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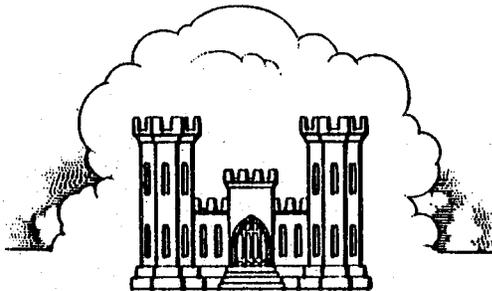
LEVEES & CHANNELS SECTION

Revised 29 Dec 2016

OPERATION & MAINTENANCE MANUAL - SACRAMENTO RIVER UNIT NO. 160

SUPPLEMENT TO STANDARD
OPERATION AND MAINTENANCE
MANUAL
SACRAMENTO RIVER
FLOOD CONTROL PROJECT

UNIT NO. 160
SUTTER-BUTTE CANAL HEADGATE



SACRAMENTO DISTRICT
CORPS OF ENGINEERS
U. S. ARMY
SACRAMENTO, CALIFORNIA

CORPS OF ENGINEERS

U. S. ARMY

SUPPLEMENT TO STANDARD

OPERATION AND MAINTENANCE MANUAL

SACRAMENTO RIVER FLOOD CONTROL PROJECT

UNIT NO. 160

SUTTER-BUTTE CANAL HEADGATE

**Sacramento District
Corps of Engineers
U. S. Army
March 1957**

**SUPPLEMENT TO STANDARD
OPERATION AND MAINTENANCE MANUAL
SACRAMENTO RIVER FLOOD CONTROL PROJECT**

UNIT NO. 160

SUTTER-BUTTE CANAL HEADGATE

LOCATION	ADDITION OR REVISION	DATE
Exhibit F	Add copy of letter of transfer dated 22 Mar 1951	28 Dec 2010
Exhibit F	Add copy of letter of transfer dated 29 Nov 2016	29 Dec 2016

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<u>Exhibit</u>	<u>Description</u>	
A	Flood Control Regulations	Unattached (contained in Standard Manual)
A-1	Location Drawing	1 sheet
A-2	Photographs of Headgates	1 sheet
B	"As Constructed" Drawings	Unattached
C	Plates of Suggested Flood Fighting Methods	Unattached (contained in Standard Manual)
D	Check List No. 1-Levee Inspection Report	Unattached (contained in Standard Manual)
E	Check Lists--Levees, Channels and Structures List of Equipment and Name Plate Data	Sheets 1 thru 14
F	Letter of Acceptance by State Reclamation Board	1 sheet
G	Semi-Annual Report Form	Sheets 1 and 2
H	Anchor Bolt Location	1 sheet
I	Front View of Manually Operated Hoist	1 sheet
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K	Limiterque Valve Controls	1 sheet
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SUPPLEMENT TO STANDARD
OPERATION AND MAINTENANCE MANUAL
SACRAMENTO RIVER FLOOD CONTROL PROJECT

REPLACED BY
OROVILLE DAM PROJECT

UNIT NO. 160

THEYMALITO
AFTERBAY

SUTTER-BUTTE CANAL HEADGATE

SECTION I

INTRODUCTION

ABANDONED
SEE LEVEE LOG
HAMILTON BEND - WEST LEVEE F. RIVER
MAINTENANCE AREA #7
YM.

1-01. Location. The improvement covered by this manual is that part of the Sacramento River Flood Control Project which includes the Sutter-Butte Canal Headgates located at the intake junction of the Sutter-Butte Canal with the west levee of the Feather River. On a straight line, the Headgates are located about 5 miles northeasterly from Biggs, California and about 6 miles southwesterly from Oroville, California. For location and general type of installation see Exhibit A-1 and A-2 of this manual.

1-02. Protection Provided. The Sutter-Butte Canal Headgates provide direct protection to adjacent agricultural lands and the towns of Biggs and Gridley, California. In addition, one of its main functions is to satisfy irrigation requirements to the area served by the Sutter-Butte Canal. The project flood capacity in this reach of the Feather River is 210,000 cubic feet per second.

1-03. Project Works. The flood control improvement covered by this manual is a part of the Sacramento River Flood Control Project authorized by the Flood Control Act of 1917, as modified by the Acts of 1928, 1937 and 1941, and consists of a reinforced concrete headgate structure having four manually operated 6' X 8' slide gates and two electrically and automatically controlled 6' X 8' slide gates. In addition to being used for flood control, the Headgates are used for irrigation purposes, therefore, they were constructed as a joint venture with the Corps of Engineers, the State of California and the local irrigation district participating.

1-04. Construction Data and Contractor. Construction work was accomplished under one contract, copies of which are on file in the Office of the District Engineer, Corps of Engineers, Sacramento, California. Pertinent data on the contract are as follows:

Construction was accomplished under Contract No. W-04-167-eng-1325 by Morrison-Knudsen Company, Inc. during the period from 16 September 1947 to 20 January 1949. Contract drawings will be found under file Numbers 4-4-284 and 4-4-293 and Specifications No. is 1259.

1-05. Flood Flows. For purposes of this manual, the term "flood" or "high water period" shall refer to flows when the water surface in the Feather River reaches or exceeds the reading of 95.0 on the Department of Water Resources continuous water stage recorder and staff gage located on the east side (left bank) of the Feather River on the downstream side of the abutment of bridge on Gridley-Oroville Road two and one-half miles east of Gridley (U. S. Corps of Engineers datum).

1-06. Assurances Provided by Local Interests. Assurance of cooperation by local interests is provided by State legislation, as contained in Chapter 3, Part 2, Division 5 of the State Water Code (see paragraph 2-02a of the Standard Manual).

1-07. Acceptance by the State Reclamation Board. Responsibility for operating and maintaining the completed works was officially accepted by the Reclamation Board of the State of California on 7 March 1951 as shown on the attached letter of acceptance, Exhibit F.

1-08. Superintendent. The name and address of the Superintendent appointed by local interests to be responsible for the continuous inspection, operation and maintenance of the project works shall be furnished the District Engineer, and in case of any change of Superintendent, the District Engineer shall be so notified.

SECTION II

FEATURES OF THE PROJECT SUBJECT TO FLOOD CONTROL REGULATIONS

2-01. Levee.

a. Description. The right bank levee of the Feather River in this area will be more particularly covered in another supplement manual. Only that portion of the levee which adjoins the abutments of the headgate structure and which directly affects the structure will be considered in this manual. The levee has been constructed with a 20 foot crown and sloped to meet the abutments of the new structure. For more complete detail in construction of above-mentioned levee, refer to the "As Constructed" drawings of Exhibit B.

b. For pertinent Requirements of the Code of Federal Regulations and other requirements see the following:

- (1) Maintenance-paragraph 4-02 of the Standard Manual.
- (2) Check Lists-Exhibit E of this Supplement Manual.
- (3) Operation-paragraph 4-04 of the Standard Manual.
- (4) Special Instructions-paragraph 4-05 of the Standard Manual.

2-02. Drainage and Irrigation Structure.

a. Description. For a more complete description of the mechanical and electrical features pertaining to the Sutter-Butte Canal Headgates see Section III of this manual.

b. For pertinent Requirements of the Code of Federal Regulations and other requirements see the following:

- (1) Maintenance-paragraph 5-02 of the Standard Manual.
- (2) Check Lists-Exhibit E of this Supplement Manual.
- (3) Operation-paragraph 5-04 of the Standard Manual.
- (4) Additional Requirements-paragraph 5-05 of the Standard Manual.

(5) Safety Requirements-paragraph 5-06 of the Standard Manual.

There are no special operating requirements for the Sutter-Butte Canal Headgates since the local irrigation demands do not conflict with the flood control requirements of the structure. The gates will generally be closed during the flood season.

2-03. Channel.

a. Description. The channel to be considered in this Manual is the entrance channel which leads from the Feather River to the new headgate structure and the exit channel which extends 100 feet downstream from the downstream wing wall of the new structure into the existing irrigation canal. Part of this channel has a bottom width of 60 feet with slopes of 1 on $1\frac{1}{2}$. Existing timber cribbing along the sides of the channel and part of the old headgate structure was left in place. For more complete detail see drawings of Exhibit B.

b. For pertinent Requirements of the Code of Federal Regulations and other requirements see the following:

- (1) Maintenance-paragraph 6-02 of the Standard Manual.
- (2) Check Lists-Exhibit E of this Supplement Manual.
- (3) Operation-paragraph 6-04 of the Standard Manual.
- (4) Safety Requirements-paragraph 6-05 of the Standard Manual.

It shall be the duty of the Superintendent to maintain a patrol of the works during all periods of flood in excess of a reading of 95.0 on the gage at the abutment of the Gridley-Oroville Road Bridge as indicated in paragraph 1-05 of this manual. The superintendent shall dispatch a message by the most suitable means to the District Engineer whenever the water surface reaches the gage reading as indicated above. The Superintendent shall cause readings to be taken at said gage or at a more convenient temporary staff gage at intervals of two to four hours during the period when the water surface is above the flood-flow stage indicated above and record the time of observations. One copy of the readings shall be forwarded to the District Engineer immediately following the flood, and a second copy transmitted as an inclosure to the semi-annual report in compliance with paragraph 3-06 of the Standard Manual.

2-04. Miscellaneous Facilities.

a. Description. Miscellaneous structures or facilities which were constructed as a part of, or in conjunction with, the protective works, and which might affect their functioning, include the following:

- (1) Bridges. None.
- (2) Utility Relocation. Change of electric service as required for control of new headgates.
- (3) Hydrographic Facilities. Gage at Gridley-Oroville Road Bridge as referred to in paragraph 1-05 of this manual. This gage to be maintained by the State.

b. For pertinent Requirements of the Code of Federal Regulations and other requirements see the following:

- (1) Maintenance-paragraph 7-02 of the Standard Manual.
- (2) Check Lists-paragraph 7-03 of the Standard Manual.
- (3) Operation-paragraph 7-04 of the Standard Manual.

SECTION III

DATA ON MECHANICAL AND ELECTRICAL FEATURES

3-01. Mechanical and Electrical Features.

a. Description. For purposes of record a detailed description of the mechanical and electrical features of the Sutter-Butte Canal Headgates follows in this section. For location and general type of installation refer to Exhibits A-1 and A-2.

(1) Gates. There are a total of six slide type gates, each being independently operated by a rising stem type screw hoist. The gates are of like design, having a clear opening for flow, when in full open position, six (6) feet wide by eight (8) feet high. Four of the hoists are manually operated. The remaining two hoists, which are located in the center portion of the structure, are each electrically operated and automatically controlled by a float switch mechanism located downstream from the headgate structure. The latter hoists are also provided with a hand wheel for manual operation when desired. Centerline of the gate opening is at elevation 106.0 and the hoist platform is at elevation 135.6. The gate assembly is referred to as a California Corrugated Co., 72" X 96" Model No. 109 Slide Gate.

(a) Gate Leaf. The gate leaf is cast iron of the standard rectangular type with horizontal and vertical ribs, having sufficient strength and rigidity for the service. The leaf is equipped with bronze bearing and sealing strips, thickness $\frac{1}{2}$ ", width $2\frac{3}{4}$ ". These strips are attached to the leaf by welding and designed to match corresponding seals in the gate frame. Dimensions of the gate leaf overall being: width $77\frac{1}{2}$ "; height $111\frac{1}{2}$ "; depth $15\frac{1}{2}$ ".

(b) Frame and Guide. The gate frame is cast iron of the spigot type anchored to the concrete structure and extending into the opening approximately $8\frac{1}{2}$ ". The seal bearing strips are welded to the frame around the opening to match the leaf seals accurately when the gate is closed to assure a reasonably watertight seal. Guides extend above the gate frame so that when the gate is fully opened the gate is held within the guides. The guides are securely held in place by anchor bolts embedded in the concrete.

(2) Gate Hoist.

(a) Stem and Guides. The stem assembly is made up of $3\frac{1}{2}$ " diameter structural steel rods joined together by threaded bronze

couplings which are locked by 1" diameter machine bolts through the stem-coupling assembly. The stem assembly is held in true alignment, by "Hardesty" standard fully adjustable stem guides anchored to the concrete at elevation 120.0 and at elevation 130.5. A connection is provided at the lower end of the stem for attaching to the gate leaf. The upper section of the stem is threaded for a distance of 108", with ACME Thd- $\frac{1}{2}$ "P., 1/2" Lead, to accommodate the hoist provided. Adjustment, by means of slotted holes and bolts are provided, in both horizontal directions for the guides to facilitate true alignment. Material for the guide assembly is cast iron with the exception of the steel machine bolts, and bronze bushings provided to protect the stem where it passes through the guide.

