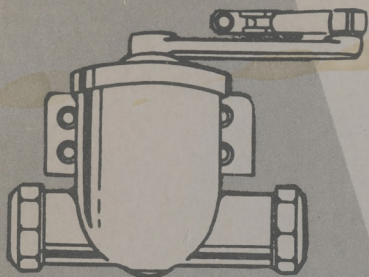
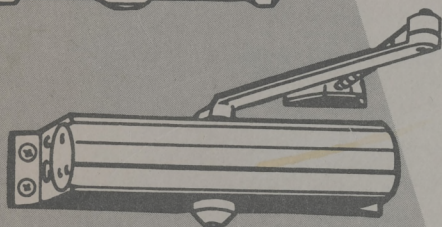


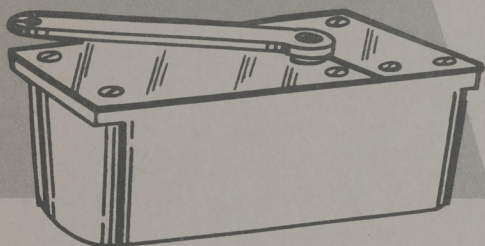
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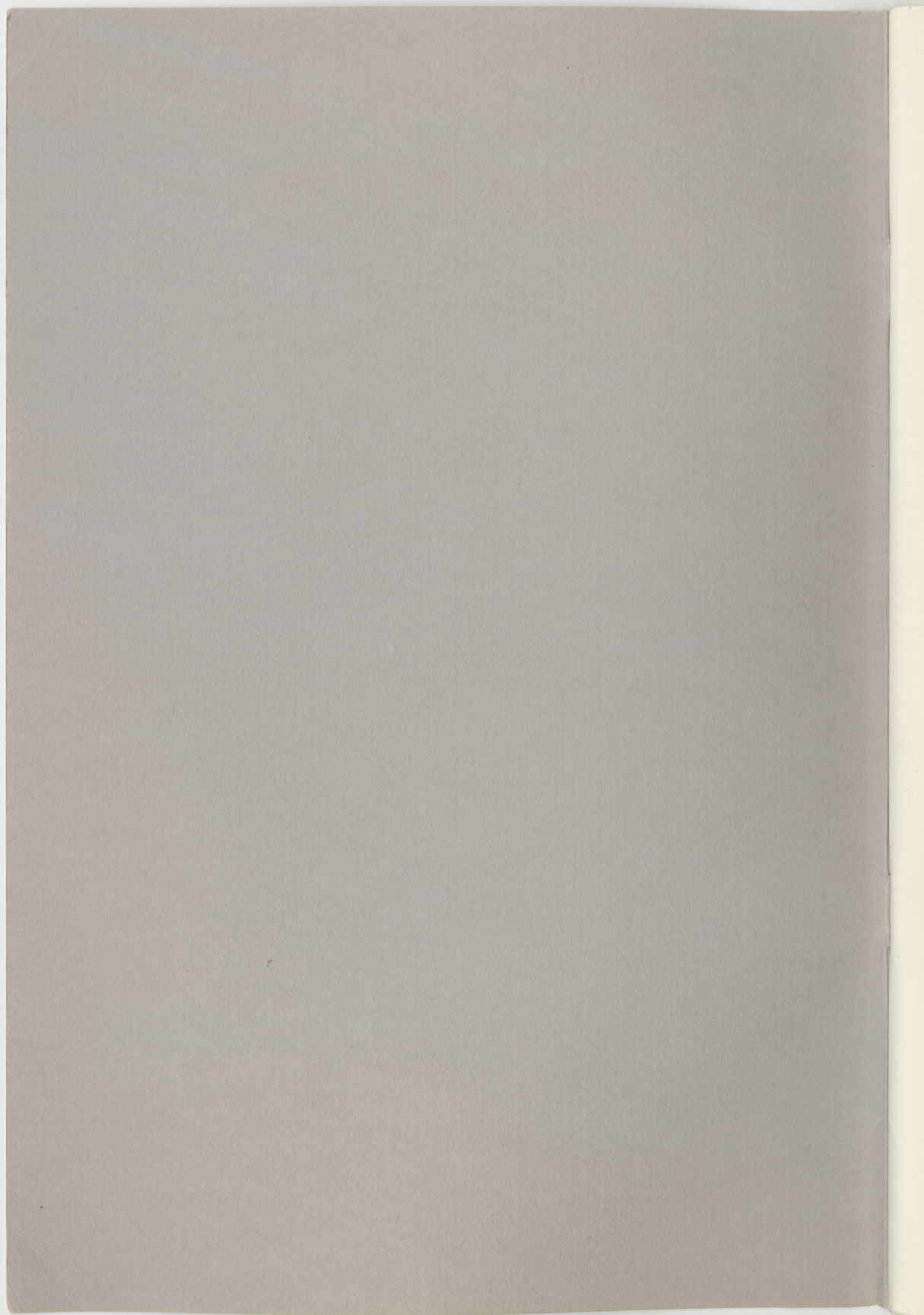


REPAIR

MANUAL

VOL. NO. 1

PUBLISHED BY THE LOCKSMITH LEDGER



DOOR CLOSER REPAIR MANUAL

VOLUME ONE

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PREFACE

The purpose of this book is to present to the locksmith, who does --- or wishes to do --- door closer repair work, a systematic reference for the models in use today. An effort has been made to use the same technical terms for each closer, though the manufacturers may differ.

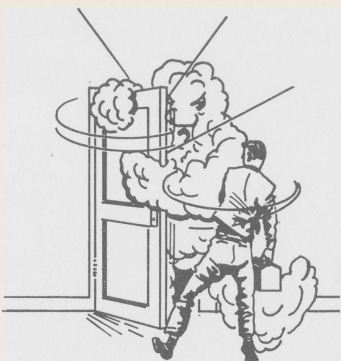
It should be noted that all model numbers of each manufacturer are not illustrated because many of these numbers simply denote the various sizes. Service procedures are standardized to allow the locksmith to develop a systematic manner for handling this work.

This book represents the first volume in a series that will cover all the domestic door closers.

Locksmith Ledger, Inc.
Little Falls, N. J. 07424

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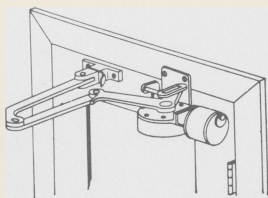
A Fit of Anger ...
A Slam of a Door ...
And the Field of
Door Closers Was Born!

PART I — HISTORY

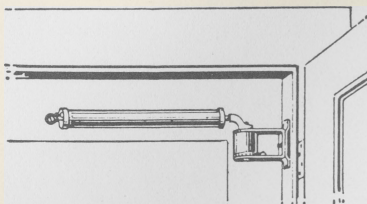
According to legend, the first door closer came about as a result of a temper tantrum. In 1880, a carpenter named Louis C. Norton was assigned the job of repairing the large wooden doors of a church so that the doors would not slam and disturb the congregation at prayer. Upon completion of the job, the pastor inspected Norton's workmanship. For some reason or other, the job did not please him. When the pastor expressed his disapproval, Norton stalked into the church vestibule, and violently closed a closet door. Much to Norton's surprise, the expected slam did not materialize. Instead, the door closed quietly!

Turning back out of curiosity to learn what had stopped the noise, Norton slammed the door once again and watched the action. As the edge of the door neared the jamb, it slowed down. At once he realized that the closing door was compressing the air within the vestibule closet. The resulting air cushion slowed the closing action of the door.

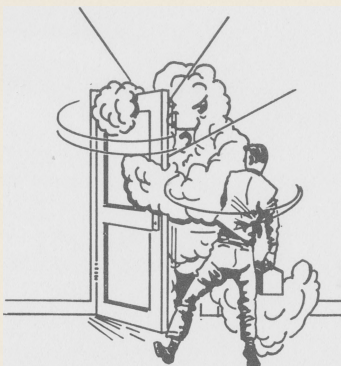
Realizing the importance of his discovery, Norton sought ways and means of building a permanent device on the doors that would create air cushions every time the doors were operated. After a series of experiments, he hit upon the idea of combining a spring with a bicycle tire pump to achieve the desired effect. (Some say it was a beer pump!) In this primitive device, the spring was used to pull the door closed, while the bicycle pump was used to absorb the shock of closing and to slow down the door as it approached the closing position. The combination of these two items comprised the first door closer which was granted a United States patent. To this day, the original prin-



Early Pneumatic Door Closer



Present Day Pneumatic Closer



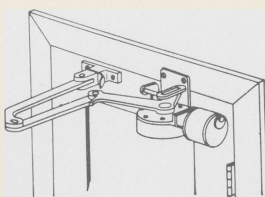
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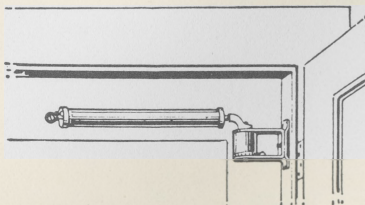
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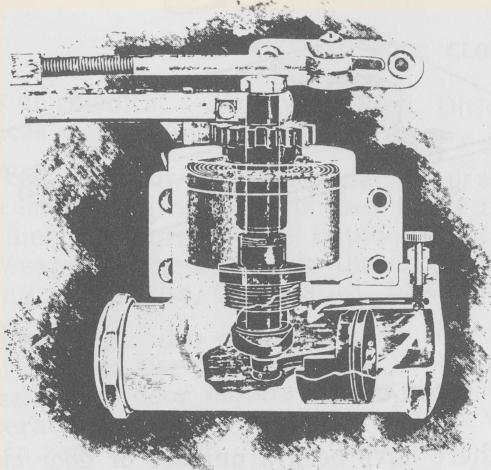


Present Day Pneumatic Closer

ciple exists in what we call the "pneumatic" or air-type closer.

The pneumatic closer is used today only on light weight doors such as screen doors. Since air compresses under pressure, the closing action is unreliable. It cannot be regulated easily because the flow of air depends upon temperature, moisture and the condition of the washers around the plunger.

In 1883, Eugene I. Blount introduced a vastly superior door closer design. Instead of employing air as the resisting medium, he used liquid. Since liquid is not compressible, and therefore more easily controlled, Blount achieved a closer that would hold the same closing speed regardless of changes in temperature and varying wind conditions. The liquid door closer, like the pneu-



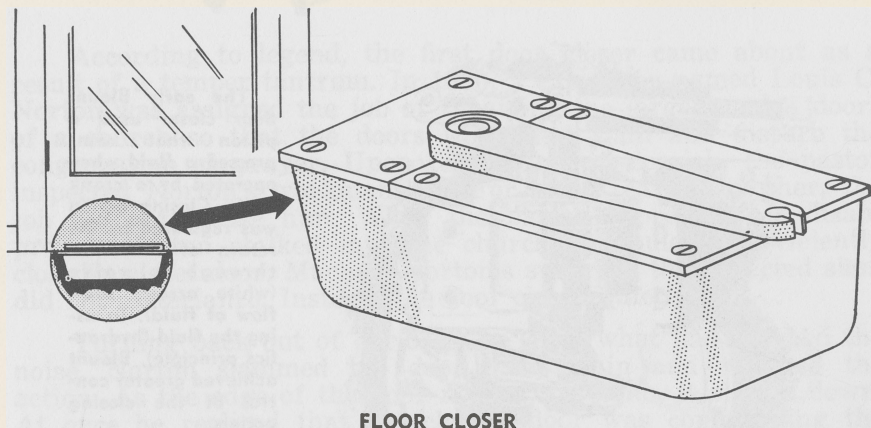
The early Blount door closer used a piston that compressed a fluid when operated by a crank shaft. Closing action was regulated by the return of the fluid through a valve (white arrows show flow of fluid). In using the fluid (hydraulics principle), Blount achieved greater control of the closing action.

matic type, was designed to be applied to the top of the door. In action, as the door opened, the arm wound up the coil spring. At the same time, the liquid flowed into a compression chamber. When the door started to close under the pressure of the spring, the liquid would be forced through a small valve port and thus slow the closing speed of the door.

In 1905, Louis C. Norton continued the development of the door closer by introducing a design using a geared shaft and piston (called rack and pinion) to assure positive control of the door. The rack and pinion now is widely accepted and is used in many commercial hydraulic closers made today.

Approximately sixty years ago a man named Bardsley devised a liquid door closer that could be applied *underneath* the bottom edge of the door. To distinguish the two types, the trade referred to the Blount type as an "overhead surface door closer", while the Bardsley was called a "checking floor hinge," since it also had pivots for hanging the door.

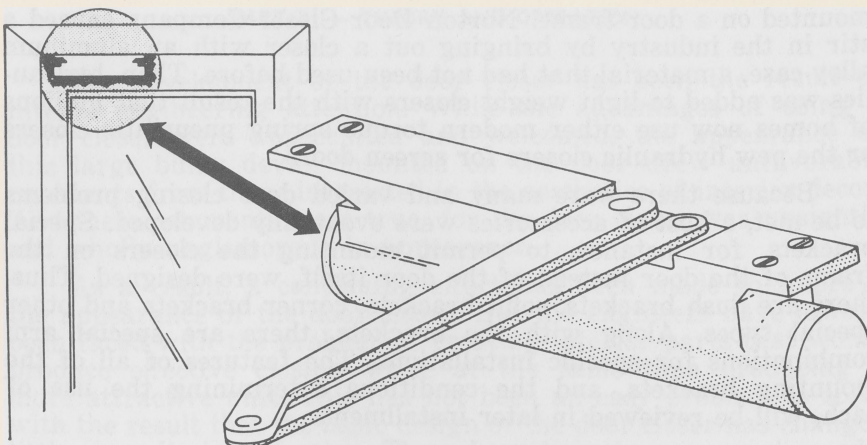
Over the years, the terms "door closer" and "door checks" were used interchangeably; similarly, the words "floor check" and "floor hinge", which resulted in confusion to buyers and sellers of the products. It was especially difficult when architects and contractors called for "door closers", and the manufacturers had nothing for sale but "door checks". Several years ago, at a meeting of hardware manufacturers held under the auspices of the United States Bureau of Standards, the term *DOOR CLOSER* was officially adopted. Although the term "door check" is still heard, the correct and accepted name for a surface mounting closing unit is *DOOR CLOSER*. Likewise, the accepted name for a closing unit mounted beneath the door (but not having any pivots included for hanging the door) is a *FLOOR CLOSER*.



Through the years, there have been a number of door closer manufacturers. Most confined their production to the standard surface type. Several manufacturers, however, developed other designs. Bakewell, for instance, devised a hydraulic (liquid) hinge which combined a closer with a hinge. Yale & Towne developed a closer that could be set into the hinge rail of the door, now called a "concealed closer".

Then, a combination of a regular surface and concealed closer was introduced by the Russell & Erwin Division of the American Hardware Corporation (now the Emhart Corporation). This was known as a "semi-concealed" closer. The engineers of Yale & Towne Company then came up with a "hipless" design to streamline the shape and please the eye. Recently, closers have taken on the "long slim look". It seems likely that the process of redesigning will go on and on.

Along with progress in design, the science of metallurgy found its way into the door closer field. Years ago, door closer cases were made of cast iron or bronze. The porous metal frequently leaked or "sweated" even before the closers left the factory! Squads of mechanics were employed to close up the "weak spots" by hammering the shells with ball peen hammers. All



CONCEALED DOOR CLOSER

types of chemical sealers were used. Different methods of glazing surfaces were employed, but the closers kept on leaking.

Today, however, leakage is not nearly as great a problem. The cast "grey iron" that is used today for cases is an alloy with extremely fine grain. The liquid cannot penetrate and there is less wear too. The carbon in the alloy acts as a lubricant for the moving parts. Also, there is less brittleness and warpage.

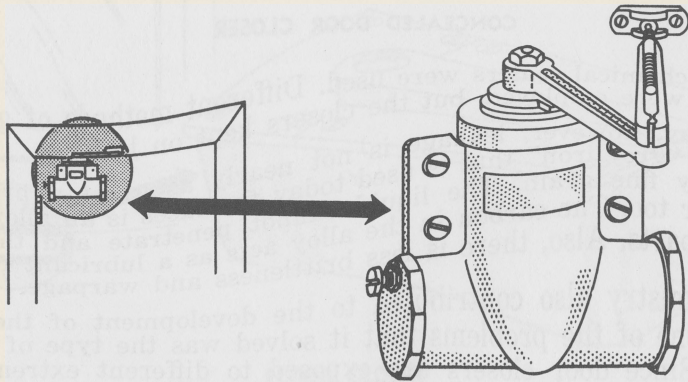
Chemistry also contributed to the development of the door closer. One of the problems that it solved was the type of liquid to use. Since door closers are exposed to different extremes of temperature, a fluid was required that would not freeze or congeal in zero weather. At the same time, the fluid must not "thin out" in hot weather. Along with these two requirements was the additional one that the liquid should have no corrosive effect on the working parts, packing or sealants. The logical fluid would ordinarily be an oil, but the porous cases of the earlier door closers could not hold it. Also, oil would attack and corrode the leather and cork packing washers. After much experimentation, the most satisfactory liquid was found to be a mixture of alcohol and glycerine.

When World War I began, glycerine became unobtainable except for military or medical use. The manufacturers had to find another fluid. By this time, however, the quality of the cases had been improved. Moreover, the chemical industry introduced new blends of mineral oils that retained their same characteristics in arctic weather as well as in desert heat. The door closer manufacturers began to switch from alcohol-glycerine to these new oils. After World War II, they abandoned leather and cork packings in favor of synthetic rubber washers.

Other innovations furthered the development of the door closer to meet modern needs. One of the first long slim look closers was made by Schlage, a closer that could be turned upside down and

mounted on a door frame. Norton Door Closer Company caused a stir in the industry by bringing out a closer with an aluminum alloy case, a material that had not been used before. Then, hydraulics was added to light weight closers with the result that millions of homes now use either modern torque spring pneumatic closers or the new hydraulic closers for screen doors.

Because there were many and varied door closing problems to be met, a host of accessories were eventually developed. Special brackets, for instance, to permit mounting the closers on the frame of the door instead of the door itself, were designed. Thus, there are flush brackets, soffit brackets, corner brackets and other special types. Along with the brackets, there are special arm combinations for specific installations. The features of all of the mounting brackets, and the conditions determining the use of each, will be reviewed in later installments.



TYPICAL STANDARD DOOR CLOSER

The history of the door closer is part of the story of the rising standard of living. The need for the door closer did not grow out of a need for convenience alone. It is tied up with hygiene also. What good is a screened hospital, for instance, if unclosed doors permit swarms of insects to invade the wards? Of what value would heating plants in large buildings be if health destroying drafts and cold could sweep through the offices? On the economics side, the door closer helps save heat and fuel in cold weather. In hot, humid weather it keeps in the cool, dry air produced by air conditioners. It does away with the noise of slamming doors. It eliminates the need of closing the door behind you; it creates areas of privacy; and it even prevents the spread of fire.

There are millions of door closers now in use. The quantity increases every day. The services of the door closer repairman are essential in maintaining these important devices. They will become more essential as time goes on. Since every door closer that comes off the production line is a potential repair job for the service man, he cannot help but find his repair business growing in volume with the passage of time.

PART 2 — THEORY AND OPERATION

The development of the door closer has been the result of intense engineering attention. While the advantages of using a door closer were appreciated and welcomed, the appearance of this large bulky device mounted on the door drew unfavorable comments from those interested in the aesthetics of interior decor. And these comments were true, for the door closer was unsightly and wholly unglamorous in appearance.

As a result, a continuing effort has been made to improve the appearance of the door closer. But the engineers have always been faced with the problem of creating interior parts that would produce effective closing while at the same time producing a more attractive unit. This has not been an easy problem to solve with the result that the basic design of the door closer has changed little since its introduction. There have been improvements made, of course, and the sum total has been to improve the appearance of the door closer, to refine its operation, and to increase its durability.

To understand the developments made in the door closer, as well as the features of past and present day units, a review of the basic theory and operation of a door closer is necessary. Two basic functions are common to all door closers — a spring and a return control medium. The *spring* is the unit that winds up (or compresses) as the door is opened and later unwinds to pull the door back to its closed position. But, since the action of the spring would close the door with a slam, the *return control* is needed to absorb the spring force and close the door quietly. The spring is common to both pneumatic and hydraulic type of closers but the return control medium is different in each type.

