

RESTRICTED

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40 MM ANTI-AIRCRAFT GUN MOUNT

MARK 1 (TWIN)

DESCRIPTION AND OPERATION
(PRELIMINARY)

U.S. Naval Gun Factory,
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40 MM MOUNT MARK 1

P r e f a c e

The contents of this pamphlet contains a complete description and operation of: -

The United States Navy 40 MM Twin Mount Mark 1.

The operation and maintenance are based entirely upon the mechanical design and standard Navy practice.

This data has been compiled by the Design Section of the York Safe and Lock Company, Special Ordnance Plant, Designers and Builders.

Chapter I

TWIN MOUNT MARK 1

CONDENSED DESCRIPTION

The twin Mount Mark 1 is the complete unit for mounting the 40 MM Machine Gun Mechanism Mark 1 and Mark 2. It provides for 360 degrees of horizontal training movement right or left from its locked position. Vertically the gun mechanism can be elevated to an angle of 90 degrees or depressed 15 degrees from its horizontal, locked position. A training stop mechanism and buffer prevent any training beyond these limits and provide protection to the electrical service cables. The power drive units also provide an automatic cut-off when approaching extreme limit of train.

The extreme limits of elevation or depression are provided with rubber bumper pads.

The movement of one handle unlocks the mount from its fixed position or prevents its movement when not in action. The gun body also can be released or locked with the movement of one lever conveniently located to the elevation operator.

The principal parts of the mount are:

1. Stand and training circle.
2. Base ring and carriage.
3. Training gear (handwheel, gear drives and seats).
4. Elevating gear (handwheels, gear drives and seats).
5. Electric Power Drives (Receivers, clutches and lever controls).
6. Fire Control Mechanism (Power clutch and cut-out mechanism).
7. Loaders platform (cartridge chutes and tool holders).
8. Cooling System (Pump, tank and piping).

1. The stand and training circle are bolted together, with the stand bolted to the ship's structure. These parts are the only stationary parts of the mount. The training circle has gear teeth cut on its outer edge, mating with the training gear pinion drive which rotates the entire mount.

2. The base ring is provided with circular roller paths and hardened steel rollers which are in contact with paths on the stationary stand. The entire weight of the mount is transmitted through these rollers to the stand. The training stop buffer and training pinion bracket are attached to the base ring while its top flange supports the carriage.

The carriage supports the gun mechanism through its roller bearing trunnions. On its sides are mounted both the training and elevating hand wheel brackets, manual gear drives, power drives, operator's seats and foot rests, platform, and smaller pipe and cable brackets. The front face of the carriage is occupied with the fire control and cut-out mechanism.

3. The training gear consists of a handwheel conveniently located on the right hand side of the mount to the operator's seat. The handwheel is connected through shafts, a set of helical gears, a set of bevel gears, a worm drive and pinion to the training circle. Turning of the handwheels will rotate the mount right or left as desired.

4. The elevating gear consists of a handwheel conveniently located to the operator's seat on the left side of the mount. This handwheel is connected through shafts, a set of helical gears, two spur gear reduction units, and a worm drive to the elevating pinion. The pinion mates with the elevating arc attached to the gun body. Pressure applied to the handwheel will elevate or depress gun mechanism as desired.

5. The electric power drive units are self-contained, electrically driven through gears, shafting and a hydraulic pump and motor to the outside connection. It is so arranged through clutches, levers and control rods that it can be manually operated (with electric power) at the mount or remote control from a distant fire control station. They are used both for elevating and training gear power drives.

6. The firing control mechanism consists of foot pedal or electric solenoid firing in conjunction with an electric firing motor and clutch arrangement through levers, shafts, springs, and rods to move the firing plunger to the fire position. The firing stop mechanism consists of an arrangement of levers and cranks to disconnect the firing mechanism during that period when any part of the ship's superstructure would fall in the line of gun fire. When this danger has passed, the mechanism automatically is reset to the firing position.

7. The platform is an all-steel weldment attached to the carriage to provide a space for the loaders to stand and load the gun during continuous fire. Tool holders and tools that may be necessary during action are conveniently located to the loader. It also supports the cartridge chutes through which the empty cartridges are ejected to the deck.

8. The cooling system is a complete unit for one gun. The tanks and pumps are mounted to the rear of the platform. The liquid tanks are set at platform floor level and the electric motor driven pumps suspended underneath the platform. A supply and return pipe to the barrel water jacket is run along the main platform girder and corners of the carriage.

CONSTRUCTION

The stand is a cylindrical steel casting machine finished to accommodate hardened steel roller paths and rollers which supports the roller paths of the rotating base ring. Its bottom surface is evenly finished for bolting to the ship's deck (or an intermediate machined ring fastened to the deck) with 16 bolts. In its bottom inside surface is pressed a hardened steel roller path which is in contact with hardened steel rollers bearing the radial and thrust load of the base ring. Machined grooves are provided for lifting jacks to remove the roller path. The top outside surface is grooved out to form a seal with the rotating training circle cover. The top surface is machined parallel to the bottom to accommodate the training circle.

The base ring is a large steel casting concentric at the bottom with a rectangular shaped form on its top to conform to the carriage base. Numerous vertical ribs add rigidity and strength to bear the entire weight of the rotating carriage. Its lower concentric surfaces have three hardened steel roll paths pressed on it to transmit the thrust and radial load thru rollers to the stand. The interior is drilled to house a centrally located steel weldment support and clamp for all electrical cables. The rear right side has a vertical projecting section upon which is mounted the training gear pinion bracket. Drilled and tapped holes are provided for holding the training circle covers. The top rectangular flanged surface is drilled for mounting the carriage. A flat sheet steel cover is used to close the large opening above the cable rack. The front riser to the carriage flange and the flat top section are drilled for mounting electrical cable tubes.

The cable support is an angle iron weldment bolted to inside lower flanges of the base ring. It supports a square insulating board drilled for approximately 20 cables. This insulating board is centrally located in the rotating carriage. From this board the cables are looped, with sufficient length to prevent excessive twisting at maximum of 360 degrees train. A split metal clamp secures the cables and forms them in a direct line to the electrical tubes.

The training circle is a large ring gear with teeth cut vertically on its outer edge. It is bolted to the top of the stand. In its lower inside surface is pressed a hardened steel roller path. Vertically drilled holes are provided for jack screws to remove the roller paths and the circle from the stand. The top is cut out for bolting the training stop block and forms a run-way for the training traveling block.

The training circle covers, in five sections, are bolted to the base ring. A clearance fit seal at the stand forms a protection for the training circle.

The carriage is a steel casting with a rectangular body section flared out at its base and flanged for mounting on the base ring. The upper portion is cored and bored for mounting the elevating bracket and from this point it inclines toward the rear with only two sides to form a "U" shaped support for the trunnion bore. On its left side are mounted the main parts of the elevating gear, handwheel brackets, pinion drive, and power drive. The right side is used for mounting the training gear equipment handwheel brackets and power drive.

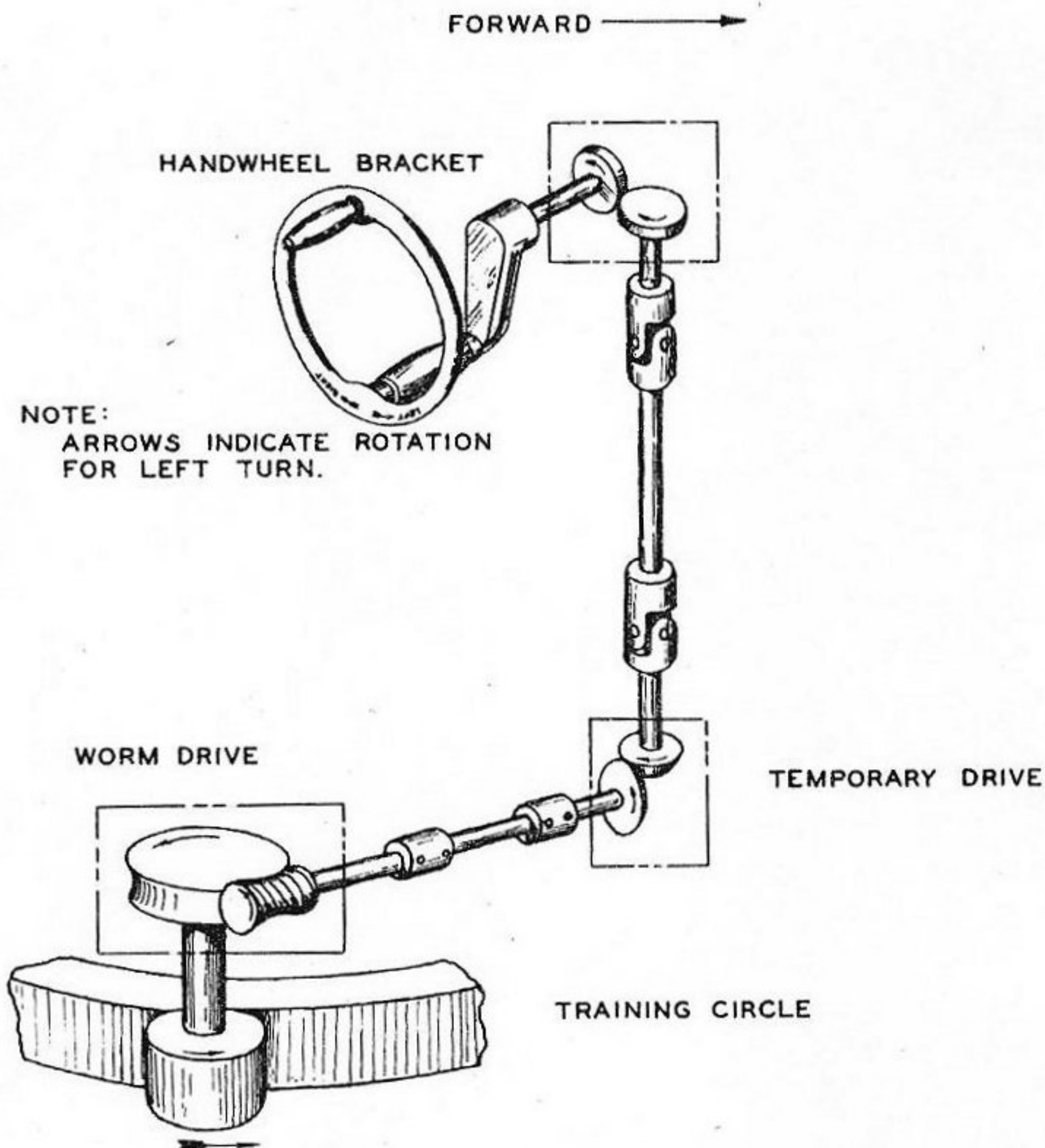
Both sides near its base are provided with protruding bolting lugs. The front lugs support the power drive housings. The inclined lugs to the rear support the main girder plates holding the platform.

The front face of the carriage contains the firing stop mechanism, cam housing, and brackets holding the firing rod levers from the foot pedal to the firing plunger.

Elevating gear, see page 10.

Training gear, see page 7.

40 MM TWIN MOUNT - MARK I
DESCRIPTION AND OPERATION
TRAINING GEAR SCHEMATIC



CONSTRUCTION

Training Gear

The handwheel bracket is a steel casting bolted to the right side of the carriage. It houses a set of helical gears splined to shafting moving in roller bearings. The larger gear is mounted on a horizontal shaft which is driven in either direction manually by a two handle crank wheel (with right and left direction arrows). The larger gear drives a smaller gear at a 90 degree angle on a vertical shaft. This shaft is splined and pinned to a universal joint and open drive shaft.

This arrangement is used on both the manual and the power drive arrangement.

The temporary drive, manually operated, consists of a beveled gear housing arrangement supported on an extended weldment bracket bolted to the side of the carriage. The bevel gears are splined and locked on stub shafts with roller bearings. The vertical shaft is splined and pinned to a universal joint and shaft that is actuated by the handwheel. This shaft, through a set of 30 to 60 degree bevel gears, drives a coupling splined shaft to the worm drive.

The worm drive bracket is a cylindrical shaped steel casting housing a worm and shaft with roller bearings. The shaft is horizontal and direct connected through a splined coupling to the bevel gear shaft. The bracket is fitted to the pinion bracket with a shim adjustment for proper meshing of worm and worm wheel.

When the power drive is used, it is direct connected with a coupling to the horizontal worm shaft.

The pinion bracket plate is a cylindrical shaped steel casting with an open side for the worm wheel contact. It is bolted and machine keyed to the base ring. The pinion shaft is vertically mounted. The pinion gear mating with the training gear is the point of contact that causes the carriage to rotate.