(b) Hoist Unit and Controls.

1. Manual Operated Hoists.

a. The four manual operated hoists are Armco AD & MP Incorporated, Denver, Colorado, #3456. Gear Ratio: high speed 6.7:1, low speed 34:1. Capacity: High speed 7,000 lb., and low speed 34,000 lbs., each based on a 40 pound crank pull. Included as part of the hoist assembly is a gear train, for driving the hoist screw lift nut, consisting of a set of bevel gear and a set of spur gears. The bevel gear and pinion are hardened alloy steel with spiral cut teeth. The spur gear is cast iron and the spur pinion is steel. Bearings for the bevel pinion shaft are taper roller bearings, the spur pinion shaft is bronze bushed and the lift nut is equipped with thrust ball bearings. The hoist assembly is anchored to the floor by means of four $1\frac{1}{2}$ " diameter anchor bolts. Position of the gate leaf at any time can be determined by a gate position indicator provided which is graduated in feet and tenths of a foot.

b. Operation.

To operate the hoist, apply required pressure to the hand crank, in the direction of rotation required to move the gate leaf up or down as desired. When the gate leaf has been positioned, remove the hand pressure applied to the hand crank and the gate leaf will be automatically held in that position by the self locking hoist screw.

2. Electric Operated Hoist.

a. General Specifications. This hoist is essentially a standard Philadelphia Gear Works motorized Limitorque Type SM unit mounted on a floor stand. The word "LIMITORQUE" has a definite meaning since a Torque Switch actually limits the torque applied to the operating parts to a safe maximum. The 60 ft. pound, 3 phase,

60 cycle, 220 volt motor provided, for the maximum total lift of 34,000 lb. at speed of around 10 inches per minute, is high torque ball bearing, enclosed squirrel cage type construction with starting torque not less than $3\frac{1}{2}$ times full load torque. The 60 ft. pound motor rating on 220 volt circuit is 80 amps stalled but only 15 amps at full load. The control cabinet is secured to the floor stand. This cabinet contains the reversing controller and an "Open-Stop-Close" push button control station with red and green indicating lights. The Limitorque controls are built to operate on the immersion principle which automatically lubricates all moving parts. The enclosing casing is leakproof. The electric motors are lubricated for life.

b. Gate Leaf Position Indicators. A "Red" light is energized when the gate leaf has been raised to full open position, "Green" light at full closed position, and both lights are energized when the gate leaf is in any intermediate position. A mechanical dial indicator is mounted on top of the hoist gear housing and is geared to the driving mechanism so as to remain in synchronism during both hand and motor operation.

c. Limit Switches. Travel in the closing direction is governed by a torque type limit switch which provides a means of adjusting the amount of thrust which may be exerted on the hoist stem and consequently the seating pressure of the gate leaf in the wedges when in closed position, and also protects the stem in case the gate leaf should be restricted in its movement at some intermediate position by an obstruction. The open position of the gate leaf is controlled by a geared limit switch.

d. Manual Operation. A handwheel is provided for manual operation. The unit is responsive to manual operation at all times except when being electrically operated. During electric operation of the hoist the handwheel does not rotate. The motor will not rotate during manual operation, nor will a fused motor prevent manual operation. There is no danger to an operator should he be turning the handwheel when the motor is started, since the automatic clutch within the "Unit" disengages the handwheel. A declutch lever is provided to change from motor to hand operation. Irrespective of the safety features provided, abnormal hoist operations should not be attempted.

e. Electric Operation. The hoist may be operated from the push-button control station at the hoist by setting the selector switch on "HAND". The "OPEN" and "CLOSED" push-buttons are normally open and the "STOP" push-button station is normally closed. The electrical controls are also interlocked with a float switch type controller, installed in a standard 48" diameter corrugated steel well and house assembly located about 550 feet downstream from the headgate structure. By positioning the selector switch on "AUTOMATIC" the

control of the hoists may be transferred to the float controller for automatic operation, also the controls may be set to operate the hoists singly or simultaneously as desired. The float control is essentially a modified version of a ROTO-TROL Multi-contact float control unit as manufactured for the Water Level Control Co. The float switch unit consists principally of three contacts or switches "RAISE", "LOWER", "STOP", operated by a float through linkage so arranged that lowering or raising of the gate will begin when the water level has raised or lowered approximately $3/4$ inches from a predetermined level. Once the gates have started to raise or lower the operation will continue as established by the controller until the water level has been restored to the predetermined level desired to be maintained. Provision is also made for adjusting the operating limits of the float switch. A battery operated alarm bell is provided in the caretakers headquarters which is interlocked with a floatwell controls etc. so that the alarm will sound should there be an interruption of the electric power supply to the gate hoists or other abnormal functioning of the controls during "AUTOMATIC" control of the hoists. The alarm circuit, being energized by a battery is therefore independent of the main electric power supply to the headgate structure and related works.

(3) Stop Logs. A vertical recess is provided in the side walls approximately 11 feet upstream and downstream from each gate to permit installation of stop logs when it is desired to dewater the gate well. The recess is 1' - 1" wide and $2\frac{1}{2}$ ' deep, and is lined with structural steel, using $2\frac{1}{2}$ " x $2\frac{1}{2}$ " x $\frac{1}{4}$ " angles at the corners and a $\frac{1}{4}$ " plate across the back. Before lowering the stop logs into the recesses, first close the gate and check to insure that the recesses are free of debris.

(4) Shelter. A shelter is provided over the hoist platform at the top of the head gate structure. This shelter consists principally of a wood frame roof with corrugated steel roofing which assembly is supported on 3" standard steel pipe columns.

(5) Electrical System. Power to operate the electrical facilities are supplied by the Pacific Gas and Electric Company. The shelter over the gate hoists at the top of the head gate structure and adjacent area is illuminated by four 150w lights in the structure, two 200w flood lights along the upstream side and one at the end to light the approach. These lights are connected to the main power supply and controlled from switch located in the shelter; the flood lights at the end may also be controlled from a switch in the caretakers house.

3-02. Inspection.

Periodic inspections are required to detect incipient faults before serious damage takes place, therefore, the importance of

making well organized inspections cannot be over emphasized. Even though the automatic controls when once adjusted for a particular condition should maintain close control of the flow in the canal with very little attention and the gates and hoists are relatively trouble free. It is recommended that the functioning of the controls and general condition of the outlet works and appurtenances be noted daily. Regular monthly inspections should make certain that all parts of the mechanical works are in operable condition, properly lubricated, and that no parts of the equipment and accessories are missing; that all painted surfaces are covered with adequate coats of protective paint, that there is no evidence of rust, and that the sheltered area around the hoists as well as the float well house is in clean and presentable condition. Inspection of the portions of the gate frame and guide and hoist stem assembly normally below the water surface shall, when practical, be performed when it will least interfere with the flow control. Once each year the entire mechanical installation shall be given a thorough detailed inspection. In order that no item of inspection will be overlooked, an inspection schedule listing each item should be carried on inspection tours; also full use should be made to any available inspection and maintenance manuals, pertinent catalogs and technical data supplied with the equipment by the respective manufacturers. The series of inspections conducted throughout the year should include but not necessarily be limited to the following items:

(1) Gates.

(a) All units and bolts on the assemblies which are accessible should be inspected for tightness. The leaf guide anchors should be carefully checked and any indication of looseness should be noted.

(b) The gate leaf and frame bronze seal bearing surfaces should be free from grit and adequately lubricated. Once each year the gate leaf and gate frame bronze seal bearing strips shall be carefully cleaned and inspected for signs of any unusual wear, indentations or other roughness. With water pressure applied to the upstream face of the gate leaf, check for abnormal leakage past the seals when the gate leaf is in a closed position; however, it should not be expected that the seals will be absolutely watertight.

(c) The connection of the hoist stem in the gate leaf shall be carefully inspected at least once each year to insure that it is adequately secured; also check for signs of rust or other deterioration at this point.

(d) Once each year check the gate leaf, gate frame and guides for signs of rust, cavitation or unusual wear while inspecting the mechanical equipment at this point; also note condition of the concrete structure of cavitation and cracks. Any accumulation of rocks, gravel, or other debris which may restrict or hamper the functioning of the gates should also be noted.

(e) During the daily inspections note the water surfaces both upstream and downstream from the gate as well as the gate well for the presence of debris which may tend to clog the canal or restrict the movement of the gate leaf.

(2) Gate Hoist.

Stem Assembly.

1. Inspect the hoist stem assembly for signs of rust or other deterioration. Note especially the stem couplings to insure that the locking bolts are in place and that the coupling has not worked loose.

2. The stem guide anchor bolts should be tight to permit no movement of the guide assembly in either direction. Note any indication that the guides may have become misaligned by such signs as abnormal wear of the stem or bronze guide bushing on one side where the stem passes through the bronze bushing.

(3) Hoist Unit and Controls.

(a) Manual Operated Hoists.

1. Check the functioning of the hoist and note any abnormal force required to be applied to the hand wheel to raise or lower the gate, especially after the gate leaf has started to move. The hoist should operate smoothly without noise or vibration.

2. Note whether or not the hoist bearings and gears are adequately lubricated, also check to insure that the proper type and grade of lubricant is being used. Note any indication of abnormal leakage of grease.

3. The hoist stand anchor bolts must be kept tight. Note especially any indication that the stand is shifting on the concrete to which it is anchored

4. Check all metal surfaces and note any signs of rust or wear.

(b) Electric Operated Hoist.

1. Check the functioning of the hoist when operated by the hand wheel to raise or lower the gate including the functioning of the declutching lever provided to change from motor to hand operation. When the gate has once started to move the hoist should move smoothly without noise or vibration.

2. Set the electric selector switch on "HAND" and check the functioning of the hoist by operating the pushbutton control station. Note especially any unusual noise or vibration as well as the functioning of the torque limit switch at closure of the gate leaf and the geared limit switch at full open position of the gate leaf. The gate leaf on closing should seat tight without shock.

3. Note any failure of the controls to disengage the hand wheel control when the hoist motor is energized.

4. Check the operation of the gate position indicator unit mounted on top of the hoist. It should operate smoothly without noise or vibration. Also check the reading of the indicator in relation to the actual gate opening.

5. While operating the gate hoist also check the functioning of the two gate leaf position indicating lights and note whether they fail to be energized at the proper time.

6. Operate the selector switch and note any malfunctioning at the "HAND", "OFF", or "AUTOMATIC" position.

7. Set the selector switch on "AUTOMATIC" position and note the functioning of the hoist under automatic control by the float controller located in the float well house downstream from the headgate structure. Note especially any signs of abnormal hunting of the gates in controlling the flow and any failure of the control system to maintain the predetermined water surface in the canal at the prescribed elevation within the set limits plus or minus.

8. Check the float and float switch assembly and note any improper functioning particularly any failure of the float assembly to rotate the driving sheave properly, also note any debris which may have collected in the float well that might tend to interfere with the free movement of the float.

9. Check all electrical controls and appurtenances and note any points requiring adjustment or other maintenance.

10. Check the oil level in the hoist gear housing and other points requiring lubrication before starting to operate. At least every three months note any need for lubrication; also check to insure that the proper grade and types of lubricants are being used. The Limitorque controls are built to operate on the immersion principle which automatically lubricates all moving parts.

11. Note any abnormal wear, rust, or other deterioration, as pertains to any of the metal work.

12. The hoist stand floor anchors must be tight and any indication that the base may be shifting on the floor should be particularly noted.

(4) Stop Logs.

(a) The metal work forming the recesses provided to receive the stop logs should be inspected, when accessible, and any rust spots or other items requiring maintenance should be noted.

(b) Before lowering the stop logs into the recesses inspect to insure that they are clear of debris which might prevent a satisfactory dewatering of the gate well.

(5) Shelter and Float Well-House Assembly.

(a) Inspect the metal and other surfaces and note need for repainting or other maintenance.

(b) The hoist floor area under the shelter as well as the float well house shall be clean and orderly and in a good state of repair at all times. Note also any tools or other loose materials or equipment which may have been left on the floor and constitutes a safety hazard, as well as accumulations of oil, greasy rags, paint or other inflammable materials which are a potential fire hazard.

(c) The door to the float well house should be kept securely locked when not occupied by authorized personnel.