In the *pneumatic* type closer, the return control operates by *air*. Housed in a narrow tube like a bicycle pump, this type of control has a plunger unit and an air cup attached to the power spring. As the spring pulls back to its unwound position, it also pulls back the air cup. During its travel backward, however, the air cup compresses the air remaining in the tube, thus slowing the action of the spring and door. A small vent in the closer housing or tube permits the compressed air to escape and thus permits the spring to close the door slowly. An adjustment, usually a regulating screw, controls the size of the vent and the amount of air that escapes, thus making closing action adjustable.

In the *hydraulic* door closer, a spring also is used to pull back the door but the return control operates with a *fluid*. Essentially, the principle is the same—compressing the return control as the spring is wound up and providing small holes that permits the fluid to release from its compression, thus controlling the return action of the spring. The fluid is contained within a sealed section of the door closer and its compressing and release action takes place fully within the door closer housing.

The unit that compresses the fluid is a *piston*. Positioned within the face of the piston is a large "one-way" hole that is

controlled by a *ball valve*. The piston, as well as the spring, are connected to a *main shaft* that extends outside the top of the door closer and connects to the *operating arms* attached to the door. The operating arms transfer the action of door opening to the main shaft, and in turn activate the spring and piston.

Opening a door on which a closer unit is mounted produces this action: As the door is opened, the operating arms are moved, thus moving the main shaft of the closer unit. The main shaft winds up the spring attached to its upper portion and, at the same time, moves the piston connected to its lower portion. The piston moves sideways. As it moves, the ball valve in its face opens up, allowing the fluid to pass through and behind the piston.

When the door is fully opened, the action of the arms begins to reverse — that is, closing begins. The wound up spring begins to unwind and starts to pull back on the operating arms and the door. The piston, connected to the main shaft with the spring, also begins to reverse its action. As this occurs, however, the "one-way" ball valve in the piston face seats itself in the flow passage and blocks the return flow of the liquid. With the pulling force of the spring applying pressure to the piston, the fluid becomes trapped in front of the piston.

If this trapped fluid was not released, the spring would not be able to return the piston to its former position and the door would not close. Thus, to release the fluid, a small vent leading to a passage that flows behind the piston, is provided in the housing. The compressed fluid then flows through this vent and slowly returns in front of the piston. Since this return action takes place slowly, the piston slowly moves back to its former position, the spring slowly unwinds and the door closes slowly.

As mentioned earlier, all of this hydraulic action takes place within the door closer case. And, this action is essentially the same in present day closers as in the early type closers. However, to continue tracing the development of the closer from early to present day types, consider the design of the early closer and the parts which produced the above action.

A view of an early type door closer is shown in the accompanying illustration. This style has become almost universally recognized as the standard shape for a door closer although recently the shape has been changed to long slim and rectangular shapes. The trade now refers to this style of closer as an *overhead hydraulic surface door closer* to differentiate from other styles that have been developed.

The main part of the overhead hydraulic surface door closer is the *outer case* or *housing*, which contains all of the working parts except the operating arms. The upper section of the housing is called the *spring chamber* since it contains the *spring* and the *ratchet*, which is the device that winds up the spring. Also contained in the spring chamber is the *packing gland* which serves as the upper bearing for the main shaft. The spring chamber is protected from dust, rain and foreign material by a *cover* or *top cap*. Extending through the top cap are the top end of the

main shaft and the top of the ratchet. The operating arms attach to the main shaft protruding above the housing.

The lower section of the housing is called the *piston chamber* because it contains the piston. This section also houses the *hydraulic fluid*, the *control valves* for the return of the fluid, and

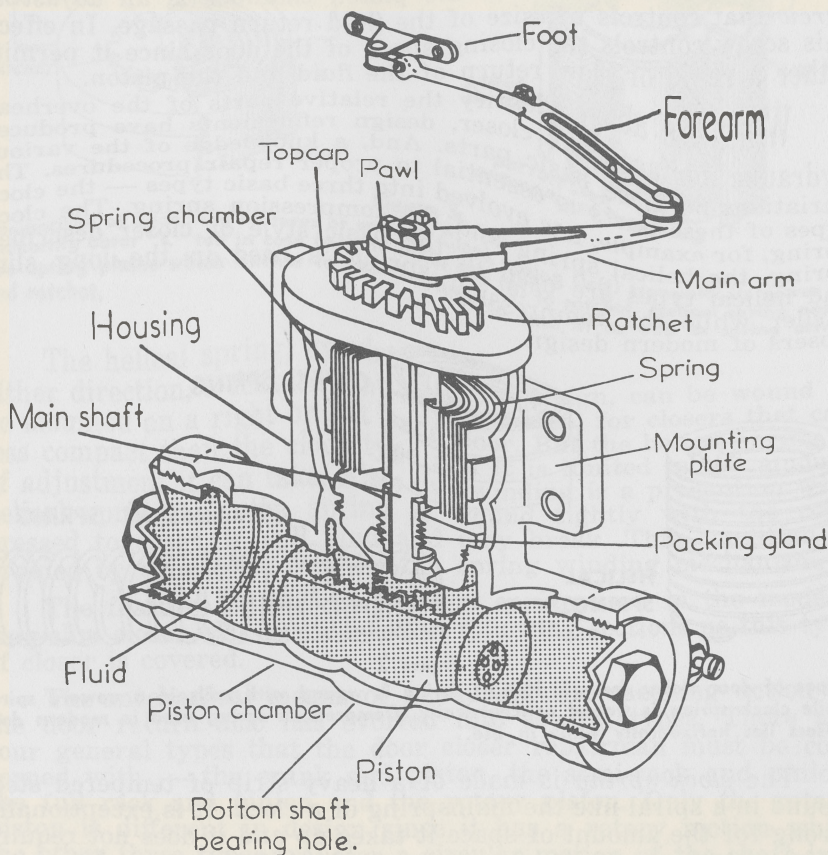


Figure 1

A cut away view of a typical overhead hydraulic surface door closer showing the component parts.

the bottom portion of the main shaft. Note the bearing hole at the base of the main shaft. Note also that the hydraulic fluid is sealed within the piston chamber by *end caps* and by the packing gland which prevents the fluid from entering the spring chamber.

At the rear of the housing are two protruding plates that provide the means for mounting the door closer. The four holes are countersunk either for machine or wood screws since the closer may have to be mounted to either wood jambs, doors, or to additional mounting plates or brackets.

The operating arms comprise several items. The *main arm* attaches directly to the top of the main shaft by a threaded nut. A small movable part called the *pawl* fits into the head of the ratchet while the *forearm* clamps to the main arm. The forearm attaches to the door frame by a swivel, called the *foot*, and once again, the holes in the foot are for machine or wood screws.

Located on the side of the piston chamber is an *adjusting screw* that controls the size of the fluid return passage. In effect, this screw controls the closing speed of the door since it permits either a rapid or slow return of the fluid and the piston.

While the above identify the relative parts of the overhead hydraulic surface door closer, design refinements have produced variations of these basic parts. And, a knowledge of the various types of these parts is essential to proper repair procedures. The spring, for example, has evolved into three basic types — the clock spring, the helical spring and the compression spring. The clock and helical types are used in the basic style of closer described earlier while the compression spring is used in the long slim closers of modern design.

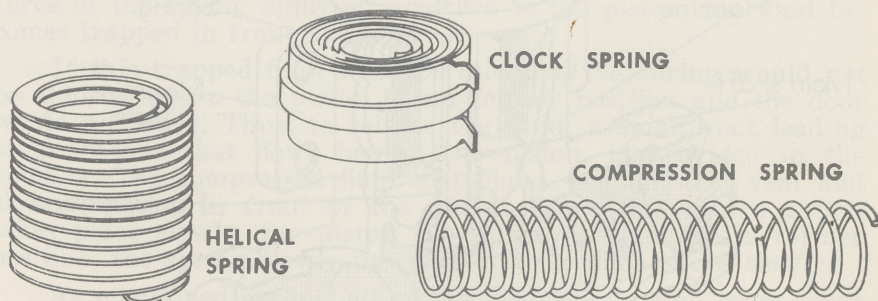


Figure 2

Types of door closer springs. Helical spring is wound with coils in an upward spiral while clock spring is wound concentrically. Compression spring used in modern door closers lies horizontally while in use.

The *clock spring* is made of a heavy strip of tempered steel wound in a spiral like the mainspring of a clock. It is exceptionally strong for the amount of space it takes up and it does not require many attaching parts for transmitting its power. Attaching consists merely of inserting the "L" hooks bent in each end of the spring into grooves in the housing and in the ratchet, which is attached to the main arm. And, because of its compactness, the clock spring permits the use of a small spring chamber, a feature that aids appearance. But, the clock spring can be wound only in one direction. Thus, it must be set in one way for a right hand door and reset in the opposite way for a left hand door.

The *helical spring* is wound like a standard spring although it naturally is much larger and more powerful. Closers using the helical spring need additional attaching parts to transmit its power, such as a ratchet, spring driver and two spring plates. The plates are anchored by lugs protruding from the inside of the spring chamber. The top and bottom ends of the spring then hook

into the anchored plates. The spring driver is set on the main shaft (in the center of the spring) and it engages both plates. The ratchet attached to the main arm activates the spring driver and thus causes the spring to wind up.

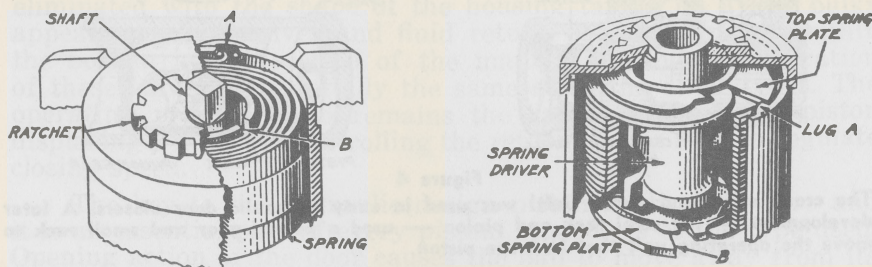


Figure 3

Comparison of anchoring features of springs. Clock spring (left) transmits its power by anchoring outer "L" tab in case (A) and inner tab (B) to ratchet. Helical spring needs two spring plates which anchor to case by lugs (A and B) as well as spring driver and ratchet.

The helical spring, by virtue of its design, can be wound in either direction, a feature that makes it ideal for closers that can be mounted on a right or left hand door. But the helical spring is less compact than the clock type and it is limited in the amount of adjustment it can take. Also, overwinding is a precaution with helical springs. If the spring is wound tightly with the coils pressed together, it will bind and may break. This condition is avoided by properly adjusting the spring winding mechanism.

The features of the *compression spring* used in the modern long slim closer will be reviewed in following sections as this type of closer is covered.

The mechanical means of producing the checking action of the door return also has evolved into several types. There are four general types that the door closer repairman must be concerned with — the crank and piston, the semi-rack and pinion, the full rack and pinion and the rotary piston. Only the rotary piston is different in design since it has a rotary motion while the other three types transfer a circular motion of the shaft into a reciprocating motion of the piston.

The *crank and piston* type operates in principle much like the crankshaft in a car engine. The bottom of the shaft is seated into the bottom of the piston chamber and it is connected to the piston by a link arm. As the crank (main) shaft is activated and wound by door opening, the piston is moved sideways in the piston chamber, transferring the fluid from one side to the other.

A development of the shaft design eliminated the crankshaft type of operation and produced the rack (gear) and pinion (track) means of moving the piston. This type incorporated a gear as part of the bottom of the main shaft and the gear moved the piston by traveling along the track. The *semi-rack and pinion* type has only four teeth in each and thus is limited in the degree of

piston travel. As can be expected, a limited degree of piston travel also limits the amount of opening that a door can make.

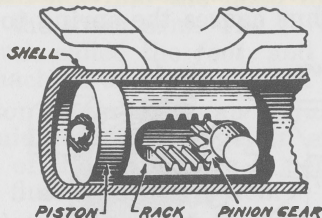
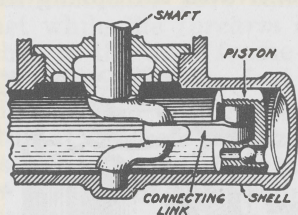


Figure 4

The crank shaft and piston (left) was used in early hydraulic door closers. A later development — the semi rack and pinion — used a partial gear and small rack to move the operating unit that had one piston.

The semi rack and pinion design uses a piston on only one end of the operating unit but it has a rack on top and bottom. Thus, it can be used for either right or left hand operation, with the pinion traveling along the top rack for one hand operation and along the bottom rack for the other hand.

The *full rack and pinion* type is the same in operating principles with the differences coming in the number of teeth in the pinion and the number of pistons. The pinion has teeth fully around its circumference and the rack is larger and has more corresponding teeth. Thus, the rack permits the pinion to make almost a full rotation and is called a full rack.

In addition, the full rack and pinion type has two pistons, one at each end of the operating unit. Each piston has its own ball valve in the face, and so allows the use of one piston for a right hand operation and the other for a left hand operation.

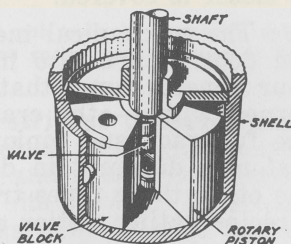
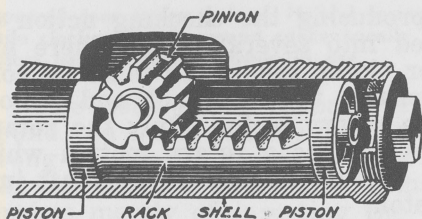


Figure 5

The full rack and pinion (left) uses a full gear, an elongated track, and two pistons. The rotary style (right) has the piston connected to the main shaft which also contains the valves.

The elongated rack also allows a longer travel of the piston with the result that the amount of opening of the door also is increased. And, by placing regulating valves for the fluid return passage at each end, it is possible to control not only the closing speed of the door but also the opening speed. This form of double control is referred to by the trade as *back-checking*.

In each of the above three types of piston designs, the circular movement of the main shaft is transferred into a sideward move-

ment of the piston which traveled in a tubular chamber at the bottom of the housing. Another design — the *rotary piston* — has the piston attached directly to the main shaft so that the piston revolves with the shaft. In effect, the tubular piston chamber was eliminated with the shape of the housing taking on a less bulky appearance. The valves and fluid return passages are set within the bottom hollow section of the main shaft and the operation of these valves is essentially the same as in the other types. The operating principle also remains the same — a moving piston displacing a fluid and controlling the return of this fluid to regulate closing speed.

The key to the hydraulic design piston is the *ball valve* and it is an essential part of every piston, regardless of the type used. Opening action of the door causes the ball to move away from its seat, thus opening a passage for the flow of the fluid through and behind the piston. The ball is free moving having no attachments or springs to unseat from the passage, and being activated only

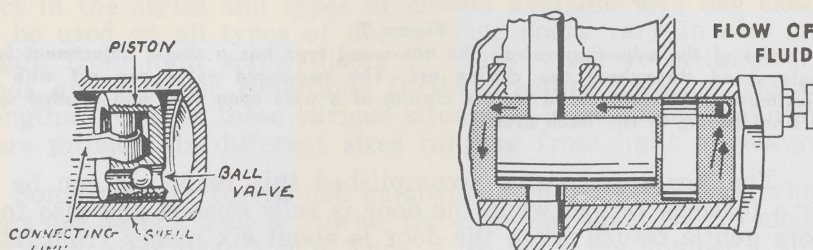


Figure 6

The heart of the hydraulic operation. The ball valve (left) opens as piston moves forward with door opening, thus allowing fluid to pass behind piston. On return stroke of piston, ball valve closes and fluid must flow back through return passage (see arrows, right).

by the direction of flow of the fluid. When the fluid flow direction is changed by the spring returning the piston (closing), the ball reseats and blocks the passage, sealing the fluid behind the piston. The fluid then must flow back in front of the piston through the return passages.

As mentioned earlier, the return flow of the fluid is controlled by an adjusting screw that enlarges or reduces the passage opening as needed. Adjusting valves can be provided with knurled knobs for finger operation, slotted heads for screwdriver operation or key operation. Whatever type is used, the basic function of controlling the size of the return passage (and thus the closing speed) remains the same.

To further refine the control operation, two types of adjusting valves were developed — a one speed valve and a two speed valve. The function of the *one speed valve* is to produce a *single* constant speed throughout the closing cycle. The speed can be adjusted by turning the valve as desired. Whatever the speed is set at, however, it will remain constant from the time closing begins and later ends.

The one speed control could not take care of unusual closing conditions. When set for a rapid and forceful return against heavy wind resistance, the final latching of the door would occur with a slam. The powerful return of the door when fully opened continues all the way through the closing arc and final latching occurs with a slam, after wind resistance was overcome. Thus, it became obvious that a control to set two different speeds during the closing arc was needed.

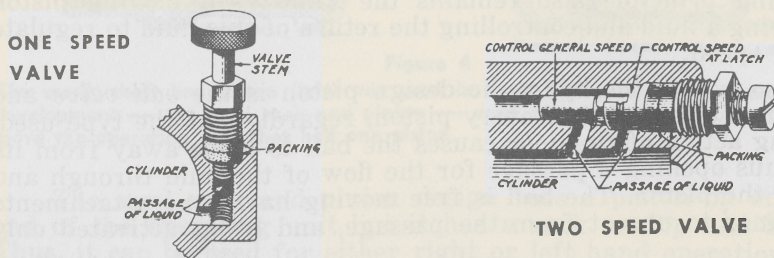


Figure 7

Principles of the adjusting valve. The one-speed type has a single adjustment for a single speed throughout the closing arc. The two-speed valve can set with one adjustment a different speed for the closing of a wide open door and another speed for final closing at the latch area.

The *two speed valve* accomplished this result. It can be set for a forceful return when the door is fully opened and also for a more gentle return when the door is about six inches from latching. Or, it can be set for a gentle return when fully opened and a more forceful return for final closing. Such a function is useful on misaligned doors when a little extra force is needed to compensate for latch resistance, for example.

Two speed valves have two fluid return passages with a single screw controlling both; thus, adjustment of both passages is accomplished by turning the single screw. It should be pointed out that two speed valves also can be set for a single constant speed throughout the closing arc, just as a one speed valve.

One of the major problems confronting door closer manufacturers over the years has been the fluid to be used in the door closer. Ideally, the fluid must have a variety of characteristics. Since the operation of the closer depends on the flow of the fluid, the fluid must flow easily and must maintain its flowing properties throughout the extremes of heat and cold. It must not evaporate easily in warm weather or sludge up in cold weather, or over a period of time. In addition, it must not sweat through the pores of the metal case or have a corrosive effect on the working parts or the packing materials.

Numerous fluids were tried and years of experience has seen two general types of fluids now used, although each has a disadvantage. Petroleum oil fills most of the requirements but one—sweating through the housing. In earlier years, the housing was quite porous with the result that the oil sweated through to the outside, gathering dust and taking on dingy appearances. Recent

developments in metallurgy produced fine-grained castings of housings that resist sweating but the cost of these housings is considerably higher.

A mixture of glycerine and alcohol is the other type of fluid generally used in door closers. While the glycerine-alcohol mixture flows extremely well in cold temperatures and does not sweat through the housing, it lacks durability since the alcohol evaporates, changing its consistency. When this occurs, the mixture tends to sludge and gum up, effecting the operation of the ball valve and the packing. The only way that gummy deposits can be cleaned out of the passages and parts is by a complete overhaul — disassembling the closer and boiling the component parts in a strong solvent. In effect, this is the major function of door closer repair.

To add to the development of the door closer, economic demands and a wide variety of closing conditions have had its effect in the styles and types of closers available. No one closer can be used on all types of doors, since doors vary in size and weight, from light screen doors to heavy wood or metal doors. Winds and climatic conditions further require different closing strengths. To meet these various situations, door closer manufacturers provide six different sizes ranging from light to heavy.

Some manufacturers use numbers to indicate the size while others use letters. Yale & Towne, for example, has a No. 70 model ranging in sizes from 1 to 6. Thus, a No. 71 is the number 1 size, a No. 72 is the number 2 size, etc. The largest size is the No. 76. It also has a No. 90 series which ranges from 91 to 95.

Manufacturers who use letters follow a similar identification pattern. An LCN "A" closer, for instance is equivalent to the No. 1 size; the "B" is equal to the No. 2 size, etc.

