Adjustment is particularly important on trucks which have been in service with varied system pressures. Never exceed Cascade's recommended maximum operating pressure for this clamp.

Regular Maintenance Is Important

Every 200 Hours

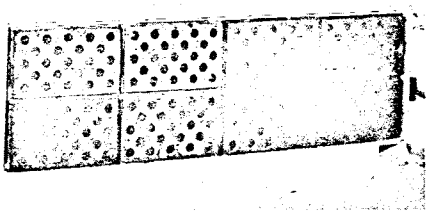
1. Inspect the hydraulic lines. Check to see that the O-ring fittings are tight and that hoses are attached securely. Worn components should be replaced.

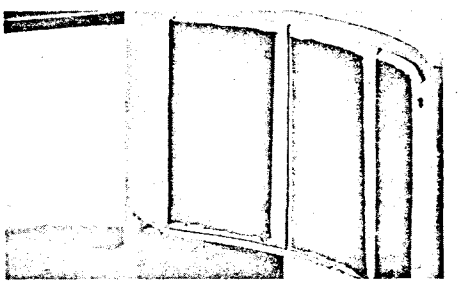
2. Inspect the mounting hooks and bolts to be certain that the clamp is solidly mounted on the truck carriage.

3. Inspect the load arms.

Drum and Multipurpose Arms

Inspect the arm contact surfaces. If the rubber pads are damaged or excessively worn, greater clamping pressures will be required to lift unit loads. Higher clamping pressures increase the chance of product damage. Replace all parts which cannot be satisfactorily repaired.





Pallet (Fork) Arms

Inspect the fork arms. Check the underside of the fork at the heel for wear. If the heel area touches the ground while the truck is traveling, the resulting wear may seriously weaken the fork. Excessive heel wear is due to improper operating techniques, and can easily be avoided. Worn fork arms should be replaced.

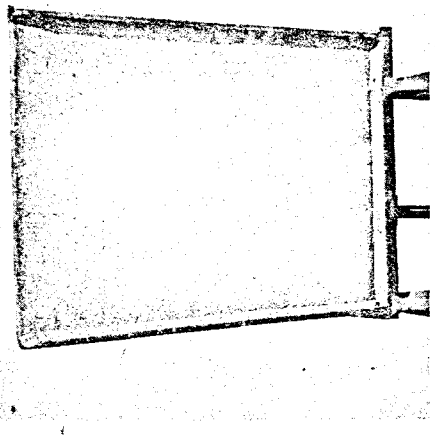
Inspect the leading edges of the forks. They may be nicked or bent. Damage of this kind is preventable, and usually results from striking nails, dock boards, concrete walls or floors or similar objects with the forks. Minor damage to tips can be repaired by grinding them smooth. Replace the arm if it cannot be satisfactorily repaired.

Bent forks should be replaced. Their original structural strength will not return with straightening.

Bale Arms

Inspect the ribbed, steel contact surfaces of the arms.

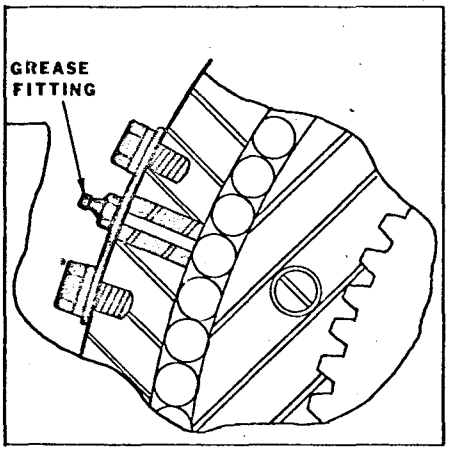
1. Clean and lubricate the two arm carriers. Inspect the arm carrier bushings. All bushings should be free of imbedded metal chips, cracks and gouges, and well-seated in their retaining grooves.



Visually check the guide tubes in the clamp. They should also be free of contamination. Apply a new coating of lubricant, preferably a medium-weight, wheel bearing grease, to the arm carrier bushings and the guide tubes.

2. Inspect the cylinder rods for nicks in the surface that could cut the cylinder packing. The rods are chrome-plated and, if the nicks are not too deep, their sharp edges can be smoothed off with a 320 grit (or finer) hone stone, emery paper, or crocus cloth. If damage is extensive, obtain a new rod and repack the cylinder.

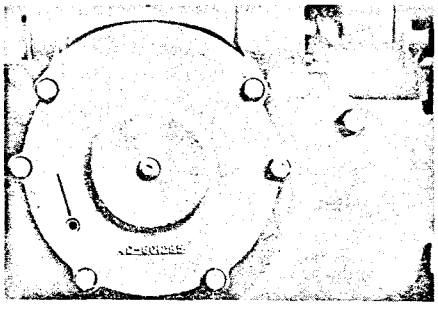
3. Lubricate the ball bearing race in the clamp's rotating mechanism.



A single fitting is located on the rim of the race on all rotators except Models C2R and C3R. Due to the external ring gear construction on these models, the grease fittings are located on the back side of the stationary base plate. Use a good grade of high pressure NLGI consistency No. 0 grease. Rotate the clamp during lubrication to distribute the grease evenly around the ball race. *Do not* over-grease the race, because the lubricant will be forced out through the seals. Although this will not affect rotator operation, it will detract from the general cleanliness and appearance.

4. Inspect the grease seal located between the rotator's face plate and outer race for leakage. If necessary, replace the seal. Refer to the maintenance instructions for details of this procedure.

5. Check the grease level in the worm and pinion drive unit. Lubricant level should be maintained to the height of the fill plug on the drive housing cover. Use Keystone Lubricant WG-1 or the equivalent.



Servicing Instructions

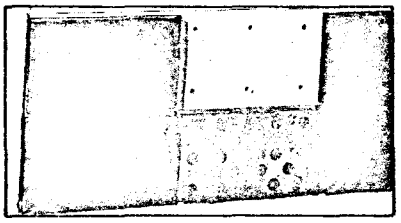
The hydraulic drive motor, clamping cylinders, and load arms are easily serviced without removing the clamp from the truck. However, the arms should be extended beyond the width of the frame so that each arm is fully accessible.

This also allows for the bumper guard removal, exposing the cylinders, their hydraulic lines and the revolving connection face.

The clamp must be demounted if the basic rotator, worm drive group, revolving connection, check valves or other hydraulics require attention.

Drum and Multipurpose Arms

1. Metal arms and rubber contact surfaces are bolted together. Nuts which secure the rubber pads are accessible on the back side of the arm. Loosen nuts to remove the pads if repair or replacement is required on either portion of the complete arm.



2. If further work is required on either arm, remove them from the clamp frame. They must be removed for servicing as follows:

(a) Open the arms to their maximum range.

(b) Remove the retaining nut and cotter key in the end of the arm carrier from the rod end of each cylinder.

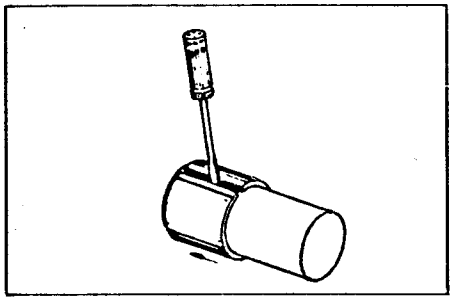
(c) Retract the cylinder rods using the truck auxiliary valve, thus leaving the arms extended.

(d) Manually pull the arms out of the guide tubes in the frame. This may take some effort.

Wipe off any old lubricant. Inspect the arm carrier bushings. All bushings should be free of imbedded metal chips, cracks and gouges, and well-seated in their retaining grooves. Visually check the guide tubes in the frame. They should also be free of contamination. Apply a new coating of lubricant, preferably a medium-weight, wheel bearing grease, to the arm carrier bushings and the guide tubes.

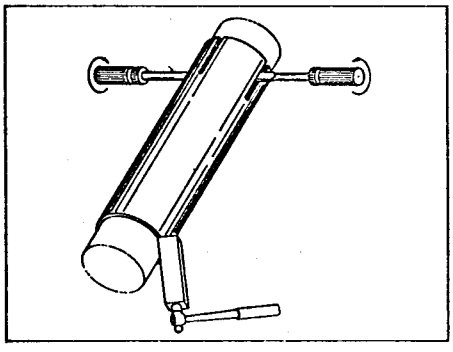
Arm Carrier Bushing Replacement

Should it ever be necessary to replace the nylon bushings on the arm carrier bars, remove them as shown below.



To remove the small split bushing, spread it apart with a screw driver and pull it out of the retaining groove and off the bar.

To remove the larger bushing, first, pry it out of the retaining groove on the notched end. This requires two screw drivers. Force the bushing off the bar with wood block and hammer as shown in the diagram.



New nylon bushings are much easier to get onto the arm carrier bar and into position in the retaining grooves if they are first expanded. Submerge for a few minutes in hot water. The larger bushing can then be placed over the end of the arm carrier bar, and driven down the bar and into position with a *soft* hammer. The large bushing must be carefully seated in its groove. If it is driven on so that either end is riding up on the edge of the groove, the arm carrier will jam in the guide tubes when replaced in the frame. The smaller split bushing can easily be spread open by hand and placed in its retaining groove after it has been heated.

Clamping Cylinders

1. To remove the cylinders for servicing, begin by opening the arms beyond the width of the frame. Remove the retaining nut and cotter key in the end of the arm carrier from the rod end of each cylinder. (When replacing these nuts, remember that they should be tightened down sufficiently to allow the insertion of a cotter key through the castellated nut and rod end or threaded anchor.) Retract the cylinder rods using the truck auxiliary valve, thus leaving the arms extended.

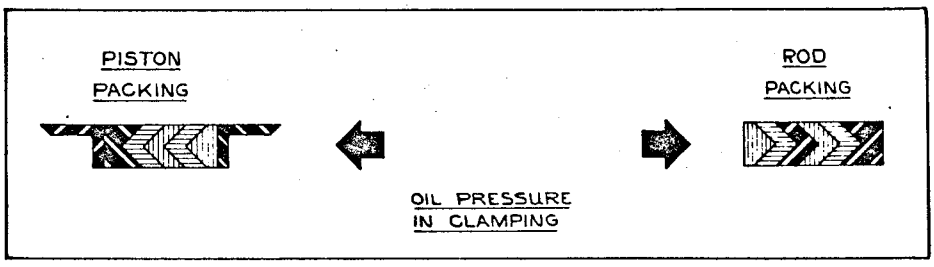
2. Remove the clamp bumper guard. It is held in position by four capscrews, two located on each end of the frame.

3. Now that the hydraulics are exposed, disconnect at the cylinder ports the 4 hose lines which run from the revolving check valve to the cylinders. Cap the cylinder ports and hoses with plastic plugs to prevent contamination of the hydraulic system. Take off the retaining nut on the anchor end of each cylinder. Both cylinders may now be lifted clear of the frame and disassembled.

4. Using a spanner wrench, remove the threaded end of the cylinder and pull the cylinder rod from the shell. DO NOT use a punch, chisel, screw driver or similar tool to loosen the threaded washer. These tools will seriously damage the cylinder. Removing the rod exposes all components for inspection and replacement.

Please refer to the illustration of the clamp cylinder in this manual for the proper disassembly sequence. Be sure to carefully inspect the packing and seals for signs of wear. If necessary replace the sealing parts.

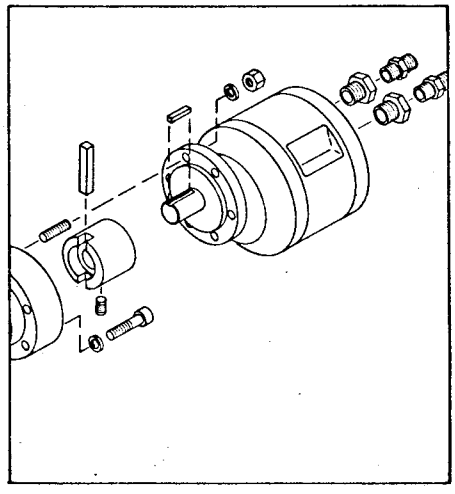
5. Before reassembling the cylinder, thoroughly wash all components with clean solvent. Apply hydraulic oil to the interior of the cylinder shell. The internal parts should also be coated with petroleum jelly or hydraulic oil before being reassembled into the cylinder. When replacing the two sets of packing, make sure that the open V sections face in the direction of the pressure in the clamping operation. This will allow the lips of the V-ring packing to flare against the metal surfaces in clamping, and provide a positive seal.



Insert the piston rod and other components into shell and secure the threaded washer in place with a spanner wrench. Replace the cylinder in the clamp frame and connect the hose lines.

Hydraulic Motor

The hydraulic motor may be removed from the drive group for servicing. Disconnect the jumper hoses from the two ports on the end of the motor. Loosen the capscrews which bolt the motor to the worm shaft housing. Slide the motor out of engagement with drive coupling and pull it off carefully. Remove the coupling and key.



Worm Drive Group

Due to the limited clearance between the rotating portion of the clamp and the lift truck mast, it is usually necessary to demount the clamp from the truck carriage at this point. Having already disconnected the jumper hoses and removed the load arms and hydraulic motor, proceed as follows:

(1) Remove the lower mounting hooks from the back of the clamp. This will free the unit from the truck carriage.

(2) Lift the clamp off the truck. Lay it face down on a suitable workbench. In this position the unit may be completely disassembled.

(3) Remove the 4 capscrews holding the worm gear assembly to the rotator base plate. The assembly fits snugly into the base plate, and two small pry bars may be required to free it. Place one pry bar on each side of the gear case, and lift it away from the base plate.