(d) Check to insure that there is an adequate supply of the different kinds of oils and greases required for all lubricating operations and that they are properly stored together with adequate tools and facilities for proper application of each to the various parts.

(e) Check the supply of spare parts and note need for replenishment.

(6) Electrical System.

(a) Note whether all light fixtures and controls are functioning properly and are clean. The flood light fixtures should be clean inside and out. The flood lights should be checked at night.

(b) Inspect the circuit breakers and switches and note any indication that maintenance is required. Also check the adequacy of the number of spare fuses on hand.

(c) Periodic inspections, at least every six months, should be made of the entire electrical system provided for operation of the hoist.

(d) The reliance for power to operate the electrical facilities is placed on the local utility company that supplies electric power. Any condition noted in the inspection that may affect in any way the reliability of the power supply should be especially noted and brought to the attention of that company without delay.

3-04. Maintenance.

a. Since the proper functioning of the outlet works is vital to an adequate control of the flow, it is essential that its headgate works and appurtenances be continuously maintained in the best possible condition. Maintenance procedures are outlined in general and should be expanded and improved upon as experience is gained in operation of equipment. All repairs shall be by skilled technicians in the same standards as the contract specifications for the original construction. All damaged or unserviceable parts shall be repaired or replaced without delay. In making major repair or adjustments, full use should be made of the applicable contract plans and specifications, approved shop drawings, operating procedures and pertinent catalogs, including technical manuals supplied by the manufacturers of the equipment. Certain specific requirements for the principal units are outlined below.

(1) Gates.

(a) Rust spots disclosed by the inspection of the gate leaf, exposed surfaces of the gate frame etc., shall be thoroughly cleaned with a wire brush and painted in accordance with the original contract specifications.

(b) When dirt or grit is found on exposed surfaces of the bronze seal bearing strips, but in any event once each year, they shall be cleaned and washed down with cleaning solvent and allowed to dry. After drying apply a coat of waterproof grease. The seals for

the two gates controlled by the motor operated hoists should be lubricated once every three months, however, if this is impractical the interval may be extended to coincide with the period when dewatering the gate will least interfere with flow control. Before applying the lubricant, first hoist the gate leaf to full open position, apply a heavy coat with brush or hand, and then lower the gate leaf to full closed position and then raise to open position desired for flow regulation.

(c) Repairing the surfaces of the seal bearing strips must be performed with great care and by a mechanic skilled in bearing repair. The final finished rubbing surfaces should be polished. When the gate leaf is removed, wood plank should be clamped or otherwise secured to the face of the bearing strips to protect these surfaces.

(d) Any signs of excess cavitation or wear as pertains to the gate leaf and frame should be filled with suitable metal and ground smooth.

(e) When tightening anchor bolt nuts use a suitable size wrench in order to avoid undesired overstressing of the threads.

(f) The canal and gate well shall be kept cleared of any debris which may tend to clog the canal or restrict the operation of the gate.

(2) Gate Hoist.

(a) Stem and Guides.

1. Perform such maintenance or adjustments as noted on the inspection report. Care must be exercised to insure that the guides are properly aligned one with the other as well as with the hoist stand in order to avoid possibility of excessive wear on the stem and guide bushings. Guide anchor bolts must be sufficiently tight to maintain the alignment when once set. Should there be a tendency for the bolts to work loose, lock the nuts by setting the threads with a punch or by other suitable means.

2. Replace the guide bronze bushing in case excessive wear is indicated. The new bushing should be pressed into the casting and then reamed or otherwise finished to size.

3. In assembling the sections of the stem, clean the threads thoroughly and apply a light coat of waterproof grease to the male threads; also exercise care to insure that the threads of the couplings and stem sections are properly matched. Excessive force

required to thread the couplings on the stem should be a warning of cross threading or that the threads are not clean or properly lubricated.

4. The locking bolt through the stem-coupling assembly is provided to prevent the action of the hoist screw, in raising and lowering the gate leaf, from unscrewing the coupling. Should the bolt or the hole through the coupling become worn replace the locking bolt and/or the coupling as required.

5. Rust spots noted on the stem should be thoroughly cleaned off and stem coated with a suitable grade of water-proof grease or rust preventative.

(b) Hoist Unit and Controls.

1. Mechanically Operated Hoists.

a. The hoist shall be kept well lubricated irrespective of use. Grease at each of the pressure fittings provided, using a good grade of "Chassis" lubricating grease. For principal points to be lubricated refer to EXHIBIT C — Manual Operated Hoist. It is recommended that the covers of the gear housings be removed about once each year and the gears, etc. examined for wear, rust and adjustment. Also swab the gears with grease.

b. Any rust spots noted on the metal work shall be carefully cleaned and repainted or otherwise treated in a suitable manner. For unpainted surfaces which have a tendency to rust, coat with a light coating of water-proof grease or suitable rust preventative.

c. Perform such other maintenance indicated on the inspection report as being required.

2. Electrically Operated Hoist and Controls.

a. Before operating the hoist the grease level should be checked and grease added if necessary, thereafter inspect the lubrication at least every three months. The Limitorque hoisting controls are built to operate on the immersion principle which automatically lubricates all principal moving parts and the enclosing casing is designed to be leakproof, however, a slight seepage of lubricant at the seals is not necessarily an indication that the seals are faulty. The lubricant should not be corrosive to gears, ball or roller bearings, must be neutral in reaction, have no grit, abrasive or fillers present, should not precipitate sediment, should not separate at temperatures up to 300°F. and should have moisture resisting characteristics.

The lubricant shall also have good resistance to oxidation and be non-channeling.

b. Procedure for setting and checking the geared limit switch as follows:

i. Setting: Make certain that the electric current is turned off. Position the leaf in full open position by manual operation. Note the direction in which the large gears are turning on the drum switch connected to the "open" contactor coil. With the gate leaf in this position depress the drive pinion, located between the two gear trains in the switch. This allows the gear nearest the pinion to be turned by hand. Turn this one gear, in the same direction as noted when the gate was being opened, until the drum switch makes a quarter turn and opens the circuit. Release the pinion. This switch is now set.

ii. Checking: Connect the current and check above setting as follows: Move the gate to the mid position by hand operation. Press the "Open" pushbutton - making sure that the leaf is moving in the "open" direction; allow the limit switch to stop the motor and note position of the leaf. Move the gate leaf to full closed position, then back off one turn of the handwheel. Set the "closed" light switch following the same procedure as outlined above. This switch should open slightly before the torque switch opens. Be careful not to disturb the setting of the opposite gear train.

c. Procedure for setting the torque switch as follows: Make sure the electric current is off. Loosen the jam nut on the adjusting screw. Move the screw for light seating. Close the gate by motor and check for tightness of closing and if satisfactory close the jam nut. For heavier seating move the screw out and retighten the jam nut. The exact setting of the Torque Switch is determined by trial and must be set to limit the force that can be applied to the hoist stem, during the closing operation, to safe limits or not in excess of 34,000 pounds.

d. Miscellaneous. Maintenance and adjustment of the electrical automatic controls should be performed only by a skilled electrician and mechanic. Care must be exercised during painting to insure that the paint will not reach surfaces of moving parts where it may harden and restrict movement. Use type and grades of lubricants as recommended by the manufacturer and apply sparingly. Keep all units free of excessive accumulations of grease and dirt. Switches shall be kept mechanically and electrically operable and the electric circuits shall be kept free from shorts and grounds and maintained in an operable condition at all times.

(3) Stop Logs Recess.

(a) Any rust spots on the recess metal work noted during the inspection shall be cleaned with a wire brush and repainted.

(b) Remove any debris which may have lodged in the recesses and adjacent areas.

(4) Shelter and Float Well-House Assembly.

(a) Remove all debris which collects in the float well that may foul the movement of the float. The inlets to the well must be kept free.

(b) All metal work shall be kept well painted and in good repair at all times.

(c) When maintenance and other work has been completed remove all tools from the floor and do not permit accumulations of grease, oily rags, or other combustible materials to remain which may constitute a possible fire hazard.

(5) Electrical System.

(a) Maintenance of the power line is the responsibility of Pacific Gas and Electric Company.

(b) The panelboards, switches, instruments, and appurtenances shall be kept clean and free from dust. Doors of all cabinets shall be kept closed to exclude dust. Circuit breakers and switches shall be kept operable at all times. The lighting fixtures shall be cleaned at least once a year removing all dust and insects. Keep an adequate supply of fuses on hand for ready use. Flood lights should be adjusted at night for the most effective direction of beaming.

SECTION IV

REPAIR OF DAMAGE TO PROJECT WORKS AND

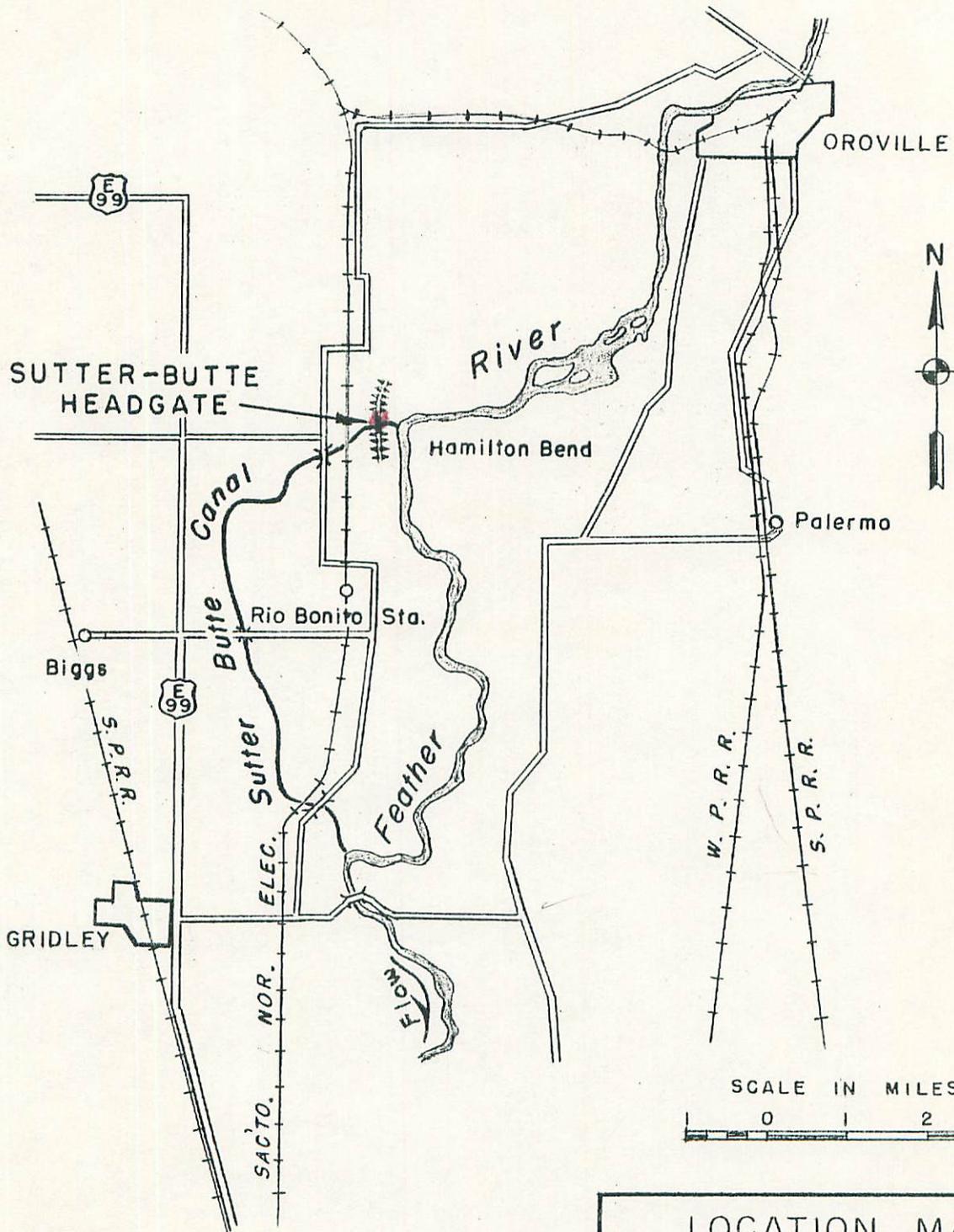
METHODS OF COMBATING FLOOD CONDITIONS

4-01. Repair of Damage. In the event of serious damage to the project works, whether due to flood conditions or other causes, and which may be beyond the capability of local interests to repair, the Superintendent will contact a representative of the Division of Water Resources, State of California, who coordinates maintenance of project works of the Sacramento River Flood Control Project. The State representative will give assistance or advice, or will determine appropriate action to be taken.