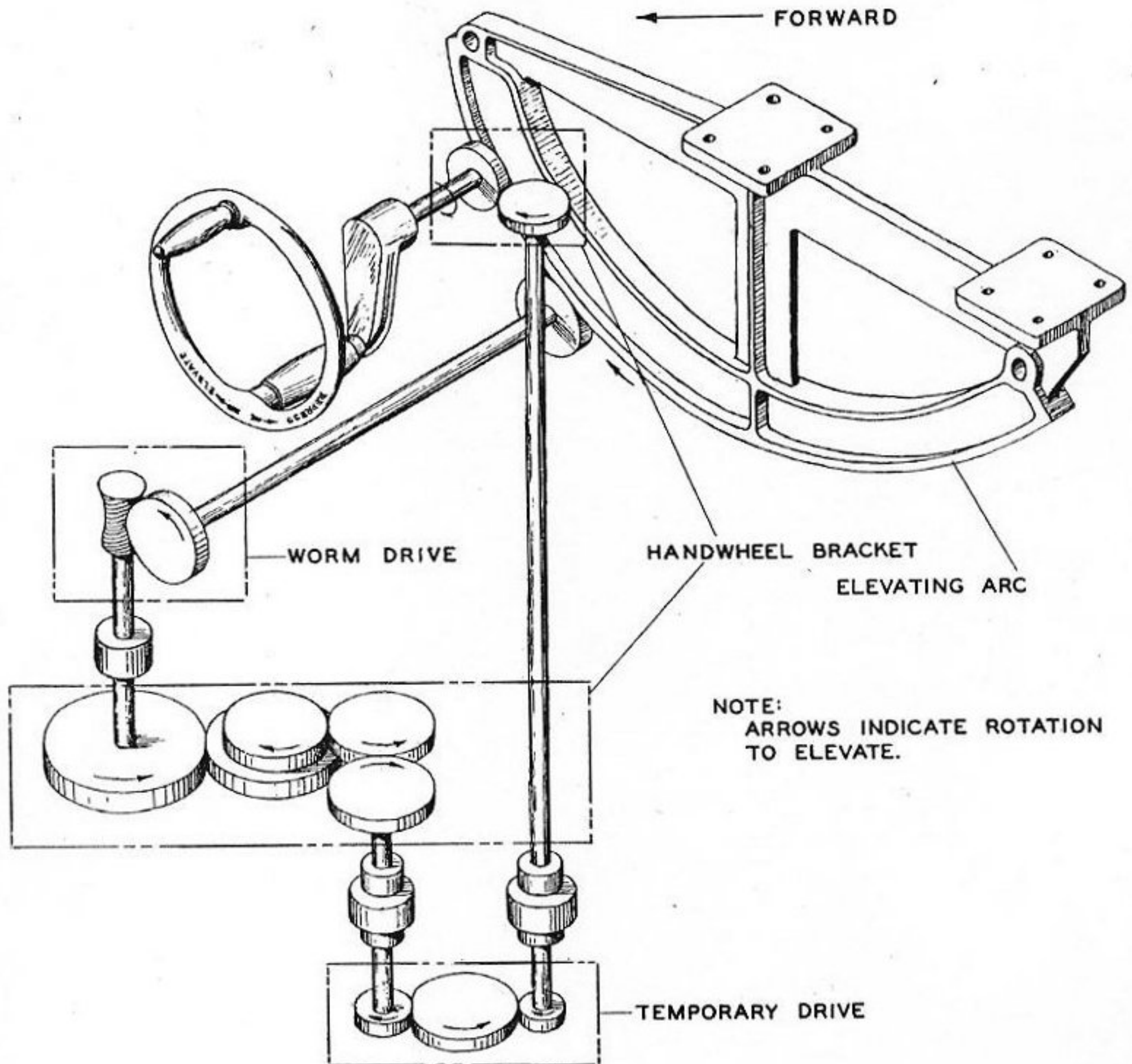
The training centering device is an arrangement for locking the rotating carriage to the stand when not in operation. The carriage is prevented from moving by the centering pin which is mounted vertically in the buffer bracket. The buffer bracket is bolted to the base ring on the center line of the mount at rear. The centering pin is a round steel pin with an eye at one end for connecting to a crank. The other end is swaged into a yoke shape that straddles the stationary block mounted on the training circle. It is moved in a vertical direction by a small bell crank, a spring cushioned connecting rod, and a hand lever. The hand lever moves in a bracket located on the platform. The hand lever is held in the In (locked) or Out (training) position by a spring plunger which engages a drilled hole on the bracket. The connecting rod is in two pieces connected together inside of a short cylinder with a spring in

compression between them. This spring arrangement keeps the centering pin in tight contact with the stationary block, thus preventing any swaying motion of the carriage when locked.

The training stop consists of the stationary block mounted on the training circle, a traveling block which moves in a path on the training circle and a shaft arrangement on the base ring. The shaft and rocker arm is a steel forging splined to fit a forged steel buffer arm. Two phosphor bronze bushings pressed into the carriage and a split collar clamp retain the rocker arm and provide a bearing for the shaft. The rocker arm is in contact with the buffer pistons and the buffer arm with the traveling block at certain times. For the operation of the training stop buffer, see page 19.

The training buffer is housed in a phosphor bronze casting, cored and machined for two recoil cylinders and a reservoir for the operating fluid. Its outer flanges are reinforced and drilled for attaching to the surface (rear) of the base ring. The bottom is machined to fit the periphery of the base ring and so shaped to act as a guide for the traveling block. A section of the training circle cover is bolted to an outside flange. In each of the cylinders is located a pin for centering the piston spring, a piston, and an oil seal cover that also acts as a piston guide. The inside cylinder walls have three graduated oil escape grooves cut in its inside surface. For operation, see page 19.

40 MM TWIN MOUNT-MARK I
DESCRIPTION AND OPERATION
ELEVATING GEAR SCHEMATIC



ELEVATING GEAR

All gears and shaft couplings are keyed with six splines. All shafts run in roller bearings.

The handwheel bracket, operating the elevating gear, is the same for both the temporary and the power drive and is located on the left hand side of the carriage. It is made up of several small pieces bolted to the main casting. The handwheel is made up with two hand grips fastened at 180 degrees on a rim wheel to form a crank. The crank is connected to a horizontal shaft with a set of 90 degree, left hand helical gears. The shaft and the gears are housed in the top piece of the main bracket. The main bracket is flanged and forms the upper housing of four horizontal stub shafts and gears. The lower bracket is fastened to the main and houses the four roller bearings for these shafts.

The temporary drive gear housing is made up of two flanged castings. It is machined for roller bearings for a set of three reduction gears and shafts. The housing is supported on a steel weldment bolted to the lower side surface of the carriage.

The worm drive consists of two cylindrical brackets with an opening in the sides to provide for contact of the worm and worm wheel. The one bracket houses the worm and shaft and is attached to the pinion bracket which houses the worm wheel, a shaft and pinion.

The training centering device consists of a round pin drilled out to accommodate a spring and plunger and machined to engage the control rod. The control rod extends from the hand lever bracket mounted on the left side of the carriage. The hand lever has an extended crank to which the control rod is pinned to force the centering pin into the locked position and out to the released position. The centering pin enters a tapered hole in the elevating arc to prevent gun from moving when not in use.

The platform is a fabricated steel weldment: the two main supports are flat steel with a stiffening flange welded along its top side. These main supports are bolted to the right and left side of the carriage near its base and extend to the rear of the mount. The under frame consists of two side pieces toward the front of the platform, with corner gussets to the main supports and a middle cross support running from the right to left sides. A rear center piece acts as a brace between the two main supports with a vertical plate from this point on both sides to the outside edge of the front side pieces. Heavier steel sheets welded to the underside of frame in rear are used for holding the water pump and motor. A formed pipe on either side acts as a stiffening brace between base ring and platform.

The right and left sides from the main supports to the outside edge are covered with a single piece of rough floor plate. The middle section between the main supports is not covered, in this opening are located the two cartridge chutes. Several bent brackets are welded to the sides of the main supports to act as holders for various tools.

The right side main support and right side piece are cut out to clear the firing stop flexible shaft.

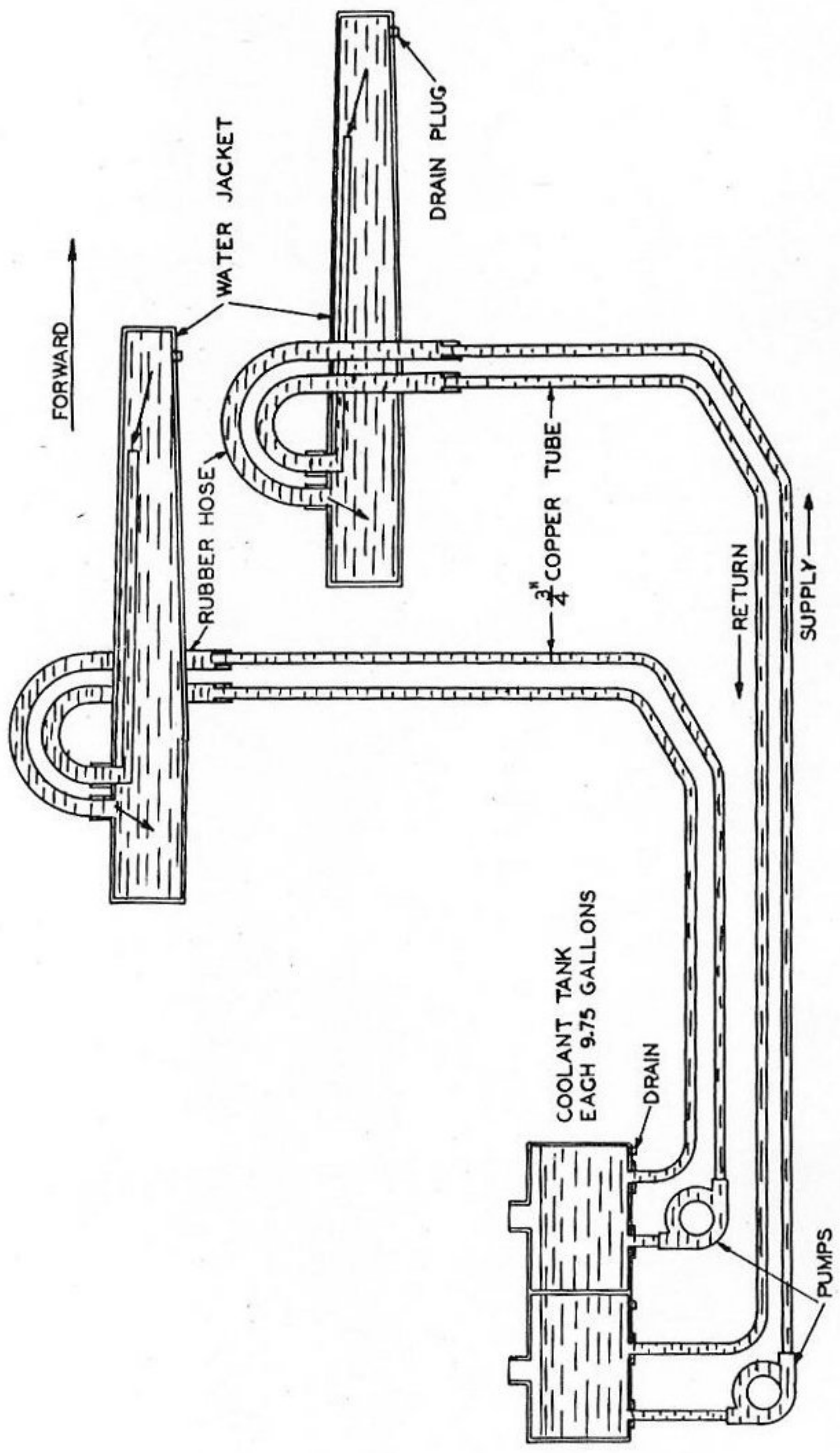
A pipe welded hand railing on both sides and rear provides safety for the loaders when the carriage is being rotated.

The cartridge chutes are "U" shaped steel troughs located on an arc equidistant from the center line of the trunnions and following the line of travel of the cartridge deflector. They are clamped to the platform hand rail, the middle cross piece of the platform frame and the front face of the carriage. From the "U" shaped form, it changes to a flared tube inside the carriage and then to a round tube through the carriage.

OPERATORS SEATS

The operators seats are made up of a steel tube weldment with a flange fitting for attaching to the side of the carriage. With a short piece of pipe from the flange forming the base of a tee, another short piece of pipe extends back to a fitting with a screw handle that regulates the height of the seat. The vertical seat support has a fitting that permits the seat to be adjusted to the front or rear. It is clamped in place with a hand screw for quick regulation. The seats are formed of metal, with a curve wood base. From the tee is welded another short piece of pipe which has a foot pedal bracket pinned to it.

The training operators seat is slightly different than the elevators having a back support for the operator in applying pressure on the firing pedal. The foot bracket also is slightly different. It has one stationary foot pedal and one movable pedal keyed to the firing rod shaft. On its under side is a return spring for returning the pedal to its normal position.



40 MM TWIN MOUNT - MARK I
 DESCRIPTION AND OPERATION
 COOLANT SYSTEM
 DIAGRAM

COOLING SYSTEM

The cooling system is a forced circulating system providing a cooling liquid around the gun barrel in order to reduce the high barrel temperature caused by constant firing.

A liquid supply of 9.75 gallons is held in a sheet steel tank located at the rear of the platform. Directly underneath the tanks are located the horizontal electric driven pumps. The pump and motors are under-hung from the rear end of the platform with the electric control switches mounted conveniently to the training operator. The supply tank is provided with two pipe connections in its base; one going to the pump inlet, the other is the return from the gun barrel water jacket.

From the pump, the liquid is carried in a 3/4" copper supply pipe along the main girder and the corner of the carriage to a point adjacent to the trunnions. The return pipe parallels the supply pipe and both are held securely in place by clamps at regular intervals. At a point near the trunnions, hose connections are provided for a flexible connection between the carriage and the moving gun mechanism. The supply hose is connected to the rear opening (breech end), from this point it circulates around the barrel and toward the muzzle end where the return inlet is connected through a flat tubing to the return hose connection. The water jacket holds approximately 3.70 gallons of water. The capacity of the cooling system, including jacket, pipes and tanks is approximately 13.75 gallons.

When necessary to remove the barrel, the water connection on top of the jacket can be quickly disconnected. Care must be taken to drain the liquid in the hose and the jacket into a receptacle, to be replaced in the liquid supply at the tank when the barrel is replaced. This must be done with the pump running in order to refill the jacket. Each gun has its own complete cooling system, motor and control switch.

FIRE CONTROL MECHANISM DESCRIPTION

The firing control mechanism consists of a number of shafts, levers, and gearing so arranged that through pressing of the right foot pedal on the elevating operators side, the firing plunger is operated. Through this shafting, the firing plunger can be operated either for manual or power firing. The firing operation can also be automatically interrupted when any part of the ship structure falls in the line of fire. This is accomplished by imparting the exact motion and location of the carriage from the training gear and elevating arc to a special cut cam plate. Through flexible shafting and gear reduction, this cam plate moves at the same speed as the carriage and imparts a motion to a plunger and shaft that interrupts the firing. After the danger of firing through the ship's structure has passed, the cutout mechanism actuated by springs returns the

fire control shafting to normal firing. The foot pedal must be released in both manual and power firing position in order to resume firing.

Automatic remote firing is accomplished through energizing the firing solenoid. The firing cutout mechanism functions on automatic firing similar to manual firing.

FIRING CONTROL MECHANISM CONSTRUCTION

The firing cam and cam gear are housed in an oval shaped malleable iron casting made up of a lower bracket and a cam cover. The bracket is mounted on the front face of the carriage with four machine bolts.

The cam is furnished as a blank assembled to the cam gear and is cutout to correspond with the free firing of the gun in all positions, the raised section of the cam corresponds to the ship's structure coming in the line of the gun bore sight at all directions of train and elevation. This procedure is carried out when mounts are located aboard ship. When cam has been cut and replaced in the housing, a check is made with sights and test lamp which is attached to a threaded receptacle provided on cover of cam housing. When test lamp is lit, gun is in firing line of superstructure.