(4) The circular gear case cover is held in position with two capscrews. Remove them. Because the gear cover is sealed with an O-ring on its circumference, it may not lift off easily. If that is the case, remove the sealing screw in the center of the cover and insert a longer screw. This will act as a jack in freeing the cover. Drain the lubricant from the gear housing at this point.

(5) Loosen the capscrews and lockwashers which hold the cap and the adapter on opposite ends of the worm shaft housing. Remove the cap and adapter. This will free the worm shaft and attached ball bearings. Lift the shaft clear of the worm gear teeth, and pull it out of the housing at the motor mount end.

(6) Removal of the gear case cover exposes the worm gear, pinion and ball bearings. The hardened pinioned gear shaft is pressed into the brass worm gear. A woodruff key is used to lock the two components together. Using a press on the toothed end of the pinion, push the gears and bearings out of the case as a single assembly.

(7) Examine the worm gear and pinion. Check the bearings to be sure they are functioning properly. If any part of this assembly is damaged and requires attention, continue disassembly as follows:

(a) Remove the snap ring on the end of the pinion gear shaft.

(b) Press the pinion out of the worm gear. Be sure to shoulder against the brass gear as close to the larger ball bearing as possible. Press against the snap ring end of the pinion shaft. Because the worm gear is brass, and therefore, relatively soft, special care is needed to see that it is not damaged.

(c) As the shaft moves out of position, the first ball bearing may be removed. The woodruff key should be driven out as soon as it passes out of the worm gear hub.

(d) The second ball bearing will remain on the pinion. To remove it, shoulder against the bearing, and force the pinion shaft out by pressing against the snap ring end.

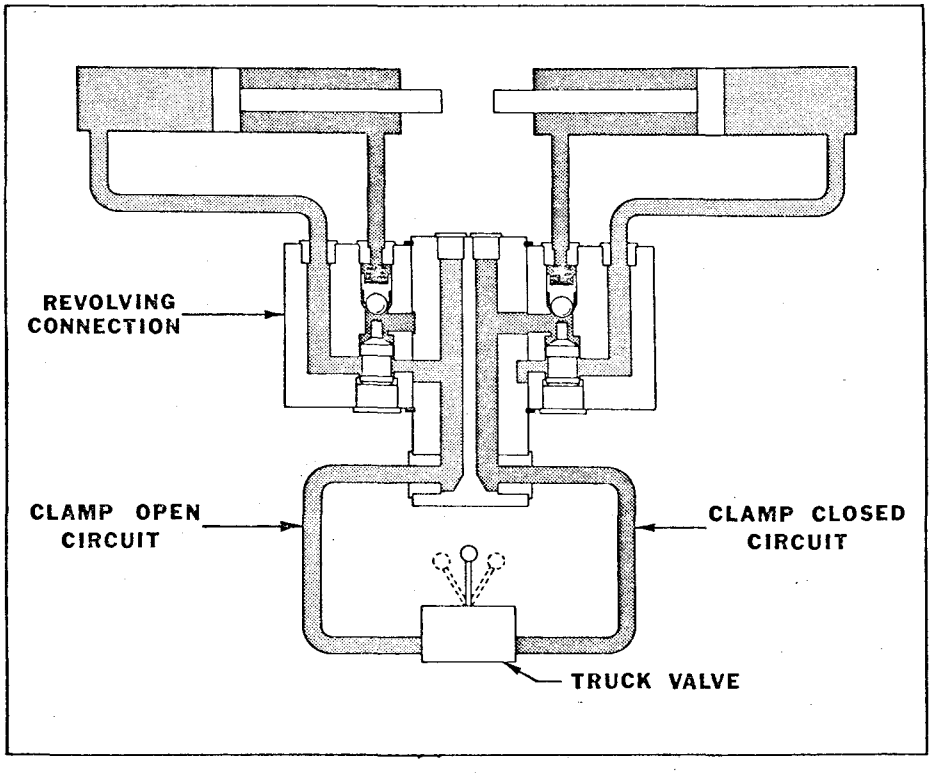
(e) When reassembling the drive group, remember to fill the gear case ½ full with Keystone Lubricant WG-1 or the equivalent before replacing the circular cover.

(f) Reassembly is a direct reversal of the previous steps. Before beginning however, inspect each component for wear. Obtain replacement parts as required. Wash all parts thoroughly in clean solvent such as kerosene and dry with compressed air.

Revolving Connection and Check Valve Group

The revolving check valve assembly located in the center hub of the clamp consists of two spring-loaded, pilot-operated valves in a single body. Both valves operate to maintain clamping pressure on the load at all times. In addition, the revolving connection provides a simple, effective method of transferring the the hydraulic flow to the clamping cylinders across a moving surface. An important feature of the connection is a special cam located on the rotating stem. This cam closes off the oil flow to the cylinder actuating the lower arm when the clamp is positioned for "off the floor" (horizontal) load pickup. This locks the lower arm, and allows the clamp operator to rapidly and accurately handle the load.

To service the revolving connection and check valves follow these steps:



(1) Remove the two hoses and O-ring fittings from the stem of the connection projecting from the back of the rotator. Plug the two exposed ports with plastic caps.

(2) The stem is held in position by a horizontal locking bar, and vertical metal pin inserted in the bar and the stem. Remove the two capscrews which bolt the bar to the rotator base plate. Remove the bar and pin.

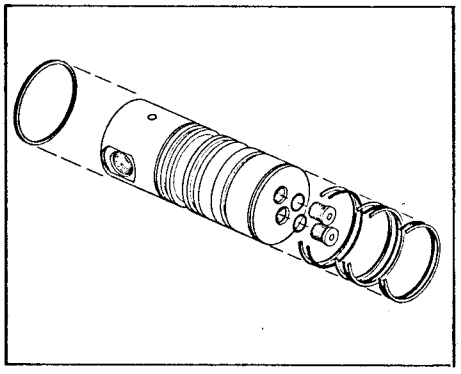
(3) Pull the revolving check valve assembly out of the clamp. Place it in a clean work area for disassembly.

(4) Remove the snap ring on the stem at the front face of the valve.

(5) Pull the stem from the valve body. It should come out easily. Removing the stem exposes the three O-ring seals and four back-up rings.

(6) Before removing the O-rings and back-up rings, carefully note their positions in the grooves on the stem.

(7) Cascade strongly recommends the installation of a *complete set* of new seals whenever any one seal requires replacement. Use only Cascade approved components. A complete Seal Kit is available for all models.



(8) Check the following areas when servicing the seals.

(a) The sealing surface where the O-ring is seated in the valve body must be smooth. Rough areas cause premature wear and early leakage.

(b) Stem grooves must be free of sharp edges to prevent cutting of the inside diameter of the O-ring during installation.

(c) Excessive stretching of the O-ring when installed can cause permanent deformation. An O-ring may be stretched no more than 25% of its diameter without permanent distortion.

(d) Installation of back-up rings in their proper locations is essential. Refer to the illustration in this manual.

Apply a liberal amount of petroleum jelly or hydraulic oil to the seals, stem and the interior of the valve body before reassembling. Rotate the stem slowly as you push it in to the body. This will avoid damaging the seals and make reassembly easier.

(9) After the stem has been removed from the body, the four plugs in the body which retain the check valve components should be taken off. These plugs are located front and back on the C7R revolving connection, and on opposite sides on the C2R, C3R, C4R and C6R valve.

The two springs and poppets will slip out of two of the bores. A spacer and pilot plunger will slip out of each of the other two opposing ports.

Inspect for excessive wear and clean all components with a solvent such as kerosene. Examine for smoothness the interior surfaces of the valve body, particularly the two poppet seats. Check the poppets for gouges, nicks and imbedded material.

(10) For help in reassembling the revolving check valve and connection, refer to the isometric illustration in this manual. Replace the poppets and springs in the valve body. Test the valve under pressure before continuing with reassembly. Attach a hose line from the carriage junction block to a male connector fitting installed on the valve

Pressure the line using the truck auxiliary valve. This should seat the poppet securely. Examine the open bore opposite the poppet. No oil should leak past the seal. If leakage is evident, there has been damage to the poppet or valve body and they need to be replaced. If the unit is in good working order, replace the plunger, spacer and O-ring plug. Remove the male connector used in testing, and replace the original O-ring plugs or fittings in their proper positions.

Basic Rotator Assembly

Having removed the motor and drive group, you are ready to disassemble the rotator itself.

(1) The base plate is bolted to the ball race. Remove the capscrews located on the back of the plate. Lift off the base plate, exposing the face plate and two piece bearing race.

(2) If either the rotator face plate or clamp frame are damaged and require replacement, the frame should be separated from the rotator at this point. The two assemblies are fastened together by eight large capscrews located in counterbores in the four corners of the face plate. Remove the bolts.

(3) A circular polyurethane seal is located in the rotator's center hub. Pull it out of the hub at this point.

(4) The ring gear — bearing race assembly is bolted to the face plate. Remove the series of Allen head capscrews located in the perimeter of the ring gear. Separate the bearing race from the face plate.

(5) To disassemble the ring gear from the other half of the bearing race, proceed as follows:

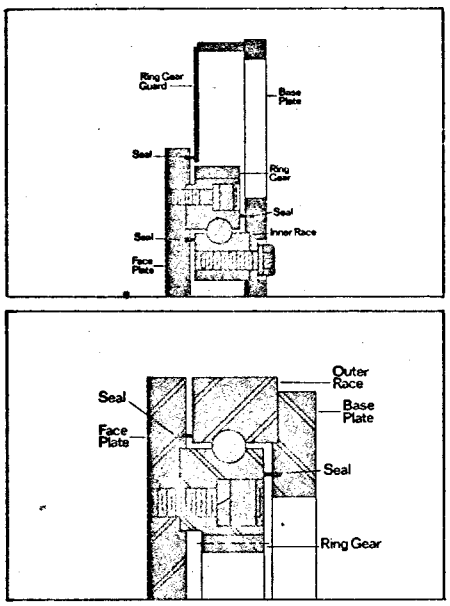
(a) Loosen the two capscrews and lockwashers which hold the retainer plate and grease fitting to the outer rim of the bearing race. (On Model R3B rotators, this retainer plate is located on the inner rim of the race.) Pull the spacer plug out of the race. The steel balls are inserted and removed through this hole.

(b) Remove the balls from the bearing race. The balls will drop out of the hole most rapidly if the ring gear is rotated slowly by hand. A container should be provided for collecting the steel balls. The R3R rotator contains 77 balls in its race; the R4R holds 108; the R6R race has 131; the R7R rotator contains 114.

(c) After approximately 80% of the balls have been removed from the race, tip the bearing to concentrate the remaining balls at one point. The two halves of the race may then be pulled apart. Collect the remaining balls and place them in the container.

Basic Rotator Assembly
(Continued)

(6) Examine the face and base plates. Grease seal strips are located in grooves in the perimeter of each plate.



Replace these seals each time the rotator is disassembled.

Obtain new lengths of sealing strips. Use only the Cascade approved components called for in the parts lists which follow in this manual.

To install a seal, start one end of the strip in the cleaned groove. Be sure to push the seal to the bottom of the groove and, at the same time, compress the strip back toward the end from which the installation was begun. If the seal is difficult to insert, stretch the next few inches to be placed in the groove. This will provide a thinner cross-section on the seal strip, which should then slip easily into position.

The replacement sealing strip will be longer than required. Trim it when the installation is nearly complete so that the two ends will just meet. Bond the ends together with 3M Brand Weatherstrip adhesive No. 8001 or the equivalent. This will hold the new strip in place.

When the adhesive has dried, lubricate the seal with SAE 30 weight oil. This will cause it to swell and tighten in the groove.

(7) Reassembly of the rotator is a direct reversal of the previous steps with the exceptions noted below:

(a) Inspect each component for wear. Obtain replacement parts as required. Wash all parts thoroughly in clean solvent such as kerosene and dry with compressed air.

(b) When bolting the bearing race to the face plate, and the base plate to the bearing race, torque all capscrews to 65 foot pounds lubricated. Use Lubriplate No. 110 or equivalent to grease the capscrews.

(c) Before replacing the polyurethane ring in the rotator hub, lubricate the sealing lips with Lubriplate No. 110.

(d) When the rotator has been reassembled and bolted to the clamp frame, and the complete unit has been installed on the truck carriage, lubricate the ball bearing race thoroughly with a good grade of high pressure NLGI Consistency No. 0 grease. Rotate the clamp during lubrication to distribute the grease evenly around the race.

(8) No adjustments are required on the rotating mechanism before returning the clamp to service. The worm drive group is dependent upon machine tolerance for correct gear alignment once properly assembled.

Maintenance Tips

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Insufficient clamping pressure.	1. Insufficient hydraulic oil in supply tank.	1. Bring hydraulic oil supply to proper level.
	2. Obstruction of flow in hydraulic lines.	2. Remove obstruction.
	3. Aerated hydraulic oil.	3. Bleed trapped air from the lines.
	4. Failure of the truck's hydraulic pump.	4. Repair or replace hydraulic pump.
	5. Relief valve on the truck set too low or malfunctioning.	5. Reset or repair. Pressure should not exceed 2,000 psi.
	6. Hydraulic pressure bypassing clamp cylinder packing.	6. Replace worn or damaged piston seals. ① ②
Loss of clamping pressure.	1. Check valve poppet not sealing completely against valve seat.	1. Disassemble check valve. Clean poppet and valve body. Replace poppet if necessary. ① ②
	2. Pilot plunger in check valve holding poppet off seat.	2. Disassemble check valve. Clean plunger, spacer and bore. ①
	3. Worn packing seals in clamping cylinder allowing a by-pass of oil.	3. Replace cylinder packing. ① ②
	4. Fittings or hoses leaking between check valve and clamp cylinders.	4. Tighten or replace parts as necessary to stop leakage.