The following listing compares the number and letter identification of sizes:

No. 1	equals	A	No. 4	equals	D
No. 2	equals	B	No. 5	equals	E
No. 3	equals	C	No. 6	equals	F

Not every size is available from all manufacturers. The old Norwalk made sizes 2 to 5 only, eliminating the No. 1 and 6 sizes. LCN does not make an "A" and Reading does not manufacture a No. 6. Thus, the average range of sizes is between 2 and 5 (B and E).

PART 3 — SERVICE AREA AND EQUIPMENT

The previous sections have described the background, components and operation of the door closer. All of this information is vital to the door closer repairman, since he must know how a door closer operates before he can attempt to repair any malfunctioning.

There is another factor that must be considered before any serious effort is made to repair door closers. This is the service area where the work is to be performed and the manner in which the area is set up with the tools and necessary equipment. Still another factor is the proper use of the equipment to *safely* disassemble and reassemble door closers.

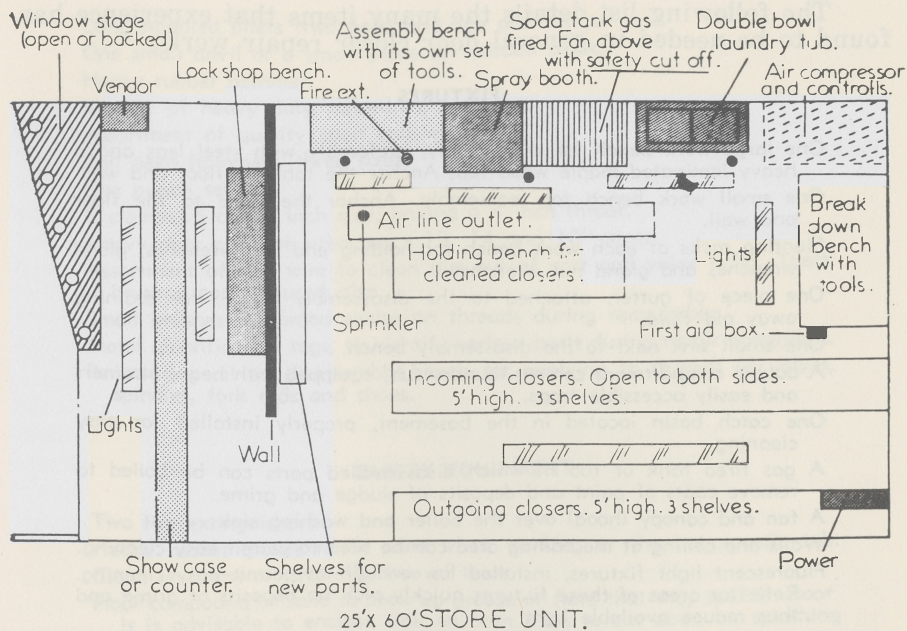
Safety in a door closer service area is extremely important. Many veteran repairmen consider door closers as one of the most dangerous pieces of hardware on which to work. Its awkward shape, powerful spring tensions, tight screw fittings, and sludge deposits, add up to a potentially hazardous operation. Smashed fingers, broken toes, eye accidents, chemical burns and scars are some of the injuries that could result from a lackadaisical attitude in performing door closer repair.

At the outset, it must be emphasized strongly that the repairman should know exactly what he is doing at all times in repairing a closer. The casual relaxing of safe shop practices, mental lapses, rushing or trying to find short cuts could give nothing but serious injury. Common safety practices, such as cleaning up of spilled fluid, should always be observed. Spilled fluid, for example, could make someone slip while applying the force needed to remove nuts, causing a fall and possible serious injury. Use common sense work methods, avoid looking for short cuts or schemes and door closer repair will become easier and less dangerous.

Because of the specialized equipment and material needed for door closer repair, the service area should be in a room or section of the shop that is separate from all other departments. And, an early decision should be made as to whether only a few brands will be serviced or all brands will be handled. The types and volume of closer repair naturally determines the amount of investment that should be made into setting up a door closer repair section.

Since the amount of repair handled is individual, no attempt can be made to suggest the ultimate in service areas to fit every shop. High volume shops will have specialized features that the low volume shop may not be able to justify, in terms of plain economics. Then, the matter of arranging the individual tables, bins and work areas into a setup for efficient flow of work depends upon the space available and again the amount of work.

However, to illustrate how an efficient working area can be set up, the accompanying drawing shows the placement of various sinks, bins, tables, and overhead lights for a 25 x 60 ft. area. Note that plenty of aisle and working space is given for each area and that overhead lights in each area provide ample visibility.



While the sketch is obviously set up for a high volume shop, there are features that are needed by all door closer repair shops, regardless of volume. One of the first is good cross ventilation. Rancid odors from liquids used in door closers and in cleanings can be irritating and proper circulation of air is important. A good suction fan in the wall is ideal for drawing out the odors and keeping the air fresh.

A solid workbench is a must. The bench should be made of sturdy materials and solidly anchored to the floor and to the wall. A sturdy vise also is needed, one having at least a 4" jaw and a wide track. A vise with removable jaws will permit the replacement or recutting of the jaws when the serrations have worn off. The wide track will make the vise easier to operate and this ease will be appreciated in the actual repair since repairing a closer requires removing and replacing it in the vise about 15 different times. Factories and some high volume shops use hydraulic vises for speed and comfort.

A variety of tools is needed to disassemble the many types of closers and these tools are available commercially. Sets of tools can be purchased for individual closers or universal sets which can be used on more than one type of closer also are available.

Since the repair of a closer requires complete cleaning of old sludge and grime, a tank or tub is needed in which to soak the disassembled parts. Cleaning solutions, such as caustic, which is heated by gas or other means, is used to dislodge the sludge. Rinsing of the parts after cleaning calls for a sink of some sort and an air compressor for minute cleaning or paint spraying of the rebuilt closer.

The following list details the many items that experience has found to be needed in general door closer repair work:

FIXTURES

- One large work bench for disassembly, preferably with steel legs and a heavy laminated maple wood top. Anchor the table to floor and wall.
- One small work bench for reassembly. Anchor the table to the floor and wall.
- Slanting racks at each work bench for holding end cap wrenches, gland wrenches and gland nut wrenches.
- One piece of gutter, attached to the disassembly bench, for draining away old fluid.
- One small sink next to the disassembly bench.
- A double compartment cement laundry tub, equipped with heavy strainers and easily accessible traps.
- One catch basin located in the basement, properly installed for easy cleaning.
- A gas fired tank or tub in which disassembled parts can be boiled to remove coats of paint and deposits of sludge and grime.
- A fan and canopy (hood) over the boiler and washing sink.
- Walls and ceiling at the boiling area can be tiled to permit easy cleaning.
- Fluorescent light fixtures, installed low enough to permit easy cleaning.
- Reflector areas of these fixtures quickly pick up deposits of grime and thus reduce available light.
- Steel baskets, 18" x 18", with long handles. These are used to hold disassembled parts while rinsing and while soaking in hot caustic. Long handles are needed to protect against splashing of hot liquids while baskets are lowered into solutions. A mechanized version can be set up using a steel track or trolley with a chain and pulley. The baskets then can be attached to the pulley and moved as needed while standing away from the tubs.
- Low ceiling over disassembly bench. This will help for setting up a leverage bar when removing springs with a broken band.
- A medium sized air compressor.
- A spray-hot water attachment for washing boiled parts with hot water under air pressure. This mixture will remove the most stubborn deposits without heavy work. The air gun also can be used for air-cleaning parts prior to reassembly and for spraying the completed closer with paint.
- Air hose at assembly bench for cleaning out ports and inaccessible passages.

TOOLS

- A complete set of door closer disassembly tools, designed specifically for the brand of closer being repaired. Two sets of tools are recommended; one for each work bench to eliminate walking and misplacing of tools. The tools at the reassembly bench should be close to the vise and should be kept spotlessly clean.
- Two wide jaw vises, one for the disassembly bench and one for the reassembly bench.
- Heavy drill press, floor model, to be used for removing stubborn screws and case nuts from floor closers.
- Heavy duty bench grinder.
- Double electrical outlets every two feet.
- A small torch.
- Heavy steel brush and scraper.
- Heavy pieces of strong pipe, about 4 feet long, by 3/4", 1", 1-1/2" and 2". Use for leverage when needed.

Long handled pliers (two pair) and one pair tongs.
One small anvil or a small piece of railroad track.
Heavy rubber hammer.
Variety of heavy duty screwdrivers.
Assortment of quality open end wrenches.
Ball peen hammers, three sizes.
One punch set.
C clamps, 5 and 6 inch size, having a 4 inch throat.
Heavy duty crescent wrenches - 12, 14 and 18" sizes.
Assortment of stiff wire to clean dirt out of port and valve holes. Tooth brushes can be used also.
Small brushes to spread sealer on threads during reassembly.
Metal identification tags, to identify various parts during repair operations.
Penetrating oil on disassembly bench for applying to threads of valves, spindles, fork rods and shoes.

SAFETY EQUIPMENT

Two fire extinguishers.
Heavy rubber gloves to be used when working at the hot caustic tub.
Clean uniforms or coveralls, free of tears.
Floor compound or sand to soak up grease or fluid that may spill on floor.
It is advisable to enclose sink on both sides to cut down on splashing of water and dirt deposits.
First aid kit.
Safety glasses. Rubber type which completely enclose eye area are recommended when working with caustic.
Eye cup and eye cleaning solution. For use if foreign fluids splash into eyes.
Safety shoes.

In addition, a working stock of replacement parts and supplies is needed, such as new pistons, springs, packing, arms, new fluid, etc. A stock of rebuilt closers is advisable since a closer should be loaned while the original closer is being repaired.

New door closers should be stocked also. In a number of cases, a malfunctioning closer may not be worth the effort and expense of repair. New closers should be sold wherever possible and thus a good supply of mounting brackets should be kept on hand.

The amount of parts, new closers, brackets, etc., kept on hand depends on the individual needs of the shop. Tools, parts and supplies are available through regular trade channels and can be obtained within a relatively short period of time. The stock, however, should not be permitted to run low or out because of the unpredictable demand for door closer repair.

A wide variety of door closer work can come into the shop at any time and each job that comes in will be subject to the customer's needs and demands. As with all other types of service work, door closer repair must be handled with the customer's needs as the prime consideration. Plain business economics calls for prompt, efficient handling of the repair and the shop must be geared to perform the service so that repeat business and a fair margin of profit can be assured.

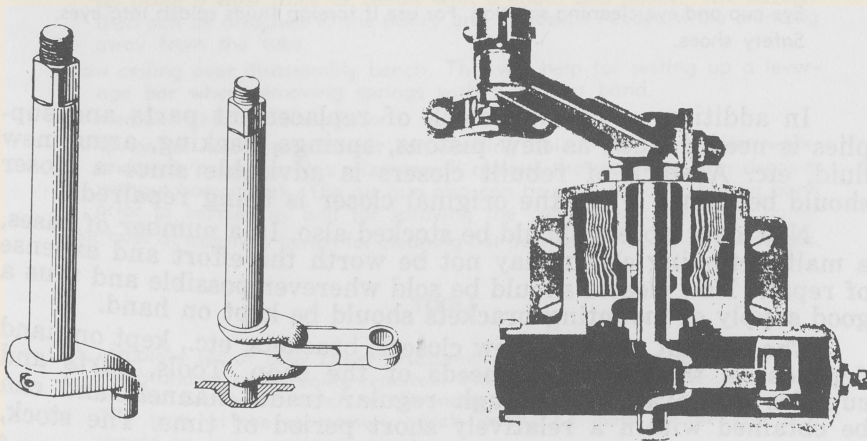
PART 4 — DEVELOPMENT OF THE YALE DOOR CLOSERS

The development of the Yale line of door closers traces the early days of the door closer itself. The beginning dates back to 1882 when a Boston carpenter, Louis C. Norton, invented the pneumatic door closer, the first such device to reach the market. This was followed quickly by a hydraulic door closer patented by Eugene I. Blount in 1883. The essential difference between the two types was the checking medium; the first Norton closer used air as a checking medium; the first Blount closer used a fluid (hydraulics). Thus, the Blount device became the first modern door closer.

The mechanical design employed by Blount featured a crank shaft which was joined to a piston by a connecting link. Therefore, the rotary action of the crank shaft was transformed into a sideward movement of the piston through this connecting link. This type of mechanical operation now is referred to by the trade as a *crank and piston* closer.

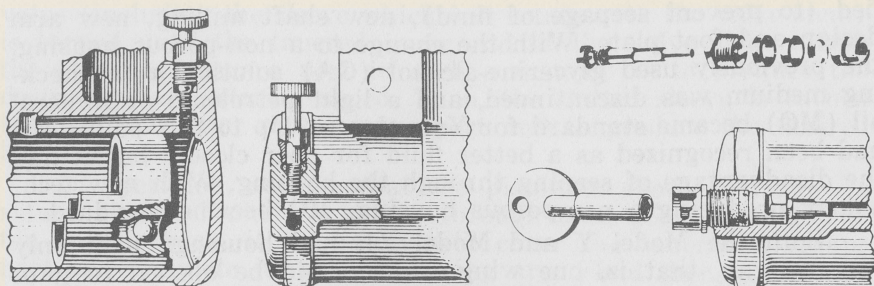
Blount set up a company to market his invention. But, in 1883, after several years of struggle, he entered into an agreement with The Yale & Towne Mfg. Company to manufacture and market his closer. This arrangement continued until 1896 when Yale bought the patents and trademarks. After making minor

The Blount shaft (left) was redesigned to include a bottom bearing in the Model Y closer. At right is interior view of Model Y closer.



improvements, Yale continued to market the device under the Yale-Blount brand name until 1911.

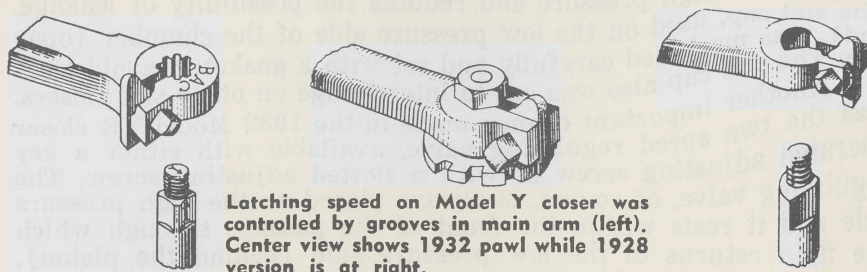
At that time, Yale introduced its Model Y door closer which contained several improvements, such as a new crankshaft, repositioning of the valve, and standardization of parts. The Model Y crankshaft used a step bearing in the bottom of the housing to stabilize the shaft against the heavy sideward pressure (See Illustration). Also, the return passage for the fluid was relocated



Blount placed the valve at the top of the housing (left) but Model Y valve was positioned in center (middle view). At right is two speed valve (slot and key type) used on Models Y and YR closers.

at the rear of the piston chamber, below center, so that partial loss of fluid would not affect checking action.

Perhaps the most important improvement in the Model Y closer was the standardization of parts. This permitted inter-



Latching speed on Model Y closer was controlled by grooves in main arm (left). Center view shows 1932 pawl while 1928 version is at right.

changeability during repair and eliminated custom fitting of replacement parts.

A single regulating valve was used in the Model Y closer but control of the closing speed at the point of latching was regulated by three grooves in the main arm. Thus, by positioning the arm on the shaft (setting it in any of these grooves), timing of the piston stroke was controlled and the speed at latching regulated. In addition, the Model Y had a new arm with a loose pawl and clamp screw along with a new foot plate.

Power in the Model Y closer was provided by a clock type spring, similar to the clock springs used today. This spring was handed and could be used for either a right or left door installation; but, to do so, the spring had to be removed from its chamber and positioned for right or left hand use. To provide a closer that was not handed, Yale introduced its Model YR closer in 1919. The Model YR had a helical torsion spring and thus could be mounted for either a right or left hand installation without repositioning the spring.

Subsequent improvements in the Model YR saw a new main arm, ratchet and pawl introduced in 1928. Many changes were made in the 1932 model, including a general improvement of manufacturing techniques. A new non-porous housing was speci-

fied (to prevent seepage of fluid), new shaft milling, new arm design and foot plate. With the change to a non-porous housing, the previously used glycerine-alcohol (GA) solution as a checking medium was discontinued, and a light petroleum or mineral oil (MO) became standard for Yale closers. Up to this point, MO had been recognized as a better fluid for door closers but it had the disadvantage of seeping through the housing. With new technology producing a non-porous housing, MO became standard.

Both the Model Y and Model YR had housings with only one end cap, that is, one wing which could be opened to gain access to the piston chamber. The opposite end of the piston chamber was closed, being a part of the solid housing casting. Only a small hole for the valve assembly was drilled in this wing.

To understand the reason for having only one end cap, remember that in a crank and piston closer, the piston operates in only one side of the piston chamber. Thus, high compression of the fluid is produced only in the operating side, which is called the high pressure end of the chamber. Having a solid or closed wing at the high pressure end reduces the possibility of leakage. The end cap, used on the low pressure side of the chamber (open end), was machined carefully and set with a gasket to avoid leakage. The end cap also was cut to interchange on other size closers.

Another important change made in the 1932 Model YR closer was the two speed regulating valve, available with either a key operated adjusting screw or with a slotted adjusting screw. The regulating valve, of course, is always placed on the high pressure side and it rests within the front of the passage through which the fluid returns to the low pressure side (behind the piston). This return passage has *two* escape ports and the regulating valve is designed to control the amount of fluid that flows through both ports.

The two speed control involves a small sleeve mounted on the valve stem. The sleeve engages in one position only on the valve stem; thus, when the valve stem is turned, the sleeve turns with it. A V-shaped groove is cut into the circumference of the sleeve and this groove gradually widens at one end. Any fluid entering this groove is directed into the main return passage behind the valve stem.

As the sleeve turns (with the valve stem), it presents a narrow or wide portion of the V-groove to the end most escape port leading from the piston chamber. Naturally, the narrower the V-groove positioned over this port, the narrower the opening and the more the flow of fluid will be restricted. A full rotation of this sleeve, therefore, adjusts the flow of fluid from nothing (blank portion covers the escape port) to an unrestricted flow (widest portion of V-groove over the port).

The end result is that two adjustments are possible with one valve. The tapered end of the main valve stem, as it is screwed in or out of the return passage, regulates the general closing speed. The slotted sleeve, within $\frac{3}{4}$ of a single turn, regulates the latching speed. To make these adjustments, the entire

valve (including the sleeve which will rotate with the valve stem) is turned until the tapered inner end of the valve stem covers the innermost escape port in such a manner as to produce the desired general closing speed. Then, the slotted sleeve is turned to cover the outer most escape port and to produce the desired latching speed.

In operation, assume that the piston is about to make its return stroke. Fluid will escape through both ports. As the piston travels back, it eventually will cover the innermost escape port and complete its general closing arc. Fluid then can escape only through the outer most port which is controlled by the slotted sleeve. At this point, latching speed begins and the position of the V-groove over this port then determines whether the latching speed will be slowed down or increased.

NOTES

PART 5 — REPAIRING THE YALE MODEL Y CLOSER

The Model Y door closer was introduced by Yale & Towne in 1911, as the successor to the original Yale-Blount closer. The mechanical improvements made in the Model Y have been covered in the previous section and this section will cover the actual methods of disassembly and reassembly.

It should be pointed out, however, that repair may not always be advisable with this model. Cost of repair as compared to purchasing a new closer, and its undeniable age are to be considered before repair is attempted. The general improvement now obvious in today's door closers warrants an effort by the door closer repairmen to retire closers that have served their usefulness and to sell new.

While the following method will produce a satisfactory repair, it is given primarily to explain the construction features and to form the basis for understanding the mechanical features and techniques of subsequent models.

With the *door closer housing* securely clamped in a vise (do not overtighten), push the *main arm* to test the closer action and to determine the possible cause of malfunction. Try the action with the valve adjusted to various positions and, if the action cannot be corrected, disassemble as follows:

Using a suitable wrench, unscrew the *top shaft nut*. Then, loosen the *clamp screw* that secures the main arm to the shaft. Before prying the *main arm* off the shaft, note the arrow on top of the shaft and note the three letters (B, A, C) which are stamped into the base of the arm. Note also that the hole in the arm, which fits over the shaft, has a series of grooves and thus the arm can be installed so that any of these grooves fit over the shaft.