4-02. Applicable Methods of Combating Floods. For applicable methods of combating flood conditions reference is made to Section VIII of the Standard Operation and Maintenance Manual, revised May 1955, where the subject is fully covered.

EXHIBIT A
FLOOD CONTROL REGULATIONS
(See Standard Manual)

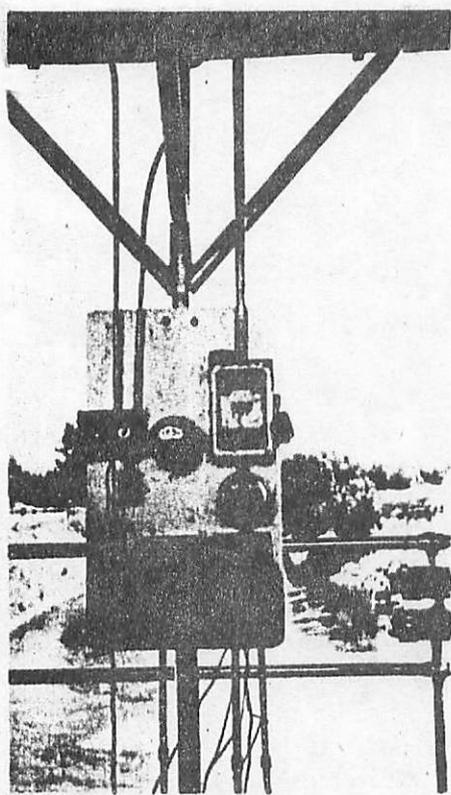
EXHIBIT A
Unattached



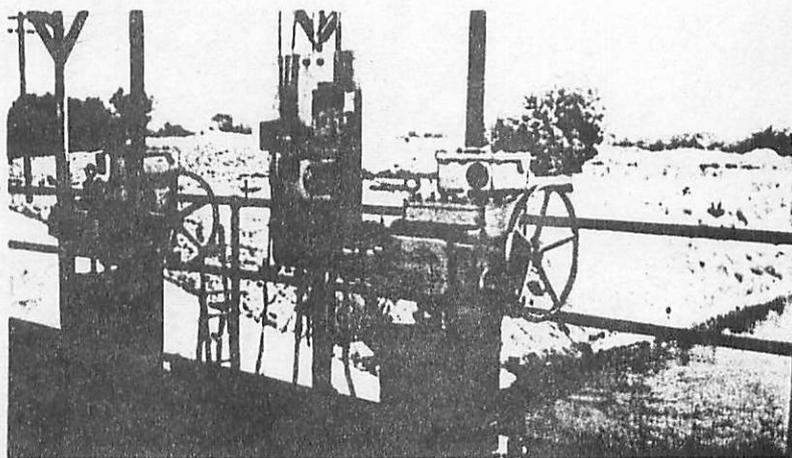
LEGEND

 -- Location of work in this Unit.

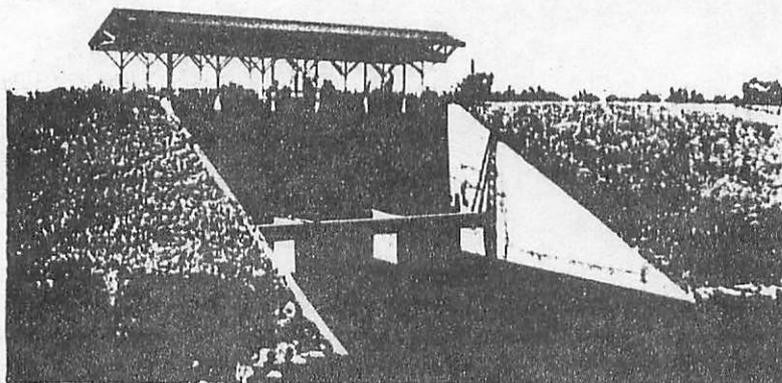
LOCATION MAP
 UNIT NO. 160
 SUTTER - BUTTE
 CANAL HEADGATE



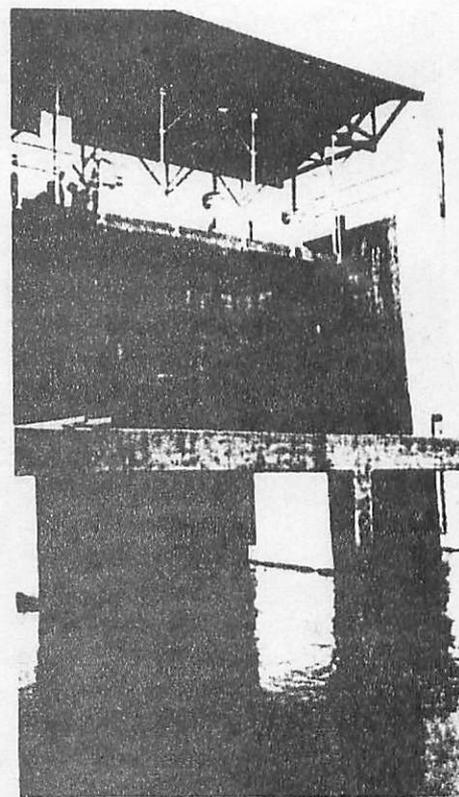
PANEL



TWO ELECTRIC MOTOR OPERATED HOISTS



HEAD GATE STRUCTURE
SUTTER-BUTTE



HEAD GATE STRUCTURE
Showing two of the four Manual
Operated Hoists.

EXHIBIT B

"AS CONSTRUCTED" DRAWINGS

See separate folder for the following drawings:

<u>Drawing No.</u>	<u>Title</u>	
4-4-284	Sutter-Butte Canal Headgates, sheets 1,2,4,5,6,7,&8	
4-4-293	Sutter-Butte Canal Headgates (Plan, Sections and Details)	1 sheet

SHOP DRAWINGS

5008	72" x 96" Mod. #109 Slide Gate	1 sheet
5009	Frame & Parts Details	1 sheet
5955	Detail of Parts for Lift Rod	1 sheet
B-72002	Limatorque - Cross Section, elev. view	1 sheet
B-72003	Limatorque - Cross Section, plan view	1 sheet

EXHIBIT C

PLATES OF SUGGESTED FLOOD FIGHTING METHODS

(See Standard Manual)

**EXHIBIT C
Unattached**

EXHIBIT D
CHECK LIST NO. 1
LEVEE INSPECTION REPORT
(See Standard Manual.)

EXHIBIT D
Unattached

EXHIBIT E

CHECK LISTS OF LEVEES,
CHANNEL AND STRUCTURES

LIST OF EQUIPMENT AND NAME PLATE DATA

For definition of "flood" or "high water" period,

See paragraph 1-05 of this manual

CHECK LIST NO. 2
UNIT NO. 160

SUTTER-BUTTE CANAL HEADGATE

Inspector's Report Sheet No. _____

Inspector _____

Date _____

Superintendent _____

Item	Remarks
(a) Location by Station	
(b) Settlement, sloughing, or loss of grade	
(c) Erosion of both slopes	
(d) Condition of roadways, including ramps	
(e) Evidence of seepage	
(f) Condition of farm gates and fencing	
(g) Maintenance measures taken since last inspection	
(h) Comments	

INSTRUCTIONS FOR COMPLETING SHEET 2, EXHIBIT E

- Item (a) Indicate levee station of observation, obtained by pacing from nearest reference point; indicate right or left bank.
- Item (b) If sufficient settlement of earthwork has taken place to be noticeable by visual observation, indicate amount of settlement in tenths of a foot. If sloughing has caused a change in slope of the embankment sections, determine the new slope. Note areas where erosion or gulying of the section has occurred.
- Item (c) If sufficient erosion or gulying of back face of back toe of levee has taken place to be noticeable by visual inspection, indicate area affected and depth.
- Item (d) Note any natural change in any section of roadway or ramps. Indicate any inadequacy in surface drainage system.
- Item (e) Indicate any evidence of seepage through the embankment section.
- Item (f) Indicate the serviceability of all farm gates across the embankments and roadway, and indicate if repainting is required.
- Item (g) Indicate maintenance measures that have been performed since last inspection and their condition at the time of this inspection.
- Item (h) Record opinion, if any, of contributory causes for conditions observed and also any observations not covered under other columns.

NOTE: One copy of the Inspector's Report is to be mailed to the District Engineer immediately on completion, and one copy is to be attached to and submitted with the Superintendent's semi-annual report.

CHECK LIST NO. 3

CHANNEL AND RIGHT-OF-WAY

UNIT NO. 160

Inspector's Report Sheet No. _____

Inspector _____

Date _____

Superintendent _____

Item	Remarks
(a) Name of channel and location by stations	
(b) Vegetal growth in channel	
(c) Debris and refuse in channel	
(d) New construction within right-of-way	
(e) Extent of aggradation or degradation	
(f) Condition of riprapped section	
(g) Condition of bridges	
(h) Measures taken since last inspection	
(i) Comments	

INSTRUCTIONS FOR COMPLETING SHEET 4, EXHIBIT E

- Item (a) Indicate station of observation obtained by pacing from nearest reference point.
- Item (b) Note nature, extent, and size of vegetal growth within the limits of flood flow channel.
- Item (c) Note nature and extent of debris and refuse that might cause clogging of the conduits of the irrigation intake works, fouling of the tainter gates, or the bridges over the channel.
- Item (d) Report any construction along the diversion channel or above the diversion works that has come to the attention of the inspector and that might affect the functioning of the project.
- Item (e) Indicate any change in grade or alignment of the channels, either by deposition or sediment or scour, that is noticeable by visual inspection. Estimate amount and extent.
- Item (f) Indicate any change that has taken place in the riprap such as disintegration of the rock, erosion, or movement of the rock. Note the presence of vegetal growth through the riprap.
- Item (g) Note any damage or settlement of the footings of the bridges. Indicate condition of wooden structures and if repainting is required. Indicate condition of bridge approaches, headwalls, and other appurtenances.
- Item (h) Indicate maintenance measures that have been performed since the last inspection and their condition at time of this inspection.
- Item (i) Record opinion, if any, of contributory causes for conditions observed, also any observations not covered under other columns.

NOTE: One copy of the Inspector's Report is to be mailed to the District Engineer immediately on completion, and one copy is to be attached to and submitted with the Superintendent's semi-annual report.

EXHIBIT E

SUTTER BUTTE CANAL HEADGATES

DESCRIPTION OF EQUIPMENT AND NAME PLATE DATA

UNIT NO. 160

- 4 - Slide gates, screw type, hand operated, Armco AD & MP Inc., Denver, No. 3456.
- 2 - Slide gates, motor operated, Limitorque Control, Type S-M, size 4, Valve 6' x 8'. Serial No. 12898.
Motor: Electric Specialty Co. Type H55P, 3 Ph, 60 cycles, 220 Volts, 14.3 Amps., 6 HP, 1800 RPM, Serial No. 627889 and 627890.
- 1 - Main Switch, 3 pole, 250 Volt, 60 Amp., Cutler-Hammer.
- 2 - Watthour Meters, one for headgates and one for the house.
- 1 - 2 pole, 230 Volt, 25 Amp. air circuit breaker, Square D. for lights and controls.
- 2 - Cutler-Hammer 4 pole, 250 Volts, 50 A. frame air circuit breakers for Limitorque Motor Controls.
- 1 - Timing relay "Synchropulse", Eagle Signal Corporation. Type No. HQ713B6, Serial No. 4935-9734, arrangement No. 10936, 230 Volts, 60 cycles, Contacts 3 amps, minimum cycle 5 minutes, maximum cycle 30 minutes.
- 1 - Westinghouse safety switch, 2 pole, 30 A., 250 Volt.
- 1 - Toggle switch, 10A, 125V., S. P. for outdoor lights.
- 2 - Selector switches: "HAND - OFF - AUTO", for motor control.
- 2 - Magnetic Starters, Reversing, 30 A., 3 pole, 230 V., 60 cycles, mounted on the gate frame.
- 2 - " CLOSE - OPEN - STOP" push button stations for motor control, mounted on the control cabinet.
- 2 - Red and green indicating lights, one set for each Limitorque control.
- 1 - Float switch with controls for automatic operation of motor operated slide gates. This float switch is located in the float-well about 500 feet below the gate structure.