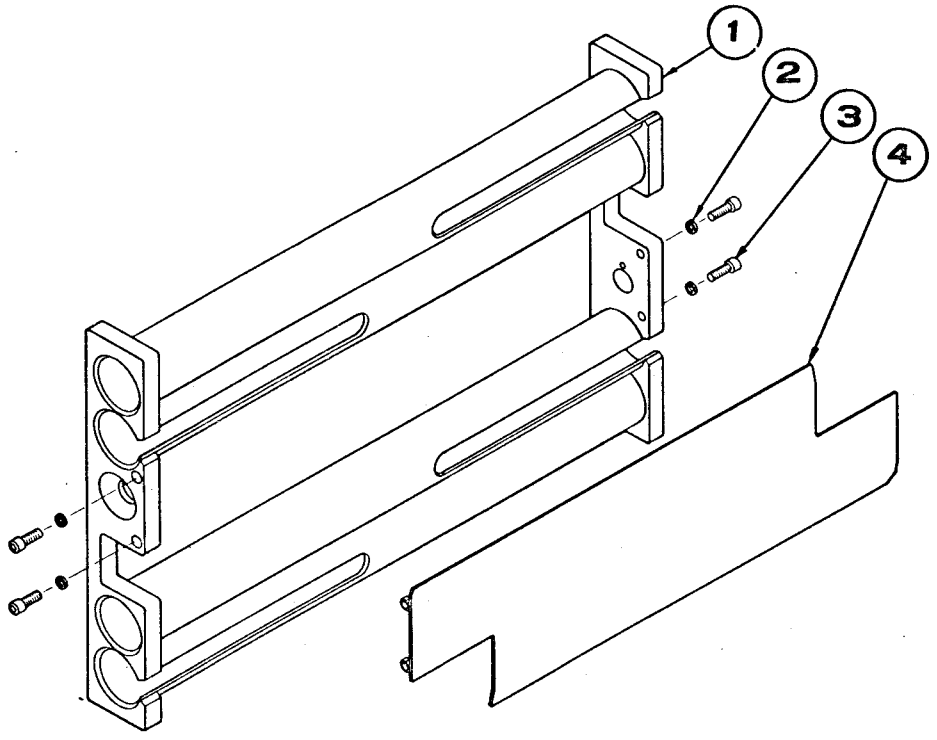
PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Slow arm travel.	1. Low volume hydraulic pump.	1. A minimum volume of 12 gallons per minute is recommended. Higher volumes are desirable.
	2. Interference between sliding arm carrier and guide tubes in frame.	2. Remove, clean and inspect arm carriers and guide tubes. Check for excessive wear on the nylon arm carrier bushings. Lubricate the bushings.
	3. Bent arm carriers or frame.	3. Replace damaged unit. ②
	4. Restriction in hydraulic line from truck pump to clamp.	4. Relieve any restrictions. Larger diameter hoses may be required. ②
	5. Worn piston packing in the clamping cylinder allowing a by-pass of oil.	5. Replace cylinder packing. ① ②
	6. Restrictor fittings on the clamping cylinders are shut down too far.	6. Adjust the fittings. Refer to the installation instructions.
Erratic or uneven arm travel.	1. Low volume hydraulic pump.	1. A minimum volume of 12 gallons per minute is recommended. Higher volumes are desirable.
	2. Aerated hydraulic oil.	2. Bleed trapped air from the lines.
	3. Restrictor fittings on the clamping cylinders are shut down too far.	3. Adjust the fittings. Refer to the installation instructions.
	4. Partial obstruction of flow in hydraulic lines.	4. Remove obstruction.
	5. Arm carrier guide tubes in the frame are contaminated.	5. Remove and clean arm carriers. Clean and lubricate guide tubes.
Excessive clamp cylinder maintenance.	1. Contamination in the hydraulic oil supply.	1. Flush and clean oil reservoir and hydraulic lines.
	2. Cylinder rod nicked or otherwise damaged.	2. Inspect the rod for nicks in the surface that could cut the cylinder packing. The rods are chrome plated, and, if the nicks are not too deep, their sharp edges can be smoothed off with a 320 grit (or finer) hone stone, emery paper, or crocus cloth. If damage is extensive, replace the rod. ②
Slow rotating speed and/or low torque.	1. Restriction in the hydraulic feed lines.	1. Remove the restriction.
	2. Aerated hydraulic fluid.	2. Bleed the air from the lines.
	3. Hydraulic hoses from the truck valve to the revolving unit are too small. This creates back pressure in the return lines. Remember that on any hydraulic motor the effective working pressure is directly related to the pressure differential across the motor drive gears. Back pressure in return line reduces the efficiency of the drive group, both in speed and torque. For example, if inlet pressure is 1000 psi and return line pressure is 500 psi, then only 500 psi is effectively working.	3. Minimum of SAE No. 6 size hose recommended ($^5/_{16}$" inside diameter). For maximum efficiency on the Model C6R and Model C7R clamps use SAE No. 8 hose ($^{13}/_{32}$" inside diameter). ②
	4. Off-center load exceeding rated torque of the revolving unit.	4. Reduce off-center load to rated capacity of the unit.
	5. Lack of lubrication.	5. Lubricate all bearings.
	6. Hydraulic drive motor worn and allowing bypass of fluid around drive gears.	6. Repair or replace the motor depending upon the severity of the wear. ① ②
	7. Worn bearings in worm drive produce binding.	7. Replace the worn bearings. ① ②

① Replace with Cascade approved components available through lift truck manufacturers and their authorized dealers.
② Refer to the proper isometric drawing in this manual for assistance in assembly.

Recommended Spare Parts List

						Number of Attachments Serviced		
C2R Part No.	C3R Part No.	C4R Part No.	C6R Part No.	C7R Part No.	Description	1-5	6-19	20-50
C-13663	C-13663	C-13663	C-13663	C-13664	Bearing	2	2	4
C-13661	C-13661	C-13661	C-13661	C-13666	Bearing	1	1	2
C-13662	C-13662	C-13662	C-13662	C-13665	Bearing	1	1	2
C-624923	C-624923	C-624923	C-624923	C-622147	Pinion	0	1	2
C-2787	C-2787	C-2887	C-2787	C-2813	O-ring	2	2	4
C-2833	C-2833	C-2833	C-2833	C-2794	O-ring	1	1	2
C-7204	C-7204	C-7204	C-7204	C-7219	Snap Ring	1	1	2
C-625431	C-625431	C-625431	C-625431	C-601287	Worm	0	1	2
C-625430	C-625430	C-625430	C-625430	C-601282	Gear	0	1	2
C-626314	C-626314	C-626314	C-626314	C-629459	Revolving Connection	0	0	1
C-630888	C-630888	C-630888	C-630888	C-630888	Revolving Connection Kit	1	2	4
C-7000	C-7000	C-7000	C-7000	C-7000	Ball	2	4	4
C-626313	C-626313	C-626313	C-626313	C-626313	Guide	2	4	4
C-631808	C-631808	C-631808	C-631808	C-631808	Spring	2	4	4
C-624656	C-624830	C-624850	C-624875	C-624895	Clamp Cylinder	0	2	4
C-629495	C-629491	C-630445	C-629496	C-628488	Clamp Cylinder Packing Kit	2	4	8
C-624608	C-601970	C-601975	C-600341	Not Used	Arm Carrier Bushing, Long	4	4	8
C-624600	C-601971	C-601976	C-600342	Not Used	Arm Carrier Bushing, Short	4	4	8
Not Used	Not Used	Not Used	Not Used	C-631243	Arm Carrier Bushing	8	8	16

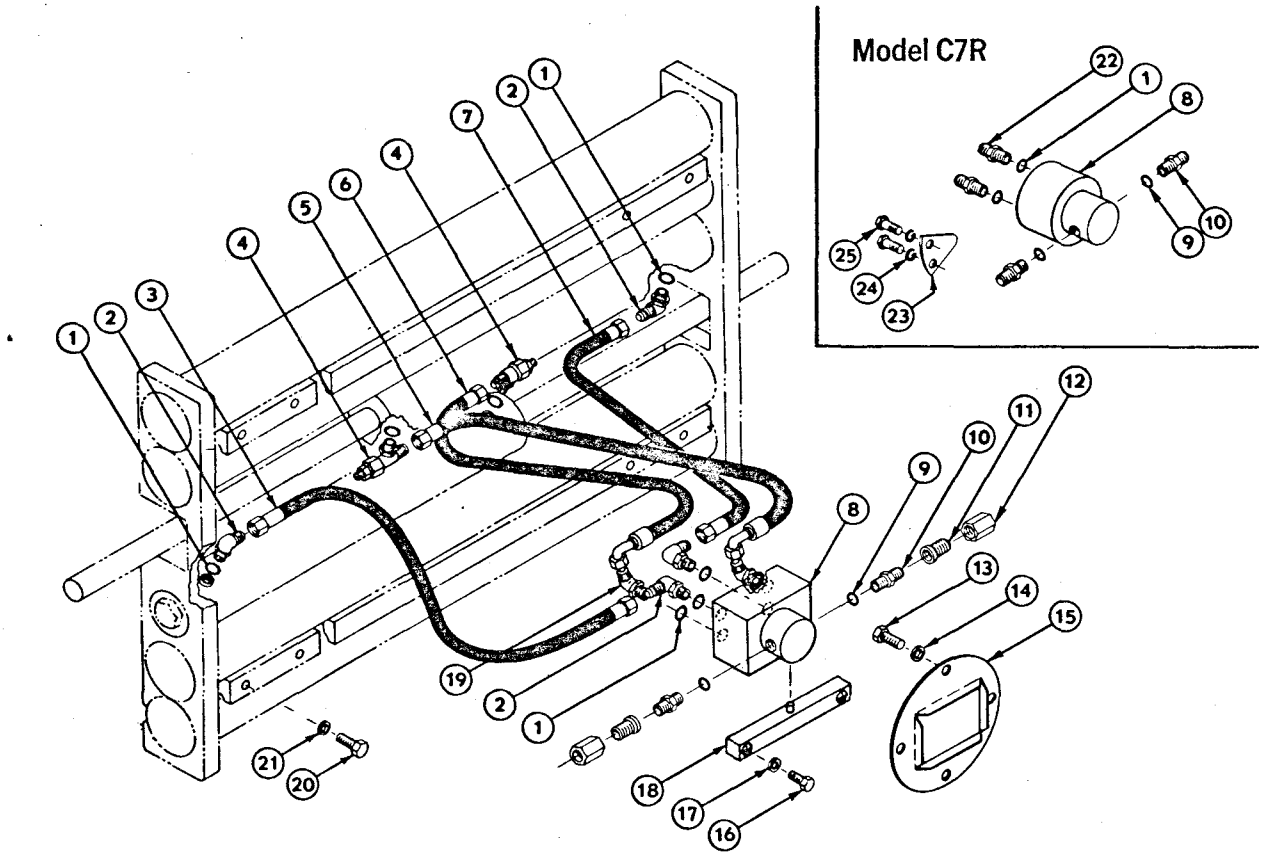
Frame Group



		C2R C-624634		C3R C-624829		C4R C-624839		C6R C-624874		C7R C-624894		
Ref. No.	Description	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	†Special Part No.
1	Frame	1	C-625346	1	C-625371	1	C-625408	1	C-625478	1	C-625582	
2	Lockwasher	4	C-6372	4	C-6372	4	C-6374	4	C-6374	4	C-6374	
3	Capscrew	4	C-4472	4	C-4472	4	C-4506	4	C-4506	4	C-4506	
4	Bumper	1	C-625352	1	C-625377	1	C-625414	1	C-625484	1	C-625588	

†If non standard parts are used, they will appear in this column.

Check Valve Group



Ref. No.	Qty.	Description	C2R C-624905 Part No.	C3R C-624915 Part No.	C4R C-624922 Part No.	C6R C-624930 Part No.	C7R C-625246 Part No.	†Special Part No.
1	8	O-ring	C-2840	C-2840	C-2840	C-2840	C-2841	
2	4	Ell	C-601676	C-601676	C-601676	C-601676	C-601250	
3	1	Hose	C-2105	C-2119	C-2120	C-2106	C-2272	
4	2	Restrictor Tee	C-617487	C-617487	C-617487	C-617487	C-601221	
5	1	Hose	C-631381	C-631434	C-631443	C-631460	C-631476	
6	1	Hose	C-631381	C-631434	C-631443	C-631460	C-631476	
7	1	Hose	C-2105	C-2119	C-2120	C-2117	C-2272	
8	1	Rev. Connection	C-626314	C-626314	C-626314	C-626314	C-629459	
9	2	O-ring	C-2841	C-2841	C-2841	C-2841	C-2841	
10	2	Male Connector	C-601377	C-601377	C-601377	C-601377	C-601377	
11	2	Reducer	C-2671	C-2671	C-2671	Not Used	Not Used	
12	2	Nut	C-2618	C-2618	C-2618	Not Used	Not Used	
13	4	Capscrew	C-3573	C-3573	C-3573	C-3573	Not Used	
14	4	Lockwasher	C-6287	C-6287	C-6287	C-6287	Not Used	
15	1	Retainer	C-631265	C-631265	C-631265	C-631265	Not Used	
16	2	Capscrew	C-3604	C-3604	C-3604	C-3604	C-3254	
17	2	Lockwasher	C-6288	C-6288	C-6288	C-6288	C-6288	
18	1	Bar Keeper	C-626592	C-626592	C-626592	C-626592	C-626592	
19	2	Ell	C-611302	C-611302	C-611302	C-611302	Not Used	
20	8	Capscrew	C-3653	C-3653	C-3707	C-3709	C-3758	
21	8	Lockwasher	C-6290	C-6290	C-6292	C-6292	C-6296	
22	4	Connector	Not Used	Not Used	Not Used	Not Used	C-601377	
23	2	Retainer	Not Used	Not Used	Not Used	Not Used	C-628345	
24	4	Lockwasher	Not Used	Not Used	Not Used	Not Used	C-6288	
25	4	Capscrew	Not Used	Not Used	Not Used	Not Used	C-3601	

†If non standard parts are used, they will appear in this column.