The arrow on the shaft will be pointing at any of these letters; file a notch in the arm, over the appropriate letter, to indicate the position of the arrow. The purpose of the arrow and the letters is to adjust latching speed and a further explanation is given in the reassembly procedure. At this point, the main arm can be pried off the shaft (See Illustration 1).

The *ratchet*, which fits into the center of the top cap and which slides on the main shaft, is the next part to be removed. Use a flat bladed tool to pry the ratchet up and out. If the ratchet is stuck, spray the closer with steam or hot water to loosen the bind. Soak the closer if necessary; then, pry up the ratchet (Illustration 2).

Illustration 1

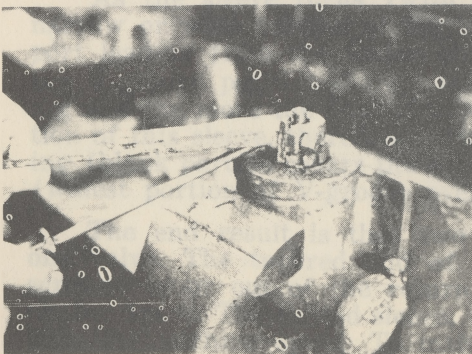


Illustration 2



Yale Model "Y" Door Closer

- A—Top Shaft Nut**
- B—Arm**
- C—Ratchet**
- D—Top Cap**
- E—Spring**
- F—Packing Gland Nut**
- G—Steel Washer**
- H—Packing Washers, Leather (3 required)**
- I—Gland**
- J—Shaft**
- K—Connecting Link**
- L—Piston**
- M—Piston Link Pin**
- N—Pin Cap**
- O—Housing**
- P—End Cap**
- Q—Valve**
- R—Valve Seat**

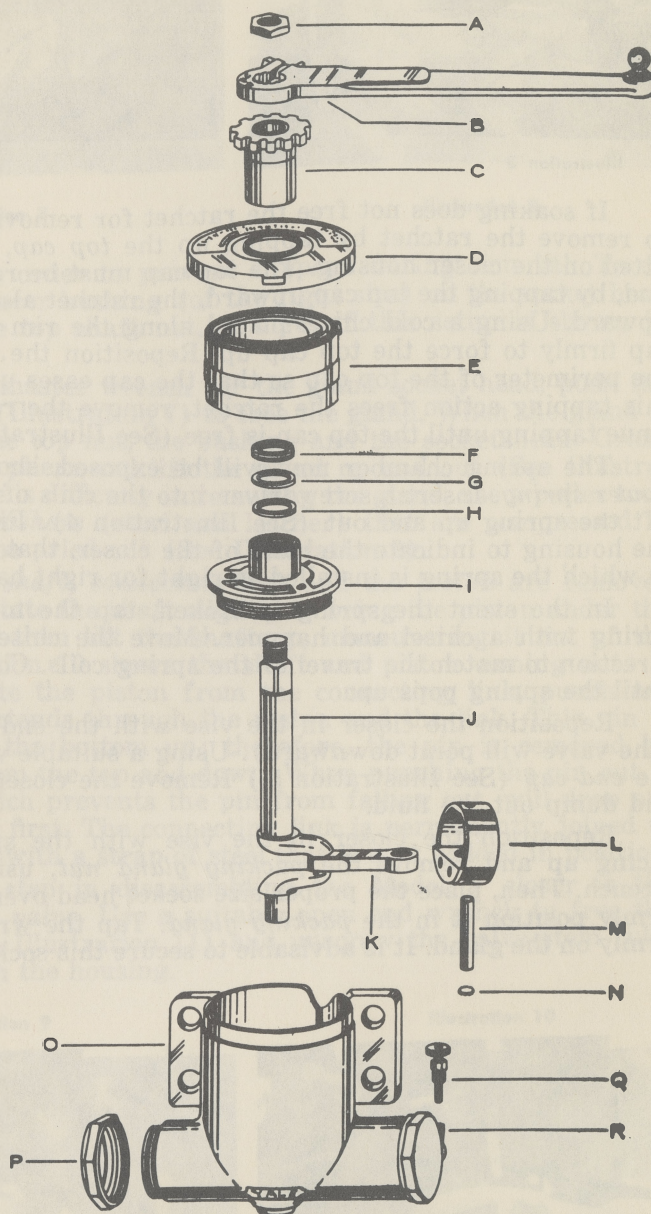




Illustration 3

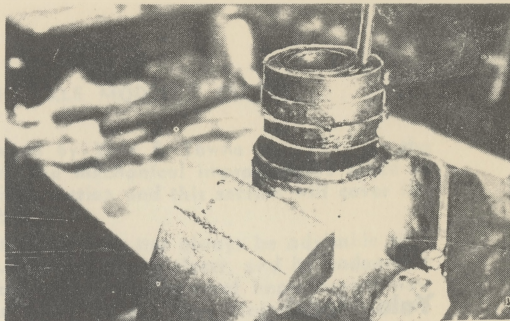


Illustration 4

If soaking does not free the ratchet for removal, it is possible to remove the ratchet by tapping up the *top cap*, which is press fitted on the closer housing. The top cap must be removed anyway and, by tapping the top cap upward, the ratchet also will be forced upward. Using a cold chisel placed along the rim of the top cap, tap firmly to force the top cap up. Reposition the chisel all along the perimeter of the top cap so that the cap eases up evenly. When this tapping action frees the ratchet, remove the ratchet and continue tapping until the top cap is free (See Illustration 3).

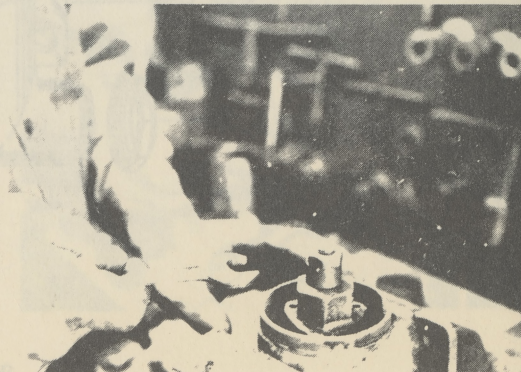
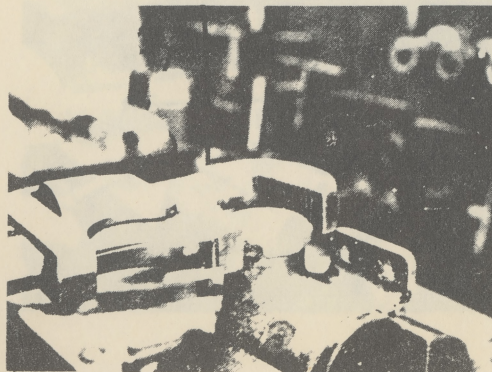
The spring chamber now will be exposed, showing the *clock power spring*. Insert a screwdriver into the coils of the spring and lift the spring up and out (See Illustration 4). File a notch into the housing to indicate the hand of the closer, that is, the position in which the spring is installed as right for right hand application.

In the event the spring is broken, tap the top edges of the spring with a chisel and hammer. Move the chisel in a circular direction to match the travel of the spring coils. Continue tapping until the spring pops up.

Reposition the closer in the vise with the end cap facing up (the valve will point downward). Using a suitable wrench, remove the *end cap* (See Illustration 5.) Remove the closer from the vise and dump out the fluid.

Reposition the closer in the vise with the spring chamber facing up and remove the *packing gland nut*, using the proper wrench. Then, place the proper size socket head over the shaft and firmly position it in the *packing gland*. Tap the wrench to seat it firmly on the gland. It is advisable to secure this socket head tightly

Illustration 6



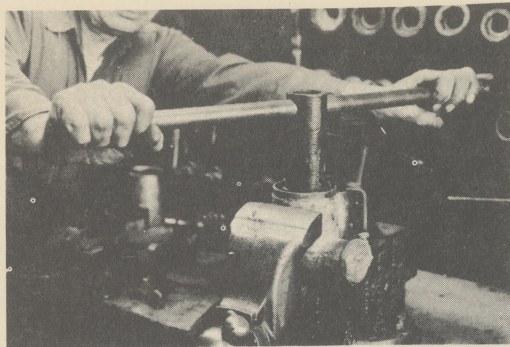


Illustration 7

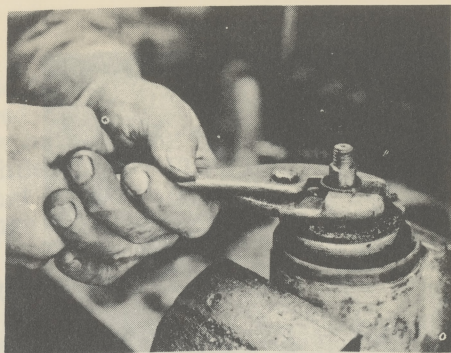


Illustration 8

to the gland in order to prevent slippage during removal. To do this, place a spacer bushing (of the right size) on the socket head and replace the top shaft nut. A view of this setup is shown in Illustration 6.

Using the master wrench for the gland socket head, push the wrench firmly (Illustration 7) to free the gland. When the gland is free, remove the top nut, the bushing and the socket head. Grasp the gland with pliers and lift the gland up and out (See Illustration 8). If there is difficulty in removing the gland, use a puller tool. The *packing washers* (steel and leather) that are compressed in the gland can be pried out (See Illustration 9).

The *main shaft*, *connecting link* and the *piston* are removed as one unit. Rotate the shaft slightly to bring the piston under the gland hole and then lift the shaft up, maneuvering it out of the gland. Illustration 10 shows the shaft and piston coming out.

To separate the piston from the connecting link, punch out the *pin* that extends through the piston and the link. This pin is inserted from the bottom up; therefore, the pin is removed by punching it from the top and down. When punching the pin out, a *spider cap*, which prevents the pin from falling out, will drop out of the pin hole first. The connecting link is permanently joined to the crankshaft with a strap of steel that is spot welded in position.

The final step in disassembling the Model Y closer is the removal of the *valve*. Use a suitable open end wrench to free the *valve nut* (See Illustration 11) and unscrew the valve stem fully from its seat in the housing.

Illustration 9



Illustration 10





Illustration 11

REASSEMBLY PROCEDURE

After discarding all damaged or worn parts, immerse the remaining parts in hot cleaning solution to remove all old paint, dirt, grime and grease. Soak as long as needed to clean the parts thoroughly. Blasts of hot water and compressed air will help to clean fluid passages of grime and dirt. When clean, remove the parts and air dry, or immerse in a light oil to remove the droplets of water and to prevent rust from forming.

For the reassembly, a specially made vise is used in which additional steel plates are mounted to the jaws. Cutouts in the steel plates conform to the shape of a door closer. These plates distribute the holding pressure of the vise jaws over the entire housing, to prevent cracking the housing from over-pressure.

The Model Y was the first Yale closer that used standardized parts. Thus, any new parts required can be those that interchange with other Yale closers of similar design.

Reassemble as follows: Place the housing in the vise with the valve seat up. Use a *new* valve assembly, having two leather and one steel washer. Screw in the valve stem fully and also screw in the valve nut. Finger tighten the valve nut only. Peen a new valve wheel on the valve stem; then, back off on the valve stem so that the valve is fully open.

Reposition the housing in the vise with the end cap facing up. Attach a new gasket to the end cap and apply a sealing compound to the end cap threads. Replace the end cap and firmly tighten it.

Attach the piston to the connecting link by replacing the pin. The pin should enter the bottom of the piston, go through the link and seat in the top of the piston. Replace the spider cap in the bottom of the piston.

Reposition the housing in the vise with the spring chamber facing up. Lower the shaft (with piston attached) into the housing and maneuver the piston into the piston chamber through the gland hole. Note that the wing in which the piston operates (high pressure side of the piston chamber) is wider than the opposite wing (low pressure side). Thus, the piston can be inserted in only one direction. A light coating of new fluid on the piston will help in easing the piston into the wing. Be sure that the bottom of the shaft is seated in the bearing hole at the bottom of the housing.

New fluid now should be poured into the piston chamber. The Model Y closer originally used a glycerine-alcohol mixture (GA

liquid), the commonly accepted fluid for the conditions that existed at that time. The fluid was changed in 1932 when the Model YR closer was developed, having a new housing made of close-grained cast iron that prevents seepage. While pouring in the fluid, operate the piston (rotate the shaft) so that the fluid reaches all parts of the piston chamber. Pour in enough fluid to produce a constant level at the gland hole.

Apply a sealing compound to the threads of the packing gland and slide the gland over the shaft and into the housing. Screw the gland into position. Then, set the gland socket wrench into the gland, secure the wrench with a bushing and the top nut, and firmly tighten the gland.

Place three leather washers into the packing gland, ramming each one fully down with a ramming tool. Set a steel washer on top of the packing washers and replace the packing gland nut. Rotate the shaft several times, to properly seat the leather washers, while firmly tightening the packing gland nut.

Replace the clock power spring, hooking its outer tabs into the notches in the housing. The spring should be replaced so that it winds properly for the hand of application. When replacing this spring, determine the original position by observing the notch filed into the housing prior to its removal.

Align the top cap with the housing and tap the top cap in place. Install the ratchet, lining up the groove in its side with the inner tabs of the spring. The engagement of the tabs with the ratchet groove must be made in order to wind up the spring during operation.

Before installing the main arm, it should be noted that the position of the arm on the shaft determines the latching speed. Remember that this closer has only one valve which regulates *only* the general closing speed. This control is released just prior to latching, with the result that the door could slam closed. By alternating the position of the arm on the shaft, however, the timing of the piston stroke is controlled so that the closer can give silent closing at the point of latch.

The means of setting the position of the arm is established by the *arrow* on the shaft, the *grooves* in the main arm hole and the imprinted *letters* (B, A and C) on the main arm. When the arrow points to the middle letter (A), release of the checking action at the point of latch is obtained. This action is advisable when there are misaligned jambs or when heavy wind is present. If the arrow points at the letter (B), silent closing at the point of latch, on a *right* hand door, is obtained. Changing the arrow to point at (C) produces silent closing on a *left* hand application.

Install the main arm on the shaft, setting the arrow to point at the appropriate letter. Then, replace the top nut to complete the reassembly.

Operate the closer several times to observe the checking action. Then, turn the regulating valve to produce the desired speed and firmly tighten the valve nut.

PART 6 — REPAIRING THE YALE MODEL YR CLOSER

The Model YR closer was introduced by Yale & Towne in 1919 to provide a closer for universal application. Its design permitted installations on right or left hand doors without disassembling the closer to properly position the spring. Its predecessor, the Model Y closer, also could be installed on right or left hand doors. But the Model Y closer had to be disassembled to set the power (clock) spring for right or left hand usage.

To accomplish the universal action, the Model YR closer was equipped with a new power spring — a helical torsion spring. With the new spring came additional parts to transfer the spring power to the crankshaft. And, since the helical spring was higher than the clock spring, a slightly larger housing was required for the Model YR closer.

A major redesign of the YR closer was made in 1932 and this newer model featured such refinements as a two speed valve, non-porous housings and a change to light petroleum oil as a checking fluid. A summary of these refinements is given in Part 9. Throughout its development, however, the YR closer retained the basic design of the earlier Blount closer — a crankshaft operating a piston in one wing of the piston chamber.

With the *door closer housing* securely clamped in a vise (do not overtighten), push the *main arm* to test the closer action and to determine the possible cause of malfunction. Try the action with the valve adjusted to various positions and, if the action cannot be corrected, disassemble as follows:

Using a suitable wrench, unscrew the *top shaft nut*. Then, loosen the clamp screw that secures the main arm to the shaft. Mark the notch in the ratchet into which the movable *pawl* of the main arm rests. Grasp the main arm and push the pawl out of its notch. Slowly ease the main arm to release any tension and pry off the *main arm*.

The *ratchet* is press fitted on the spring driver. Using a flat bladed tool, pry up the ratchet. The *top cap* also is press fitted on the housing. To remove the top cap, tap it lightly with a cold chisel and hammer, completely around its perimeter. When the top cap is free, it will pop upward; stand back for this operation.

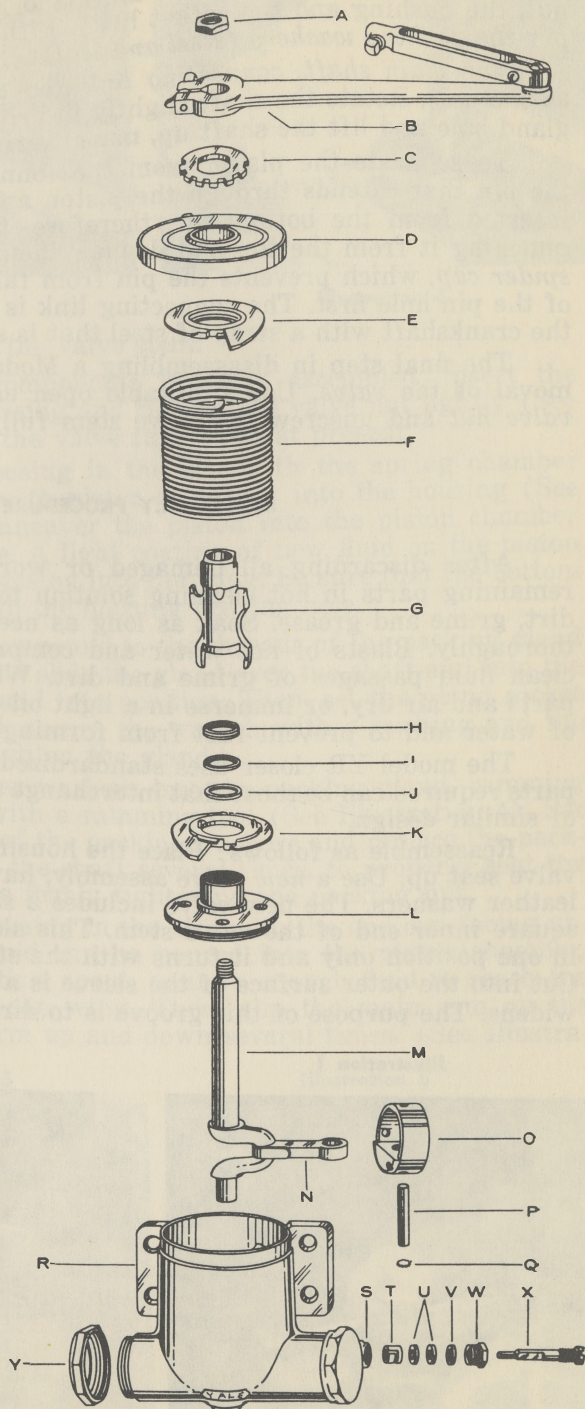
The *spring chamber* now will be exposed, with the spring and the top spring plate protruding slightly from the housing. Lift the *top spring plate (top dog)* away from the spring, easing it out of engagement with the hook of the spring. Reaching into the center of the spring, lift the *spring driver (middle dog)* up and off the main snatt. Next, lift the *power spring* up and out of the spring chamber and separate the *bottom spring plate (bottom dog)* from the spring. Note that the top and bottom dogs are the same.

Reposition the closer in the vise with the end cap facing up (the valve will point downward). Using a suitable wrench, remove the *end cap*. Lift the closer from the vise and dump the fluid.

Reposition the closer in the vise with the spring chamber facing up and remove the *packing gland nut*, using the proper wrench. Then, place the proper size socket head over the shaft and firmly position it in the *packing gland*. It is advisable to secure this socket head tightly to the gland in order to prevent slippage during removal. To do this, place a spacer bushing (of the right size) on the socket head and replace the top shaft nut to hold the head.

Yale Model "YR" Door Closer

- A—Top Nut**
- B—Arm**
- C—Ratchet**
- D—Top Cap**
- E—Top Spring Plate**
- F—Spring**
- G—Spring Driver**
- H—Packing Gland Nut**
- I—Steel Washers**
- J—Packing Washers, Leather**
- K—Bottom Spring Plate**
- L—Packing Gland**
- M—Shaft**
- N—Connecting Link**
- O—Piston**
- P—Piston Link Pin**
- Q—Pin Cap**
- R—Housing**
- S—Valve Seat**
- T—Bushing**
- U—Leather Washers**
- V—Steel Washers**
- W—Valve Nut**
- X—Valve Stem**
- Y—End Cap**



Using the master wrench for the socket head, push the wrench firmly to free the gland. When the gland is free, remove the top nut, the bushing and the socket head. Lift the gland up and out; pry the *packing washers (steel and leather)* out of the gland.