EXHIBIT E

MECHANICAL-ELECTRICAL EQUIPMENT

INSPECTION CHECK LIST

UNIT NO. 160

PROJECT: Sutter-Butte Headgates

INSPECTOR _____

DATE: _____

<u>ITEM</u>	<u>PERIOD; EVERY</u>	<u>REMARKS</u>	<u>DATE, MAIN & INITIAL</u>
(1) <u>Gates</u>			
(a) <u>Bolts & nuts;</u> <u>Tightness & condition.</u>	6 months		
(b) <u>Bronze seal bearing</u> <u>surfaces</u> —Condition of <u>surfaces</u> —lubrication.	"		
(c) <u>Connection of leaf to</u> <u>hoist stem.</u> Tightness, wear, rust.	"		
(d) <u>Metal work of leaf frames</u> <u>and guides.</u> Rust, cavi- tation.	"		
(e) Note any indications of abnormal wear, metal sur- faces and concrete.	"		
(f) Debris in gate well, etc.	Week		
(g) Miscellaneous.	Week		
(2) <u>Gate Hoist</u>			
(a) <u>Stem Assembly</u>			
1. <u>Metal work.</u> Rust or other deteri- oration of stem and guides.	3 months		
2. <u>Stem coupling assembly.</u> Tightness including locking bolt.	"		

<u>ITEM</u>	<u>PERIOD; EVERY</u>	<u>REMARKS</u>	<u>DATE, MAINT & INITIAL</u>
3. <u>Stem guide Assembly.</u> Anchor bolts. Alignment of guides. Condition of bronze guide bushing.	3 months		
4. Stem wear, etc. Including connection to gate leaf.	"		
5. Miscellaneous.	"		
(b) <u>Hoist Unit & Controls</u>			
<u>1. Manually operated Hoists</u>			
a. <u>Functioning of hoist.</u> Force required to operate hand wheel, noise, etc.	Month		
b. Lubrication.	3 months		
c. <u>Stand anchor bolts.</u> Tightness, etc.	Month		
d. <u>Metal Surfaces.</u> Rust & excessive wear.	"		
e. Miscellaneous.	"		
<u>2. Electrically Operated Hoist</u>			
a. <u>Hand operation.</u>	Month		
b. <u>Declutching control lever.</u> Note whether it functions properly.	"		
c. <u>Functioning by pushbutton controls.</u> Raising. Lowering. Smoothness of hoist operation. Setting of tongue and gear limit switches.	"		

<u>ITEM</u>	<u>PERIOD;</u> <u>EVERY</u>	<u>REMARKS</u>	<u>DATE, MAINT</u> <u>& INITIAL</u>
<u>Note shock if any at full closed position.</u>			
<u>Check functioning of selector switch. At "Hand", "Off", and "Automatic" positions.</u>			
With hoist motor energized, is handwheel automatically disengaged.			
Miscellaneous.			
<u>d. Gate Position Indicators</u> Month			
<u>Functioning of lights.</u> <u>Functioning of gate position indicators.</u> Smoothness of operations. Lubrication. Accuracy of indicator. Miscellaneous.			
<u>e. Functioning by "Automatic" control.</u> Day			
Note signs of control hunting. Smoothness of hoist operation. Accuracy of flow control maintained in the canal. Functioning of floatswitch controller etc. Note any sluggishness in the float drive assembly. Is float clean and free of debris. Note presence of debris in float well. Are pipe connections through the float well wall clear to permit free flow.			

<u>ITEM</u>	<u>PERIOD; EVERY</u>	<u>REMARKS</u>	<u>DATE, MAIN & INITIAL</u>
f. <u>Functioning of Miscellaneous electrical controls.</u>	Day		
g. <u>Hoist Unit - General</u> Oil level is Limitorque gear housing. Note grade and quality of oil used. Check adequacy of lubrication of all units.	3 Months		
h. <u>Metal work</u> - Abnormal wear, rust spots etc.			
i. <u>Floor stand anchors.</u>			
j. <u>Miscellaneous.</u>			
(3) <u>Stop Logs Recesses.</u>	Year		
(a) <u>Metal work.</u>			
(b) Debris in recesses, etc.			
(4) <u>Shelter & Floatwell-House assembly.</u>	Week		
(a) Note condition of metal work including paint.			
(b) Note whether floor area is clean & orderly.			
(c) Note possible safety hazards.			
(d) Note possible fire hazards.			
(e) Check whether floatwell house is locked.			
(f) Adequacy of lubricants on hand and their storage.			
(g) Adequacy of spare parts on hand.			
(h) <u>Miscellaneous.</u>			

<u>ITEM</u>	<u>PERIOD; EVERY</u>	<u>REMARKS</u>	<u>DATE, MAINT & INITIAL</u>
(5) <u>Electrical System</u>	Month		
(a) Function of lights & controls.			
(b) Note whether fixtures are clean and properly adjusted.			
(c) Check circuit breakers.			
(d) Check switches etc.			
(e) Functioning of all elec- trical circuits and controls.	6 Months		
(f) Note any conditions that may in any way effect the reliabi- lity of the power supply.	Month		
(g) Miscellaneous.	Month		
(6) <u>Painted surfaces.</u>	6 Months		
(a) Note general conditions and need for repainting.			
(b) Check especially electrical controls and moving parts to insure paint is not restricting movement.	Particularly after repainting		

NOTE:

- 1 - The period indicated is to serve as a general guide. More frequent inspections shall be made if operating experience and type of service for a particular service justifies.
- 2 - Under "Remarks" briefly indicate maintenance, adjustment, required.
- 3 - When required maintenance etc. has been completed, indicate date and initial.

EXHIBIT E

MECHANICAL-ELECTRICAL EQUIPMENT

LUBRICATION SCHEDULE

UNIT NO. 160

PROJECT: Sutter-Butte Headgates

<u>ITEM</u>	<u>LUBRICANT</u>	<u>PERIOD ; EVERY</u>
(1) <u>Gates & Hoist</u>		
(a) <u>Gates</u>		
Bronze Seals.	Water-proof grease Calol WP#2 apply with brush.	3 Months
(b) <u>Gate Hoist</u>		
Stem Assembly.	Coat with water-proof grease, Calol WP#1., apply with brush. If found inadequate to prevent rust apply suitable rust preventative. NO-OX-ID Type E.	3 Months
(c) <u>Hoist Unit & Controls</u>		
1. <u>Manual Operated Hoist</u>		
Bearings	Chassis lubricating grease, "UNO-BA-FI, Chassis Lube." or Calol WP#1. Apply to Zerk fittings with pressure gun.	3 Months
Exposed machine surfaces that have a tendency to rust.	Apply a light coat of rust preventative fluid. "Stop-Rust-The Delta Mfg. Co."	
Internal gear- ing	Swab gears with Marfax O O.	12 Months
2. <u>Electric Operated Hoist</u>		

<u>ITEM</u>	<u>LUBRICANT</u>	<u>PERIOD;</u> <u>EVERY</u>
Limitorque gear housing	Recommend a mild, non-corrosive, non-fluid extream pressure type lubricant; viscosity of mineral oil 190 SU at 210° F Representative lubricant is RPM Gear lubricant No. 140.	Check and fill as required before starting, and there-after at least every three months. Drain and refill after first year and there after every two year
Zerk Fittings when used.	Marfak 0 0. Applied with pressure gun.	Month
Limit switch gears	Remove limit Switch compartment cover and swab gears with a light coat of bearing grease Calol WP #1.	Year
Position Indicator gearing	Remove cover and swab gears with a light coat of bearing grease. Calol WP #1.	Year
Rototrol and appurtenances	Mfgs recommendations.	Mfgs recommen-dations.
(d) <u>Electrical System</u>		
Switches.	General Electric Transile Oil.	3 months
Switch hingepins & Relays.	Transile Oil with graphite.	6 months
Push button contracts.	Petroleum if required.	6 months
Instruments, etc.	Mfgs recommendations.	Mfgs recommen-dations.

EXHIBIT E

(2) General Notes

1 - There are many lubricants suitable for service as pertains to the above items of equipment. The trade names indicated above are listed as being representative; any equivalent lubricant may be used.

2 - Manufacture of lubricants specified above.

Calol., - - Standard Oil Co.

ND-OX-ID., - - Dearborn Chemical Co.

UNO., - - Union Oil Co.

Transile., - - General Electric Co. special oil for electrical equipment.

RPM., - - Standard Oil Co. of California

Marfax., - - The Texas Co.

3 - When available use manufactures recommendations for the service. The mixing of different Mfgs. lubricants even though each is recommended for the same application should be avoided whenever practical. By keeping the different types of lubricants required to an absolute minimum, will simplify storage problems, and minimize the chance of applying the wrong type of lubricant.

EXHIBIT F
LETTER OF ACCEPTANCE
BY STATE RECLAMATION BOARD

EXHIBIT F



DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

NOV 29 2016

Ms. Leslie M. Gallagher
Executive Officer
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, CA 95821

Dear Ms. Gallagher:

The purpose of this letter is to notify the Central Valley Flood Protection Board of the completion of an effort to update the Operation and Maintenance Manual Supplements for the Sacramento River Flood Control Project and the Lower San Joaquin River Levees and Lower San Joaquin River and Tributaries Project. These updates are a compilation of revisions made to the project over time and where we had record of a transfer letter to the Board. These updated supplements are the most current version and should be utilized as the baseline version for any future project modifications.

This process and the compiled updates have been coordinated with the Central Valley Flood Protection Board and Department of Water Resources staffs for review and comment. All comments have been addressed or incorporated into the manuals.

The Board staff has been provided a copy of the manuals in electronic format. Future updates will include entire unit supplements so updates can be seen in context with the entire unit supplement. The list of completed supplements, by the unit number and title, are attached. If you have any questions regarding this transmittal, please contact Gary Kamei at 916-557-6845.

Sincerely,

A handwritten signature in black ink, appearing to read "D. G. Ray", written over a horizontal line.

David G. Ray, P.E.
Colonel, U.S. Army
District Commander

Enclosures

Standard O&M Manual Sacramento River Flood Control Project	
Unit No.	Project Name
101	RD 341 Sherman Island
102	E. Levee of Sac River, Isleton to Threemile Slough & N. Levee of Threemile Slough from Sac River to SJ River
103	Both Levees of Georgiana Slough & E. Levee of Sac River from Walnut Grove to Isleton
104	Levees around Grand Island
105	Levees Around Reyer Island
106	S. Levee Lindsey Slough & W. Levee of Yolo BP from Lindsey Slough to Watson Hollow and N. Levee of Watson Hollow Drain
107	Levees Around Hastings Tract
108	Levees Around Peters Tract
109	West Levee of Yolo Bypass & E. Levee of Cache Slough
110	Levees Around Sutter Island
111	E. Levee of Sac River from Freeport to Walnut Grove
112	Levees Around Merritt Island
113	E. Levee Yolo Bypass, N. Levee Miner Slough, W. Levees Sutter Slough, Elkhorn Slough & Sac River, All Bordering RD 999
114	W. Levee of Sac River from Northern Boundary of RD 765 to Southern Boundary of RD 307
115	E. Levee of Sac River from Sutterville Rd to Northern Boundary of RD 744
116	W. Levee of Sac River from Sac Weir to Mi 51.2 & S. Levee of Sac Bypass & E. Levee of Yolo Bypass from Sac Bypass to Southern Boundary of RD 900
117	E. Levee Sac River through City of Sac from Tower Bridge to Sutterville Rd
118.1	E. Levee of Sac River from American River to Tower Bridge & S. Levee of American River from Mayhews Downstream to Sac River
118.2	N. Levee American River, E. Levee Natomas Canal, Both Levees Arcade Creek, S. Levee Linda Creek, & Magpie Creek Diversion Channel
118.2 Sup	Vegetation on Mitigation Sites E. Levee of Sac River from American River to Tower Bridge & S. Levee of American River from Mayhews Downstream to Sac River
119	Putah Creek Channel & Levees & W. Levee of Yolo Bypass from Yolo Causeway Downstream 3 mi. Includes O&M manual for the Yolo Basin wetlands, and South Fork Putah Creek Preserve Restoration Section 1135 Authorization.
120	Relocated Willow Slough Channel & Levees & W. Levee Yolo Bypass from mouth of Relocated Willow Slough to Yolo Causeway
121	R. Levee of Yolo Bypass from Willow Slough Bypass to Woodland Rd RD2035
122.1	W. Levee of Sac River from Mi 70.8 to Sac Weir & N. Levee of Sac Bypass & E. Levee of Yolo Bypass from Woodland Hwy to Sac Bypass
123	W. Levee of Sac River from East End of Fremont Weir to Mi 70.8 & E. Levee of Yolo Bypass from East End Fremont Weir to Woodland Hwy RD 1600