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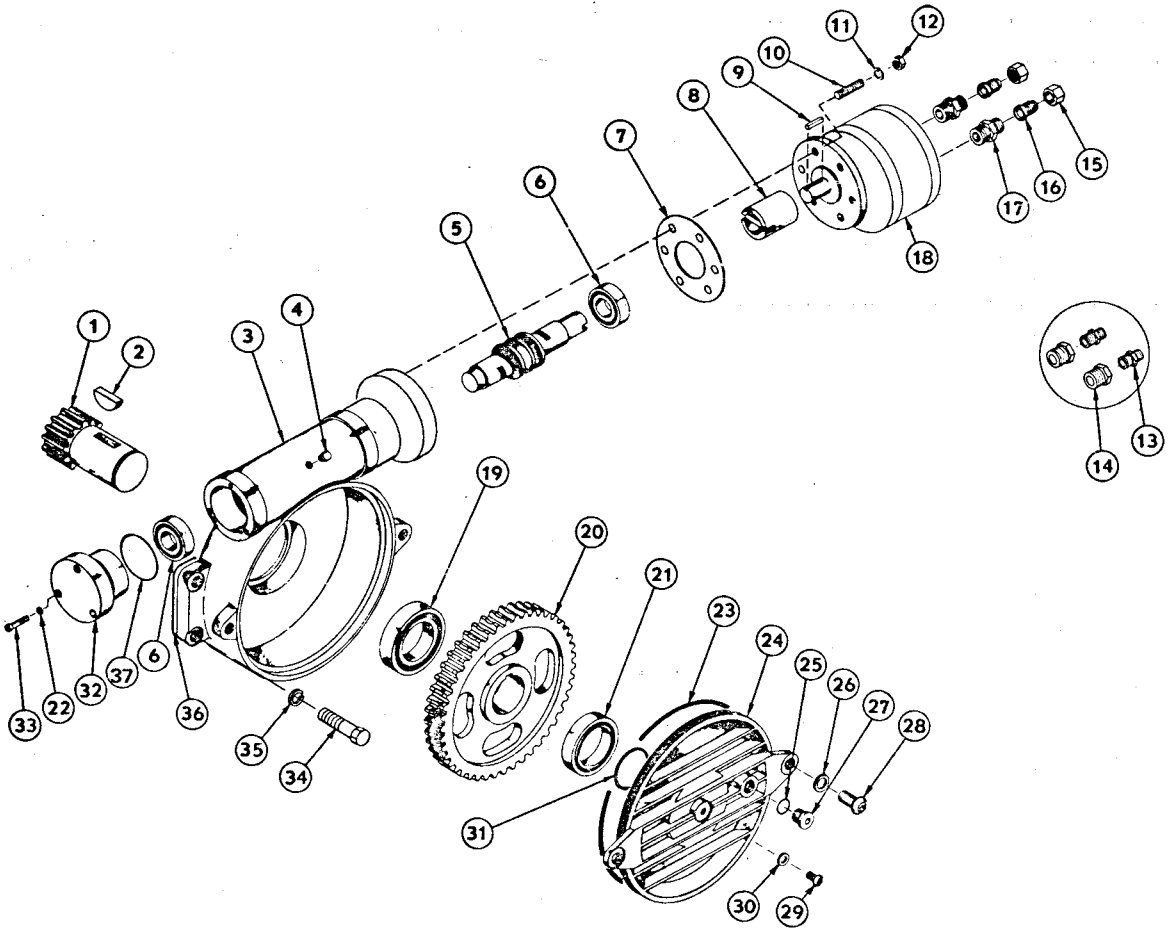
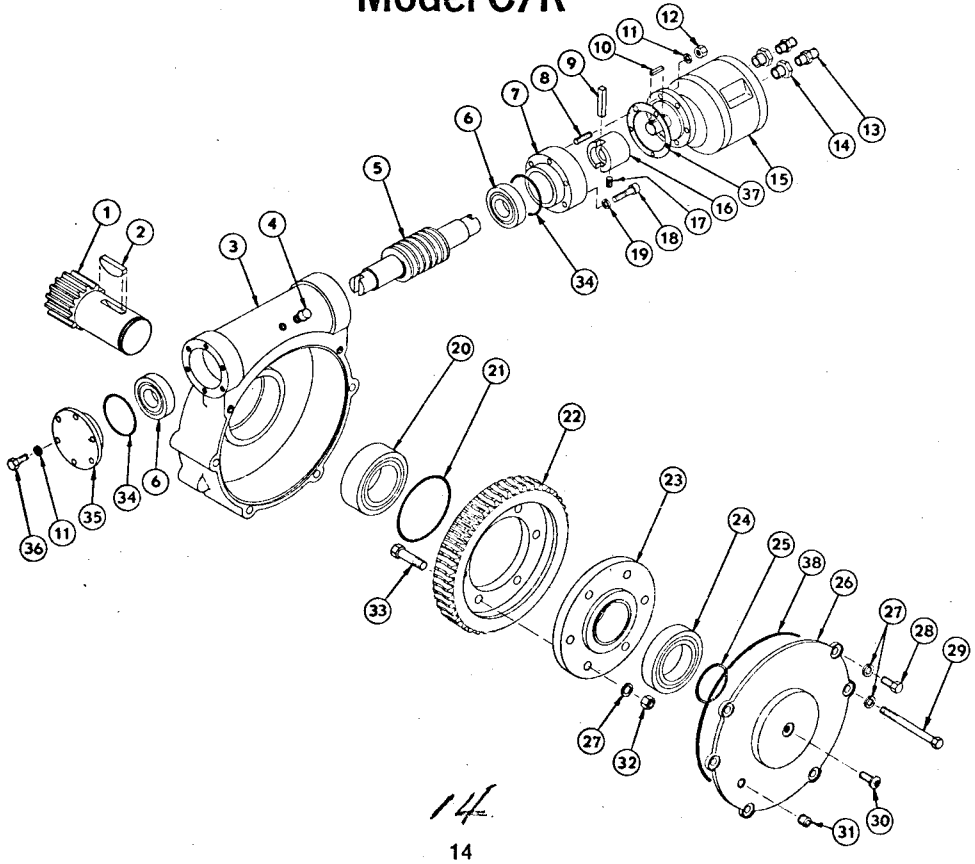
Rotator Drive Group
Model C2R-C3R-C4R Std., C4R Heavy Duty and C6R



Rotator Drive Group
Model C7R



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Rotator Drive Group
Model C2R-C3R-C4R Std., C4R Heavy Duty and C6R

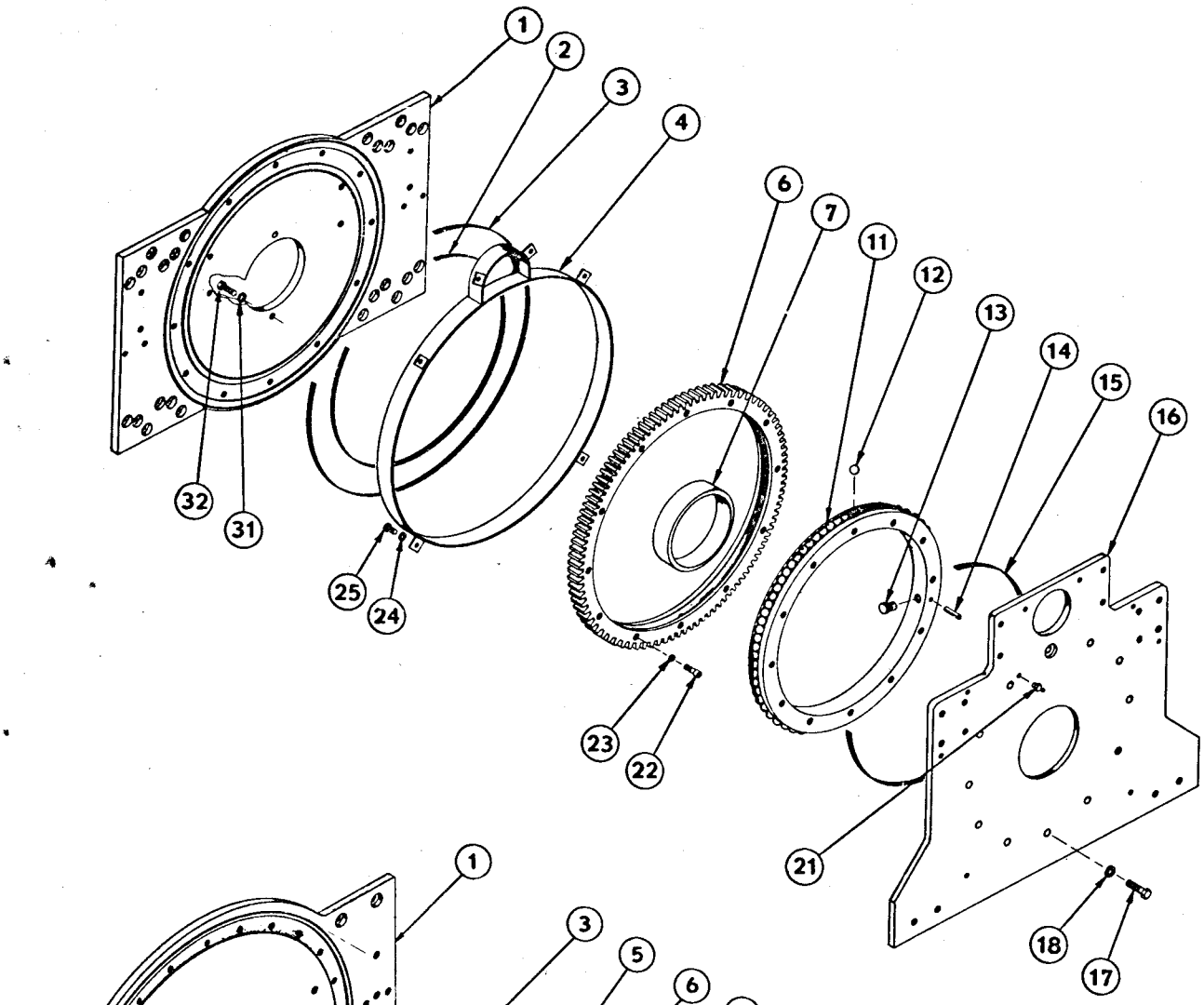
		C2R C3R, C4R C-630412	C4R Hvy. Dty. C-630490	C6R C-630491		
Ref. No.	Qty.	Part No.	Part No.	Part No.	Description	*Special Part No.
1	1	C-624923	C-624923	C-624923	Pinion	
2	1	C-13654	C-13654	C-13654	Key	
3	1	C-625429	C-625429	C-625429	Case	
4	1	C-2655	C-2655	C-2655	Plug	
5	1	C-625431	C-625431	C-625431	Worm	
6	2	C-13663	C-13663	C-13663	Bearing	
7	1	C-632253	C-632253	C-632253	Gasket	
8	1	C-630414	C-630414	C-630492	Coupling	
9	1	C-630488	C-630488	C-630488	Key	
10	6	C-610392	C-610392	C-610392	Stud	
11	6	C-6288	C-6288	C-6288	Lockwasher	
12	6	C-5702	C-5702	C-5702	Nut	
13	2	Not Used	Not Used	C-2310	Connector	
14	2	Not Used	Not Used	C-6775	Bushing	
15	2	C-2618	C-2618	Not Used	Nut	
16	2	C-2671	C-2671	Not Used	Reducing Adaptor	
17	2	C-2313	C-2313	Not Used	Connector	
18	1	C-15016	C-14322	C-15017	Motor	
19	1	C-13661	C-13661	C-13661	Bearing	
20	2	C-625430	C-625430	C-625430	Gear	
21	1	C-13662	C-13662	C-13662	Bearing	
22	3	C-6370	C-6370	C-6370	Lockwasher	
23	1	C-2833	C-2833	C-2833	O-ring	
24	1	C-625427	C-625427	C-625427	Cover	
25	1	C-2841	C-2841	C-2841	O-ring	
26	2	C-6292	C-6292	C-6292	Lockwasher	
27	1	C-602580	C-602580	C-602580	Plug	
28	2	C-4884	C-4884	C-4884	Capscrew	
29	1	C-4874	C-4874	C-4874	Capscrew	
30	1	C-603680	C-603680	C-603680	Seal	
31	1	C-7204	C-7204	C-7204	Snap Ring	
32	1	C-625428	C-625428	C-625428	Cap	
33	3	C-4441	C-4441	C-4441	Capscrew	
34	4	C-3655	C-3655	C-3655	Capscrew	
35	4	C-6290	C-6290	C-6290	Lockwasher	
36	2	C-629166	—	—	Spacer	
37	1	C-2787	C-2787	C-2787	O-ring	