The cam and cam gear are locked on a stub shaft moving in roller bearings in the lower bracket. Two other shafts are mounted in this housing. The one shaft extends through the lower bracket with the end slotted to fit a flexible drive shaft. This flexible drive shaft is connected through gearing to the training gear pinion shaft. One bearing is fitted in the bracket and the other in the cover. Keyed to this shaft is a small gear which drives a larger spur gear keyed to a reduction drive shaft. A pinion gear on this shaft drives the cam gear and like the first drive shaft has one bearing in the bracket and one in the cover. Outside bearing retainers also act as covers to totally enclose the mechanism.

The movement of elevation is made radially across the moving cam with a push rod connected to a flat gear rack. The gear rack is mated to a quadrant gear keyed to the trunnion. Inside the cam housing the push pull rod is connected to the cam pin guide which is threaded for adjustment of length of rod. A jam nut is provided between rod and cam guide. The cam pin guide is maintained in a fixed position at right angles to the cam by a machined sliding tongue and groove fit between cam pin guide and cover.

The cam pin with steel balls swaged in each end rides in the guide with the lower end bearing on the cam surface. The opposite end of the cam pin bears against a flat sided yoke, keyed to the cutout shaft. When the cam pin is in the cutout

section of the cam, the gun is in the clear firing position. When the gun bore falls in line with the ship's structure, the raised section of the cam forces pin upward. This upward pressure on the cutout shaft yoke causes it to turn, the moving of the shaft causes the cutout mechanism to function, and electrical test switch to open its contacts. The cutout shaft enters the cover parallel to the push and pull rod. It is supported in plain sleeve bearings and is pinned with the cutout yoke and a lever to operate the electrical switch. The cutout yoke is held firmly against the cam pin by spring tension and seats in the cover.

The electrical switch is a single contact type with two copper spring contacts for connection to a test lamp. The contacts are direct connected to a lever arm pinned on the cutout shaft.

The firing stop training connection consists of two stub shafts and a set of bevel gears mounted at a 90 degree angle. The shafts are provided with roller bearings mounted in a cylindrical shaped steel bracket. The bracket is fastened to the top of the training gear bracket with 5 bolts. The vertical shaft is keyed to the training pinion shaft while the horizontal shaft is slotted to drive a 7/16" flexible shaft. This flexible shaft drives the firing stop cam gear and is approximately 4 ft. long.

The firing stop elevating connection consists of a quadrant gear and shaft, a flat gear rack and a bracket holding the gear rack and covering the quadrant gear. The quadrant gear and shaft is made in one piece and is keyed to the left side trunnion. The shaft is reamed for free movement of the firing plunger. The gear rack and rod is one piece of phosphor bronze with a keyway cut in its lower side for a sliding fit in the keyed portion of the bracket. The rod is direct connected to a push and pull rod which imparts the motion to the cam pin in the firing stop cam housing.

The firing solenoid is electrically operated by remote control. The solenoid is bolted to a bracket on the front face of the carriage adjacent to the firing motor. Through a set of crank levers and connecting rod it moves the firing clutch into position that through this unit (the firing clutch) the gun will fire.

The firing clutch and gear reduction unit consists of a self-contained worm drive gear reduction with the worm wheel mounted in line with the same shaft as the manual operated clutch arrangement. The shaft is mounted horizontally with roller bearings sustaining the radial load. The worm wheel locked on its shaft with the two roller bearings and spacers for adjustment with the worm. The one end of the worm wheel shaft is machined out to accommodate a small roller bearing (for mounting the clutch shaft) with its end face cut with teeth to act as the constantly

running end of the clutch. The sliding clutch forms the opposite contact side of the clutch, is thrown out of engagement by a partly raised stationary cam surface inside the housing. This sliding clutch moves on the shaft and rotates it through its splined fit. Two other parts, the latch and the latch sleeve, are mounted loose on the shaft, their mating faces have raised lugs for operating engagement. The latch section is also grooved to fit the fingers of the clutch lever yoke. The yoke is keyed to the operating shaft which is held in the housing above the latch. The operating shaft is held in the housing at one end with a pinned collar and the opposite end keyed to an outside crank lever. The worm and shaft is connected through a flexible coupling direct to a constant speed firing motor.

The firing stop cam housing, the cutout mechanism, firing solenoid, clutch and gear reduction unit are connected through shafting and levers to the foot lever firing pedal and the firing plunger at the trunnions. See operation of firing mechanism, Page 22 and 23. See schematic diagrams.

Chapter II

TWIN MOUNT, MARK 1

OPERATION

Temporary Manual Drives

All electrical cables to mount are controlled from the fire control station.

The hand levers from both the elevating and training gears are located conveniently in relation to the seats. Both seats are adjustable, horizontal and vertical, with the aid of hand set screws and can be set for individual operators in relation to hand levers, sights and foot pedals.

Preparation of Mount to Fire

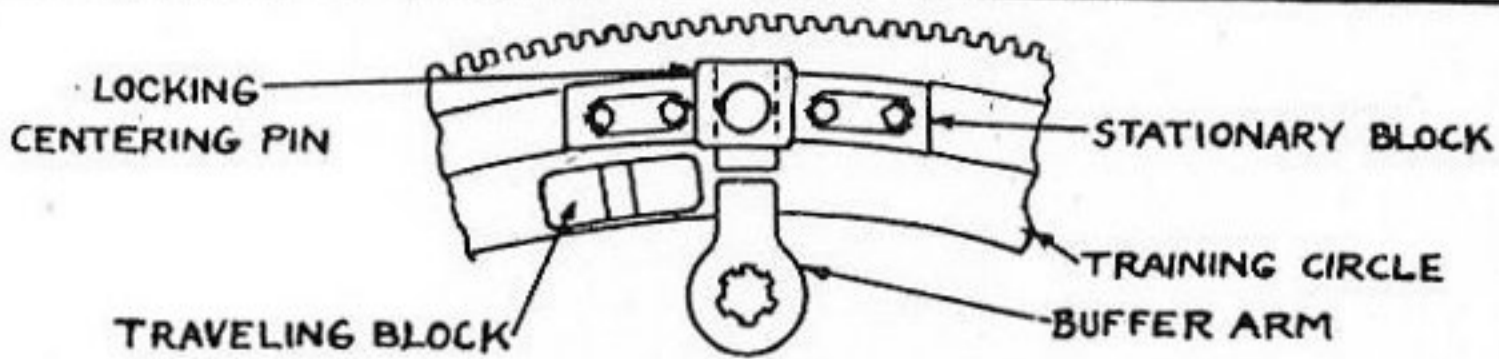
The training operator releases the training center handle located in rear center of platform making certain that the handle locking pin is secured in the released position. The control switches for water pump motors are set to run position making certain that pump is running. Apply pressure with both hands to handwheel brackets and mount will rotate in direction, right or left, as indicated by arrows on handwheel.

The elevating operator releases the elevating centering pin by operating the hand lever located on the left top side of carriage checking that handle plunger is locked in the OUT position. The emergency switch to firing motor must be thrown on RUN position. (This switch is located conveniently to the elevating operators seat.) Apply pressure with both hands to handwheel bracket and rotate wheel in direction required to elevate or depress gun mechanism. Before loader has prepared gun to fire as per Pamphlet Description and Operation of Gun Mechanism, Mark 1 and Mark 2, elevation operator should check foot lever operation, noting that plunger operates. Gun should be well elevated when making this check.

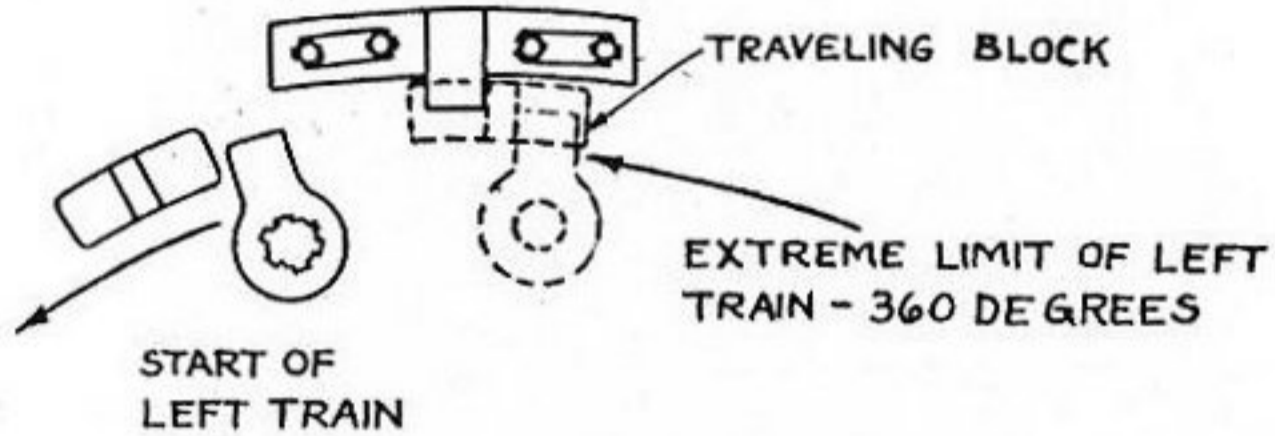
Manual firing is controlled by the elevating operator in depressing the right foot pedal a short distance and power firing is actuated. In the event power motor is shut off, manual firing is accomplished by depressing foot pedal to the extreme limit. If, either during power or manual firing, the gun is pointed in the line of the ship's structure, the firing stop mechanism will interrupt firing. When this occurs, the foot pedal must be released and again depressed to fire when ship structure is cleared of line of fire.

The maximum elevation from the horizontal position of gun is 90 degrees. The maximum depression is 15 degrees. At both these points rubber pads are provided to reduce the bumping shock.

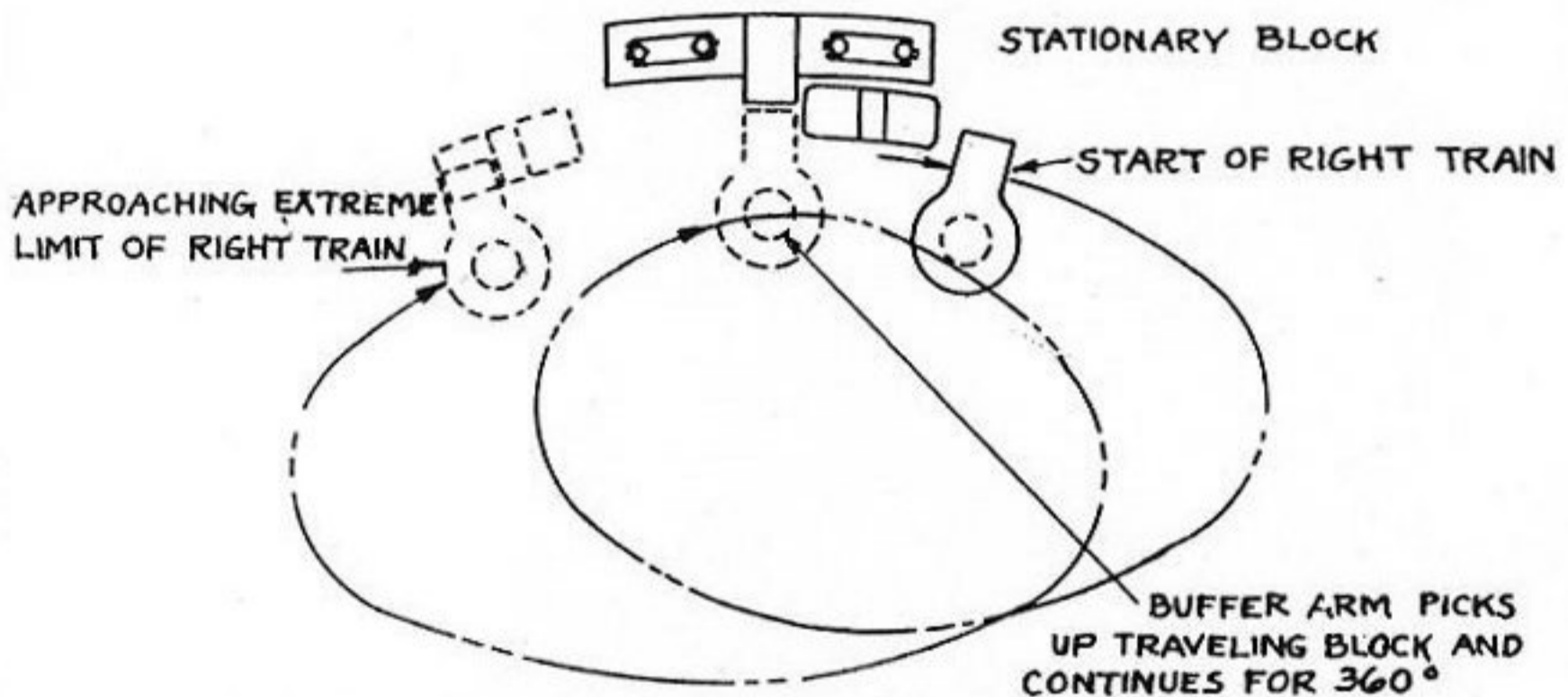
The maximum training possible from the locked location of the mount in either direction is 360 degrees.