124	N. Levee of American River from Natomas E. Canal to Sac River & E. Levee of Sac River from Natomas Cross Canal to American River. Includes supplement, Vegetation on Mitigation Sites.
125	Back Levee of RD 1000
126	Cache Creek Levees & Settling Basin Yolo Bypass to High Ground
127	Knights Landing Ridge Cut & Sac River & Yolo BP Levees of RD's 730 and 819 & S. Levee of Sycamore Slough
128	E. Levee of Sac River from Sutter Bypass to Tisdale Weir all within RD 1500
129	S. Levee of Tisdale By-Pass from E. Levee Sac River to W. Levee Sutter BP & W. Levee of Sutter BP Downstream to E. Levee of Sac River
130	W. Levee Sac River from Sycamore Slough to Wilkins Slough (Mi. 89.9 to Mi. 117.8)
131	W. Levee Sac River from Wilkins Slough to Colusa (Mi. 117.8 to Mi. 143.5)
132	Back Levees of RD 108
133	E. Levee of Sac River from Winship School to Tisdale BP & N. Levee of Tisdale BP & W. Levee of Sutter BP from Long Bridge to Tisdale BP
134	Levees of RD 70, E. Levee of Sac River from Butte Slough Outfall Gates to Winship School & W. Levee of Sutter BP from Butte Slough Outfall Gates to Long Bridge
135	E. Levee of Sutter BP from Sutter Buttes Southerly to Junction with Feather River & E. & W. Levees of Wadsworth Canal & Levee of Intercepting Canals
136	E. Levee of Sac River from Butte Slough Outfall Gates to the Princeton-Afton Rd (Mi. 138.3 to Mi. 164.4)
137	W. Levee of Sac River from North End of Princeton Warehouse to Colusa Bridge
138	E. Levee of Sac River from Parrott-Grant Line to Princeton-Afton Rd
139	W. Levee of Sac River from N. Boundary of LD 2 to North End of Princeton Warehouse
140	W. Levee of Sac River in LD 1 (Mi. 170.5 to Mi. 184.7). Includes mitigation site O&M manual, Yuba County
141.1	E. Levee of Feather River from Bear River to Natomas CC & S. Levee of Bear River & Both Levees of Yankee Slough. Parts 1 and 2
141.2	E. Levee of Feather River from Bear River to Natomas CC & S. Levee of Bear River & Both Levees of Yankee Slough. Parts 1 and 2
142	Back Levee of RD 1001
143	W. Levee of Feather River from North Boundary of RD 823 to E. Levee of Sutter Bypass
144	W. Levee of Feather River from North Boundary of LD 1 to North Boundary of RD 823
145	E. Levee of Feather River, S. Levee of Yuba River, Both Levees of WPRR Intercepting Channel, W. Levee of South Dry Creek & N. Levee of Bear River
146	N. Levee of Bear River & S. Levee of South Dry Creek RD 817 & Vicinity of Wheatland
147	Levee Around the City of Marysville & N. Levee of Yuba River to a Point 1.8 Mi. Upstream from Marysville

148	W. Levee of Feather River from North Boundary of RD 777 to North Boundary of LD 1
149	S. Levee of Yuba River Maintenance Area No. 8
151	E. Levee Feather River from Honcut Creek to Marysville & S. Levee of Honcut Creek & E. Levee of RD 10
152	W. Levee of Feather River from N. Boundary of RD 777 to Western Canal Intake (Levee of Drainage District No. 1)
153	Lower Butte Creek Channel Improvement, Colusa, Glenn & Butte Counties
154	Moulton Weir & Training Levee Sacramento River
155	Colusa Weir & Training Levee Sacramento River
156	Tisdale Weir & Bypass
157	Fremont Weir, Sacramento River
158	Sacramento Weir, Sacramento River
159	Pumping Plants No. 1, 2 & 3, Sutter Bypass
160	Sutter Butte Canal Headgate
161	Butte Slough Outfall Gates
162	Knights Landing Outfall Gates, Sacramento River

Standard O&M Manual San Joaquin River

Unit No.	Project Name
1	Right Bank Levee of the San Joaquin River & French Camp Slough within RD 404
2	Right Bank Levee of the San Joaquin River & French Camp Slough within RD 17
3	North Levee of Stanislaus River & East Levee of the San Joaquin River within RD 2064, 2075, 2094 and 2096
4	East Levee of San Joaquin River within RD 2031
5	East Levee of the San Joaquin River Within RD No. 2092
6	East Levee of the San Joaquin River in RD Nos. 2063 & 2091
7	West Levee of San Joaquin River & North Levee of Old River RD Nos. 524 & 544
8	Right Banks of Old River & Salmon Slough Within RD No. 1 & RD No. 2089
9	Levees Around RD No. 2062 & San Joaquin County Flood Control District Area No.2
10	West Levee of Paradise Cut RD No. 2058 & SJ County Flood Control District, Area No.2
11	West Levee of San Joaquin River from Durham Bridge to Paradise Dam Within RD No. 2085 & 2095
12	West Levee of San Joaquin River From Opposite Mouth of Tuolumne River Downstream to Stanislaus County Line Within RD Nos. 2099, 2100, 2101, & 2102
13	West Levee of the San Joaquin River in RD No. 1602

REGISTERED MAIL
Return Receipt
Requested

Trrieta
Sutter-Butte Canal Headgate
Accepted by
The Reclamation Board
7 March 1951.
See letter dated 8 March 1951.

PERM-P 824,001 (Feather R.)

22 MAR 1951

The Reclamation Board
State of California
1100 "G" Street
Sacramento, California

Gentlemen:

Reference is made to your letter of 8 March 1951 stating that the Reclamation Board has accepted the Sutter-Butte Canal Headgate Structure for maintenance by the State of California.

In accordance with the above, the Sutter-Butte Canal Headgate structure located on the west levee of the Feather River, about 4.5 miles northwesterly of Ridge, California, is hereby transferred to the State of California for maintenance and operation as of 7 March 1951.

The construction referred to above was completed on 20 January 1949 by Morrison-Knudsen Co., Inc., Contractor, under Contract No. 1-01-167-ang-1325 in accordance with approved plans and specifications.

The required maintenance and operation of the flood control works referred to above shall be performed in accordance with existing Flood Control regulations which have been prescribed by the Secretary of the Army, pursuant to the provisions of Section 3, of the act of Congress, approved 22 June 1936, as amended and supplemented, to govern the maintenance and operation of flood control works. In accordance with Paragraph 206.10(10) of these regulations this office will furnish you at a later date, with an operation and maintenance manual to assist in carrying out the obligations established.

Sincerely yours,

Copy Furnished:
Engrg. Div. (2)
Bardsale State Engr.
O.C.E. Sacramento Field Off.
Div. Engr.

G. C. HAUG
Lt. Colonel, Corps of Engineers
District Engineer

Unit 13A

160

14

Service Act

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THE RECLAMATION BOARD
of the
STATE OF CALIFORNIA
1100 O Street
Sacramento 14, California

March 8, 1951

District Engineer
Sacramento District
U. S. Corps of Engineers
P. O. Box 1739
Sacramento, California

Dear Sir:

Subject: Sutter Butte Canal Headgates

Reference your file PSKKO-B, December 1, 1950, and
February 9, 1951.

The Reclamation Board at its regular meeting March 7,
1951, accepted the Sutter Butte Canal Headgate structure for
maintenance by the State of California, contingent upon the
performance of additional work along the canal banks by the
Corps of Engineers if found necessary at the end of the next
irrigation season.

A copy of your letter of transfer will be appreciated.

Yours very truly,

THE RECLAMATION BOARD
A. M. BARTON
Chief Engineer and General Manager

By /s/ S. A. Honaker
S. A. HONAKER
Assistant Secretary

EXHIBIT G

SUGGESTED SEMI-ANNUAL REPORT FORM

CORPS OF ENGINEERS, U. S. ARMY
Office of the District Engineer
SACRAMENTO DISTRICT
Wright Bldg., 1209-8th St.
Sacramento, California

TO: The District Engineer
Sacramento District
Corps of Engineers
1209-8th Street
Sacramento, California

(1 May 19__)
(1 Nov. 19__)

Dear Sir:

The semi-annual report for the period (1 May 19__ to 31 October 19__)
(1 November 19__ to 30 April 19__)

a. The physical condition of the protective works is indicated by the inspector's report, copies of which are inclosed, and may be summarized as follows:

(Superintendent's summary of conditions)

It is our intention to perform the following maintenance work in order to repair or correct the conditions indicated:
(Outline the anticipated maintenance operations for the following 6 months.)

b. During this report period, major high water periods (water level at 95.0 at Gridley-Oroville Bridge) occurred on the following dates:

Dates

Maximum Elevation

Comments on the behavior of the protective works during such high water periods are as follows:
(Superintendent's log of flood observations)

During the high water stages when the water level reached a height of _____, on the gate or excess thereof (dates) _____, it was necessary to organize and carry out flood operations as follows:
(See Maintenance Manual _____.)

c. The inspections have indicated (no) or (the following) encroachments or trespasses upon the project right-of-way.

d. (No) (_____) permits have been issued for (the following) improvements or construction within the project right-of-way.

Executed copies of the permit documents issued are transmitted for your files.

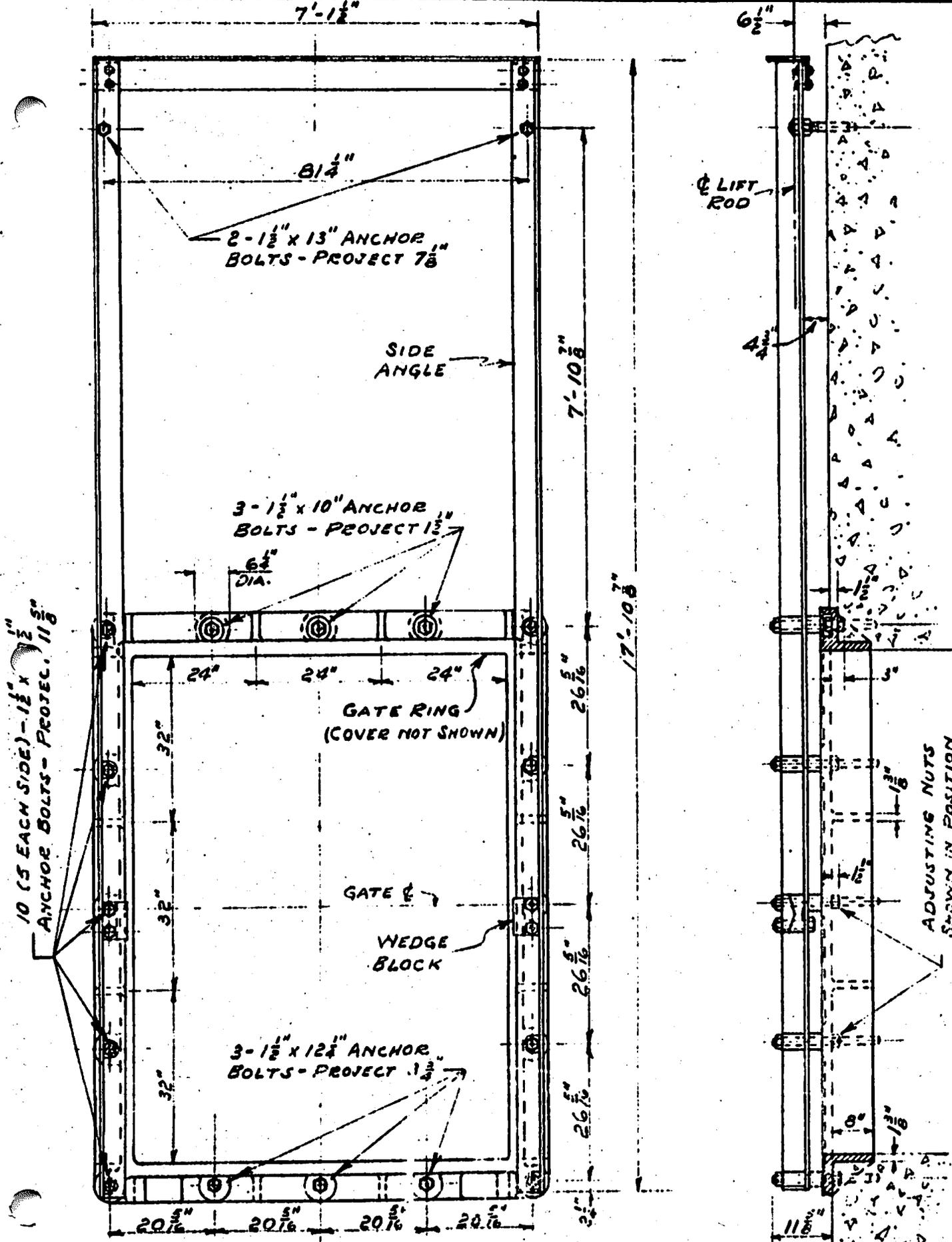
e. The status of maintenance measures, indicated in the previous semi-annual report as being required or as suggested by the representatives of the District Engineer, is as follows:
(Statement of maintenance operations, item by item with percent completion.)

f. The fiscal statement of the Superintendent's operations for the current report period is as follows:

	<u>Labor</u>	<u>Material</u>	<u>Equipment</u>	<u>Overhead</u>	<u>Total</u>
1. Inspection					
2. Maintenance					
3. Flood fighting operations					
TOTAL					

Respectfully submitted,

Superintendent of Works



10 (5 EACH SIDE) - 1 1/2\" x 1 1/2\" ANCHOR BOLTS - PROTECT. 11 5/8"

2 - 1 1/2\" x 13\" ANCHOR BOLTS - PROJECT 7 5/8"

3 - 1 1/2\" x 10\" ANCHOR BOLTS - PROJECT 1 1/2\"

6 1/4\" DIA.