Model C7R

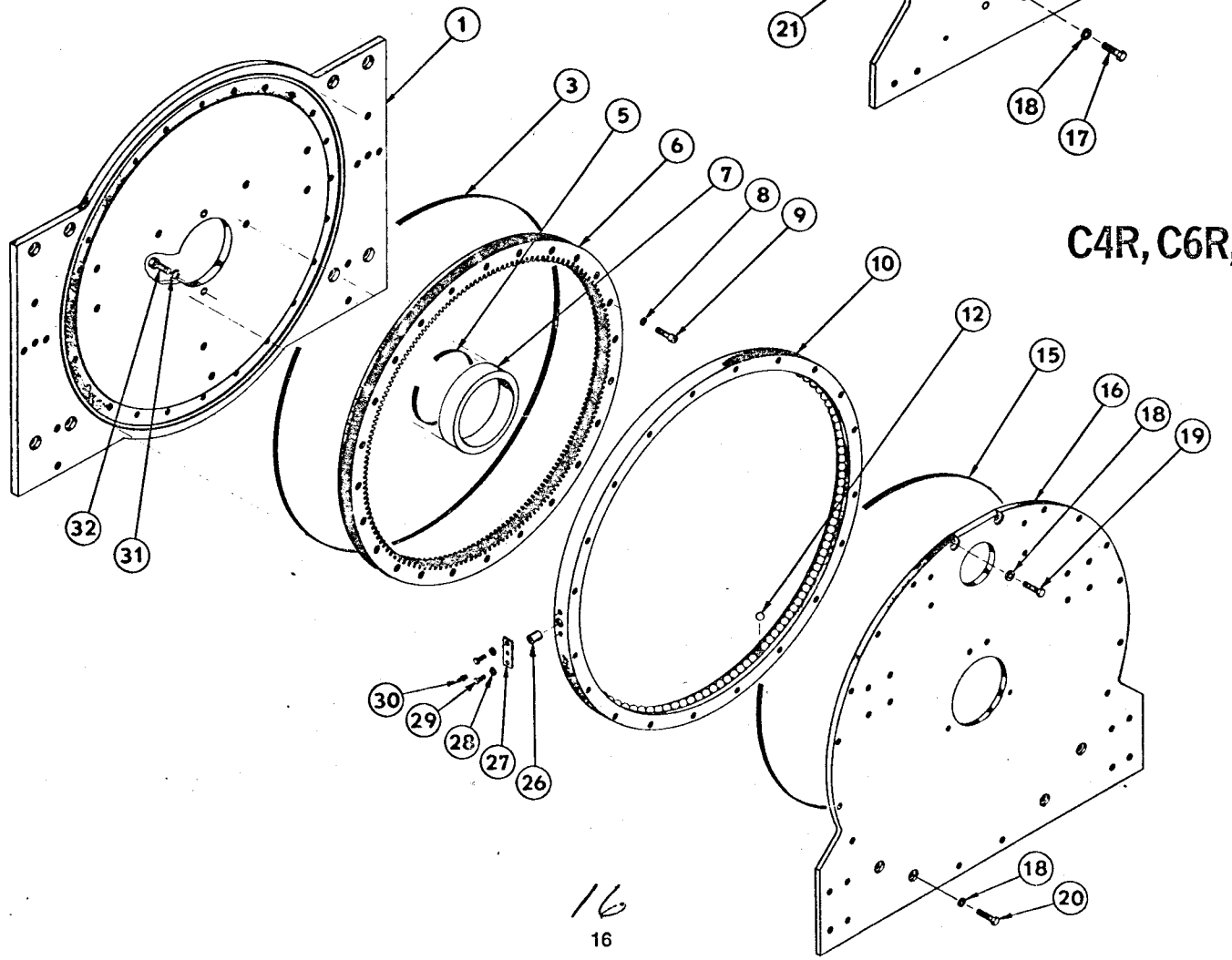
C-632255

Ref. No.	Qty.	Description	Part No.	†Special Part No.	Ref. No.	Qty.	Description	Part No.	†Special Part No.
1	1	Pinion	C-622147		19	6	Lockwasher	C-6372	
2	1	Key	C-601634		20	1	Bearing	C-13666	
3	1	Case	C-603006		21	1	O-ring	C-2813	
4	1	Plug	C-7411		22	1	Gear	C-601282	
5	1	Worm	C-601287		23	1	Hub	C-603005	
6	2	Bearing	C-13664		24	1	Bearing	C-13665	
7	1	Adaptor	C-601290		25	1	Snap Ring	C-7219	
8	6	Stud	C-610392		26	1	Cover	C-632254	
9	1	Key	C-601289		27	12	Lockwasher	C-6292	
10	1	Key	C-14330		28	2	Capscrew	C-3357	
11	12	Lockwashers	C-6288		29	4	Capscrew	C-3372	
12	6	Nut	C-5702		30	1	Capscrew	C-4884	
13	2	Connector	C-2314		31	1	Plug	C-602850	
14	2	Bushing	C-6778		32	6	Nut	C-5706	
15	1	Motor	C-601291		33	6	Capscrew	C-601283	
16	1	Coupling	C-601292		34	2	O-ring	C-2794	
17	1	Setscrew	C-4981		35	1	Retainer	C-601286	
18	6	Capscrew	C-4273		36	6	Capscrew	C-3253	
					37	1	Gasket	C-632253	
					38	1	O-Ring	C-632258	

C2R, C3R



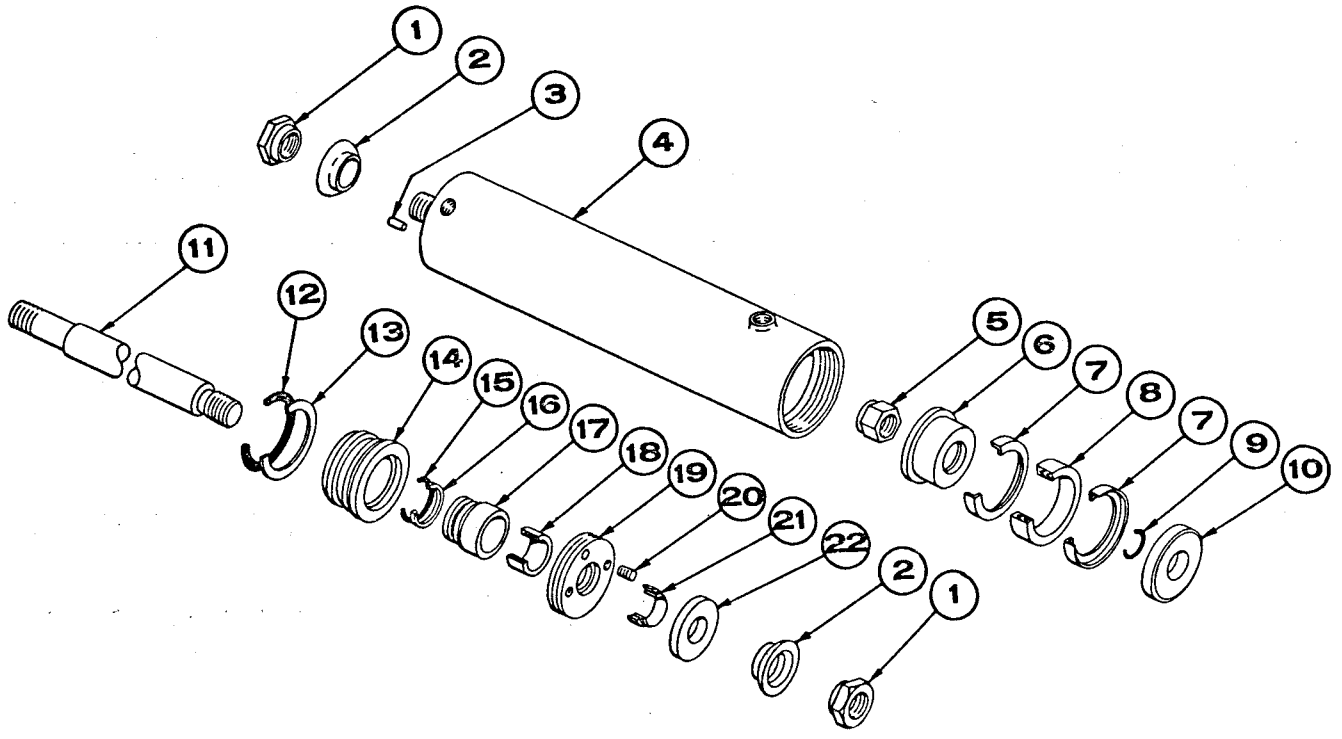
C4R, C6R, C7R



Basic Rotators

	C2R C3R C-633802		C4R C-633685		C6R C-633703		C7R C-628314			
Ref. No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Description	*Special Part No.
1	1	C-625395	1	C-622110	1	C-633705	1	C-622174	Face Plate	
2	1	C-625398	—	—	—	—	—	—	Seal—Inner	
3	1	C-625396	1	C-622112	1	C-625507	1	C-622157	Seal—Outer	
4	1	C-625403	—	—	—	—	—	—	Guard	
5	1	Not Used	1	Not Used	1	Not Used	1	C-628445	Seal	
6	1	C-625397	1	C-622111	1	C-625508	1	C-622156	Ring Gear	
7	1	C-631264	1	C-631264	1	C-631264	1	C-628444	Ring—Plastic	
8	—	—	16	C-6374	24	C-6374	16	C-6448	Lockwasher	
9	—	—	16	C-4506	24	C-4506	16	C-607105	Capscrew	
10	—	—	1	C-622117	1	C-625506	1	C-622155	Outer Race	
11	1	C-625399	—	—	—	—	—	—	Inner Race	
12	77	C-7024	108	C-7024	131	C-7024	114	C-7001	Bearing Ball	
13	1	C-625400	—	—	—	—	—	—	Plug	
14	1	C-7890	—	—	—	—	—	—	Roll Pin	
15	1	C-625402	1	C-622123	1	C-625515	1	C-622161	Seal	
16	1	C-633803	1	C-633684	1	C-633704	1	C-628313	Base Plate	
17	12	C-3655	—	—	—	—	—	—	Capscrew	
18	12	C-6290	16	C-6290	20	C-6290	16	C-6294	Lockwasher	
19	—	—	—	—	—	—	2	C-3736	Capscrew	
20	—	—	16	C-3656	20	C-3655	14	C-3738	Capscrew	
21	1	C-7401	—	—	—	—	—	—	Grease Fitting	
22	12	C-4506	—	—	—	—	—	—	Capscrew	
23	12	C-6374	—	—	—	—	—	—	Lockwasher	
24	6	C-6288	—	—	—	—	—	—	Lockwasher	
25	6	C-3602	—	—	—	—	—	—	Capscrew	
26	—	—	1	C-625516	1	C-625516	1	C-622162	Plug	
27	—	—	1	C-622114	1	C-622114	1	C-622160	Bar	
28	—	—	2	C-6288	2	C-6288	2	C-6288	Lockwasher	
29	—	—	2	C-3601	2	C-3601	2	C-3253	Capscrew	
30	—	—	1	C-7413	1	C-7413	1	C-7416	Grease Fitting	
31	2	C-6287	2	C-6287	2	C-6287	—	Not Used	Lockwasher	
32	2	C-3573	2	C-3573	2	C-3573	—	Not Used	Capscrew	

Cylinder Group

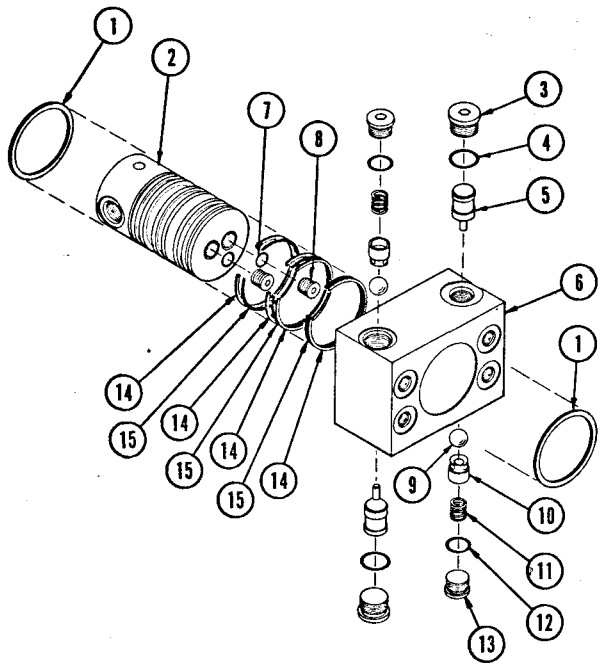


Ref. No.	Description	C2R C-624656 Qty.	C2R C-624656 Part No.	C3R C-624830 Qty.	C3R C-624830 Part No.	C4R C-624850 Qty.	C4R C-624850 Part No.	C6R C-624875 Qty.	C6R C-624875 Part No.	C7R C-624895 Qty.	C7R C-624895 Part No.	†Special Part No.
1	Nut	2	C-630980	2	C-630980	2	C-630982	2	C-630984	2	C-630984	
2	Sleeve	2	C-630981	2	C-630981	2	C-630983	2	C-630985	2	C-630985	
3	Roll Pin	1	C-7878	1	C-7878	1	C-611210	1	C-7961	1	C-7961	
4	Shell Assy.	1	C-625558	1	C-625569	1	C-625879	1	C-626202	1	C-626191	
5	Nut	1	C-5880	1	C-5881	1	C-5881	1	C-5884	1	C-5884	
6	Piston Half	1	C-625563	1	C-603113	1	C-603395	1	C-626206	1	C-629803	
*7	Nylon Rider	2	C-603379	2	C-603119	2	C-603394	2	C-608204	2	C-603462	
*8	Packing Assy.	1	C-7676	1	C-7606	1	C-7609	1	C-7669	1	C-7536	
*9	O-ring	1	C-2707	1	C-2709	1	C-2709	1	C-2716	1	C-2716	
10	Piston Half	1	C-625564	1	C-603114	1	C-603396	1	C-626207	1	C-629809	
11	Rod	1	C-625562	1	C-625573	1	C-625884	1	C-626205	1	C-626194	
*12	O-ring	1	C-2785	1	C-2787	1	C-2789	1	C-2795	1	C-2738	
*13	Parbak Ring	1	C-615128	1	C-615130	1	C-615132	1	C-615138	1	C-615201	
14	Retainer	1	C-601626	1	C-603116	1	C-604349	1	C-626208	1	C-603466	
*15	O-ring	1	C-2717	1	C-2720	1	C-2784	1	C-2786	1	C-2786	
*16	Parbak Ring	1	C-615121	1	C-615124	1	C-615126	1	C-615129	1	C-615129	
17	Bushing	1	C-601627	1	C-603115	1	C-603315	1	C-603184	1	C-603184	
*18	Packing Assy.	1	C-7501	1	C-7500	1	C-1808	1	C-7502	1	C-7502	
19	Thread. Wash.	1	C-625565	1	C-603118	1	C-602078	1	C-626209	1	C-629805	
20	Setscrew	1	C-4943	1	C-4968	1	C-4968	1	C-4968	1	C-4969	
*21	Wiper Ring	1	C-13774	1	C-13775	1	C-13777	1	C-13779	1	C-13779	
22	Washer	1	C-625566	1	C-625574	1	C-625883	1	C-626210	1	C-626210	
*Included in Repair Kit No.			C-629495		C-629491		C-630445		C-629496		C-628488	

†If non standard parts are used, they will appear in this column.