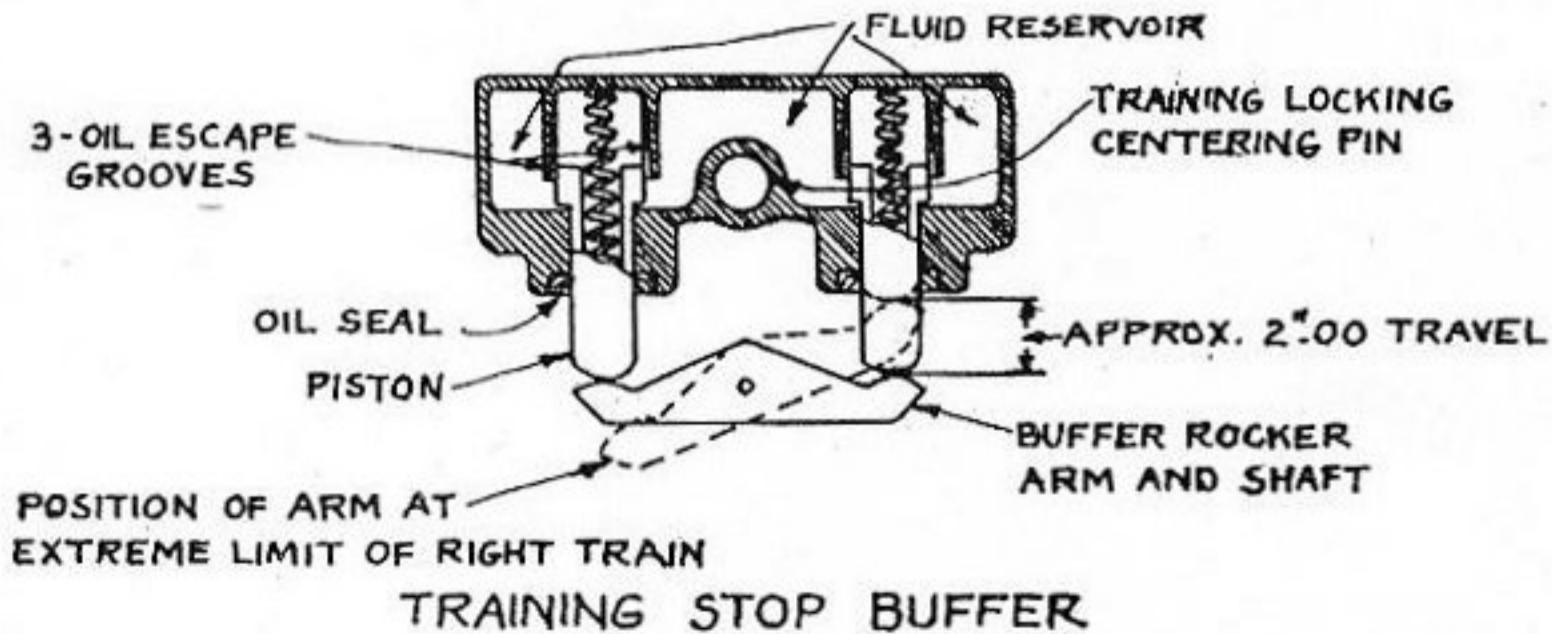
TRAINING STOP ARRANGEMENT
MOUNT IN LOCKED POSITION



MOUNT MOVING IN LEFT TRAIN DIRECTION



MOUNT MOVING IN RIGHT TRAIN DIRECTION



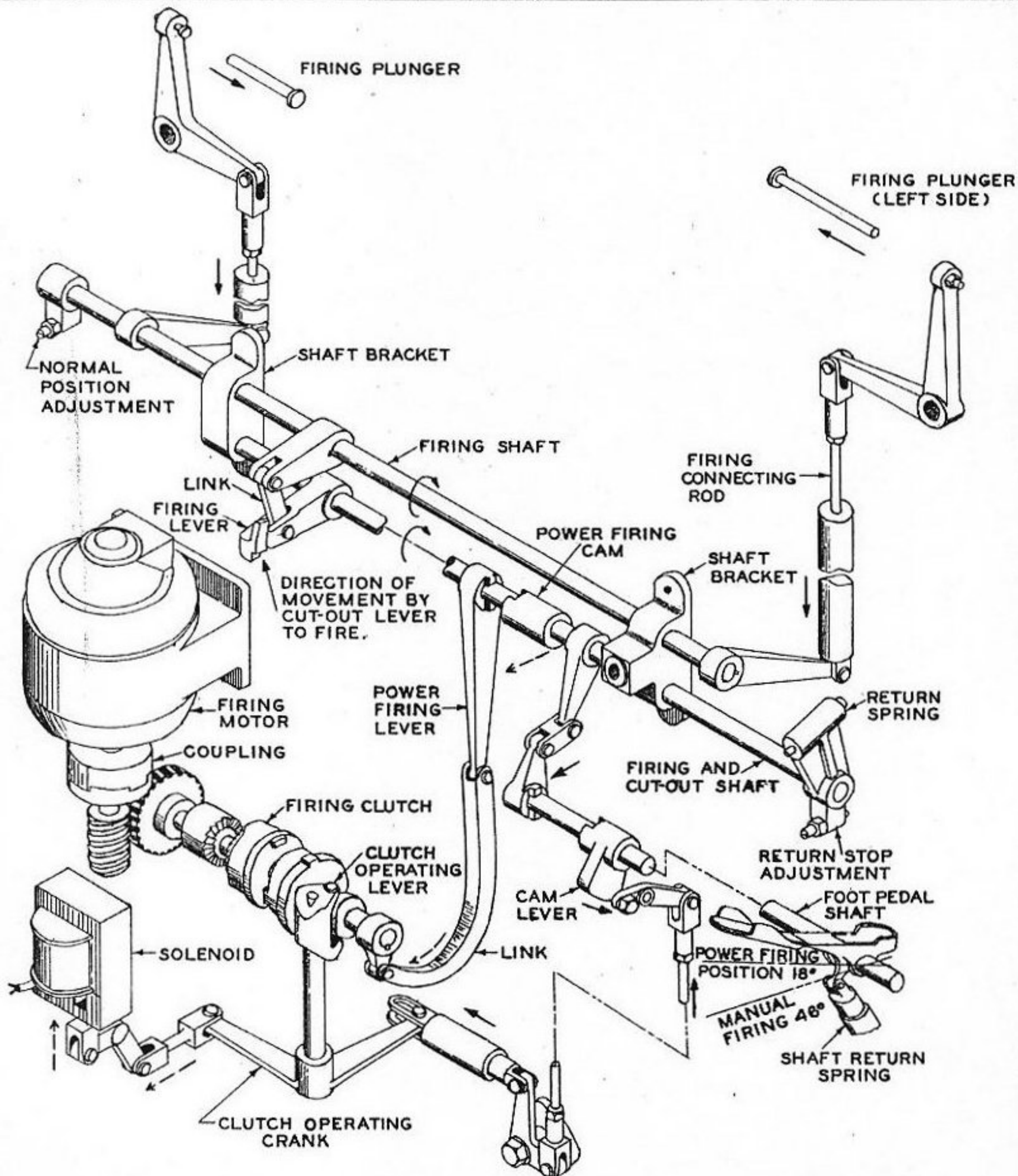
TRAINING STOP BUFFER

The training stop and buffer are designed to prevent mount rotating in excess of 360 degrees from the locked position thus preventing an excessive twist in electrical cables. Fig. 5, Sketch "A", shows the stationary block and the buffer arm in the locked position. The traveling block can be either to the right or the left of the stationary block. From the locked position, mount is rotated toward the left, the buffer arm moves the traveling block in front of it a distance of approximately 360 degrees. At this point, the traveling block strikes the stationary block. The traveling block being interposed between the stationary block and the moving buffer arm forces the buffer arm to turn in its shaft. This shaft forces the rocker arm in contact with the buffer piston, forcing it inward. The buffer piston offers a graduated resistance to the rocker arm through its coil spring and hydraulic pressure of the liquid contained in the buffer. The movement of the piston inward forces the liquid from the piston chamber through three graduated grooves in cylinder walls into its supply reservoir. This buffer action eliminates the possibility of a violent impact with the stationary block. When mount is moved in opposite direction, the piston spring will force the rocker arm back to its normal position.

From the above position, figure 5, Sk. "C", mount is now rotated toward right a complete revolution, passing stationary block where it picks up the traveling block. The traveling block is now pushed ahead for another complete revolution until it again comes in contact with the stationary block, where the buffer action is the same as described in preceding paragraph but on opposite piston.

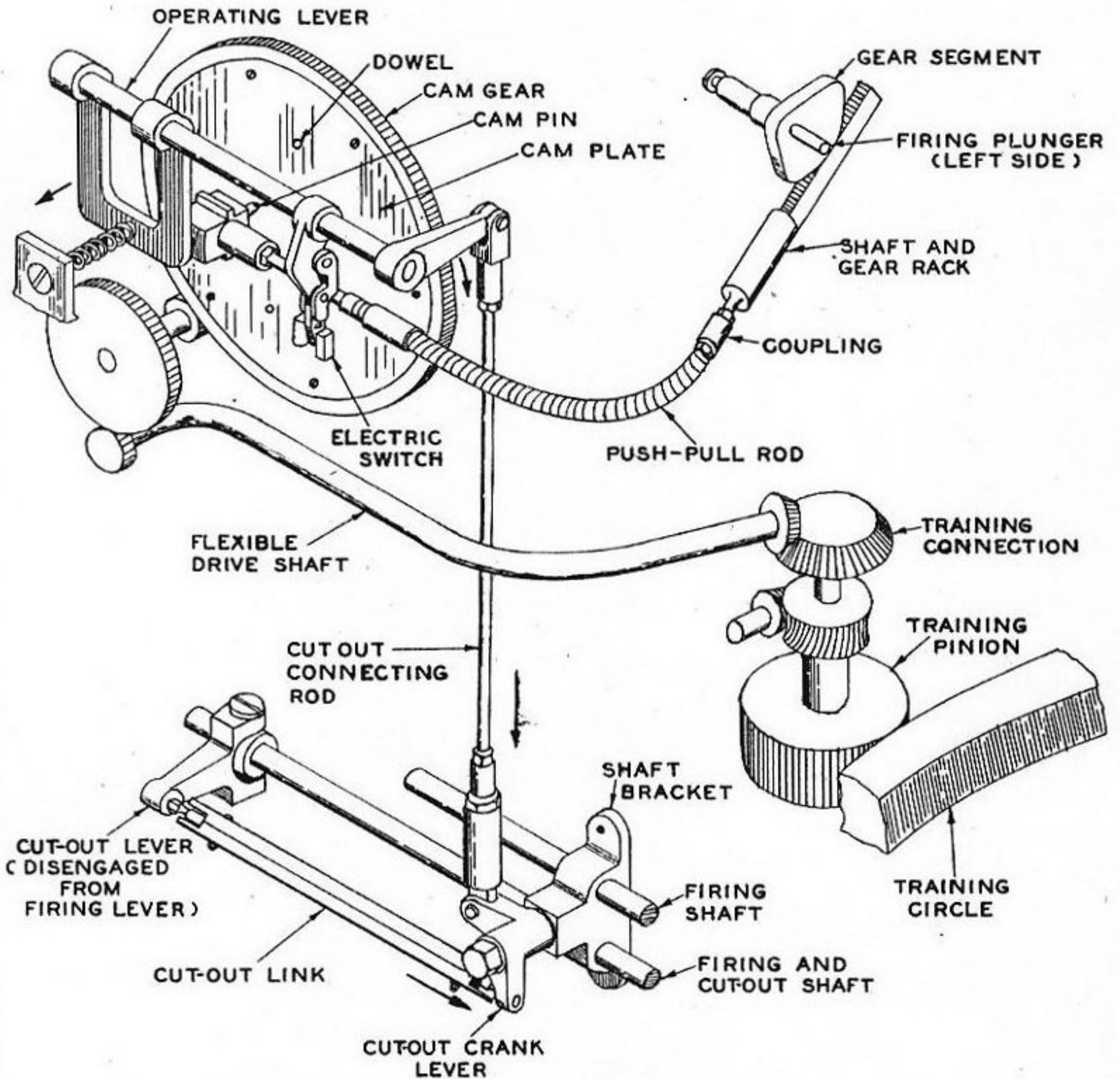
The training gear ratio is 320 to 1, therefore, with a handwheel speed of approximately 60 R.P.M., the mount is rotated 67.2 degrees per minute. One complete revolution of the handwheel is equal to one degree and seven minutes of train.

The elevating gear will move throughout the entire travel of the elevating arc of 115 degrees with approximately 56.6 revolutions of the handwheel bracket. One complete revolution of the handwheel is equal to two degrees of elevation.



← INDICATE MOTION MANUAL FIRING
 ←-- INDICATE MOTION POWER FIRING

40MM TWIN MOUNT-MARK I
 FIRING MECHANISM-SCHEMATIC
 DESCRIPTION AND OPERATION



ARROWS INDICATE MOTION OF LEVERS AND SHAFTS WHEN MECHANISM MOVES TO STOP FIRING POSITION.

40MM TWIN MOUNT-MARK I
 STOP FIRING MECHANISM
 SCHEMATIC
 DESCRIPTION AND OPERATION

Operation of Firing Mechanism

There are three methods of firing through the fire control mechanism:-

1. Depressing the right foot pedal on the elevator's side to the full movement of pedal, approximately 36 degrees.
2. Depressing the right foot pedal a short distance with the firing motor running connects the firing clutch for automatic firing.
3. Automatic remote control firing through the firing solenoid actuating the firing motor and clutch similar to foot pedal in No. 2.

The firing cutout mechanism controls the stop firing levers when any part of the ship's structure is in line with the gun barrel in all of the above methods of firing. Plate 4 shows the schematic arrangement of the cutout mechanism which operates as follows:-

The bevel cam gear moves in direct relation to carriage, i.e., one complete revolution of the cam corresponds to one revolution of the carriage. The cam gear is driven through a stub shaft keyed into the top of the training gear pinion shaft. Motion is transmitted through this vertical shaft to a set of 90 degree bevel gears to a horizontal stub shaft. The stub shaft has tongue and groove fit with a flexible shaft. This shaft makes several bends (to suit the mount structure) with a direct drive to a small gear, thence through a stub and reduction gear to the cam gear.

The necessary motion to correspond to the gun elevation is obtained from a quadrant gear keyed direct to the trunnion on the left side of the gun body. The quadrant gear drives a flat gear rack direct connected through a push and pull rod to a cam pin guide. A cam pin moves in a sliding fit in the cam pin guide. A single steel ball is swaged in both ends of the cam pin. One end rides in the cutout section of the special machined cam, the other end is in light contact with a flat sided yoke that operates the cutout shaft in the cam housing. Elevation of the gun moves the push pull rod and forces the cam pin radially across the cam and the flat yoke. This movement is in direct ratio to the gun elevation at any given point. Training of the mount, right or left, moves the cam centrifugally around the cam pin. The cutout section of the cam coincides with the clear firing position of the gun bore while the raised section is the stop firing section with the danger of firing through the ship structure. The slope angle from the cutout section to the raised section is 30 degrees. When the cam pin reaches a point two-thirds of the distance up the slope, the pin forces the yoke upward and rotates the cutout shaft in the cam housing a sufficient distance that with its

externally fitted lever, it forces a connecting rod downward to move a crank. This crank is fulcrumed on a bracket holding two other shafts. The crank arms are set at 90 degrees. Downward pressure on the crank pulls a horizontally mounted link with ball stud connections at either end connected to the cutout lever. This movement disengages the cutout lever and renders the firing lever and shaft inoperative.