The *main shaft, connecting link* and the *piston* are removed as one unit. Rotate the shaft slightly to bring the piston under the gland hole and lift the shaft up, maneuvering it out of the hole.

To separate the piston from the connecting link, punch out the *pin* that extends through the piston and the link. This pin is inserted from the bottom up; therefore, the pin is removed by punching it from the top and down. When punching a pin out, a *spider cap*, which prevents the pin from falling out, will drop out of the pin hole first. The connecting link is permanently joined to the crankshaft with a strap of steel that is spot welded in position.

The final step in disassembling a Model YR closer is the removal of the *valve*. Use a suitable open end wrench to free the *valve nut* and unscrew the valve stem fully from the housing.

REASSEMBLY PROCEDURE

After discarding all damaged or worn parts, immerse the remaining parts in hot cleaning solution to remove all old paint, dirt, grime and grease. Soak as long as needed to clean the parts thoroughly. Blasts of hot water and compressed air will help to clean fluid passages of grime and dirt. When clean, remove the parts and air dry, or immerse in a light oil to remove the droplets of water and to prevent rust from forming.

The model YR closer uses standardized parts. Thus, any new parts required can be those that interchange with other Yale closers of similar design.

Reassemble as follows: Place the housing in the vise with the valve seat up. Use a *new valve assembly*, having one steel and two leather washers. The new valve includes a *sleeve* that fits over the square inner end of the valve stem. This sleeve engages the stem in one position only and it turns with the stem as the stem turns. Cut into the outer surface of the sleeve is a groove that gradually widens. The purpose of this groove is to direct fluid into the main

Illustration 1

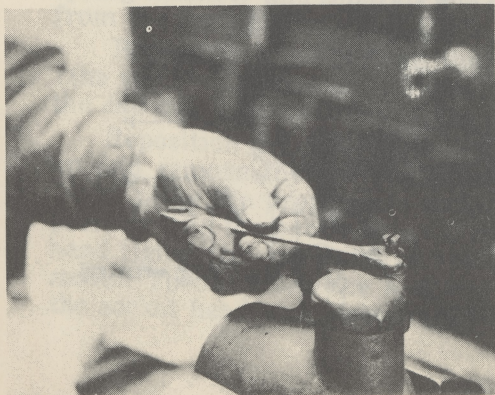


Illustration 2



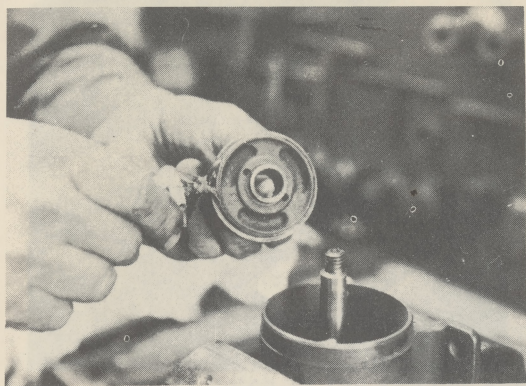


Illustration 3

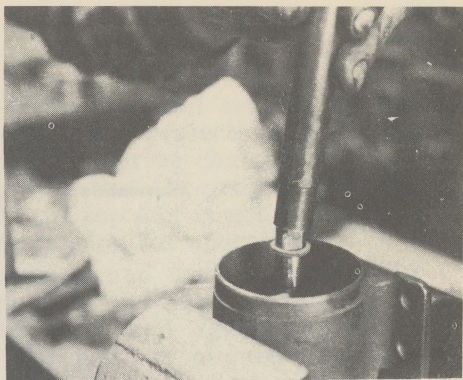


Illustration 4

return passage behind the valve stem.

With the valve components properly assembled, insert the valve stem into the housing and tighten the valve nut lightly (See Illustration 1). Leave the valve fully open at present.

Reposition the housing in the vise with the spring chamber up. Lower the shaft (with piston attached) into the housing (See Illustration 2) and maneuver the piston into the piston chamber through the gland hole. A light coating of new fluid on the piston will help in easing the piston into the wing. Be sure that the bottom of the shaft is seated in the housing bearing hole.

Apply a sealing compound to the threads of the packing gland (See Illustration 3) and slide the gland over the shaft and into the housing. Screw the gland into position. Then, set the gland socket wrench into the gland, secure the wrench with a bushing and the top nut, and firmly tighten the gland.

Place three leather washers into the packing gland, ramming each one fully down with a ramming tool (See Illustration 4). Set a steel washer on top of the packing washers and replace the packing gland nut. Rotate the shaft several times, to properly seat the leather washers, while firmly tightening the packing nut.

Reposition the housing in the vise with the end cap facing up. At this point, new fluid can be poured into the piston chamber. Using a container with a spout, pour in enough fluid to reach the top level of the end cap wing. Then, slip the main arm on the shaft and push the arm up and down several times. (See Illustration 5)

Illustration 5

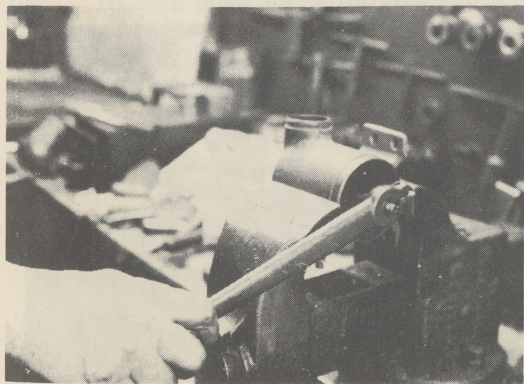


Illustration 6

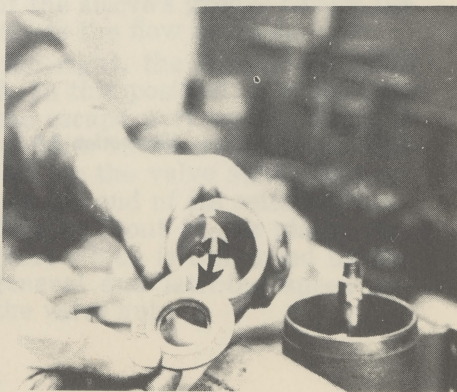
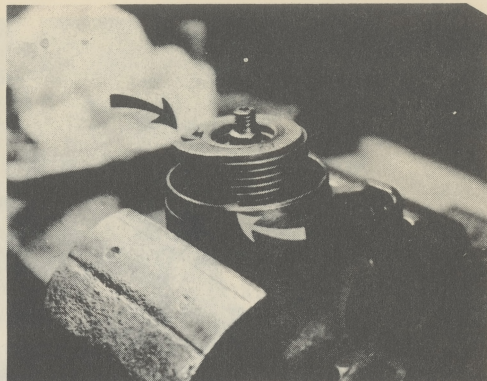


Illustration 7



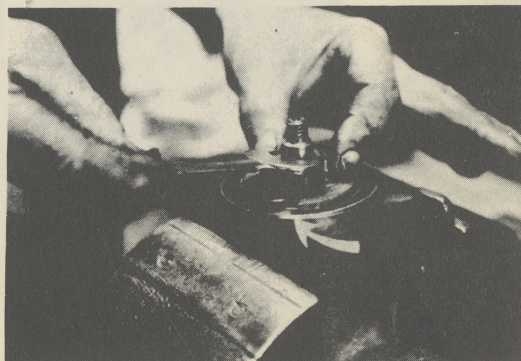
tion 5). This will operate the piston and cause the fluid to fill all passages in the housing. If the fluid level drops, add more fluid. Apply a sealing compound to the threads of the end cap and replace the end cap, tightening it firmly.

Reposition the housing with the spring chamber facing up. The helical power spring is the next part to be replaced. It does not matter which end of the spring faces the gland. Before setting the spring in its chamber, snap the bottom dog into one end of the spring. Be sure that the lug at the end of the spring coil engages the notch in the bottom dog (See Illustration 6). Drop the spring and bottom dog into the spring chamber and rotate the spring *counter-clockwise* until it stops. This will butt the projection of the bottom dog against a lug in the housing and anchor the dog.

Slide the middle dog (spring driver) on the shaft and drop the middle dog into position with the bottom dog. A properly positioned middle dog will have the flats of its two bottom prongs butting against the flats of the projections on the bottom dog. Lay the top dog in position on the top end of the spring, engaging the end of the spring coil into the notch in the dog (See black arrow, Illustration 7). The flats of the projections on the top dog should butt against the flats of the top end of the middle dog.

At this point, note the lug in the top inner area of the spring chamber (See white arrow, Illustration 7). This lug is used to anchor the top dog and to set the spring for operating tension. The next step is important! While pushing down on the top dog (to force the spring down), place an open end wrench on the flanged upper end of the middle dog (See Illustration 8). Then, turn the

Illustration 8



wrench and middle dog *counter-clockwise* until tension is felt. Next, lift the spring up slightly so that the projection of the top dog slides over and behind the lug in the spring chamber. Release the turning pressure slowly making sure that the projection of the dog butts against the anchor lug. If the top dog is not engaged in this manner, the spring will have no tension for operating.

Align the top cap with the housing and tap the top cap in place. Set the ratchet on the flange of the middle dog and tap in position. Install the main arm on the shaft and tighten the clamp screw. Push the main arm until the pawl is aligned with the original notch in the ratchet and push the pawl in place. Replace the top nut to complete the reassembly.

Adjusting the closing speed with the two speed valve is not complicated as long as the function of the slotted sleeve on the valve stem is noted. It has been pointed out that the sleeve has a gradually widening groove cut into its outer surface and that the sleeve rotates with the valve stem as the stem is turned.

Note also there are *two* escape ports leading into the main return passage for the fluid. The *innermost* port is controlled by the valve stem tip while the *outermost* port is controlled by the slotted sleeve. Thus, the valve stem sets the general *closing* speed and the slotted sleeve sets the *latching* speed.

Both adjustments are set by turning the valve stem and this is possible because the sleeve rotates in a *fixed* orbit while the stem slides through the sleeve. The only change in position that can occur with the sleeve is to present either a narrow or wide slot over the outermost escape port. This positioning takes place in less than $\frac{3}{4}$ of a full turn of the stem.

To make the adjustment, the valve stem is turned by using a screwdriver in the outer slot. This causes the tip of the valve stem to move in or out so that it sets over the inner most escape port. At the same time, the slotted sleeve will rotate in a fixed orbit. When the valve stem has been set over its port to give the desired general closing speed, the fine adjustment can be made.

Before making this adjustment, note the V notch that is cut in one end of the outer slot of the valve stem. The position of this notch indicates the adjustment of the slotted sleeve. When the notch is straight up and down, the sleeve is set for silent closing at latch. In this position, a narrow portion of the sleeve's groove covers the outermost escape port and thus restricts the flow of fluid.

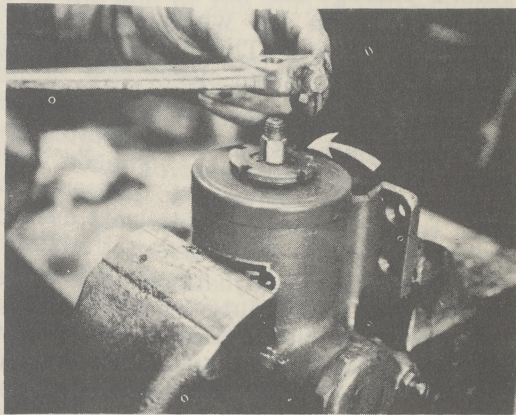
When the notch is angled to the right, the sleeve is set for a release of checking action at latch. In this position, a wider portion of the sleeve's groove covers the escape port so that there is little or no restriction to the flow of fluid. It should be noted that the innermost escape port (controlled by the valve stem) is completely blocked off as the piston nears the end of its return swing. When this occurs, the fluid remaining in front of the piston can only escape through the outermost port which is controlled by the slotted sleeve. When the desired general and latching speed adjustments are made, firmly tighten the valve nut.

PART 7 — THE YALE YR CLOSER, MODEL 1959

The model 1959 YR Yale closer is an improved model of the standard YR first introduced by Yale & Towne in 1919. Its principle of operation is constructed along the same fundamental theory of the original Yale Blount closer. A drive shaft, which operates as a crank, is linked to a piston by the connecting rod. This piston slides horizontally in a cylinder, which is part of the housing. A ball valve is incorporated within the piston to permit easy passage of the fluid when the door is opened. When the door closes, the valve seats, trapping the fluid in the outer chamber and forcing it through a screw-regulated valve built into the rear of the housing.

Through the years following its original concept, several model changes have taken place. In 1928, a new main arm, new ratchet and pawl were introduced. In 1932, further changes were made and this model has been in use up to the present time.

The arrow points to the square milling of the shaft which was introduced in the 1959 Model YR closer. This closer remains essentially the same as its previous models, in terms of operation and mechanical design.



In 1959, a newer model was introduced, with several engineering refinements. One change was in the main shaft, which was milled square, as compared to the older VEE shape. The arm was broached square, and the top cap was made of pressed steel. The jamb plate was made universal at this time.

The nature of the crankshaft checking mechanism is such that in the revised arm assembly, it became necessary to *index* (mark) the arm for proper positioning to preserve correct timing. The top end of the main arm is marked "A" "B" & "C". Position "A" centers the crank so the mechanism will check either right hand or left hand. In position "B", which is 90° different, the closer is set up for right hand, parallel arm use. In "C" position, the closer is set for left hand, parallel arm operation. It should be noted that the replacement of these index marks on the arm repeats the presence of the marks as were originally on the 1919 Model Y closer.

The closer is serviced in the identical manner as the model YR closer, previously described. Most of the parts used in the 1932 model can be used in the current 1959 model. Because of this interchangeability of parts, many Y and YR closers are in use today that would have been discarded for lack of current parts production.

The original design of the model YR closer permitted installations on right or left hand doors. This is also true of the 1959 model. The "secret" of this universal application is the helical torsion spring which constitutes the power unit.

The efficiency of the model YR closer is equal for doors of either hand. A given size closer is, therefore, applied to *all* doors, interior or exterior, of a given size. Only the weight and/or size of the door necessitates a larger spring chamber and a corresponding change in size.

NOTES

PART 8 — ABOUT CORBIN DOOR CLOSERS

To fully understand the service procedures for the Corbin line of door closers, a review of the company's development of its closer is necessary. This section will deal with the development of the Corbin closer (manufactured by the P & F Corbin Division of the Emhart Corporation, which was formerly The American Hardware Corporation). Service and repair procedures for the various Corbin models will be given in following sections.

The beginning of door closer production by Corbin took place in the early 1900's when crankshaft style Corbin closers made their appearance. The company improved upon these early closers, however, and brought out its "1911" model which contained several important features. The 1911 model had a rack and pinion design and an unusual reversing mechanism that made the closer suitable for installation on either right or left handed doors, without alteration.

Subsequent improvements were made to the 1911 model and, as these improvements were incorporated, the model numbers were changed to indicate those having the new features. The improved closers, however, still used the basic design features of the 1911 model and thus the review of Corbin closers will begin with the 1911.

The major improvement in the 1911 model was the use of a rack and pinion instead of the earlier crankshaft design. However, Corbin still does produce a crankshaft type closer and this type is identified by the company as its "60" series. Essentially, the 60 series closer can be considered as the successor to the early Corbin closers.

The 1911 closer was the first Corbin closer to use the reversing dog mechanism that permitted universal application. Heart of this reversing mechanism is three dogs in the spring chamber. Both the top and bottom dogs connect to the ends of the helical spring and these dogs are separated by a middle dog which is attached to the ratchet. The middle dog can be rotated in either direction (by pushing the main arm and the ratchet in either direction). As it rotates, the middle dog activates either the top or bottom dog (only one at a time) without disturbing the other dog.

A full understanding of this action is necessary since any disassembly will require exact replacement of the dogs to function universally again. To illustrate this, assume that the closer is applied to a left handed door. Upon opening, the ratchet will rotate to the right; this will cause the middle dog to rotate to the right. As it rotates, the ratchet will activate the bottom dog and thus wind up the spring. The winding up action occurs because the bottom end of the spring is hooked into a slot in the bottom dog.

The top dog also is connected to the power spring, having the top end of the spring hooked into a slot. However, rotation of the top dog is blocked by a stud which projects from the cover of the housing.

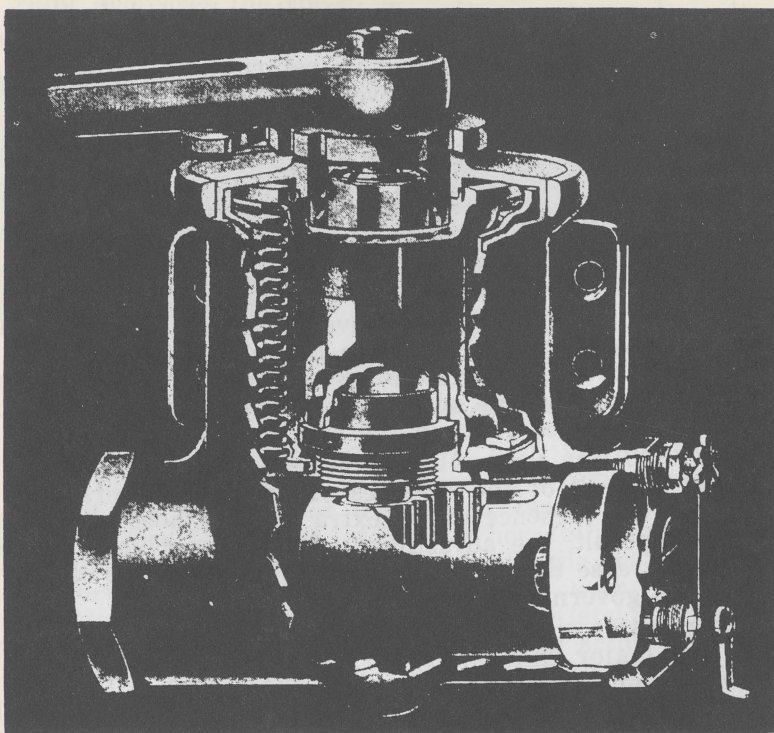
When the closer is applied to a right hand door, a reverse action takes place. Upon opening, the ratchet and middle dog

rotate to the left with the middle dog contacting the top dog. This winds up the power spring from the top and the bottom dog is prevented from rotating by a stud located in the bottom of the case.

The end cap was the next improvement on the 1911 model and this brought about the 127 model. The 1911 model uses a packing washer under the end cap and the end cap has an air vent that removes air from the filled piston chamber as the cap is being screwed in place. The end cap in the 127 model has a longer threaded area which permits the end cap to be screwed up closely to the end of the case. Thus, the need for the packing washers was eliminated and the air vent was enlarged. In addi-

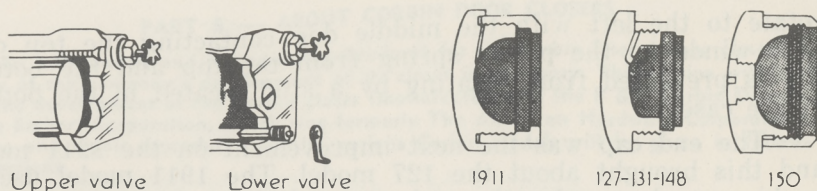
**The Model 131 Corbin door closer — same as the 1911 and 127 models
but without the lower valve.**

(Reproduced from the Corbin Door Closer Manual)



tion to the new end cap, the 127 model closer has a new connecting rod and bracket assembly, one using a double hinged joint to replace the ball and socket on the 1911.

The next improvement was the addition of a second regulating valve and this improved closer was designated model 131. The second valve was added to increase the control over the closing speed, and it was placed below the regular valve (upper) wheel. With only one valve on the 1911 and 127 models, a controlled checking action was produced during the entire return of



Comparison of valve assemblies and end caps.

the door. But the checking action ended with the door a few inches from latching. As a result, the final latching could occur with a slam, or not at all.

The second (lower) valve provides an additional escape port for the fluid so that a fast checking action can take place during most of the return and then slow down for quiet latching. The location of the escape port for the lower valve is the key to this fast, then slow return action. This port is located further into the case than the port for the upper valve. Thus, when the piston is going through the beginning of its return, both ports are open. Near the end of its travel, however, the piston covers the lower valve escape port and thus the fluid can return only through the upper port, giving a slower return just before latching.

The lower valve also can be closed completely to permit only the upper valve to control the closing action. A small wrench is used to operate the lower valve. When the wrench is in the vertical position, the valve is open; a horizontal position of the wrench indicates that the valve is closed.