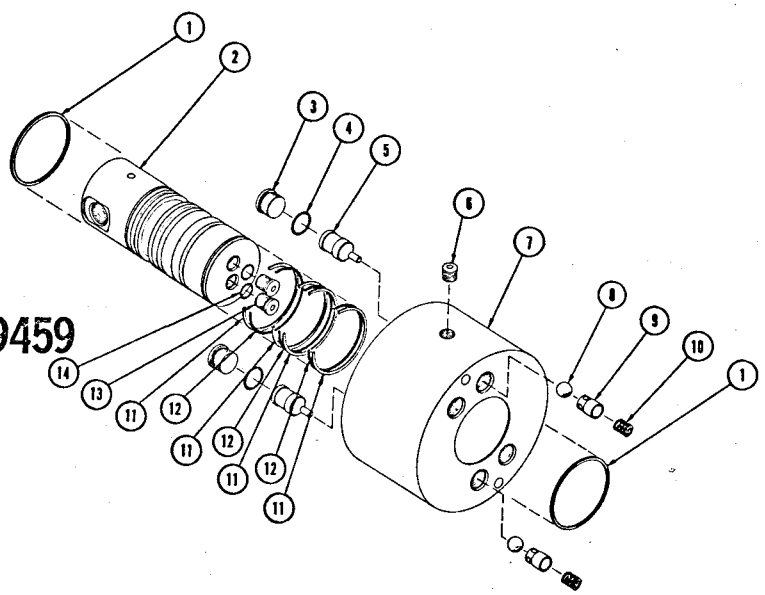
Revolving Connection and Check Valve

Used on C2R, C3R, C4R, C6R Part No. C-626314



Ref. No.	Qty.	Part No.	Description	†Special Part No.
1	2	C-7213	Snap Ring	
2	1	C-626317	Shaft	
3	2	C-609453	Plug	
4	2	C-2842	O-ring	
5	2	C-626316	Plunger	
6	1	C-626315	Body	
7	2	C-2840	O-ring	
8	2	C-604510	Plug	
9	2	C-7000	Ball	
10	2	C-626313	Guide	
11	2	C-631808	Spring	
12	2	C-2841	O-ring	
13	2	C-602580	Plug	
*14	4	C-2940	Back-up Ring	
*15	3	C-2789	O-ring	

*Included In Repair Kit No. C-630888

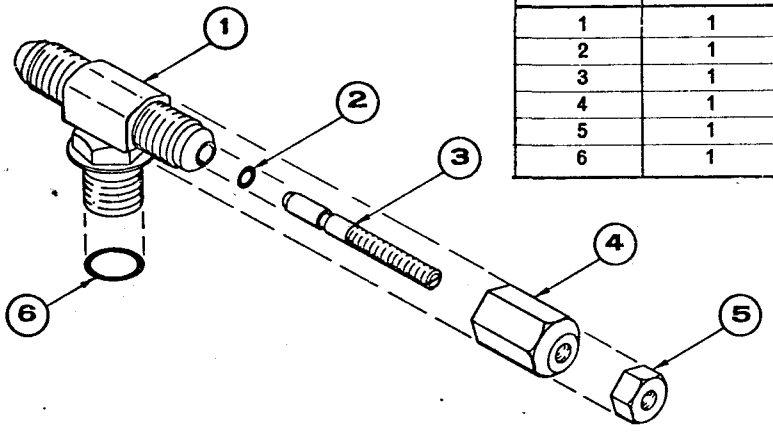


Used on C7R only – Part No. C-629459

Ref. No.	Qty.	Part No.	Description	†Special Part No.
1	2	C-7213	Snap Ring	
2	1	C-629461	Shaft	
3	2	C-609453	Plug	
5	2	C-626316	Plunger	
6	1	C-6603	Plug	
7	1	C-629460	Body	
8	2	C-7000	Ball	
9	2	C-626313	Guide	
10	2	C-631808	Spring	
*11	4	C-2940	Parbak Ring	
*12	3	C-2789	O-ring	
13	2	C-604510	Plug	
14	2	C-2840	O-ring	

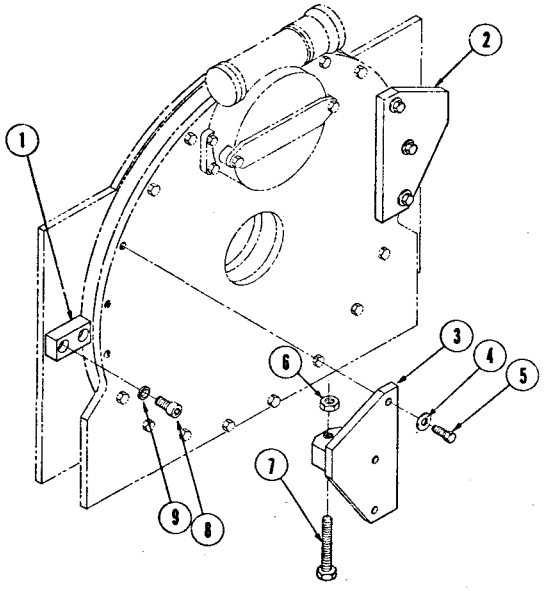
*Included in Repair Kit No. C-630888

Restrictor Fitting

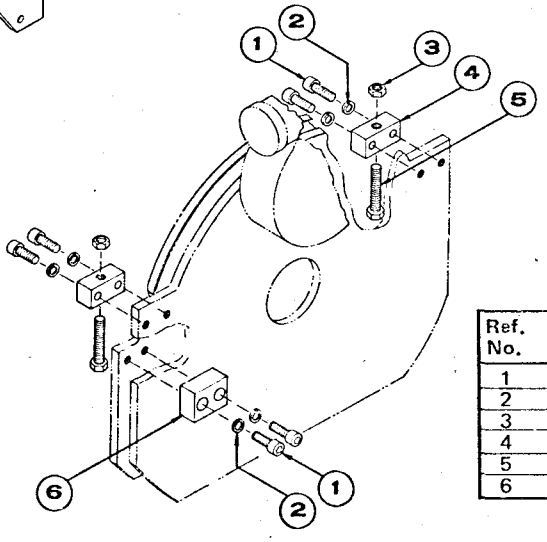


Reference No.	Quantity	Description	C2R, C3R C4R, C6R Part No. C-617487	C7R Part No. C-601221
			Part No.	Part No.
1	1	Tee	C-617486	C-601248
2	1	O-ring	C-2698	C-2701
3	1	Setscrew	C-11100	C-601252
4	1	Cap	C-11099	C-601251
5	1	Jam Nut	C-5715	C-5717
6	1	O-ring	C-2840	C-2841

Optional 180° Stops

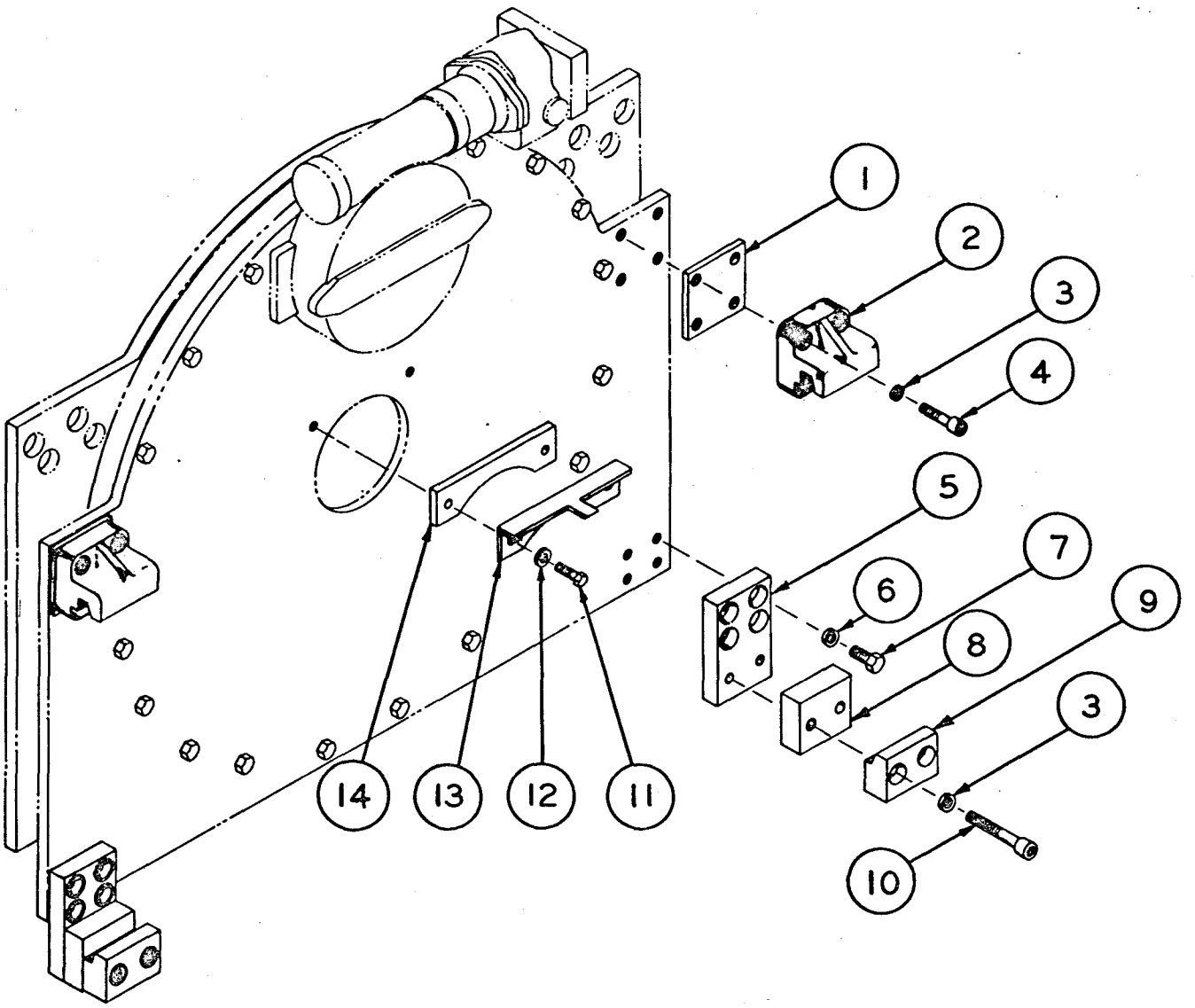


Ref. No.	Description	C3R C-633767 Qty.	C3R C-633767 Part No.	C4R C-633656 Qty.	C4R C-633656 Part No.	C6R C-633713 Qty.	C6R C-633713 Part No.
1	Stop Block	1	C-625456	1	C-625467	1	C-625522
2	R. H. Stop	1	C-633770	1	C-633659	1	C-633716
3	L. H. Stop	1	C-633771	1	C-633660	1	C-633717
4	Lockwasher	4	C-6290	4	C-6290	6	C-6290
5	Capscrew	4	C-633801	4	C-633683	6	C-633683
6	Nut	2	C-5932	2	C-5932	2	C-5933
7	Capscrew-Spec.	2	C-633662	2	C-633662	2	C-633712
8	Capscrew	2	C-4505	2	C-607084	2	C-607102
9	Lockwasher	2	C-6374	2	C-6447	2	C-6448



Ref. No.	C7R C-625250 Qty.	C7R C-625250 Part No.	Description
1	6	C-4545	Capscrew
2	6	C-6448	Lockwasher
3	2	C-5935	Jam Nut
4	2	C-626407	Stop Block
5	2	C-626436	Capscrew
6	1	C-626408	Block