1. Manual firing operation is performed by depressing the right foot pedal to the extreme limit of approximately 36 degrees. This rotates the foot pedal shaft counter clockwise, moving the cam lever (operating the levers to power firing clutch, see Power Firing) and the lever and link arrangement to firing and cutout shaft. This shaft, turning in a clockwise direction, moves the cutout lever which is machined on one side for engagement with a firing lever, upwards. A spring return arrangement is keyed on one end of this shaft and an arm with a screw and jamb nut on both ends for adjustment of cutout lever position. The cutout lever is keyed on the shaft with a sliding fit permitting it to be disengaged when the ball stud link moves it to the cutout or stop firing position. The firing lever is free on the shaft and must be engaged with the cutout lever in order to move a lever (through a short link connection) keyed to the firing shaft, upward. This upward motion rotates the firing shaft in a clockwise direction, moving two levers keyed to it at 180 degrees from its pressure lever in a downward direction.

These levers extend through a slot in the front face of the carriage and are attached to one end of the firing connecting rods. These rods are arranged with a cylindrical casing holding a spring in compression when rod is forced in the firing direction. Part of the connecting rod, which is in a vertical position, is inside of the carriage and the top part is outside. The top part is attached to a 90 degree crank. The downward movement of the rod causes the crank to force the firing plunger mounted in the trunnions, inward.

When the foot pedal is released, the rods, levers, and shafts are returned to their normal position by spring tension exerted at the firing plunger and return spring located on foot pedal. The spring return arrangement on the end of the firing and cutout shaft will return it to normal position if cutout mechanism has disconnected cutout lever.

2. Power firing, through use of the firing motor, clutch, and gear reduction unit, is done by depressing the firing foot pedal approximately 18 degrees. The cam lever on this shaft moves a bent lever fulcrumed in its approximate center downward. The opposite end of this bent lever is attached to a connecting rod, pulling it upward and moving another crank with arms at 90 degrees. This crank arm forces a push rod to actuate a crank lever at the clutch and gear reduction unit. This crank lever is keyed to a shaft mounted in the clutch unit which moves the

clutch fingers operating the clutch to engagement with the normally running side of the clutch. The normally running clutch is driven through a worm and worm wheel, the worm is directly connected to the motor. When these clutch teeth are engaged, it turns the free running clutch until a raised cam surface forces it away and it engages through raised lugs with stationary lugs. The stationary lugs hold the clutch which is splined to the operating shaft, but which is free to slide. The sliding clutch has moved the operating shaft causing the short lever, externally mounted and keyed to this shaft to move in a clockwise direction a short distance. The short lever, through a curved link attached to a long lever on the firing and cutout shaft, moves this shaft in the firing direction. The long lever is loose to rotate on the shaft a short distance until engagement is made with raised lugs on its side and cutout grooves of a collar which is keyed and pinned to the firing and cutout shaft. This lever does not move during manual firing.

3. Automatic Remote control firing is actuated through an electric solenoid whose plunger pulls a crank arm and a connecting link attached to the large crank arm mounted on the clutch and gear reduction unit. This movement of the large crank operates the power firing clutch and gear reduction unit as in power firing. Several levers and shafts of the firing mechanism and all stop firing levers operate as in manual and power firing.

GENERAL INSPECTION AND MAINTENANCE

Personnel responsible for inspection and maintenance of anti-aircraft mounts must be given every facility to acquaint themselves with the instructions in the pamphlet. The possibility of damage to equipment or personal injury when carrying out the operations under service or at inspection and lubrication periods will be eliminated.

Perform lubrication as required in Lubrication Pamphlets and Chart.

When making inspection and repairs of elevating and training gears, the handwheels will be tagged with a warning note to prevent moving of this equipment. Safety tags should also be placed on electrical remote control switches during this period. When work is completed, tags must be removed by person who placed same on equipment.

All gears should be tested at least once a week to insure that they are in good working condition. All gears should be overhauled where backlash is excessive, worn parts being removed as required: bearings, spacers, and bushings shall be inspected and checked for wear. Excessive backlash or wear must be taken care of by reducing shims or making adjustments where provided.

All nuts should be properly tightened and lock washers applied. All cover plates, inspection covers, and gaskets shall be replaced. Care must be taken that working parts are kept clean and free from dirt and rust.

Cotter pins and taper pins must be properly applied and retained. All lubricators and lubricating holes must be kept clean and oil passages clear.

When cleaning bright and working parts, under no circumstances must coarse grinding materials be used, such as, sand, emery, bath brick, files, etc., which wear the surfaces and cause looseness to fitted parts. Oil, only, should be used.

Dirt and congealed oil must not be allowed to accumulate on gear racks, pawls, or sliding lever engagement points. The teeth of all pinions and wheels should be well coated with lubricants as specified on Lubrication Chart and instruction pamphlets.

Care must be taken in the moving of all hand levers that they are not forced to engagement or additional wrench leverages are used. Spanners and special tools shall only be used where intended.

Oil seals, leather packings, or other joints shall prevent leakage or ingress of dirt to the working parts, if defective, they must be renewed. These parts, when kept in storage should be wrapped and coated with a grease to keep them soft and pliable.

The main mechanism should be overhauled and inspected periodically, particularly training and elevating gears, buffers, and the firing mechanisms.

Cam rollers, clutches, and clutch levers should be examined frequently to see that they are working freely.

Examine training and elevating locking devices and note that they do not permit any movement when in locked position and work freely when operated by their hand levers.

Check training stop and buffer action.

Periodically inspect cables and loop arrangement under mount. Correct clamping if breaks are noticed due to excessive twisting strain on cables. Examine tubes and clamps holding wiring and switches. Check switch contacts and operation. Apply a thin coat of fine grade vaseline to contacts, removing excess of grease and dirt. Inspect loader lamps and connections.

The cooling system should be inspected for leaks and proper height of liquid in supply tank. The electric motor should be lubricated and pump packing examined.

SHIP MOUNTING

Relation of Mount to Location Aboard Ship

Aboard ship it is desirable that mounts are so located that in the locked position the gun bore is pointed in the normal direction of fire. From this locked position and normal direction of fire, 360 degrees of train can be made right or left. If conditions do not permit locking gun in this position, the mount can be rotated to a desirable clearance angle, but then 360 degree angle of train is obtained from this position and not the normal firing direction.

To facilitate locking of the mount upon completion of action or drill, a marker should be made on the deck or stand to correspond to a mark on the training circle cover that is visible to the operator. This will eliminate any danger of damage to locking mechanism.

Profiling of firing stop cam is done aboard ship, according to standards of Bureau of Ships with proper record of data marked on cam. This data should include mount serial number, location aboard ship and name of ship.

Gun bore sights are provided in the tool box and an electrical make and break contact switch is built into the cam housing for testing the cam with a visual lamp test.

Chapter III

TWIN MOUNT - TO ASSEMBLE

1. Place radial roller path in stand.
2. Set radial roller separator in bottom recess of stand.
3. Lay thrust roller separator on stand roller path.
4. Place eighty-four (84) steel rollers in thrust separator.
5. Set base ring assembly in stand arrangement.
6. Assemble tube insulating block and separator insulating block on either end of cylindrical spacer and clamp with 1/2" bolt, using special washers for bearing on insulators. Apply lock washer and nut.
7. Using eight (8) 3/8" bolts, fasten to steel weldment support.
8. Attach angle iron cable weldment to bottom inside flange of base ring with eight (8) 3/8" bolts.
9. Place cable split clamp on top center flange of base ring with six (6) 3/8" bolts.
10. Place sheet steel cover with gasket over top opening above cable rack with sixteen (16) 3/8" bolts.
11. Fit radial roller path (square in section) into recess in bottom of base ring, using six (6) special retainer plates with lock washers to hold it in place.
12. Place six (6) screw lifting jacks in special cutout sections and place lower thrust roller path over same. Retain in place by staking in base ring at several places.
13. Place top roller thrust bearing on top ledge support of base ring.
14. Lay thrust roller separator on top of the path and insert eighty-four (84) rollers in slots.
15. Assemble buffer rocker arm and shaft to base ring. See page 37.
16. Base ring is now assembled for placing in position on stand roller bearing as per assembly 5.

17. Press thrust rollerpath in place on training circle and stake in around edges sufficiently to hold in place.
18. Assemble training circle on top of stand using six (6) shims for proper fit of roller bearings.
19. Bolt training circle in place with fifteen (15) 1" bolts and lock washers. Locate with four (4) dowels.
20. Fasten stationary block on top of training circle using four (4) bolts and special lock washers.
21. Place traveling block in machined race-way of training circle and note that same will move freely throughout its entire path of travel.
22. Bolt assembled training buffer, (See page 36), in place on rear of base ring. Locate with dowels.
23. Bolt assembled training gear pinion bracket and worm drive to vertical machined face of base ring using shims to secure proper meshing of teeth between pinion and training circle.
24. Assemble training circle covers, (five sections) to base ring and bolt together at mating flanges.
25. Bolt carriage on top flange of base ring using special lock washers on bolt and nut.
26. Screw electrical tubes in place on top side and front face of base ring.
27. Bolt the following pre-assembled units to the left side of the carriage; elevating centering bracket, see page 36.
28. Handwheel bracket, see page 34.
29. Temporary drive bracket and gear housing, see page 35. Connect shafts to handwheel bracket shaft extensions.
30. Elevating pinion gear bracket, see page 35.
31. Elevating worm bracket, which has been matched with pinion bracket, is connected with shaft couplings to handwheel bracket and bolted to pinion bracket.
32. Bolt operators seat bracket, see page 11.
33. Bolt the following pre-assembled units to the right side of the carriage. Training gear handwheel bracket, see page 32.
34. Temporary gear box and weldment bracket, see page 33.
35. Connect vertical shaft of temporary gear drive to handwheel bracket with two (2) Universal joints and connecting shaft. Secure joints with taper pins.

36. Check that horizontal shaft in temporary gear drive is in alignment with the worm shaft. Disconnect worm bracket and connect worm shafts to intermediate shaft and gear drive with couplings. Secure with tapered pins.
37. Bolt operator's seat bracket, page 11.

Firing Mechanism:-

38. The following pre-assembled units are mounted on the front face of the carriage.
39. Attach motor adapter bracket.
40. Connect flexible drive shaft (which is run inside of carriage) to cam housing and bolt cam housing to carriage with four bolts. See page 39 for assembly.
41. Secure flexible shaft with bracket inside of the carriage and on its rear sloping face. Shaft cannot be connected to training connection bevel drive until platform is bolted in place.
42. Attach clutch and gear reduction unit bracket and solenoid bracket complete with external levers and cranks, page 38. Connect firing motor with flexible coupling.
43. Attach cam bracket and foot pedal shaft support. Apply foot pedal shaft with key and pin to foot pedal.
44. Attach crank bracket, crank, bolt and pin. Connect horizontal arm with adjustable connecting rod to long end of lever on cam bracket of #43, secure with pin, washer, and cotter pin. Connect vertical arm with spring arranged push rod. Secure with pin, washer and cotter. Connect other end of push rod with crank arm of clutch shaft.
45. Apply cutout mechanism levers and brackets (see page 40) by inserting firing shaft under motor bracket and then placing single bracket on shaft, then right extension lever (through slot in carriage), then adjustment arm and screw. Insert opposite end of firing shaft in left extension lever through carriage slots. Secure with keys and pins. Locate brackets over holes and bolt in place.
46. Connect lever and link on firing and cutout shaft to lever on foot pedal shaft. Connect long lever arm and curved link on firing and cutout shaft to gear reduction shaft lever. Key and pin levers in place.
47. Place two firing connecting rods with spring arrangement inside of carriage, through rear opening near base. Enter through hole in top of carriage and connect lower end with pin and cotter key to extension

arm protruding through slot in front of carriage.

48. Assemble gun mechanism and elevating connection in trunnions, see page 38 and page 31 of Pamphlet for 40MM Guns Mark I and Mark II.
49. Apply firing lever brackets with crank arms (pinned in place) near top of carriage. Crank arms will protrude through slots, to connect to firing connecting rods.
50. Connect push and pull rod from elevating attachment to cam pin guide.
51. Connect rod lever in crank arm of cutout shaft in cam housing to crank on cutout mechanism.
52. Connect firing motor with electrical cables and circuit controllers.

Warning note:- Gun body must be locked in place and not moved until adjustment of push and pull rod has been made. Do not operate foot lever until rod lengths have been adjusted.

53. Attach platform weldment with 10 bolts on each side of carriage. Attach pipe weldment supports from platform to base ring.
54. Attach cartridge chutes by inserting two lower weldment pieces through holes in front face of carriage and bolt in place against carriage. Place two upper chutes in place and bolt flanges to lower piece. Fasten bolts to brackets on platform cross piece and at hand rail.
55. Install complete cooling system by mounting coolant tank, filling piece and cap at rear end underneath chutes. Bolt securely to platform channel flange.
56. Attach two electrically driven water pumps to underside of carriage below coolant tank.
57. Apply two (3/4" special formed) right hand tubes and two left hand tubes with 4 pipe clamps to side of carriage and to main platform girders. Connect bottom supply tubes to pump outlets with 3/4" union and reducers from pumps. Connect rubber hose connection from supply tube to the back connection of the water jacket fitting. The remaining opening is connected through the hose connection to return pipe. Rubber hose connections are also used from return pipe to tank, and tank to pump.

58. Connect motor and electrical circuit controllers with electrical cables and clamp in place.
59. Mount training centering hand lever bracket on platform and connect with compression spring connecting rod to buffer bracket crank lever.
60. Connect flexible shaft through openings in platform to training gear connection.

Shop assembly notes:-

1. During assembly and after final fitting of gears, apply grease as per Lubrication Chart and Pamphlet.
2. Fill cooling system, operate pumps and note that sufficient circulation is provided. Take up leaks and give final leakage test after liquid has remained in system at least 24 hours. Drain and prepare for shipment.
3. Inspect and operate elevation gear throughout its complete travel. Check possible back lash.
4. Inspect and operate training gear throughout its entire range of travel. Check possible back lash. Note sufficient clearance between training circle covers and stand.
5. Apply gun bore sights and give a careful sight test using 2-man double check.
6. After gun mechanism has been proven and mount given final inspection, apply rust resistant compound as required, to machined parts as per Lubrication Pamphlet.
7. Protect finished surface of stand and prepare for shipment.

To Assemble Training Gear

Handwheel Bracket

Assemble helical gear and two roller bearings on vertical shaft. Place in position in handwheel bracket. Press oil seal in flat bearing housing and assemble over shaft, using shims to reduce lateral play. Secure bearing housing with bolts and lock washers.

Assemble horizontal shaft with helical gear and two roller bearings. Place in position in handwheel bracket meshing with mating helical gear. Press oil seal in concave bearing housing and assemble over shaft to bracket using shims for adjustment of lateral play. Secure bearing housing with bolts and lock washers.