3 - 1 1/2\" x 12 1/4\" ANCHOR BOLTS - PROJECT 1 1/2\"

GATE RING (COVER NOT SHOWN)

GATE
WEDGE BLOCK

LIFT ROD

ADJUSTING NUTS SHOWN IN POSITION

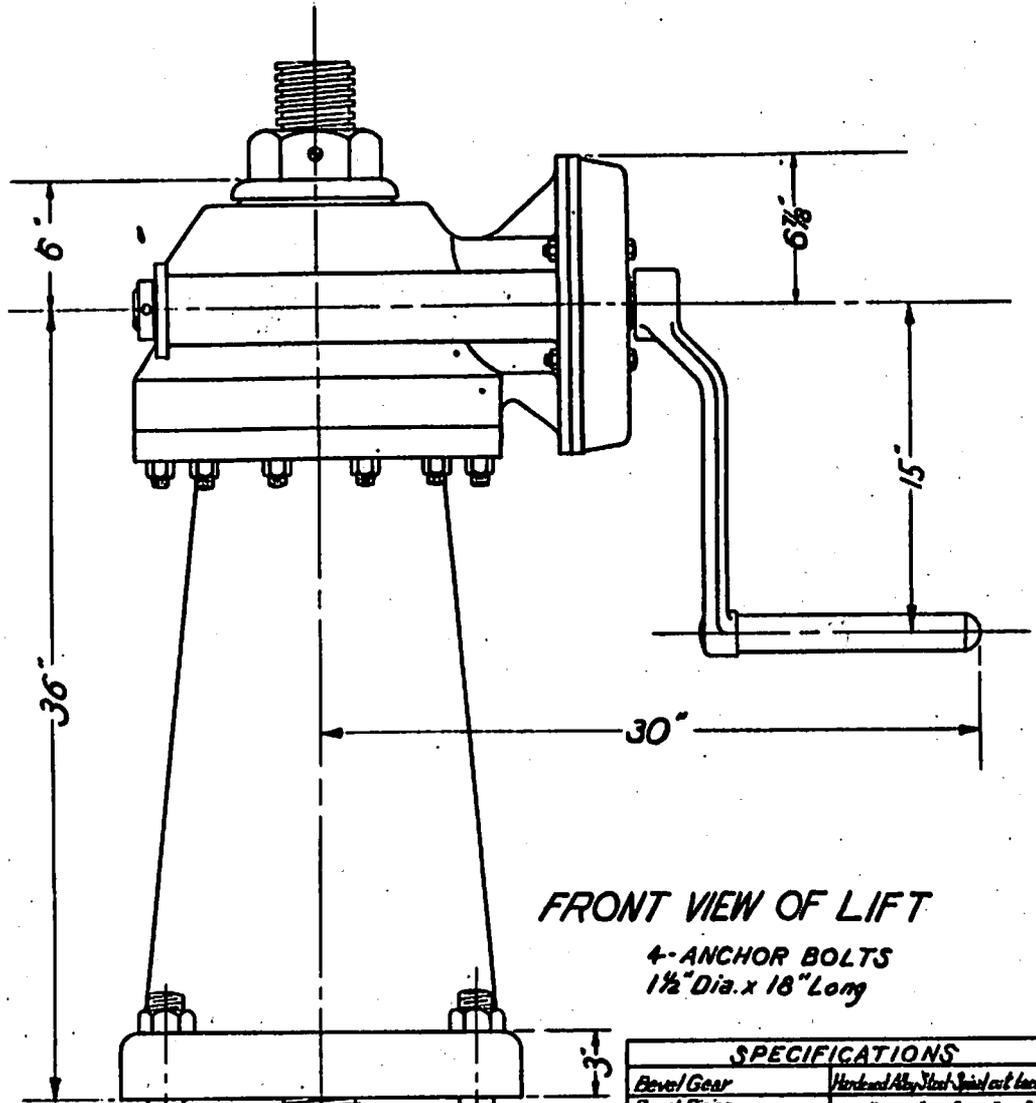
ANCHOR BOLT LOCATION

72\" x 96\" MOD #109 SLIDE GATE - BRONZE FACEU

EXHIBIT H

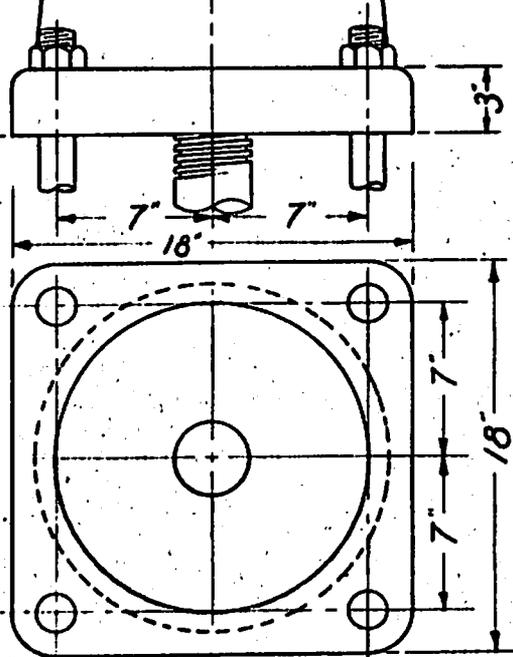
10-17-47

HARDESTY DIVISION ARMCO DRAINAGE & METAL PRODUCTS, INC.



FRONT VIEW OF LIFT

4- ANCHOR BOLTS
1 1/2" Dia. x 18" Long



PLAN OF BASE

SPECIFICATIONS	
Bevel Gear	Hardened Alloy Steel - cut teeth
Bevel Pinion	Cast Iron - cut teeth
Spur Gear	Cast Iron - cut teeth
Spur Pinion	Steel - cut teeth
For Bevel Pinion Shaft	Tapered Roller Bearing
For Spur Pinion Shaft	Bronze Bushed
For Lift Nut	Thrust Ball Bearings
Gear Ratio	High Speed 67:1 Low Speed 36:1
Capacity - High Speed	7,000 lbs with 40' pull on crank
Low Speed	34,000 "
Max Stem Dia.	3 1/2"
Threads per Inch	2
Types of Thread	Std. Acme 3/4" stem & smaller Modified Acme 3/4" dia. stem

EXHIBIT I

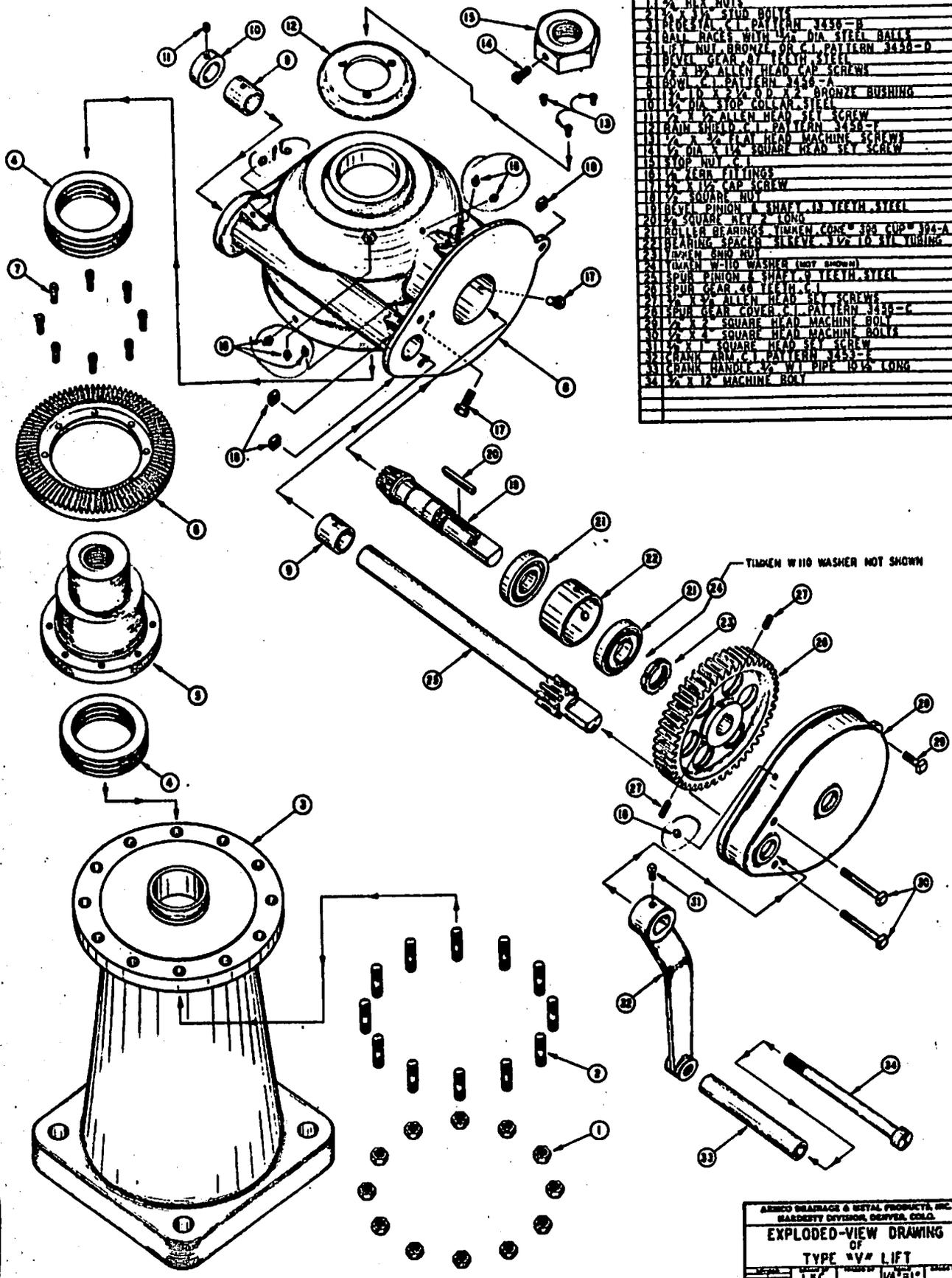
THIS SHOP DRAWING APPROVED
IN ACCORDANCE WITH
APPLICABLE PROVISIONS OF SPECIFICATIONS
U. S. ENGINEER OFFICE, P. O. BOX 711
SEABOARD, TEXAS