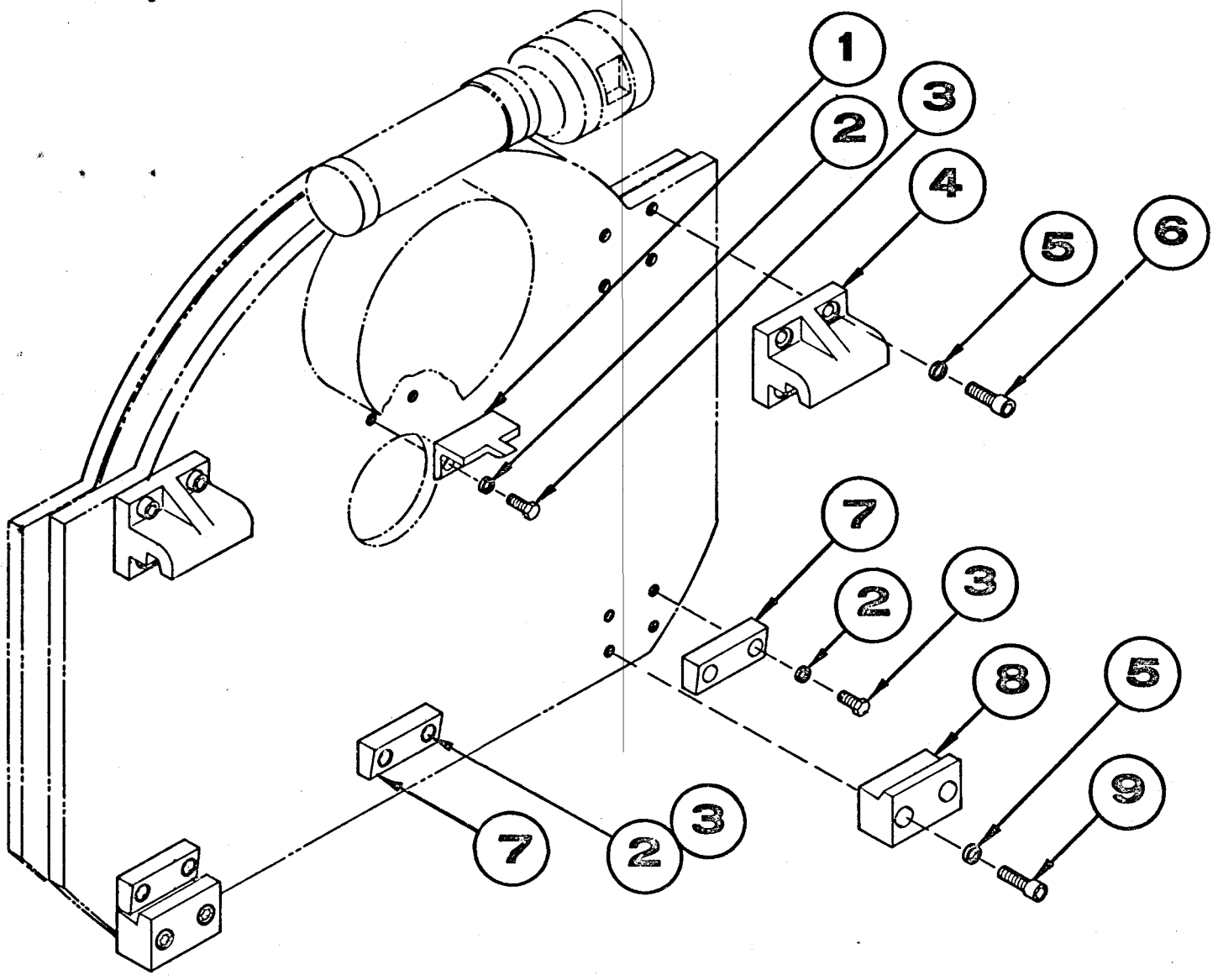
Mounting Group
Model C4R Class III 0° and 4° Forward Tilt



	C4R					
	0° Forward Tilt C-627459		4° Forward Tilt C-622124			
Ref. No.	Qty.	Part No.	Qty.	Part No.	Description	Special Part No.
1	4	C-630519	—	Not Used	Spacer	
2	2	C-625452	2	C-625452	Upper Hook	
3	12	C-6447	12	C-6447	Lockwasher	
4	8	C-607087	8	C-607085	Capscrew	
N 5	2	C-622127	2	C-622127	Extension	
N 6	8	C-6292	8	C-6292	Lockwasher	
N 7	8	C-3708	8	C-3708	Capscrew	
8	2	C-627574	2	C-622128	Pad	
9	2	C-627575	2	C-622126	Lower Hook	
10	4	C-607091	4	C-607090	Capscrew	
11	2	C-3655	2	C-3653	Capscrew	
12	2	C-6290	2	C-6290	Lockwasher	
13	1	C-626322	1	C-626322	Centering Bracket	
14	1	C-627573	—	Not Used	Spacer	

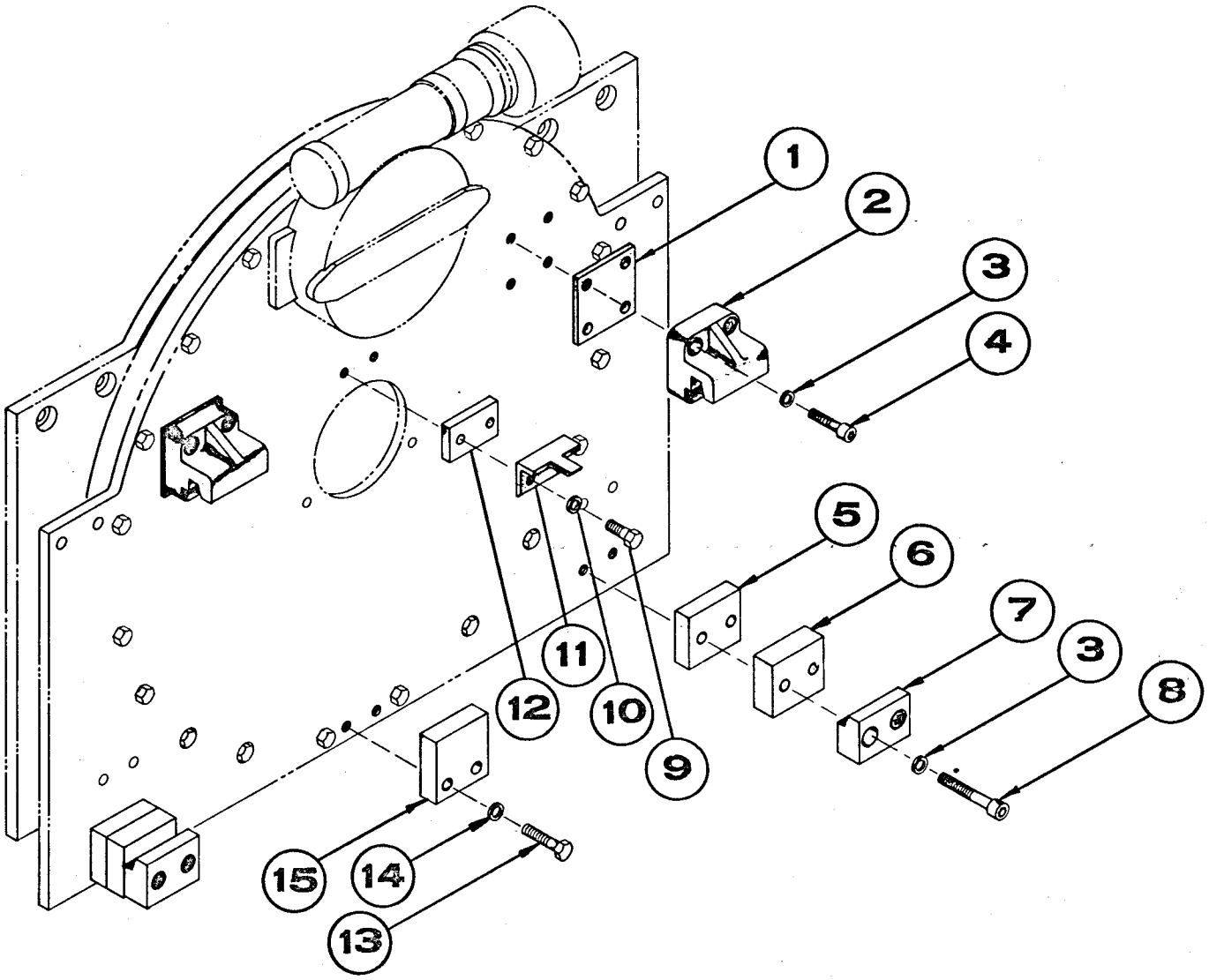
"N" on 4° Mtg. only — Item 5 mounts on opposite side of base plate than shown and Items 6 and 7 enter from front side of extension.

Mounting Group
Model C7R Class IV 4° Forward Tilt



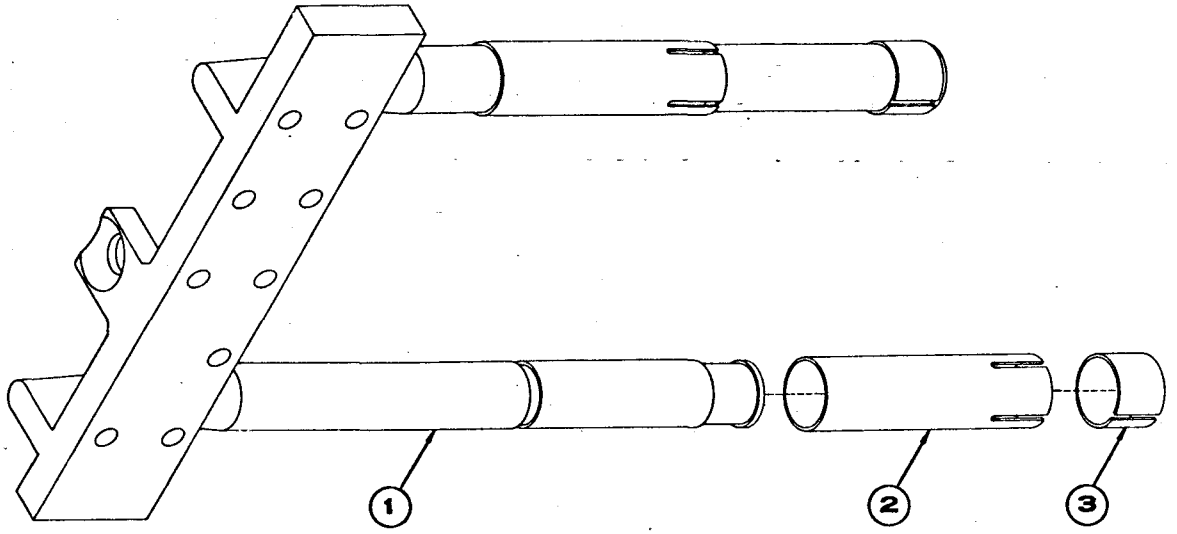
		C7R C-625247		
Ref. No.	Qty.	Part No.	Description	*Special Part No.
1	1	C-622158	Centering Block	
2	8	C-6290	Lockwasher	
3	8	C-3304	Capscrew	
4	2	C-622159	Hook-Upper	
5	12	C-6448	Lockwasher	
6	8	C-607105	Capscrew	
7	3	C-622163	Pad	
8	2	C-622164	Hook-Lower	
9	4	C-607108	Capscrew	

Mounting Group
Models C3R, C4R, Class II Model C6R, Class III



	C3R				C4R				C6R					
	0° Forward Tilt C-627445		4° Forward Tilt C-624906		0° Forward Tilt C-627458		4° Forward Tilt C-626320		0° Forward Tilt C-627465		4° Forward Tilt C-625252			
Ref. No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Description	*Special Part No.
1	8	C-630519	—	Not Used	6	C-630519	—	Not Used	4	C-630519	—	Not Used	Spacer	
2	2	C-625447	2	C-625447	2	C-625447	2	C-625447	2	C-625452	2	C-625452	Upper Hook	
3	12	C-6447	12	C-6447	12	C-6447	12	C-6447	12	C-6447	12	C-6447	Lockwasher	
4	8	C-607089	8	C-607085	8	C-607088	8	C-607085	8	C-607087	8	C-607085	Capscrew	
5	2	C-632904	—	Not Used	—	C-632904	—	Not Used	2	C-632904	—	Not Used	Spacer	
6	4	C-627369	4	C-627369	2	C-627369	4	C-627369	2	C-627574	2	C-627369	Pad	
7	2	C-625450	2	C-625450	2	C-625450	2	C-625450	2	C-622126	2	C-622126	Lower Hook	
8	4	C-607094	4	C-607087	4	C-607094	4	C-607087	4	C-607093	4	C-607086	Capscrew	
9	2	C-3658	2	C-3653	2	C-3657	2	C-3654	2	C-3656	2	C-3654	Capscrew	
10	2	C-6290	2	C-6290	2	C-6290	2	C-6290	2	C-6290	2	C-6290	Lockwasher	
11	1	C-625448	1	C-625448	1	C-626321	1	C-626321	1	C-622129	1	C-622129	Centering Bracket	
12	1	C-627603	—	Not Used	1	C-627572	—	Not Used	1	C-627603	—	Not Used	Spacer	
13	—	Not Used	—	Not Used	—	Not Used	—	Not Used	2	C-3715	2	C-3707	Capscrew	
14	—	Not Used	—	Not Used	—	Not Used	—	Not Used	2	C-6292	2	C-6292	Lockwasher	
15	—	Not Used	—	Not Used	—	Not Used	—	Not Used	1	C-630521	1	C-630520	Pad Center	

Optional Bolt-on Arm Carriers



			C2R C-630551	C3R C-630554	C4R C-630557	C6R C-630560	C7R C-625251
Ref. No.	Qty.	Description	Part No.	Part No.	Part No.	Part No.	Part No.
1	1	Arm Carrier	C-630552	C-630555	C-630558	C-630561	C-626751
2	2	Long Bushing	C-624608	C-601970	C-601975	C-600341	C-631243
3	2	Short Bushing	C-624600	C-610971	C-601976	C-600432	C-631243

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FORM NO. 5032A

ML2.512/68 Litho in U.S.A.