Handwheel crank marked right and left has two machine mated handles placed over crank bearing and held with four pins secured by peening over metal of handles. The outside grip is assembled with a sleeve threaded into the wheel, the grip fits over the sleeve and is held in place with a threaded grip bolt, secured by a tapered pin.

Bracket is now ready to be bolted to carriage.

Locate bracket with dowel pins.

See Assembly item #33, page 29.

Temporary Bevel Gear Drive

Assemble vertical shaft with a roller bearing, steel bushing spacer, roller bearing and locate in bevel gear bracket. Apply washer spacer and small bevel gear to inside end of shaft with lockwasher and locknut. Place top cover with oil seal in place over shaft and secure proper fit by using shim. Secure cover with four machine bolts and lockwashers. Small bevel gear can now be located for proper mesh with aid of washer spacer.

Apply large roller bearing for horizontal shaft in bevel gear box. Assemble shaft with a washer spacer, large bevel gear, washer spacer and ball bearing. Press oil seal in housing cover and assemble over shaft using shims to reduce lateral play. Secure cover with four bolts and lockwashers.

See Assembly items 34, 35 and 36, pages 29 and 30.

Training gear worm bracket assembly is identical to the elevating worm bracket assembly, page 41. It is fitted to training gear pinion bracket with shim adjustment and located with dowel pins at assembly. See Assembly item #23, page 29.

Pinion Bracket

Apply radial roller bearing in bottom of bracket housing; secure with snap ring and press oil seal in place.

Press oil seal in recess from top of bracket housing. Lay lower spacer on top side of oil seal and place thrust roller bearing in place securing same with bearing retainer and shim for desired fit.

Insert pinion shaft from bottom of housing bracket as splined end protrudes through thrust roller bearing, apply washer spacer and worm wheel.

Secure worm wheel with lockwasher and lock nut.

Apply firing stop training connection assembly, inserting vertical shaft with woodruff key into pinion shaft.

Training connection (bevel gear bracket) is assembled as follows:-

Place top roller bearing in bevel bracket. Press lower roller bearing on shaft up to collar, slide on spacer bushing and insert shaft from bottom of bracket. Apply washer spacer over shaft then bevel gear with woodruff key, secure with lockwasher and locknut. The horizontal shaft assembly is identical to vertical shaft. Apply end cover with threaded connection over vertical shaft. Apply top inspection cover and gasket.

Pinion bracket and training connection is fitted to base ring using shims for adjustment of proper mating with training circle assembly item #23, page 29.

TO ASSEMBLE ELEVATING GEAR

HANDWHEEL BRACKETS

Assemble handwheel shaft arrangement by placing two roller bearings in cylindrical bracket. Press oil seal in place over bearing. Insert shaft in bearings, apply spacer and helical gear. Secure with lock washer and lock nut. Bolt cylindrical bearing housing and shaft into top bracket.

Assemble mating helical gear on the long drive shaft and place in mesh with gear in top bracket. Apply spacer, two roller bearings, lock washer, and lock nut. Apply shim and end cover with six (6) bolts and lock washers.

Attach top bracket to top piece of bracket housing with bolts and lock washers.

Set four bearings in position in top piece of housing. Place gears, spacers and shafts in proper position in bearings. Press one oil seal in place inside of bottom piece of housing and one oil seal in outside location. Set two bearings in place in bottom piece of housing and bolt to top piece.

Apply space and roller bearing to shaft with coupling connection and secure with lock washer and lock nut.

Set two roller bearings over shafts. Attach all other covers with lock washers and bolts.

Attach handwheel arrangement marked elevate and depress to top horizontal shaft with lock washer and lock nut. This handwheel assembly is identical to training gear handwheel assembly, page 39. Screw in drain plug and grease fittings where needed.

TEMPORARY DRIVE

Press two roller bearings on two stub shafts.

Press two roller bearings and two spacers on stub shaft with gear mounted on shaft with woodruff key. Place these bearings in proper position in bottom piece of housing. Press two oil seals in cover.

Slip top piece of bracket over two shafts until bearings line up in bracket housing. Apply three (3) washer spacers; then retain with cover, securing same with ten (10) bolts and lock nuts. Screw in drain plug and grease fitting.

Bolt to bracket weldment support and mount on carriage, connecting shafts with flexible couplings.

See assembly items Nos. 28, 29, 30, and 31, page 29.

PINION BRACKET

Mount roller bearing and snap ring, press oil seal in place in bottom end.

Place roller bearing in bracket at top end, lock in place with retainer ring and special drilled machine screws, use shims for proper fit of bearing.

Place washer spacer on shoulder of pinion shaft and insert in bracket from bottom. A washer spacer is placed over shaft as it protrudes through top bearing. Worm wheel is held in place and spline fit with shaft is made. Lock washer and lock nut are applied to hold worm wheel on shaft. Covers and gaskets are applied with bolts and lockwashers. See assembly item No. 30, page 29.

WORM BRACKET

Assemble worm shaft with one roller bearing, snap ring loose against worm, press roller bearing on splined end of shaft. Opposite end of shaft, place bearing spacer; then press on thrust bearing and secure with lock washer and lock nut.

Enter shaft in bracket, piloting snap ring and spacer through bracket. Place snap ring in groove on inside and retain roller in place with snap ring on opposite side.

Press oil seal in end cover and apply with gasket to bracket using lock washers and bolts.

Attach bearing retainer using shim to secure lateral adjustment. Fasten retainer with six (6) lock nuts and machine bolts. Attach rectangular inspection cover and gasket.

Secure proper fit between worm and worm wheel using shim for adjustment; locate with dowel pins at assembly.

The pinion bracket and worm bracket now comprise the elevating worm drive. See assembly items nos. 30 and 31, page 29.

TO ASSEMBLE

ELEVATING CENTERING

Assemble special guide with lock washer and standard nut on small bracket. Bolt to centering stop pad of carriage on opposite side of hand lever rack with close clearance to elevating arc.

Hand lever locking bracket is assembled by placing small spring over plunger pin and entering hole in handle part of lever. Place knurled handle over lever and secure to plunger pin by riveting pin through handle. Attach lever to handle with pin and secure with collar using a taper pin. Bolt centering pin bracket on carriage.

Place compression spring and plunger inside of centering pin; then enter control rod from outside face of carriage and engage centering pin. Push into centering bracket. Mount assembled hand lever yoke over rod and bolt bracket to face of carriage.

TO ASSEMBLE THE TRAINING BUFFER:-

1. Insert spring centering pins in base of cylinders and braze pin to casting.
2. Press oil seal cover in piston retainer.
3. Place leather oil seal in groove of piston retainer.
4. Set piston spring in hollow piston and press piston through retainer and oil seal.
5. Carefully enter spring and piston in cylinder and locate retainer holes properly with buffer bracket.
6. Hold retainer in place with 6 - 3/8" bolts and lockwashers.
7. Screw in 1/2" pipe plug and 2 - 3/4" pipe plugs.

TO ASSEMBLE THE TRAINING CENTERING PIN:-

8. Secure left and right hand brackets that hold

crank lever pin, on top of buffer bracket.

9. Assemble pin through right and left brackets and crank lever checking that elongated hole in the crank lever is in the lower inside (toward buffer pistons) position.
10. Place collars over end of pin and secure with #4 taper pins.
11. Enter training centering pin from bottom of buffer bracket, checking that bottom cut off side of centering pin faces toward the striking head of buffer piston, and assemble with crank lever through elongated hole, using pin and cotter pin.

To Assemble Buffer Rocker Arm and Shaft to Base Ring:-

1. Press small bronze bushing, and large bronze bushing, into base ring at rear.
2. Place buffer arm in slotted opening of base ring between the two bronze bushings.
3. Enter rocker arm and shaft with striking surface facing away from center of base ring from top of base ring through bushings and buffer arm, checking that buffer arm is in center of rocker arm.
4. Place split clamps over collar of rocker arm and bolt to base ring.

Buffer bracket can now be assembled to base ring, pressing both pistons in until held by rocker arm. Bolt to base ring with 8 bolts on top flange and 4 bolts inside. If connecting rod to centering pin is not connected to lever crank at this point, wire same down so as to hold centering pin up in unlocked position. Attach section of training circle cover.

Assemble Training Centering Hand Lever Locking Bracket on Platform as Follows:-

Place small spring over plunger pin and enter in hole of handle part of lever. Place knurled handle over lever and secure to plunger pin by riveting pin through handle. Attach lever to handle with pin and secure with collar, using a taper pin.

Assemble Connecting Rod:-

1. Slide round casing over connecting rod until engaged by end of guide.
2. Insert spring and screw large threaded yoke into casing.

3. Secure with split pin to casing.
4. Screw small adjustable yoke and 5/8" jam nut on opposite end and connect to centering handle and crank lever on top of buffer bracket.

TO ASSEMBLE CLUTCH AND GEAR REDUCTION UNIT

Press roller bearings on worm shaft and place in bearing housing of bracket. Assemble bearing covers with shims and adjust for lateral motion. One cover has an oil seal pressed in place.

Press stationary cam into clutch side of bracket and secure with machine screws and lock washers. Assemble large roller bearing, spacer, worm wheel, spacer and small roller bearing on clutch and shaft, locking with lock washer and lock nut.

Place in bracket with bearing retainer cover using shims and spacers for adjustment of proper meshing with worm. Secure cover with six (6) bolts and lock washers.

Place the sliding clutch on the splined end of the main shaft, insert compression spring over shaft into counter bored section of clutch, apply collar and press small roller bearing on end of shaft. Opposite end of shaft is assembled with a small collar, a compression spring and a latch. The latch sleeve is slipped over the sliding clutch and attached to latch with a screw thread, locking with a set screw.

A large roller bearing is pressed on shaft up to the shoulder. The operating yoke, with contact buttons, held in place by taper pins, is now placed in its normal position in contact with the latch. The shaft assembly is placed in bracket with the small bearing mounted in cut out section of clutch.

The latch projection slides in keyway of bracket and operating yoke must be held in position with key in place to receive the operating shaft. The one end of the operating shaft is held in place with a collar and taper pin. This end is enclosed by a cover and gasket.

The opposite end of the operating shaft passes through an oil seal pressed in the bracket and has a right-angled crank, keyed and pinned on the shaft.

The end cover is now applied over the main shaft, securing lateral clearance by use of a shim. The end cover has an oil seal pressed in its outside face. A collar spacer is assembled on shaft in contact with the oil seal.

A short crank arm is keyed to the shaft and secured on it with a lock washer and lock nut.

Oil cups and grease fittings are now applied.

Assembled unit is mounted on an intermediate bracket. The top side of the clutch bracket is machined for attaching a solenoid and solenoid bracket.

TO ASSEMBLE FIRING STOP CAM HOUSING

Assemble shaft holding cam gear with a roller bearing, spacer bushing and roller bearing. Place in center bearing housing of bracket lower piece. Apply bearing retainer and shim to secure proper fit. Fasten retainer with bolts and lockwashers.

Fasten cam with flat head machine screws and dowel pin to cam gear and attach to shaft on inside of bracket with a woodruff key. Retain on shaft with a large washer, lockwasher and locknut.

Assemble large and small spur gears on intermediate shaft with woodruff keys. Press roller bearing on shaft to shoulder against the small gear. Place the washer spacer next to the large spur gear and apply top roller bearing. Place roller bearing in the bracket with spur gear in mesh with the cam gear.

Assemble shaft connecting to flexible shaft with the larger roller bearing at the shoulder, sleeve spacer, spur gear with woodruff key, small roller bearing, lockwasher, and locknut. Attach bearing retainer with screw thread for flexible shaft and place roller bearing in bracket housing. Lower piece is now ready to receive the upper piece of the bracket.

The upper piece has a switch arrangement which is assembled by fastening a bridge plate insulator to a bridge lever with two (2) machine screws and nuts. The contact bridge is made up of an inner and outer piece of phosphor bronze spring sheeting formed around the bridge insulating plate; it is held by a rivet, and machine screw and nut in the bridge. The bridge lever is connected with the break lever by a pin secured with a cotter pin. The fulcrum point of the bridge lever is held by a special machined pivot pin securing the lever to the upper piece. The break lever is then ready for engagement with the operating cutout shaft. The shaft bracket is attached to top side of upper piece with two (2) machine bolts and locknuts. The cutout shaft is now placed in position, engaging the break lever, then through the operating yoke lever. Both levers are secured to the shaft with taper pins.

The operating yoke is now assembled with its compression spring, a centering spring seat in the yoke and a threaded spring retainer in the upper piece of bracket. The cam pin guide is placed in the keyed slide grooves of the upper piece and push-pull rod attached with jamb nut. Two (2) machine bolts secure rod to the upper piece. The cam pin is placed in the guide.

The upper piece is now assembled over the lower piece, entering roller bearings in their respective housings and retaining cam pin in place. Flanges are held with eight (8) machine bolts and nuts. Four (4) drilled holes at bosses on lower piece are for mounting to carriage. Covers and gaskets are now applied.

TO ASSEMBLE ELEVATION CUTOUT CONNECTION.

Firing plunger is placed inside of gear segment. Gear segment is keyed to trunnion and retained in place by inside boss of bracket. The connection bracket is assembled with the shaft and rack slid in to position to engage gear rack. The end plug and grease fitting are screwed in to end of the bracket. Bracket is secured with five bolts to the left side of carriage. The shaft is connected to the push-pull rod with coupling and jamb nuts.

TO ASSEMBLE FIRING STOP MECHANISM (CUTOUT LEVERS AND BRACKETS)

Locate shaft brackets on bench assembly jig. Place firing shaft in bearings of bracket with lever and link keyed to shaft.

Assemble cutout shaft in bracket bearings with lever and link to foot pedal shaft keyed in place. Cam sleeve keyed and pinned in place facing the lever connecting the firing clutch.

Cutout lever is keyed on shaft. The firing lever, which is a loose fit on the shaft, is connected to link and lever on firing shaft. Clutch return assembly is pinned on end of shaft.

Bell crank is mounted on top of bracket with special bell at fulcrum. One end of crank has a ball stud pinned in place. A split link is assembled, connecting the ball stud on crank and ball stud on cutout lever.

Screw lubricators in place.

Assembly can be mounted in front face of carriage. See Page 30, Assembly No. 45.

TO ASSEMBLE ELEVATING AND TRAINING HANDWHEELS

The inside handle of the handwheel is in two parts; they are assembled over the handwheel and held with four straight pins. The handles are peened over to retain the pins in place. The outside grip is one piece with a threaded sleeve inserted in the grip and held in place with a special grip bolt which is pinned to the handle grip. This grip assembly is screwed in to the handwheel and secured with a set screw. The set screw is prevented from becoming loose by peening over metal of handwheel.