The presence of the lower valve in the 131 model caused a change in the piston, which had to be notched at the area that traveled over the escape port. To prevent the piston from turning, a tongue and groove was added to the piston. Also, a set screw replaced the threaded joint in the arm loop and connecting rod.

Model 148 was the next closer released by the company and this closer had all of the features of previous closers with one addition — the presence of an extra by-pass hole in the upper valve. As a result, the adjustment of the upper valve could increase or decrease the speed of the door at the point of latching, according to government specifications.

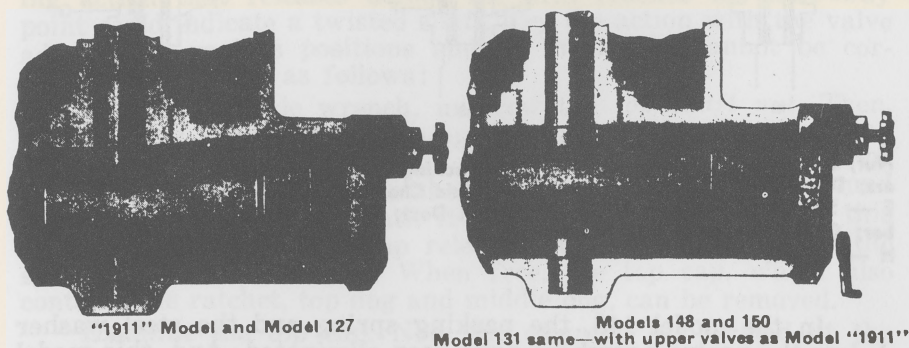
Other major changes in the closer were made with the 150 model. The major change was in the piston. A longer piston is used to give smoother travel during closing. Also, with the longer piston, the height of the piston chamber is changed. This closer also marked the beginning of Corbin's use of oil as a checking medium and the oil necessitates the use of different packing for the spindle and valves.

On all of the models prior to 150, leather packing was used to prevent leakage at the upper valve. Because of the oil used in the 150 model, a packing material not affected by oil is used. Both types of packing, however, are compressed tightly around the valve stem by screwing down the valve packing nut. In addition, a concave steel washer is used to increase the pressure on the valve stem. On the 150 closer, the washer is flat.

It is advisable to use a new valve assembly for a repair. Removing the washers for cleaning the valve components could stretch them as they come over the end of the valve stem, possibly causing a leak in this area.

Packing for the lower valve also is made of specially treated leather on both the 131 and 148 models. Use new packing washers for reassembly of the lower valve, placing four or five on the valve as needed. Note that the packing washers are compressed by the packing nut. Note also that the 150 closer uses two washers made of a material that resists corrosion by the oil checking medium.

The settings of the valves for control of the closing action should be checked at the point of reassembly. On the 1911 and 127 closers, the adjustments are easy. Turning the valve wheel to the left increases the closing speed and turning the wheel to the right decreases the speed.



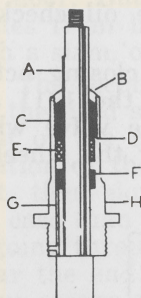
Comparison of valves on the Corbin Door Closers

On the 131, 148 and 150 closers, both valves are used for control of the closing action. The lower valve regulates the closing throughout the majority of the return swing, up to the point about 3-5 inches from final latching. When fully open, the lower valve will permit fast closing action until the piston closes the escape port. Then, the upper valve takes over, checking the closing action for the last few inches to final latching. The upper valve then can be set to give a quick closing action to overcome some obstacle to final latching (misaligned jamb, binding latch, etc.), or slow quiet action. Adjustment of the upper valve is made by turning the valve wheel while the lower valve is set by turning a small wrench on its protruding lug in short steps.

Changes in the construction of the packing gland also have been made in the various models. Most of these changes were made to effect a greater degree of efficiency in the purpose of the gland — to prevent the seepage of the fluid through the shaft. On the 131 model, there are four cork packing washers sandwiched between the packing gland nut and a steel washer. Located below the steel washer is the packing gland spring which exerts a compressing action on the washers. When reassembling a

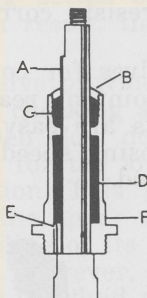
gland on the 131 closer, four new washers should be used and under no circumstances should less than four be used.

The gland in the 131 model also has a chamber located under the base for the packing spring. A return passage leads from this chamber back into the piston chamber. Any fluid reaching the chamber then is permitted to flow back, resulting in a reduction of fluid pressure against the packing washers.



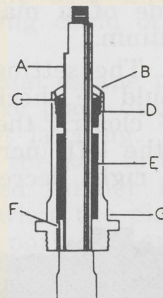
131

A — Shaft; B — Gland Nut; C — Packing Washers; D — Steel Washer; E — Spring; F — Chamber; G — Return Duct; H — Gland.



148

A — Shaft; B — Gland Nut; C — Packing Washers; D — Fluid Chamber; E — Return Duct; F — Gland.



150

A — Shaft; B — Gland Nut; C — Packing Washers; D — Steel Washer; E — Fluid Chamber; F — Return Duct; G — Gland.

In the model 148, the packing spring and the steel washer below the packing washers have been eliminated. And, this model uses only three cork packing washers which are compressed in the gland by the gland packing nut. An additional chamber lies under the packing chamber for catching excess fluid which then flows back through a return passage.

The major difference in the gland on the 150 closer is the type of material used for the packing washers. This material is specially treated to resist the corrosive action of the oil checking medium. Three washers are used in the packing chamber and a steel washer is placed on top of the washers. The packing gland nut then is tightened over the washers to compress the entire mass against the shaft. As with the other models, there is an extra chamber in the 150 gland to return excess fluid.

PART 9 SERVICING THE MODEL 1911 CORBIN CLOSER

The model 1911 Corbin closer was the forerunner of later models that had similar mechanical designs. As features were added to the 1911 closer, a new model number was assigned to indicate the extra features. Since many parts remain unchanged, however, the general service procedure for the 1911 closer can be used for the related models, 126, 127 and 131.

Before repair is started, however, a thorough understanding of the features of each model is necessary. The development of these features is given in the previous section. The general service procedure then can be adapted to allow for the minor changes encountered.

One more point should be noted. Certain parts are interchangeable throughout these related closers. A housing for the 131 can be substituted for 1911 housing. But, other parts are individual to a particular model and should be replaced with a new part of the same type.

With the door closer housing securely clamped in a vise (do not over-tighten), push the *main arm* to test the closer action and to indicate a possible cause of malfunction. For example, a checking action that releases before the arm reaches the half way point could indicate a twisted shaft. Try the action with the valve adjusted to various positions and, if the action cannot be corrected, disassemble as follows:

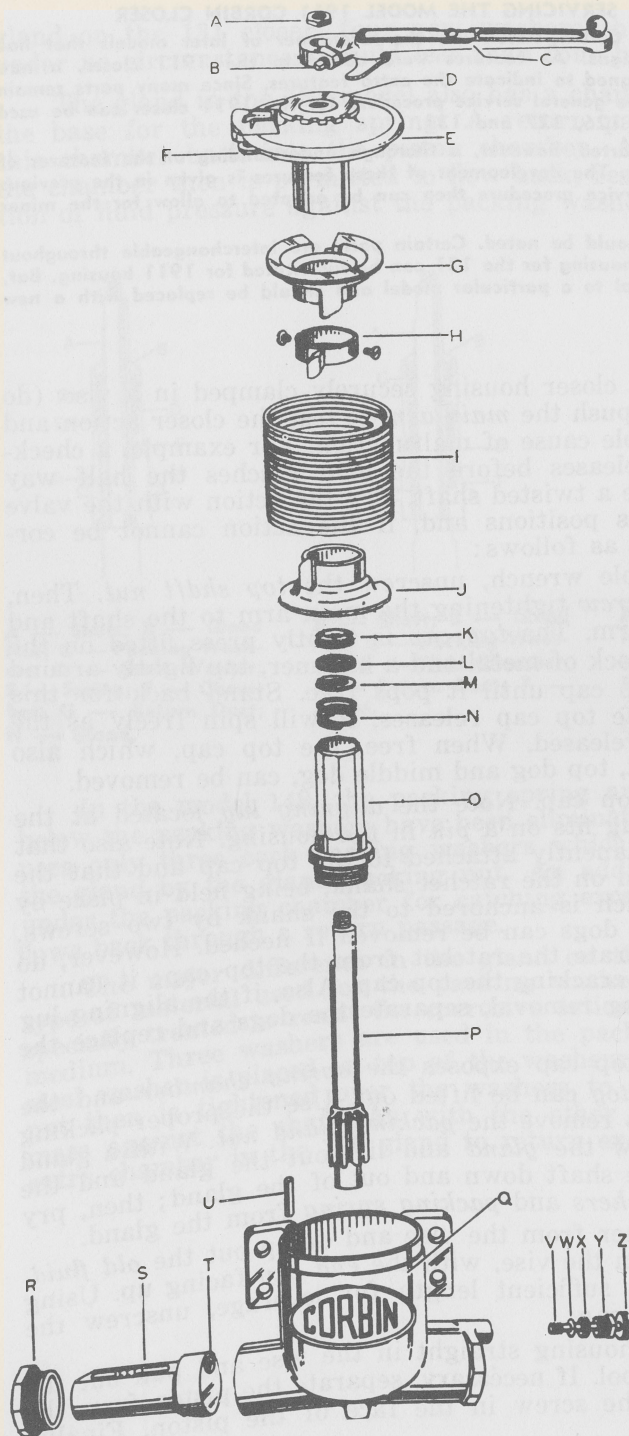
Using a suitable wrench, unscrew the *top shdft nut*. Then, loosen the *clamp screw* tightening the main arm to the shaft and remove the main arm. The *top cap* is tightly press fitted on the *housing*; using a block of metal and a hammer, tap lightly around the edge of the top cap until it pops free. Stand back for this operation. When the top cap releases, it will spin freely as the spring tension is released. When free, the top cap, which also contains the ratchet, top dog and middle dog, can be removed.

Examine the top cap. Note the *aligning lug* located at the outside rear; this lug fits on a *pin* in the housing. Note also that the *ratchet* is permanently attached to the top cap and that the *top dog* is positioned on the ratchet shank, being held in place by the *middle dog* which is anchored to the shank by two screws. The top and middle dogs can be removed if needed. However, do not attempt to separate the ratchet from the top cap; it cannot be removed without cracking the top cap. Also, if the aligning lug has broken off during removal, separate the dogs and replace the top cap.

Removing the top cap exposes the *spring chamber* and the *spring* and *bottom dog* can be lifted out. Use the proper packing gland nut wrench to remove the *packing gland nut*. With a gland nut wrench, unscrew the *gland* and lift out the gland and the main shaft. Pull the shaft down and out of the gland; then, pry out the *packing washers* and *packing spring* from the gland.

Remove the closer from the vise and dump out the *old fluid*. Reclamp the closer in the vise, with the *end cap* facing up. Using a pipe wrench with sufficient length for leverage, unscrew the firmly tightened end cap.

Reposition the housing straight in the vise and pull out the *piston* with a hook tool. If necessary, separate the piston from the *rack* by removing the screw in the face of the piston. Finally,



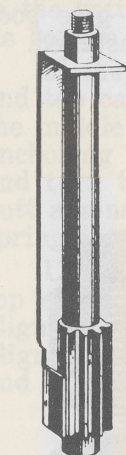
**CORBIN
MODEL 1911
DOOR CLOSER**

- A—Top Shaft Nut**
- B—Clamp Screw**
- C—Main Arm**
- D—Ratchet**
- E—Top Cap**
- F—Aligning Pin Lug**
- G—Top Dog**
- H—Middle Dog**
- I—Spring**
- J—Bottom Dog**
- K—Packing Gland Nut**
- L—Packing Washers, leather (4 used)**
- M—Packing Washer, steel**
- N—Packing Spring**
- O—Gland**
- P—Main Shaft**
- Q—Housing**
- R—End Cap and Washer**
- S—Rack**
- T—Piston and Ball Valve**
- U—Aligning Pin**
- V—Valve Stem**
- W—Concave Steel Valve Washer**
- X—Valve Packing Washer**
- Y—Valve Nut**
- Z—Valve Wheel**

unscrew the *valve nut*. Turn the wheel on the *valve stem* to unscrew the threaded inner end of the valve stem from the housing. When free of the threads, pull the valve stem from the valve hole. It may be necessary to boil the housing in cleaning solution in order to loosen the valve washers so that the valve stem can be removed. Unscrew the valve stem carefully to avoid damage to the threads from the steel washer.

All parts now should be examined for damage or wear and the defective parts discarded. To check the shaft, place it in a *spindle gauge* and note the position of the teeth. A straight shaft will have both outer teeth touching each side of the gauge while a twisted shaft will have one tooth touching one side. It should be noted that twisted shafts result from a closer that leaks. With insufficient fluid, the checking action is erratic, causing slamming or rebounds which could twist the shafts.

TESTING SHAFT FOR STRAIGHTNESS



Straight
Shaft



Twisted
Shaft

The shaft can become twisted from abrupt checking action or from no checking at all. Erratic checking action usually results from the leakage of fluid, which is the most common source of trouble. A twisted shaft can be determined by observing the checking action, prior to disassembly of the closer. A release action that occurs before the half way point of the main arm's return swing usually indicates a twisted shaft. A further check can be made with the shaft out; merely roll the shaft across a flat surface and note any wobble in the roll.

A spindle gauge is the final positive test. With the shaft (spindle) in the gauge (as shown at left), note the position of the teeth against the bottom sides of the gauge. A straight shaft will permit both outer teeth to touch the sides of the gauge while a twisted shaft will have only one tooth touching one side (see right sketch). A twisted shaft should be replaced. Note! If the shaft is so twisted that it cannot be pulled down and out of the gland, cut off the teeth of the shaft and pull the shaft up out of the gland.

REASSEMBLY PROCEDURE

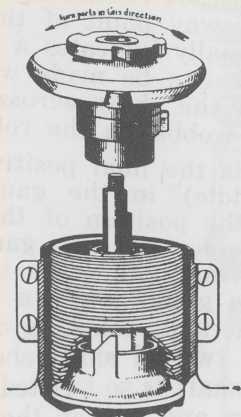
After discarding all damaged parts, immerse the remaining parts in hot cleaning solution to remove all old paint, dirt, grime and grease. Soak as long as needed to clean the parts thoroughly. Blasts of hot water and compressed air will help to clean fluid passages of grime and dirt. When clean, remove the parts and air dry, or immerse in a light oil to remove the droplets of water and to prevent rust from forming.

Reassemble as follows: Place the housing in the vise with the valve hole up. Screw in a *new* valve stem to the top of the threads in the housing. Then, insert the concave steel washer into the valve hole and lay in as many leather packing washers as

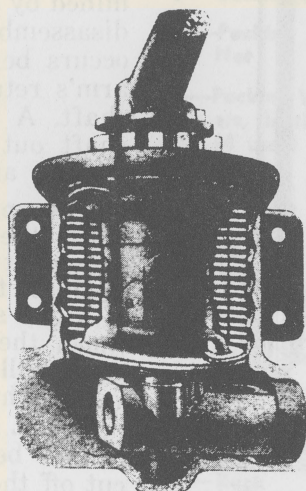
needed. Tamp the washers into the valve hole with a ramming (compressor) tool. Next, screw in the valve nut and *finger-tighten* the valve nut. Leave the valve stem open.

Reposition the housing straight in the vise (do not over-tighten — the housing cracks easily when empty!) and brush the piston chamber with a light coating of new hydraulic fluid. Jiggle the piston to make sure the ball valve is free; then, insert the piston with the ball valve going in first, in line with the regulating valve. Position the piston under the gland hole so that the rear teeth of each rack are just visible at the hole. Insert the main shaft into the gland hole, setting its bottom end into the bearing hole. A properly installed shaft will have a tooth engaging each rack.

At this point, rotate the shaft many times to check the wear of the piston. If compression is felt and heard while the piston is sliding back and forth, the piston is OK. There will be little, if any, compression heard or felt if the piston or ball valve are defective. Experience will indicate the proper amount of compression. But, do not take chances — a worn piston will give poor checking action, resulting in a twisted shaft when reinstalled.



Installing dogs



Proper position of dogs

Reposition the housing with the open end up. Use a new end cap washer and replace the end cap slowly and firmly, allowing the washer to seat properly. A sealing compound should be brushed on the end cap threads before replacing. Tighten the end cap firmly.

Reposition the housing straight in the vise and fill the piston chamber with new fluid. Pour the fluid from a container that has a spout (new fluid is expensive—do not waste it!) Place the spout against the main shaft and pour the fluid to run down along the shaft, filling the piston chamber to the level of the threads. When full, spin the shaft rapidly to move the piston back and forth,

allowing any air bubbles to escape. The fluid level will drop. More fluid should be added and the shaft rotated until the level remains constant.

Apply sealer to the gland and replace the gland, sliding it over the shaft. Use a gland wrench to firmly tighten the gland. Drop the packing compression spring into the gland (over the shaft) and drop in the leather packing washers, ramming each one in with a rammer (compressor). Four washers are usually sufficient but, as many as needed should be used, remembering that the purpose of the washers is to prevent leakage of fluid through the gland and shaft.

Replace and lightly tighten the packing gland nut. Then, place the main arm on the shaft and rotate the shaft vigorously to work in the washers. Firmly tighten the packing gland nut.

Soak up any fluid that spilled into the spring chamber when the gland was replaced. Drop the bottom dog into the spring chamber and turn it *counter-clockwise* until it hits the stop lug in the bottom of the chamber. Replace the power spring, sliding its bottom hook under the lug in the bottom dog.

If the top and middle dogs were removed from the ratchet and top cap, slide the top dog on the ratchet shank. Then, slide the middle dog on the shank and secure it by replacing the two anchoring screws. Lightly position the top cap on the housing and turn the cap *counter-clockwise* until it stops (top dog will butt against lug). Raise the cap slightly and hook the top of the spring into the top dog.

Using a ratchet wrench, wind up the ratchet and rotate the top cap until the position lug (on the cap) lines up with the aligning pin in the housing. Tap the cap on the housing, with the aligning pin sliding in the position lug. Replace the main arm and secure it to the shaft by tightening the clamp screw.

PART 10 — REPAIRING THE MODEL 150 CORBIN CLOSER

As noted earlier, the Corbin 150 closer is a refinement of the model 1911 closer and there is a basic relationship in the design and function of these closers. The disassembly and reassembly procedure for the 1911 was given in the previous section and this procedure can be used as a general method of repair for the Corbin closers, models 1911 through 150. However, to specifically pinpoint the individual refinements of the 150 closer and to provide a reference method for handling these features, the following procedure is given for the repair of the 150 closer. Illustrations are used to show the major points of the repair procedure.

Before going into the actual disassembly of a model 150 Corbin closer, the features of this current production closer, which stand it apart from the other Corbin closers, should be clearly understood. The major change is the use of oil as the checking medium. Thus, special attention must be paid to the replacement fluid used and to the new packing washers installed during reassembly.

Since the model 150 fluid is lighter in viscosity than the fluid used for earlier models, other engineering changes were made in the model 150. A longer piston is used and the height of the piston chamber was increased. The sum total of these changes leads to a simple rule regarding replacement fluid: *Use a fluid formulated specifically for the Model 150 closer* — do not use those designed for the other Corbin closers in the Model 150!

Naturally, the packing washers installed in the Model 150 closer must be made of material that is not affected by the checking fluid. Care should be made, therefore, to avoid substituting regular leather packing washers in the model 150.

Another change evident in the model 150 is the filling screw in the end cap. Filling of the closer therefore can be made through the gland hole (before replacing the gland) or through the end cap filler screw.

The gland represents another change, although this change is a carryover from the Model 148 closer. There is no packing compression spring used in the gland, having been eliminated first on the 148 and later on the 150. There is, however, a difference in the packing gland washers on the 148 and the 150. The 148 uses three cork packing washers, which are held compressed against the shaft by the packing gland nut. The model 150 uses a special packing material and a steel washer which lies between the gland nut and the packing. Thus, the washer, tightened down by the gland nut, causes compression on the packing to firmly press it against the shaft.