FILING INFORMATION
For Insertion in Manual

Section No. 100.0 Item No. 20

SUPPLEMENTARY USER MANUAL

Cascade® Clamp Arms

- **Bale Arms & Drum Arms**
- **Drum Arms**
- **Multi-Purpose Arms**
- **Pallet (Fork) Arms**
- **Pallet (Fork) Arms**
- **Slip-on Arms (Two-Drum, Four-Drum)**
- **Slip-on Arms (Multi-Purpose)**

This manual provides parts lists for clamp arms only, and supplements Cascade User Manuals. See the Basic, Side-Shifting or Revolving Clamp manual to which this clamp arms supplement is attached for instructions on the complete clamp, including arms.

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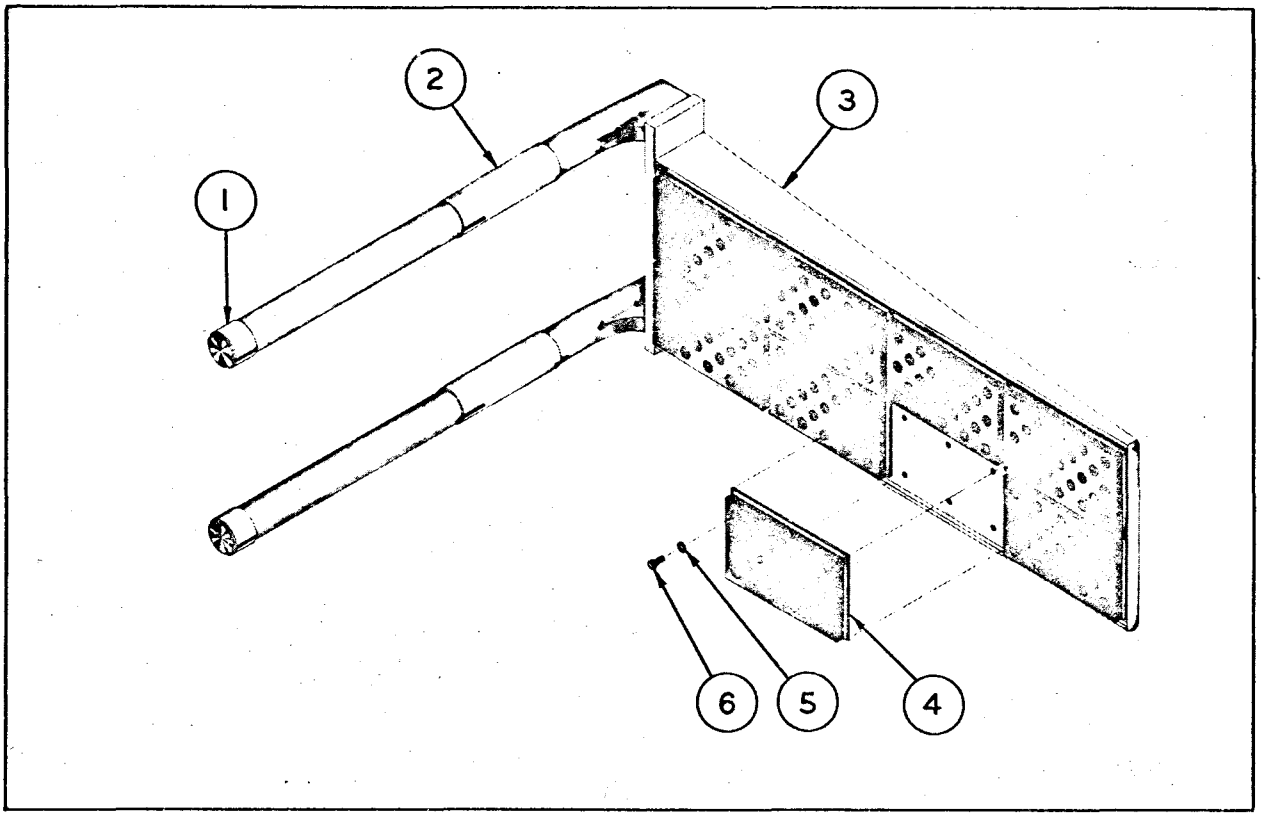
Johannesburg, South Africa • Sydney, Australia • Nagoya, Japan

Form 5001 A

Multi-Purpose Arms—All Model Clamps Listed

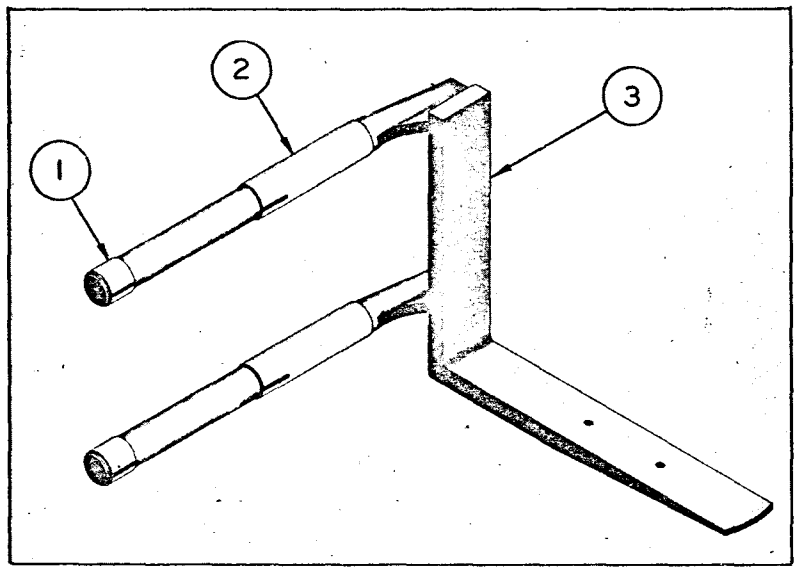


Ref. No.	Description	C2B, C2S C2R Qty.	24"	Qty.	36"	C3B, C3S C3R Qty.	24"	Qty.	36"	Special Part No.
1	Bushing, short	2	C-624600	2	C-624600	2	C-601971	2	C-601971	
2	Bushing, long	2	C-624608	2	C-624608	2	C-601970	2	C-601970	
3	Arm	1	C-625333	1	C-626200	1	C-625607	1	C-625608	
4	Rubber Pad	4	C-625336	6	C-625336	4	C-625336	6	C-625336	
5	Lockwasher	24	C-6288	36	C-6288	24	C-6288	36	C-6288	
6	Capscrew	24	C-3599	36	C-3599	24	C-3599	36	C-3599	

Ref. No.	Description	C4B, C4S C4R Qty.	24"	Qty.	36"	Qty.	48"			Special Part No.
1	Bushing, short	2	C-601976	2	C-601976	2	C-601976			
2	Bushing, long	2	C-601975	2	C-601975	2	C-601975			
3	Arm	1	C-625624	1	C-627009	1	C-625626			
4	Rubber Pad	4	C-625336	6	C-625336	8	C-625336			
5	Lockwasher	24	C-6288	36	C-6288	48	C-6288			
6	Capscrew	24	C-3599	36	C-3599	48	C-3599			

Ref. No.	Description	C6B, C6S C6R Qty.	48"	Qty.	60"					Special Part No.
1	Bushing, short	2	C-600342	2	C-600342					
2	Bushing, long	2	C-600341	2	C-600341					
3	Arm	1	C-625993	1	C-625965					
4	Rubber Pad	8	C-625336	10	C-625336					
5	Lockwasher	48	C-6288	60	C-6288					
6	Capscrew	48	C-3599	60	C-3599					

Pallet (Fork) Arms –
For Basic & Side Shifting Clamps Listed



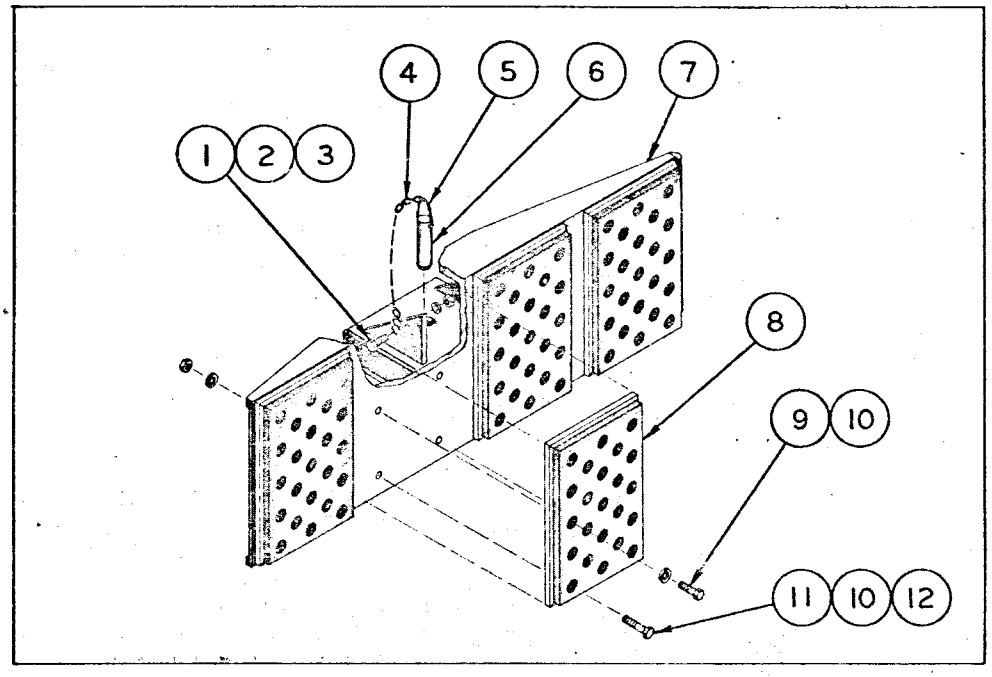
Ref. No.	Qty.	Description	C2B, C2S 30"	C2B, C2S 36"	C2B, C2S 42"	C2B, C2S 48"	Special Part No.
1	2	Bushing, short	C-624600	C-624600	C-624600	C-624600	
2	2	Bushing, long	C-624608	C-604608	C-604608	C-604608	
3	1	Fork, R.H. w/Bushings	C-632773	C-632774	C-632775	C-632776	
3	1	Fork, L.H. w/Bushings	C-632777	C-632778	C-632779	C-632780	

Ref. No.	Qty.	Description	C3B, C3S 30"	C3B, C3S 36"	C3B, C3S 42"	C3B, C3S 48"	Special Part No.
1	2	Bushing, short	C-601971	C-601971	C-601971	C-601971	
2	2	Bushing, long	C-601970	C-601970	C-601970	C-601970	
3	1	Fork, R.H. w/Bushings	C-632781	C-632782	C-632783	C-632784	
3	1	Fork, L.H. w/Bushings	C-632785	C-632786	C-632787	C-632788	

Ref. No.	Qty.	Description	C4B, C4S 36"	C4B, C4S 42"	C4B, C4S 48"	C4B, C4S 54"	Special Part No.
1	2	Bushing, short	C-601976	C-601976	C-601976	C-601976	
2	2	Bushing, long	C-601975	C-601975	C-601975	C-601975	
3	1	Fork, R.H. w/Bushings	C-632789	C-632790	C-632791	C-632792	
3	1	Fork, L.H. w/Bushings	C-632793	C-632794	C-632795	C-632796	

Ref. No.	Qty.	Description	C6B, C6S 42"	C6B, C6S 48"	C6B, C6S 54"	C6B, C6S 60"	Special Part No.
1	2	Bushing, short	C-600342	C-600342	C-600342	C-600342	
2	2	Bushing, long	C-600341	C-600341	C-600341	C-600341	
3	1	Fork, R.H. w/Bushings	C-629468	C-629469	C-629470	C-629471	
3	1	Fork, L.H. w/Bushings	C-629464	C-629465	C-629466	C-629467	

Multi-Purpose Slip-On Arms—All Model Clamps Listed



Ref. No.	Description	Qty.	C2B, C2S, C2R Part. No	Qty.	C3B, C3S, C3R Part No.	Qty.	C4B, C4S, C4R Part No.	Qty.	C6B, C6S, C6R Part No.	Special Part No.
1	Capscrew	1	C-3552	1	C-3552	1	C-3552	1	C-3203	
2	Lockwasher	1	C-6286	1	C-6286	1	C-6286	1	C-6286	
3	Nut	1	C-5926	1	C-5926	1	C-5926	1	C-5714	
4	Chain	1	C-11136	1	C-11136	1	C-10981	1	C-10981	
5	Handle	1	C-10980	1	C-10980	1	C-630453	1	C-630453	
6	Pin	1	C-10979	1	C-10979	1	C-11107	1	C-11107	
7	Base	1	C-633495	1	C-633499	1	C-633492	1	C-633620	
8	Rubber Pad	3	C-625336	3	C-625336	4	C-625336	6	C-625336	
9	Capscrew	18	C-3599	18	C-3599	8	C-3249	12	C-3249	
10	Lockwasher	18	C-6288	18	C-6288	24	C-6288	36	C-6288	
11	Bolt		(not used)		(not used)	16	C-10108	24	C-10108	
12	Nut		(not used)		(not used)	16	C-5928	24	C-5928	

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