Elevating handwheel directional arrows are marked ELEVATE and DEPRESS. Training handwheel directional arrows are marked RIGHT and LEFT.

LIST OF PLATES - TWIN MOUNT MARK 1

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Elevating Gear Schematic	2	9
Firing Mechanism Schematic	3	20
Stop Firing Mechanism Schematic	4	21
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PROCEDURE FOR ADJUSTMENT
OF FIRING MECHANISM

ILLUSTRATIONS

FIG. 1

- STEP 1: Depress guns until they are just touching rubber bumper pads on carriage at 15° depression. Attach rack and housing (F) and (H), to the carriage, meshing rack and sector teeth so that the rack projects $1/8"$ as in Fig. 1. If gun is equipped with raising block to stop gun at 5° depression, rack should project $7/16"$ instead of $1/8"$.
- STEP 2: At this time observe that cam pin guide (D), holding pin (A) in lowest portion of cam plate (C), projects $1/8"$ from under the right side of the operating plate (B) as shown in Fig. 1.
- STEP 3: Connect push pull rod (E) to rack (F) by coupling (G) and adjust so as to follow observation noted in Step 2.

FIG. 2

- STEP 4: Adjust release rod (B) by coupling (A) to give $3/32"$ engagement when they are in the rest position.

FIG. 3

- STEP 5: With the firing pedal (I) in the fully released position, adjust rod (J) until cam follower clears cam at (K) by $1/16"$. (Note: Return spring in switch must be installed on proper side to follow cam).
- STEP 6: With solenoid plunger (P) at its highest point of travel (closed) and clutch lever (R) at its farthest movement away from the carriage (or with firing clutch fully engaged), adjust link (Q) so that clevis pins are free (unloaded).
- STEP 7: With cut-out lever (N) against carriage or clutch lever (O) against its stop, adjust screws (H) and (L) until there is from $1/32"$ to $1/16"$ clearance between the contacting faces of (C) and (D), and (G) and (D) as shown in Fig. 2.
- STEP 8: Adjust screw (F) (both sides of the gun) half-way on the threads.
- STEP 9: Adjust rods (M) (both sides of gun) to bring screws (F) just against the firing plungers (E).

NOTE: Adjustments should be made in the order as given from 1 to 9, leaving each adjustment remain after being set, and proceeding to the next adjustment.

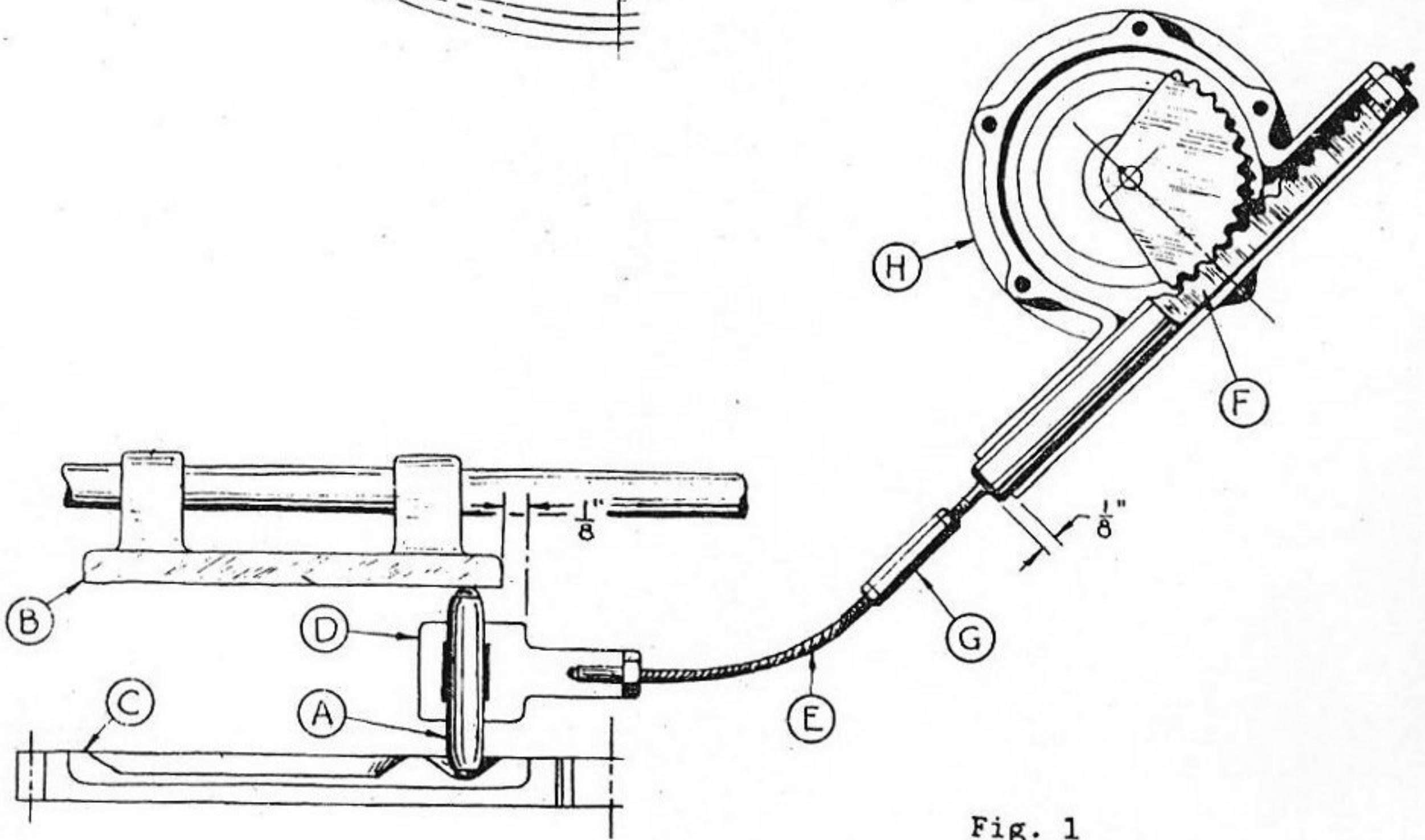
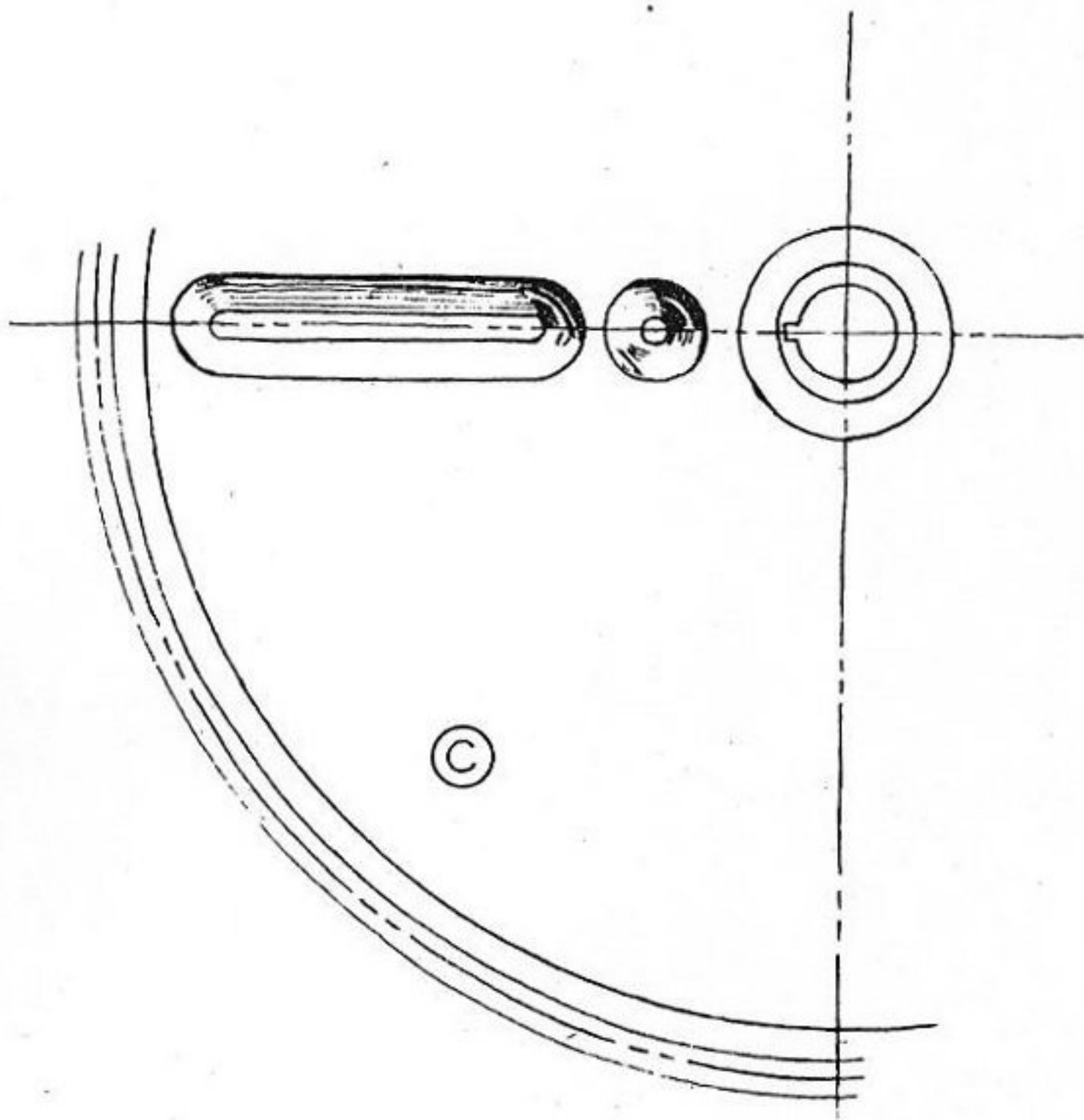