DISASSEMBLY PROCEDURE

With the door closer housing securely clamped in a vise (do not over-tighten), push the *main arm* to test the closer action and to indicate a possible cause of malfunction. For example, a checking action that releases before the arm reaches the half way point could indicate a twisted shaft. Try the action with the valves adjusted to various points and, if the action cannot be corrected, disassemble as follows:

Using a suitable wrench, unscrew the *top shaft nut*. Then, loosen the *clamp screw* tightening the main arm to the shaft and remove the main arm. The *top cap* is tightly press fitted on the housing; using a cold chisel, tap lightly around the edge of the top cap until it pops free (See Illustration 1). Stand back for this operation. When the top cap releases, it will spin freely as the spring tension is released. When free, the top cap can be removed.

Examine the top cap. Note the *aligning lug* located at the outside rear; this lug fits on a *pin* in the housing. Note also that the *ratchet* is permanently attached to the top cap and that the top dog is positioned on the ratchet shank, being held in place by the *middle dog* which is anchored to the shank by two screws. The top and middle dogs can be removed, if needed. However, do not attempt to separate the ratchet from the top cap; it cannot be removed without cracking the top cap. Also, if the aligning pin has broken off during removal, separate the dogs and replace the top cap.

Removing the top cap exposes the *spring chamber* and the *spring* and *bottom dog* can be lifted out. With the proper size gland nut wrench, remove the *packing gland nut*. Using a gland nut wrench, unscrew the *gland* (See Illustration 2) and lift out the gland and the main shaft. Pull the shaft down and out of the gland; then, pry out the steel washer and the packing washer from the gland.

Remove the closer from the vise and dump out the old fluid. Reclamp the closer in the vise, with the end cap facing up. Using a steel punch inserted into the slot of the *end cap filler screw*, tap the punch lightly with a hammer to free the filler screw so that it can be removed.

The method for doing this is shown in Illustration No. 3, which shows the filler screw being removed from a Model 148 closer. At this point, it should be noted that the model 148 closer has its filler screw located in the valve wing of the housing while the model 150 closer has its filler screw located in the end cap.

Illustration 1

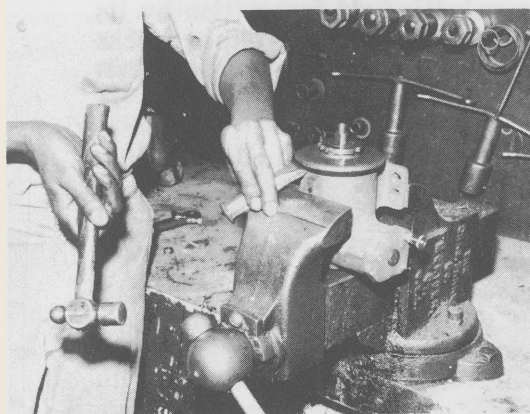


Illustration 2



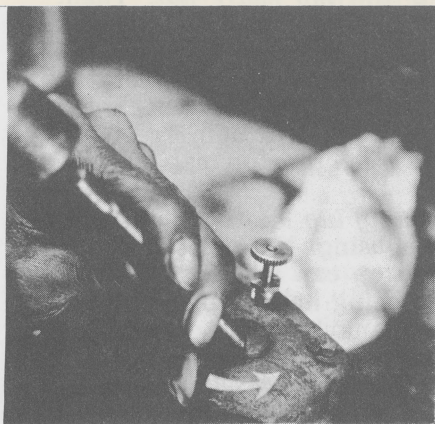


Illustration 3

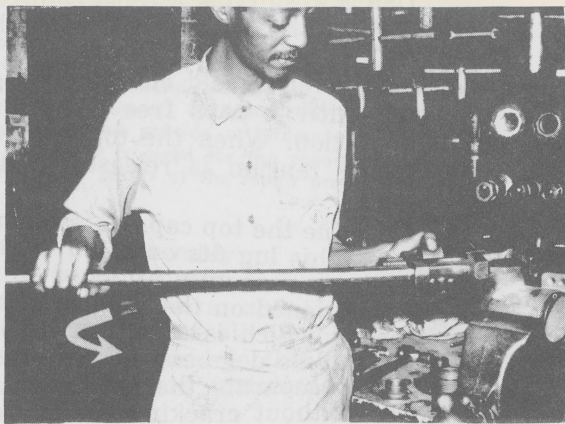


Illustration 4

Next, using a pipe wrench of sufficient length for leverage, unscrew the firmly tightened *end cap* (See Illustration 4).

Reposition the housing straight in the vise and pull out the *piston* with a hook tool (See Illustration 5). If necessary, separate the piston from the *rack* by removing the screw in the face of the piston. Finally, unscrew the *valve nut*. Turn the wheel on the *valve stem* to unscrew the threaded end of the valve stem from the valve hole. It may be necessary to boil the housing in cleaning solution in order to loosen the valve washers so that the valve stem can be removed. Unscrew the valve stem carefully to avoid damage to the threads from the steel washer.

Both the model 148 and model 150 closers have an additional regulating valve that is positioned below the upper valve. The purpose of the lower valve is to provide a faster return of the door, a condition that is sometimes needed when doors open against heavy winds.

The lower valve stem has no threads on its inner end like the upper valve stem; thus, the lower valve is held in position by its valve nut. Since the lower valve stem is smooth, it either blocks or opens an extra escape port that is located in the piston chamber. When this port is open, fluid thus flows through the lower port as well as the upper valve port, giving a faster return action.

The lower valve port, however, is located further in the piston chamber than the upper valve port. As the piston returns to the last few inches of its travel, it will block this escape port first. This immediately slows down the return action since the fluid can flow only through the upper valve port.

The presence of this lower valve gives the closer faster closing action, *where needed*. Most of the time, the lower valve does not even have to be removed during a repair. If the lower valve has been used, however, it is best to remove it and replace it with a new one.

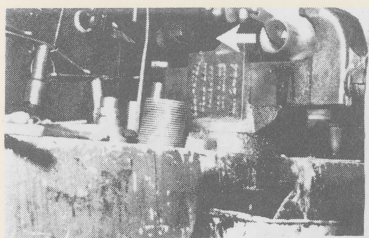


Illustration 5

All parts now should be examined for damage or wear and the defective parts discarded. To check the shaft, place it in a *spindle gauge* and note the position of the teeth. A straight shaft will have both outer teeth touching each side of the gauge while a twisted shaft will have one tooth touching one side. It should be noted that twisted shafts result from a closer that leaks. With insufficient fluid, the checking action is erratic, causing a slamming or rebounds which could twist the shafts. (A detailed explanation of the method for testing the shaft appears in Part 9).

REASSEMBLY PROCEDURE

After discarding all damaged parts, immerse the remaining parts in hot cleaning solution to remove all old paint, dirt, grime and grease. Soak as long as needed to clean the parts thoroughly. Blasts of hot water and compressed air will help to clean fluid passages of grime and dirt. When clean, remove the parts and air dry, or immerse in a light oil to remove the droplets of water and to prevent rust from forming.

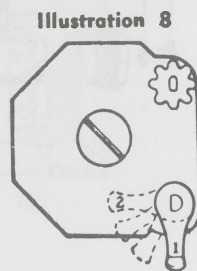
For the reassembly, a specially made vise is used in which additional steel plates are mounted to a vise. Cutouts in the steel plates conform to the shape of a door closer. These plates distribute the holding pressure of the vise jaws over the entire **housing**, thus helping to prevent cracking of the housing from over-pressure.

Reassemble as follows: Place the housing in the vise with the valve hole up. Screw in a new lower valve assembly and tighten the lower valve nut securely with a suitable two-pronged wrench. Check the action of the lower valve by using the valve key as shown in Illustration 7 for the model 148 closer.

Illustration 8 shows the open and closed position of the lower valve. In its open position, the key and the cutout of the valve stem will be vertical. Adjustments of the valve then are made in intermediate steps by turning the valve key counter-clockwise. When the key is horizontal, the valve is fully closed. Set the valve



Illustration 7



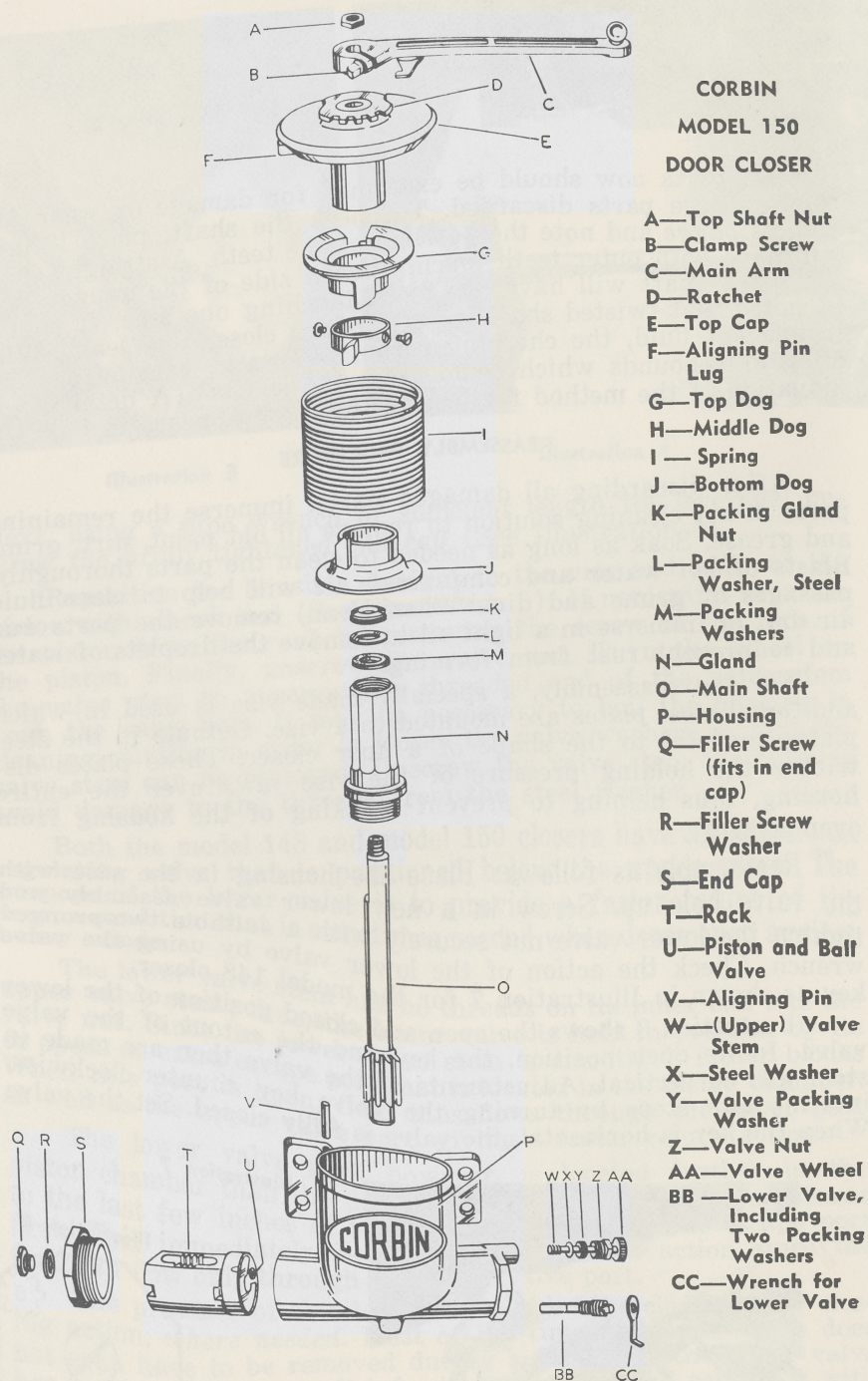


Illustration 6

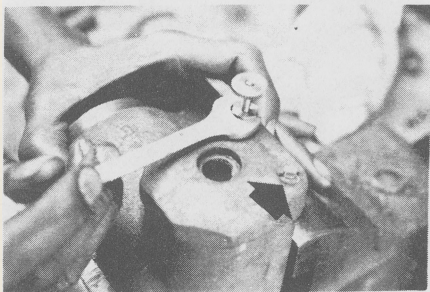


Illustration 9

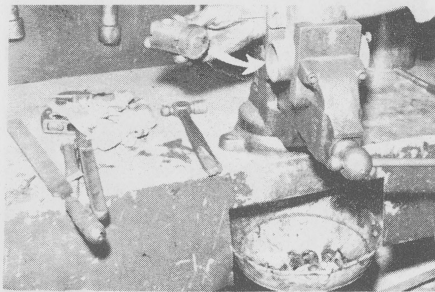


Illustration 10

in the halfway position for an arbitrary adjustment at this point.

Screw in a *new* valve stem to the top of the threads in the housing. Then, insert the *flat* (not concave as with the other Corbin valves) steel washer into the valve hole and lay in as many special packing washers as needed. Tamp the washers into the valve hole with a ramming tool. Next, screw in the valve nut and tighten the nut securely, not tightly (See Illustration 9 which shows a Model 148 valve being installed). Attach the valve wheel and leave the valve open.

Reposition the housing straight in the vise (do not over-tighten — the housing cracks easily when empty!) and brush the piston chamber with a light coating of the PROPER fluid. Jiggle the piston to make sure that the ball valve is free; then, insert the piston with the ball valve going in first, in line with the regulating valve (See Illustration 10).

Position the piston under the gland hole so that the rear teeth of each rack are just visible at the hole. Insert the main shaft into the gland hole, setting its bottom end into the bearing hole. A properly installed shaft will have a tooth engaging each rack (See Illustration 11).

At this point, rotate the shaft many times to check the wear

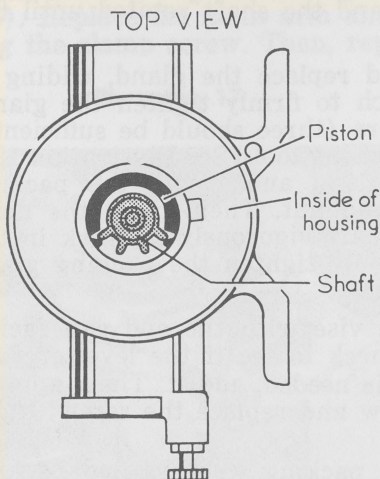


Illustration 11

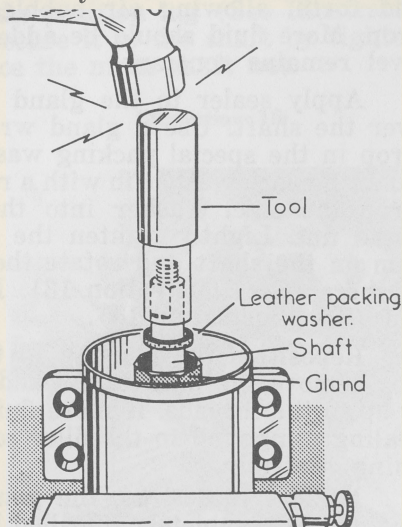


Illustration 12

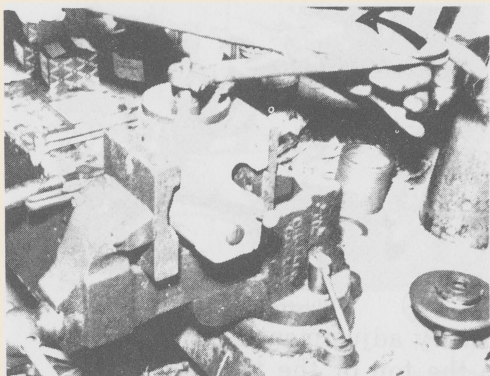


Illustration 13

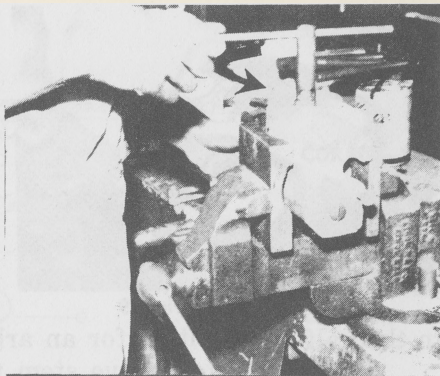


Illustration 14

of the piston. If compression is felt and heard while the piston is sliding back and forth, the piston is OK. There will be little, if any, compression heard or felt if the piston or ball valve are defective. Experience will indicate the proper amount of compression. But, do not take chances — a worn piston will give poor checking action, resulting in a twisted shaft when installed.

Reposition the housing with the open end up, and replace the end cap slowly and firmly. A sealing compound should be brushed on the end cap threads before replacing. Tighten the end cap firmly. Then, replace the filler screw in the end cap, tightening it securely but *not* firmly.

Reposition the housing straight in the vise and fill the piston chamber with new **PROPER** fluid. Pour the fluid from a container that has a spout (new fluid is expensive — do not waste it!). Place the spout against the main shaft and pour the fluid to run down the shaft, filling the piston chamber to the level of the threads. When full, spin the shaft rapidly to move the piston back and forth, allowing air bubbles to escape. The fluid level will drop. More fluid should be added and the shaft rotated until the level remains constant.

Apply sealer to the gland and replace the gland, sliding it over the shaft. Use a gland wrench to firmly tighten the gland. Drop in the special packing washers (three should be sufficient), ramming each washer in with a ramming tool (See Illustration 12). Drop the steel washer into the gland and install the packing gland nut. Lightly tighten the gland nut. Then, place the main arm on the shaft and rotate the shaft vigorously to work in the washers (See Illustration 13). Firmly tighten the packing gland nut (See Illustration 14).

Reposition the housing in the vise with the end cap facing up. Remove the filler screw and check to see if the level of fluid is up to the threads. If more fluid is needed, add it. Then, apply a sealing compound to the filler screw and replace the screw, tightening it firmly.

NOTE! If desired, the gland, packing washers and packing nut can be completely installed before pouring in the fluid. Then, the fluid can be poured into the housing through the filler screw.

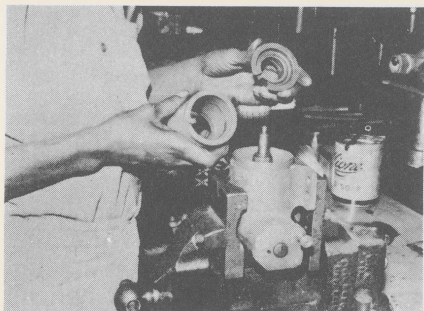


Illustration 15

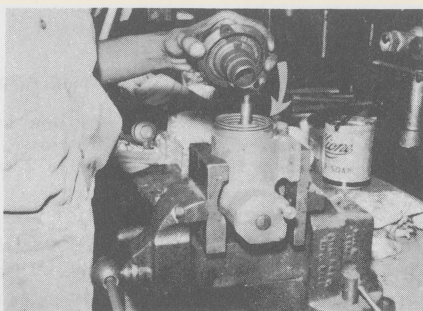


Illustration 16

With this alternate method of filling, however, the piston should still be operated many times to remove all air bubbles.

Soak up any fluid that spilled into the spring chamber when the gland was replaced. Drop the bottom dog into the spring chamber and turn it *counter-clockwise* until it hits the stop lug in the bottom of the chamber. Illustration 15 shows the bottom dog ready to be dropped in; note the notch in the dog which contacts the stop lug. Then, replace the power spring, sliding its bottom hook (shown in Illustration 15) under the lug in the bottom dog.

If the top and middle dogs were removed from the ratchet and top cap, slide the top dog on the ratchet shank. Then, slide the middle dog on the shank and secure it by replacing the two anchoring screws. Turn the dogs as shown in Illustration 16 and place the top cap in position on the housing. Turn the top cap *counter-clockwise* until it stops (top dog will butt against the lug and the top of the spring will hook into the top dog).

Using a ratchet wrench, wind up the ratchet (Illustration 17) and rotate the top cap until the position lug (on the cap) lines up with the aligning pin in the housing. While holding the ratchet wrench and top cap in this position, tap the cap on the housing with the aligning pin sliding in the position lug (See Illustration 18). Replace the main arm and secure it to the shaft by tightening the clamp screw. Then, replace the main shaft nut.