Fig. 1

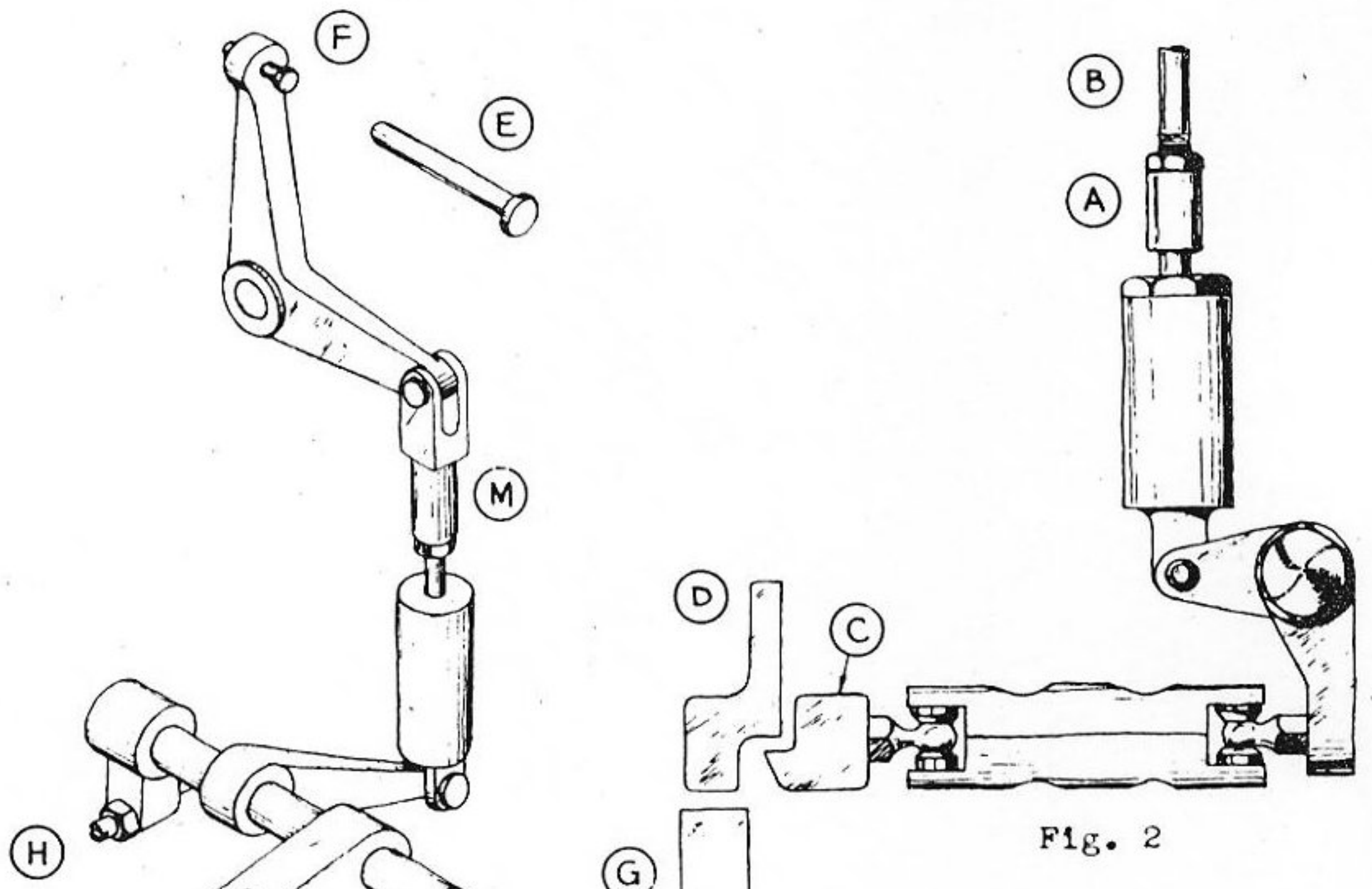


Fig. 2

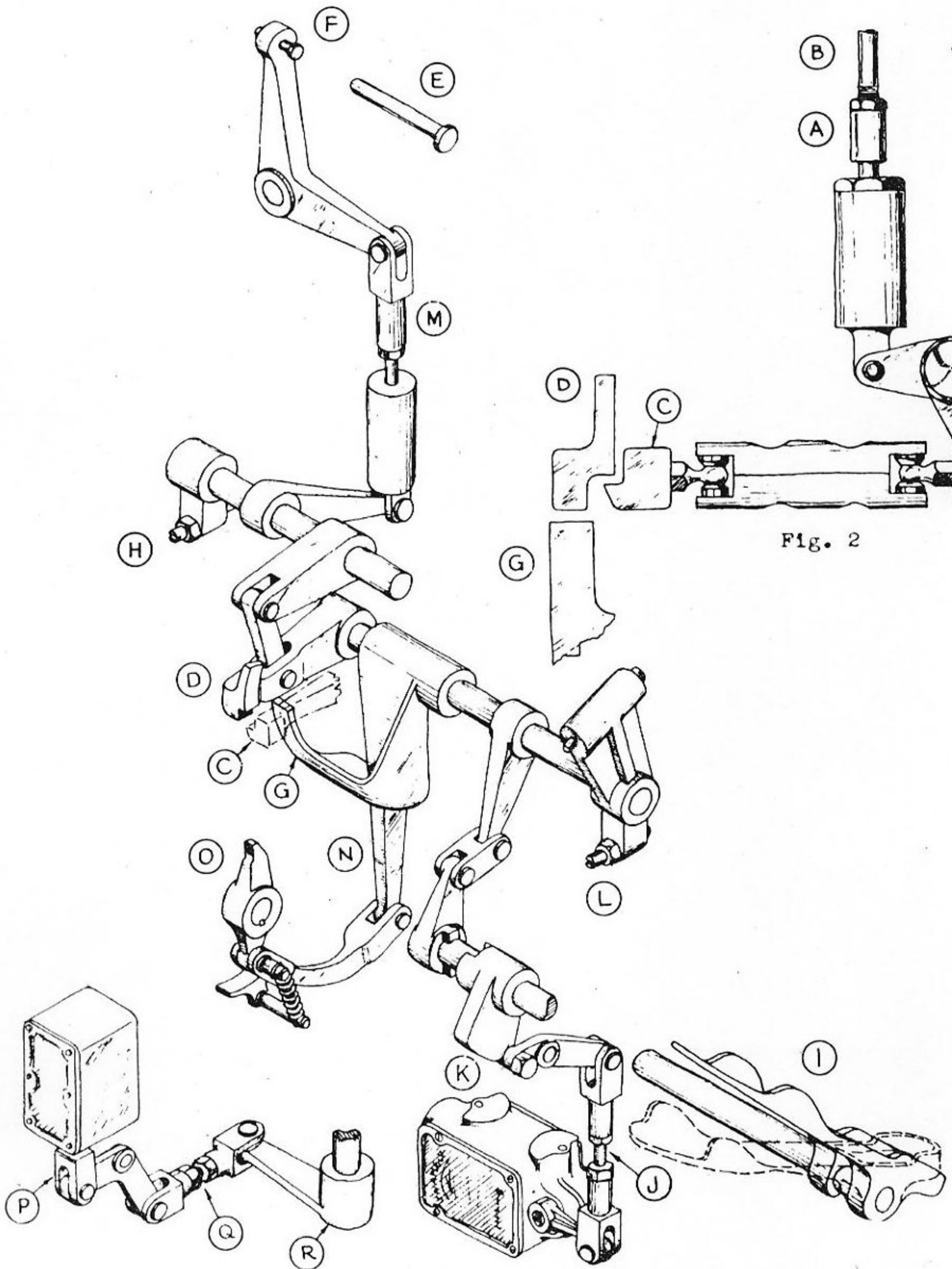


Fig. 3

Revised. August 8, 1942.

INGERSOLL-RAND
 MOTOR-DRIVEN ANTI-AIRCRAFT GUN
 COOLANT PUMPS

OPERATING INSTRUCTIONS AND MAINTENANCE

GENERAL

1. The pumps and motors under discussion in this addenda are found on the 40mm anti-aircraft gun mounts, Marks 1 and 2. The pump is a single impeller, vane type centrifugal pump directly driven by an electric motor. Each pump supplies coolant for one gun and is supplied from a welded reservoir holding 9.75 gallons. Pertinent data are given in the following table.

Table 1

Motor Driven Circulator

Design Data.

Type of pump	Ingersoll-Rand 1 $\frac{1}{4}$ -KRV- $\frac{1}{4}$
Capacity	10 GPM
Total head	20 ft.
Suction head	Flooded
Speed	1725 RPM
Liquid	Water & Ethylene Glycol
Capacity of system	13.75 gallons
Specific gravity of liquid	1.0
Motor	$\frac{1}{4}$ HP Three Phase 60 cycle, 440-volt 1725 RPM

Clearance Data - See Figure

A. Axial clearance0.005 in. Min. 0.010 in. Max.
B. Radial clearance0.0075 in. Max.

Weights

Weight of pump	21 lbs.
Weight of motor	33 lbs.

INSTALLATION

2. The pump is installed on the underside of the loader's platform on the carriage, and beneath the tank which supplies the coolant. Connections are made by means of three-quarter inch copper pipe. Tees, plugged at the middle opening, are placed in the low points of the supply and return lines to provide drainage for the system during replacement or repair.

OPERATION

Preparing the Pump for Operation

3. *Rotation.* - Check the rotation by observing through the relief holes next to the motor flange. Rotation should be counterclockwise looking at suction of pump. Refer to arrow on name plate. If rotation is incorrect, reverse any two motor leads.

4. *Stuffing box.* - The pump is equipped with a mechanical seal to prevent leakage between the rotating shaft and the stationary casing. Sealing is effected by a carbon rotating washer in contact with a stationary bronze face. Refer to figure 1 - parts 13 and 18. Leakage is prevented between the impeller hub and the carbon washer by a diaphragm shaped piece of synthetic rubber (part 14). The spring (part 15) serves to maintain the assembly in proper contact at the respective sealing points.

5. The seal may leak a few drops per minute when the pump is first put in operation, but a few hours operation should result in almost bottle tight operation.

Starting the Unit

6. *Lubrication.* - The bearings were packed with grease before the unit was shipped from the factory and will need no further attention at this time.

7. *Priming.* - These pumps are located beneath the reservoirs which supply them, and are therefore self-priming when the reservoirs are filled. The pump should not be operated without water in the system.

8. After checking that the pump has been primed, close the starter switch. In starting the unit for the first time or after any changes have been made on electrical circuits or connections, check the direction of rotation. As soon as the motor comes up to speed and runs a few minutes, stop the motor and feel the bearings to detect excessive heating or to determine any localized heating in the motor. Then start the motor again (after ascertaining that the pump casing and suction pipe are fully primed) and put the unit in service.

9. *Regulation.* - The capacity of a centrifugal pump may be reduced by throttling on the discharge of the pump. *Never throttle the suction* or run any pump any appreciable length of time with discharge valve closed.

10. *Troubles.* - If any of the following troubles are encountered, they may be due to the causes listed below:

- A. No liquid delivered
 - 1. Pump not primed.
 - 2. Speed too low. Check motor voltage.
 - 3. Impeller plugged up.
 - 4. Wrong direction of rotation.
 - 5. Air leak in suction. (Pump suction under vacuum.)

- B. Not enough water delivered
 - 1. Speed too low.
 - 2. Impeller partially plugged.
 - 3. Total head too high.
 - 4. Pump defects:
 - (a) Excessive clearances
 - (b) Impeller damaged

- C. Not enough pressure
 - 1. Speed too low.
 - 2. Air or gas in water - leaks on suction.
 - 3. Pump defects:
 - (a) Excessive clearances
 - (b) Impeller damaged

- D. Motor runs hot. Check actual temperature with thermometer.
 - 1. Pump taking too much power.
 - (a) Speed too high.
 - (b) Head lower than rating allowing pump to handle too much water.
 - (c) Liquid heavier and more viscous than rating.
 - (d) Pump defects
 - 1. Excess ring clearance.
 - 2. Rotor binding.
 - 3. Excessive seal tension.
 - 2. Electrical defects
 - (a) Voltage and frequency lower than rating.
 - (b) Defects in motor.

Maintenance

11. *Inspection of pump.* - Periodically depending upon service conditions, the pump casing, impeller and seal assembly should be inspected, and if necessary any foreign matter or clogging should be removed. If excessive vibration or heating is experienced, inspect the pump impeller. A clogged impeller may cause both.

12. *Mechanical seals.* - It is to be expected that some wear, dependent on cleanliness of the liquid, will occur at the sealing faces, but many hours of service should be obtained before replacement should be necessary. If replacement is necessary, it is suggested that the entire seal assembly including the stationary seal face and gasket be replaced. To reduce the time the mount is out of service, it would be best to replace the pump as a unit, and change the seals in the shop.

13. In installing the new seal, care should be taken to properly align the driving ears of the carbon washer and rubber diaphragm in the slots in the impeller hub. The synthetic rubber diaphragm, Part 14, can be readily slipped on the impeller hub after applying a light film of oil or grease, but should only be forced on sufficiently far to allow the insertion of the retaining wire. Make sure rubber diaphragm contacts the carbon evenly around the entire edge.

14. *Bearings.* - Refer Motor Section.

CIRCULATOR MOTOR

15. *Connections.* - The motor is designed for 440-volt, three-phase, 60-cycle current and has three external leads. If rotation is the reverse of that indicated on the name plate, interchanging any two of the motor leads will reverse the rotation.

16. *Bearings.* - The bearings are packed with sufficient grease at the manufacturing plant for several months' operation. Additional grease may be added by means of the grease cups, after removing the pipe plugs to allow the bearing to purge itself of the old grease and any excess new grease. Stop adding grease when grease appears at holes of relief fitting. *Never add grease without removing vent plugs.* Frequency of greasing is dependent on hours of operation and ambient temperature. For high ambient temperatures greasing every 2000 hours of service is suggested, and every 4000 hours for normal temperatures.

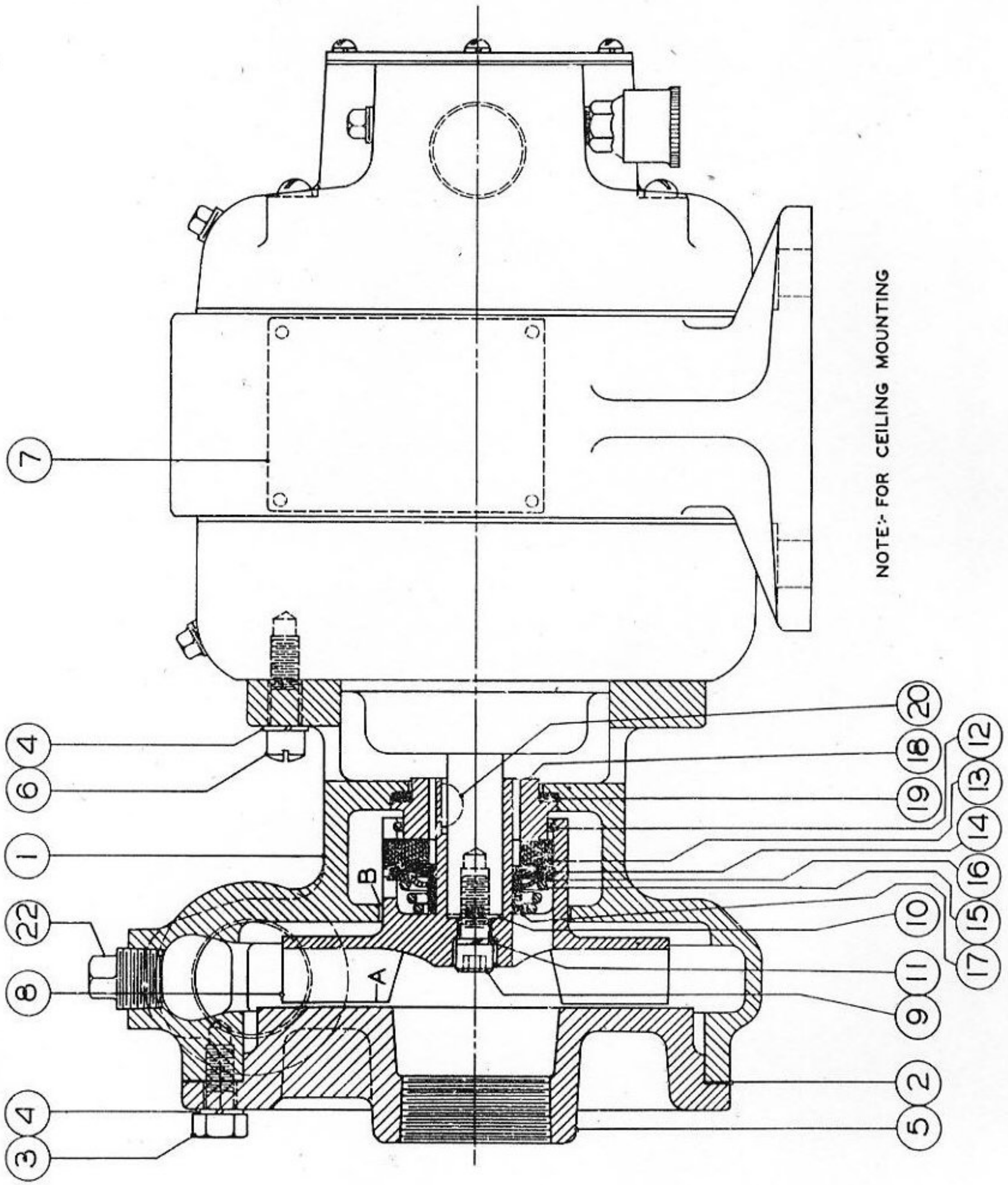
17. Use grease meeting the requirements of Navy Specification 1463 B, Grade B.

18. *Maintenance.* - Keep the motor clean and dry.

19. Indismantling the motor care must be taken to see that rabbet surfaces are not damaged. In reassembling the motor observe particularly that a snug fit is obtained between each shield and the stator at the rabbet joint. Make sure the clamp bolts are drawn up tightly.

20. Keep the bearings covered when the motor is dismantled to prevent dirt from getting in and causing damage.

21. Watch bearing closures to prevent their damage during dismantling and reassembly.



Anti-Freeze Solution for 40MM
Twin and Quadruple Mounts

1. Ethylene-Glycol combined with fresh water is considered satisfactory as an anti-freeze for the cooling systems of these mounts.

2. Ethylene-Glycol, as supplied for mount allowance, is a compound which includes two corrosion inhibiting chemicals: - the chemical triethanolamine (.1 percent) and lard oil (3.0 percent) (percentages by volume).

3. The following mixture, which freezes at approximately - 23 degrees Fahrenheit, should be used:

Ethylene-Glycol	45 percent by volume
Water	55 percent by volume

4. In an emergency, fresh water can be used with the following corrosion inhibitor added: 0.67 ounce of neutral (chemically pure) sodium chromate per gallon of water. This is not an anti-freeze solution and must be replaced with ethylene-glycol compound at the earliest opportunity.

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