Illustration 17

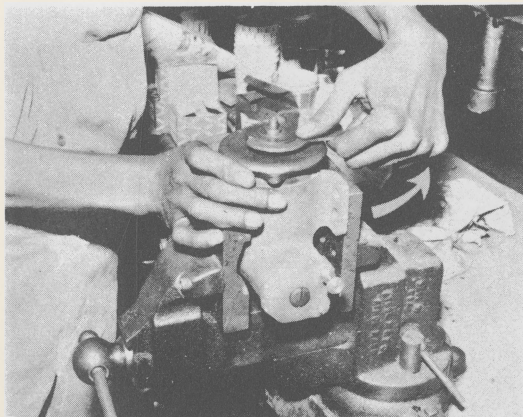
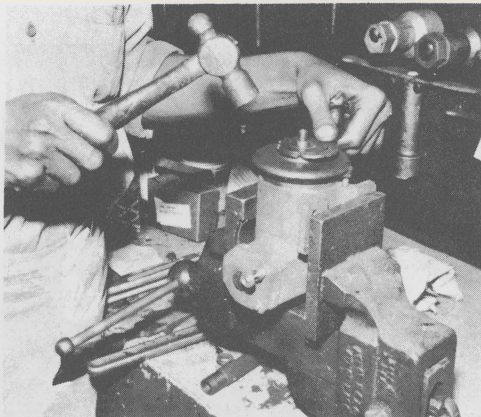


Illustration 18



PART II — REPAIRING THE CORBIN MODELS 159, 163 CLOSERS

Corbin's development of its line of overhead hydraulic surface door closers now is centered in its Series 70 closer, identified as Models 159 and 163. This closer is made in five sizes from size 2 to 6, identified as: 72, 73, 74, 75 and 76.

The design of the Model 159, 163 closer is somewhat simplified and varies from its predecessors in the Corbin line. While the closer retains its reversibility, it uses a new type power spring and a revised ratchet. The power spring changes from a helical type to a clock type. In the *clock spring*, the metal is in a strip or band form, which is wound concentrically. The entire spring then is held into a compact unit by a retaining sleeve mounted on the outer surface.

The reversibility of the clock spring is obtained by placing the spring in its chamber to wind right or left. To reverse a 159 or 163 closer, the spring must be removed and reversed in position (turned over). Also, the piston must be repositioned by rotating the shaft in the direction *opposite* to regular rotation. The closer uses a rack and pinion design, having a single piston with two heads. Two regulating valves are used: one for setting closing speed and the other for latching speed.

Observing the usual precautions involving door closer repair, the procedure for disassembling the closer is as follows:

With the closer secured in a vise, use a spanner wrench to move the *ratchet* slightly so that the *dog* which rests in the ratchet teeth can be released, thus releasing the ratchet power. Note that the dog (being pointed to in Photo 1) lies under the arm and that it is connected to a knob on top of the arm. Thus, the dog can be released from above the arm merely by turning the knob. Be careful while releasing the spring power to avoid any injury.

The *main arm* is held to the closer by a Phillips head screw. Using a screwdriver, remove this screw (See Photo 2) and the washers. Tap the main arm off the top end of the shaft.

The *ratchet* rests in position in the top cap, extending down into the *spring chamber*. Lift the ratchet up and away from the

Photo 1

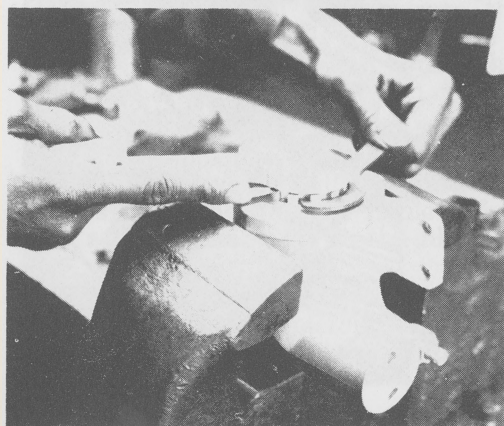
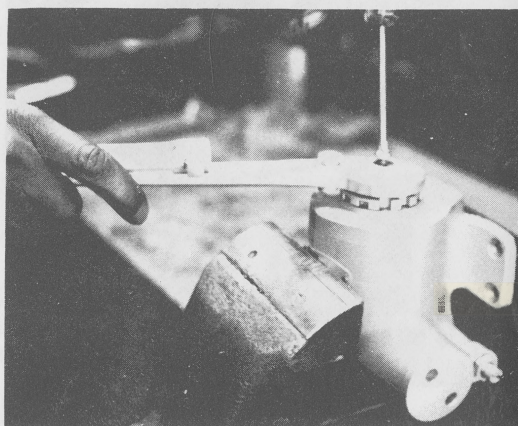
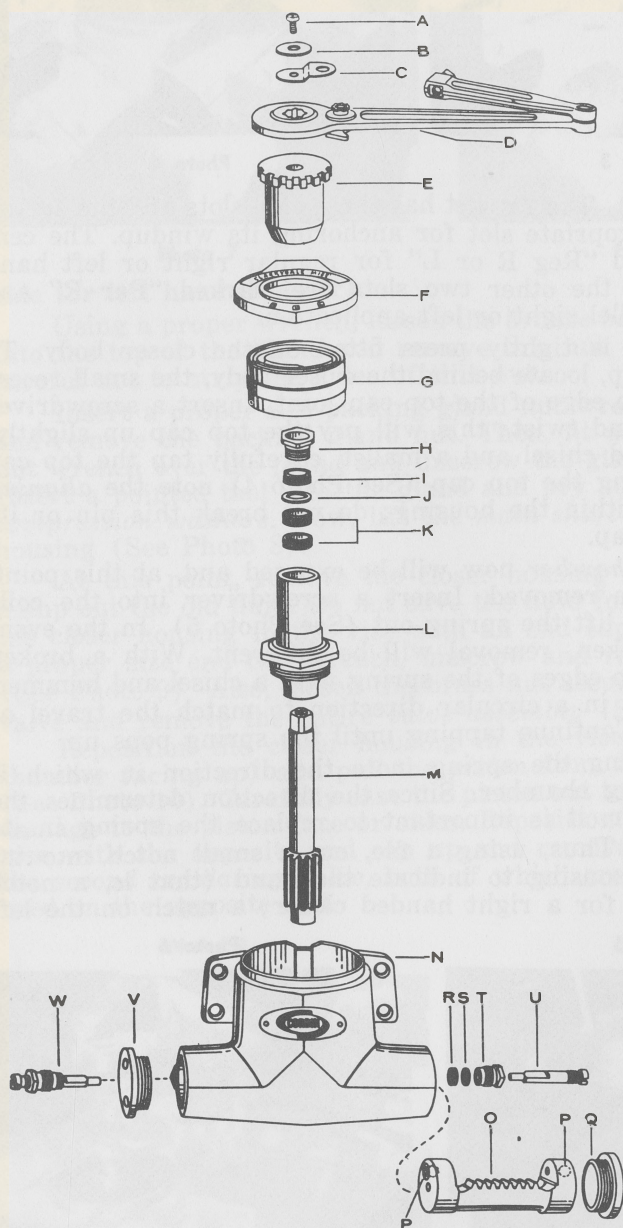


Photo 2





**CORBIN
NO. 72
DOOR CLOSER**

- A—Main Arm Screw
- B—Washer
- C—Washer
- D—Main Arm
- E—Ratchet
- F—Top Cover
- G—Band Spring
- H—Nut
- I—Packing Nut
- J—Steel Washer
- K—Packing Washer
(2 required)
- L—Gland
- M—Shaft
- N—Case
- O—Piston
- P—Ball Valve
- Q—End Cap
- R—U—Closing Valve,
disassembled
- R—Neoprene Washer
- S—Steel Washer
- T—Valve Nut
- U—Valve Stem
- V—End Cap
- W—Back Check
Valve (assembled)

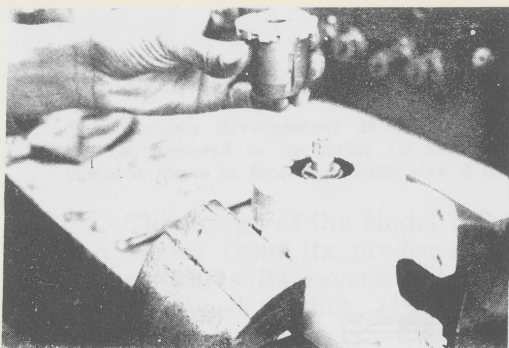


Photo 3

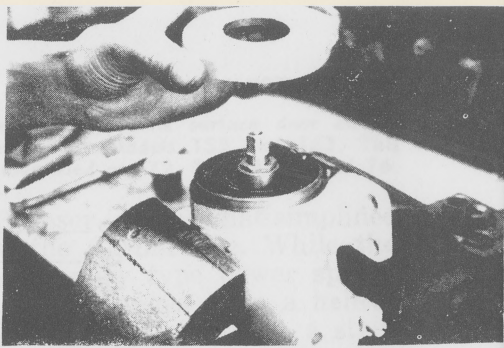


Photo 4

housing (Photo 3). The ratchet has three side slots and the spring hooks in the appropriate slot for anchoring its windup. The center slot is marked "Reg R or L" for regular right or left hand application while the other two slots are marked "Par R" and "Par L" for parallel right or left application.

The *top cap* is tightly press fitted on the closer body. To remove the top cap, locate behind the closer body, the small recess that lies along the edge of the top cap joint. Insert a screwdriver into this recess and twist; this will pry the top cap up slightly. Then, using a cold chisel and a mallet, carefully tap the top cap up. When removing the top cap (See Photo 4) note the *aligning pin* that is set within the housing; do not break this pin or its seat in the top cap.

The *spring chamber* now will be exposed and, at this point, the *spring* can be removed. Insert a screwdriver into the coils of the spring and lift the spring out (See Photo 5). In the event the spring is broken, removal will be different. With a broken spring, tap the top edges of the spring with a chisel and hammer, moving the chisel in a circular direction to match the travel of the spring coils. Continue tapping until the spring pops up.

When removing the spring, note the direction in which it rests in the spring chamber. Since the direction determines the hand of the closer, it is important to replace the spring in its original position. Thus, using a file, cut a small notch into the top edge of the housing to indicate the hand (that is, a notch on the right side for a right handed closer; a notch on the left

Photo 5

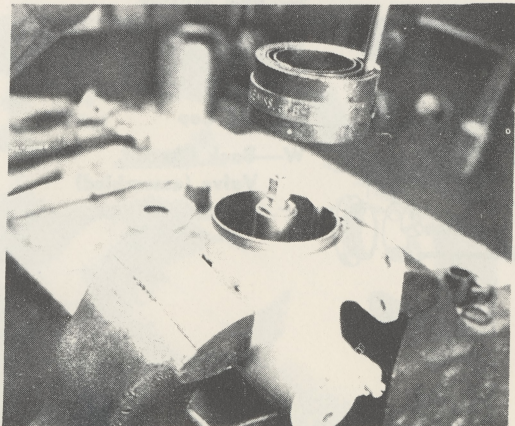


Photo 6

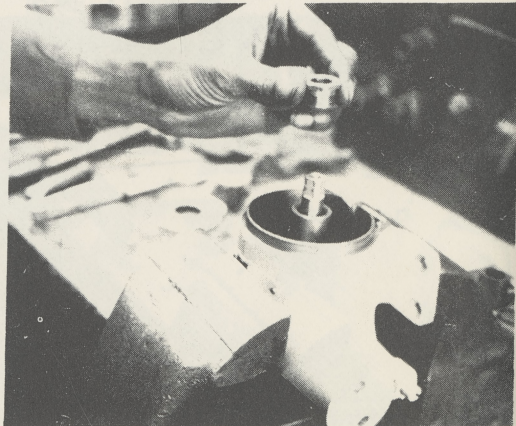




Photo 7

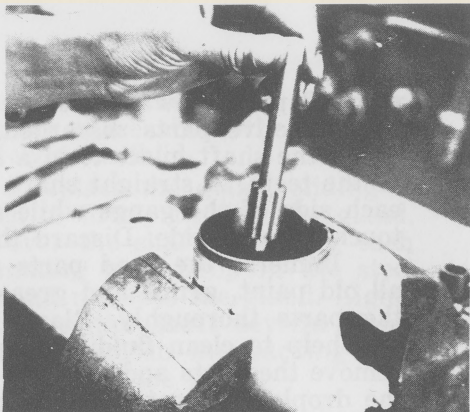


Photo 8

side for left handed closer).

Using a proper wrench, loosen the *bronze bearing nut* screwed into the top of the gland and remove this nut (See Photo 6). Be careful not to strip the sides of this nut.

Insert a proper size packing gland nut wrench into the gland and remove the packing gland nut. Then, fit a proper size gland nut wrench over the *gland* and unscrew the gland (See Photo 7). Insert a pointed tool into the gland and pry out the two *packing compression washers*. Now, lift the *main shaft* up and out of the housing (See Photo 8).

At this point, remove the closer housing from the vise and dump out the old fluid. Do not save the fluid for reuse. Reposition the closer housing in the vise with an end cap facing up. Using a proper size end cap wrench, unscrew and remove the *end cap* (See Photo 9). Also, loosen the brass nut securing the regulating valve and remove the entire *valve assembly* (See Photo 9).

Reposition the closer housing in the vise (with the spring chamber facing up) and pull the *piston* from the piston chamber (See Photo 10). Carefully ease the piston out to avoid unnecessary damage to the piston face or sides. Reposition the housing in the vise with the opposite end cap up and remove this *end cap* and the *second regulating valve*, both of which are the same as those used on the opposite end.

Photo 9

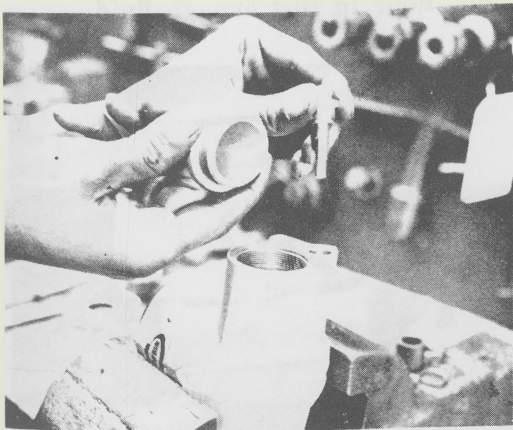
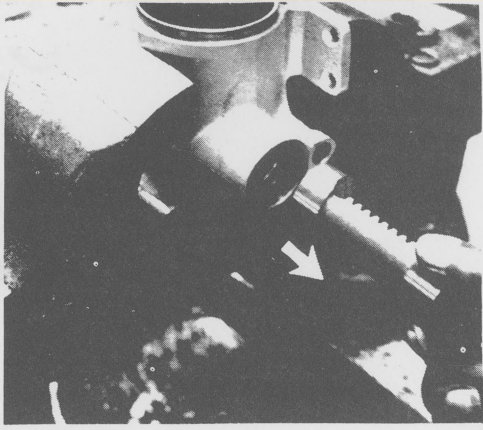


Photo 10



All parts now should be examined for damage or wear and the defective parts discarded. Use new wherever advisable. To check the shaft, place it in a spindle gauge and note the position of the teeth. A straight shaft will have both outer teeth touching each side of the gauge while a twisted shaft will have one tooth touching each side. Discard the shaft if twisted.

Immerse the good parts in hot cleaning solution to remove all old paint, grime and grease. Soak as long as needed to clean the parts thoroughly. Blasts of hot water and compressed air will help to clean fluid passages of dirt and grime. When clean, remove the parts and air dry, or immerse in a light oil to remove the droplets of water and to prevent rust from forming.

REASSEMBLY PROCEDURE

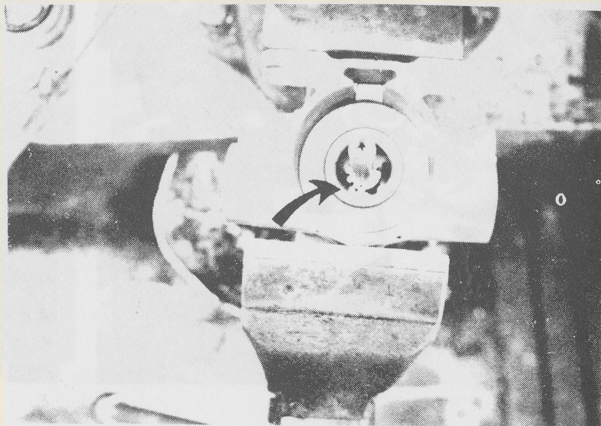
For reassembly, a specially made vise is used in which additional steel plates are mounted to the jaws. Cutouts in the steel plates conform to the shape of the door closer. These plates distribute the holding pressure of the vise jaws over the entire housing, thus helping to prevent cracking of the housing from over-pressure.

Reassemble as follows: Place the housing in the vise with one end cap up. Screw in a new regulating valve assembly and firmly tighten its brass nut. Leave this valve fully open so that fluid can enter the fluid passage. Apply suitable sealant to the end cap and replace the cap, tightening it firmly.

Reposition the housing straight in the vise and brush the piston chamber with a light coating of the proper fluid. Jiggle the piston to make sure both ball valves (one in each piston head) are free; then, insert the piston into the piston chamber. Reposition the closer in the vise and replace the other end cap and valve assembly, applying sealer and tightening firmly. Move the piston so the first tooth on the right side of the rack (there is only one rack) is under the gland hole. Then, ease the shaft into the housing, setting its bottom end into the bearing hole in the bottom of the housing. A properly installed shaft will have its first tooth mating with the beginning of the rack, as shown in the top view in Photo 11.

The closer now is ready for filling with new fluid. With a suitable container and spout, carefully pour the fluid into the closer housing, through the gland hole. Pour in just enough fluid

Photo 11



so that the level covers the upper wall of the piston chamber. This closer is designed to have an air space above the fluid; do not fill the piston chamber completely with fluid.

Apply sealer to the gland and replace the gland, sliding it over the shaft. Use a gland wrench to firmly tighten the gland. Drop the packing washers (two) over the shaft, ramming each washer into the gland with a ramming tool. Drop in the steel packing washer and screw the packing nut into the gland. Lightly tighten the packing nut; then, spin the shaft several times to seat the packing washers. Securely tighten the packing nut. Also replace the top bronze bearing nut in the gland.

Reposition the housing in the vise with the spring chamber facing up and drop the spring into the housing. Replace the spring so that it is in proper position for winding according to the hand of the door on which it will be mounted (check the filed notch or the R and L on the closer housing). Lay the top cap on the housing and line up the aligning pin with its mating hole in the cap. Tap the cap firmly on the housing.

Drop in the ratchet so that the ends of the spring slide into the proper slot of the ratchet body. Replace the main arm and its anchoring screw and washers. Using a spanner wrench inserted into the ratchet, wind up the ratchet four clicks and secure the ratchet by engaging the dog (lever) into the proper ratchet notch. Note that the ratchet has a safety feature to prevent overwinding of the spring. There are only eight notches into which the dog can be engaged with the ratchet. The unnotched area of the ratchet thus prevents applying too much tension.

At this point, operate the closer arm several times to check the return and checking action. Adjust both valves as needed to produce the desired action.

DOOR CLOSER MANUFACTURERS

Challenger Lock Co.
2349 W. LaPalma
Anaheim, Calif.

P & F Corbin Div.
New Britain, Conn.
Robert Keane

Dexter Lock Div.
Dexter Industries
1601 Madison S. E.
Grand Rapids, Mich.

Dominion Lock Ltd.
7301 Decarie Blvd.
Montreal, Canada

Dor-O-Matic Div.
Republic Industries
7350 W. Wilson Ave.
Chicago 31, Ill.

Eaton Yale & Towne
401 Theodore Fremd
Rye, N. Y.

Emhart Corp.
P. O. Box 1620
Hartford, Conn.

Hardware Products
806-12 N. Sixth St.
Reading, Pa.

Ideal Brass Works
215 E. 9th Street
St. Paul, Minn.

Illinois Lock Co.
309-11 W. Hintz Road
Wheeling, Illinois

Independent Lock Co.
Fitchburg, Mass.

Jackson Exit Device
3447 Union Pacific
Los Angeles, Calif.

L. C. N. Closers
Princeton, Ill.

Liberty Hdwe. Mfg.
44-35 Purves
Long Island City, N.Y.

New England Door Clos.
P. O. Box 28
West Springfield, Mass

Norton Door Closer
372 Meyer Road
Bensenville, Ill.

S. Parker Hardware
27 Ludlow Street
New York 2, N. Y.

Oscar C. Rixson Co.
9100 W. Belmont Park
Franklin Park, Ill.

Sargent & Co.
100 Sargent Drive
New Haven, Conn.

Schlage Lock Co.
2201 Bayshore
San Francisco, Calif.

Trans Atlantic Co.
420-42 Fairmount Ave.
Philadelphia, Pa.