By *E. J. McArthur*
Title *Work Eng* Date *Dec 47*

THE R. HARDESTY MFG. CO.	
LINE DRAWING	
TYPE V 34-1 LIFT.	
4.5	30-4-3507

PARTS LIST

1	1/2" DIA. HUB NUTS
2	1/2" DIA. STUD BOLTS
3	PROTECT. C.I. PATTERN 3430-B
4	BALL RACES WITH 1/2" DIA. STEEL BALLS
5	LOCK NUT, BRONZE OR C.I. PATTERN 3430-D
6	SPUR GEAR, 1 1/2" DIA. STEEL
7	1/2" X 1/2" ALLEN HEAD SET SCREWS
8	1/2" DIA. C.I. PATTERN 3430-A
9	1/2" DIA. X 2 1/2" O.D. X 1/2" BRONZE BUSHING
10	1/2" DIA. STOP COLLAR, STEEL
11	1/2" X 1/2" ALLEN HEAD SET SCREW
12	MAIN SHIELD, C.I. PATTERN 3430-F
13	1/2" X 1/2" FLAT HEAD MACHINE SCREW
14	1/2" DIA. X 1/2" SQUARE HEAD SET SCREW
15	STOP NUT, C.I.
16	KEEN FILLINGS
17	1/2" X 1/2" CAP SCREW
18	1/2" SQUARE NUT
19	SPUR PINION & SHAFT, 1 1/2" TEETH, STEEL
20	1/2" SQUARE KEY, 2" LONG
21	ROLLER BEARINGS, TIMKEN CO. "3/4" CUP" 3/4" A
22	BEARING SPACER, 3/16" X 1/2" X 1/2" TUBING
23	WASHER, 5/16" NUT
24	(MAIN W-110 WASHERS (NOT SHOWN))
25	SPUR PINION & SHAFT, 1 1/2" TEETH, STEEL
26	SPUR GEAR, 4 1/2" DIA. C.I.
27	1/2" X 1/2" ALLEN HEAD SET SCREWS
28	SPUR GEAR COVER, C.I. PATTERN 3430-C
29	1/2" X 1/2" SQUARE HEAD MACHINE BOLT
30	1/2" X 1/2" SQUARE HEAD MACHINE BOLT
31	1/2" X 1/2" SQUARE HEAD SET SCREW
32	CRANK ARM, C.I. PATTERN 3430-E
33	CRANK HANDLE, 3/4" W.I. PIPE 19 1/2" LONG
34	1/2" X 1/2" MACHINE BOLT



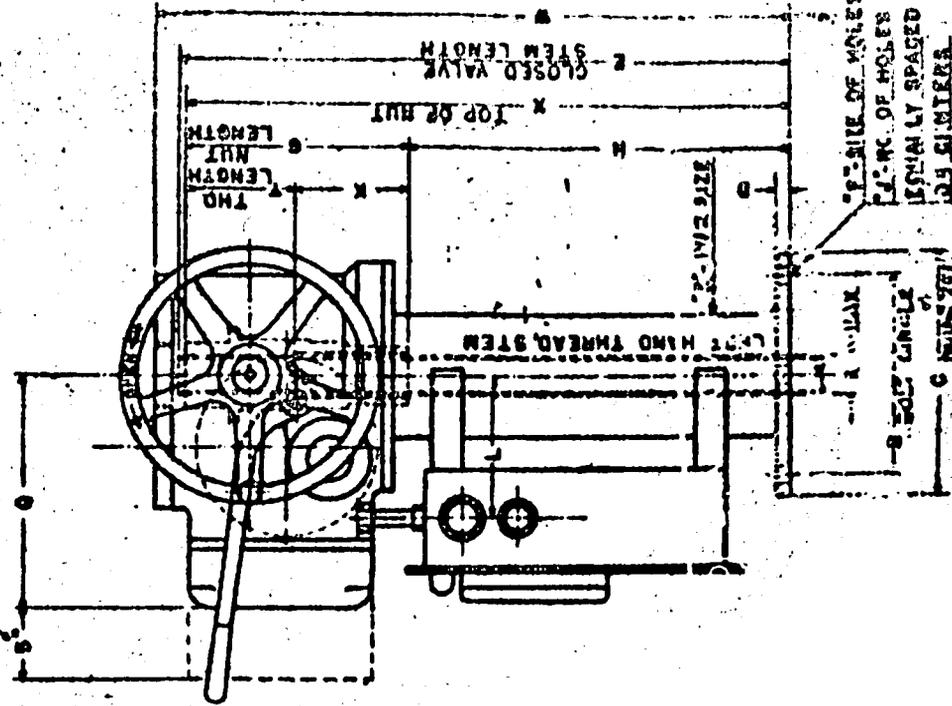
ARMCO DRUMMAGE & METAL PRODUCTS, INC.
 HARDENED DIVISION, DENVER, COLO.
EXPLODED-VIEW DRAWING
 OF
TYPE "V" LIFT

DATE	REV.	BY	CHKD.

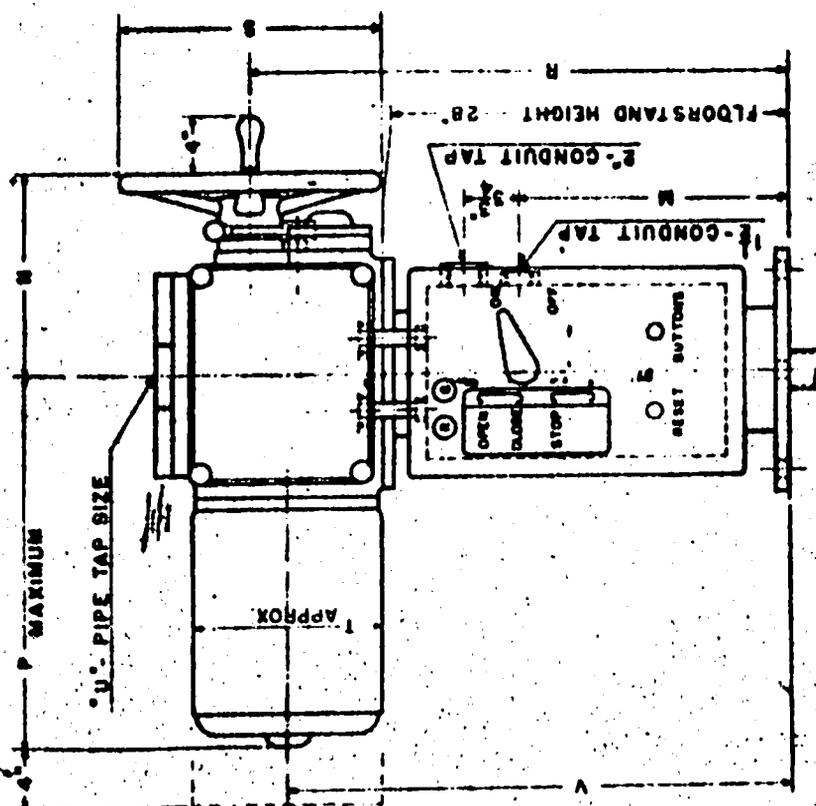
MANUALLY OPERATED HOIST

EXHIBIT J

SPACE FOR L. S. COVER REMOVAL



SPACE FOR MOTOR REMOVAL

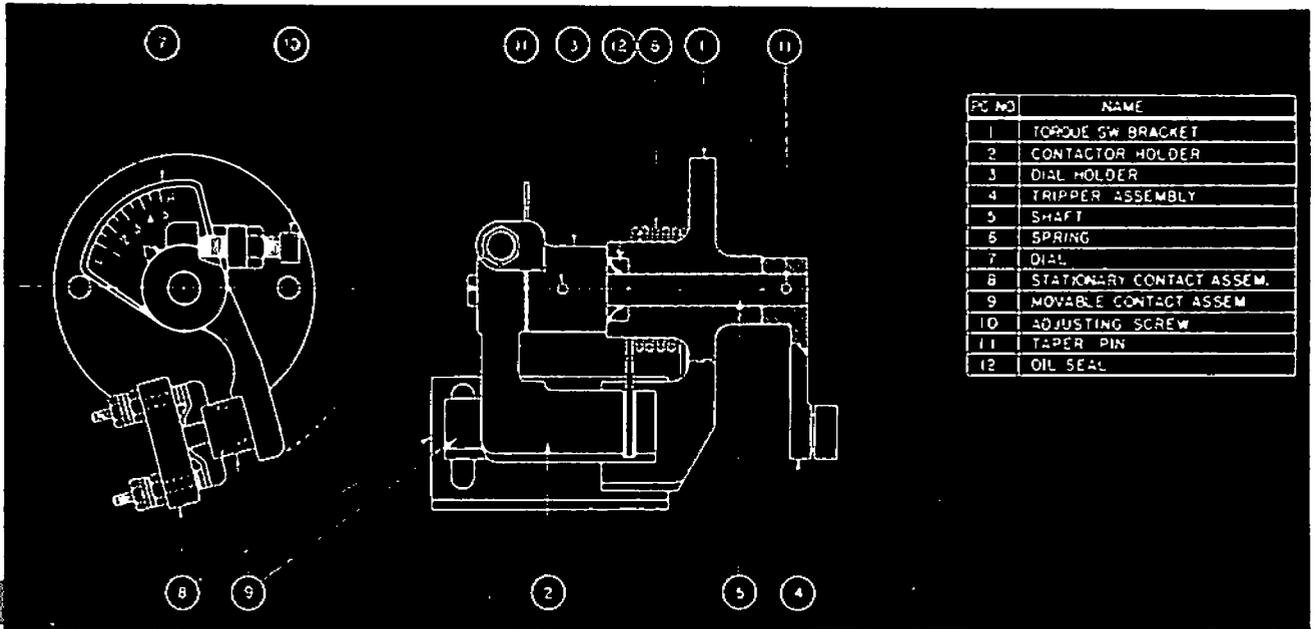


WITH CONTROL CABINET

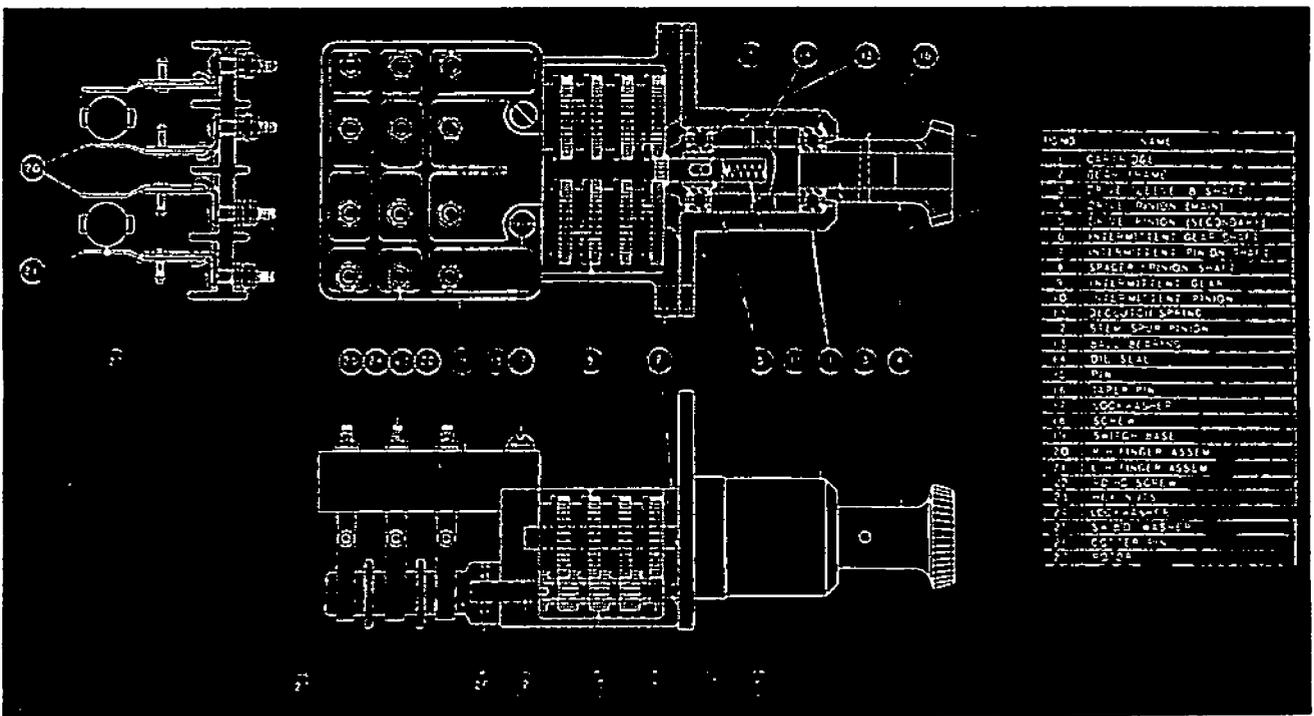
UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	O	R	S	T	U	V	W	X	Y	Z
SM-1	12	11	14	1	30	18	10	27	4	6	18	10	20	15	3	9	12	11	2	32	39	37	4	6
SM-2	2	14	17	1	40	18	12	27	4	6	8	18	12	22	14	15	12	11	3	53	41	53	6	8
SM-3	3	14	17	1	42	18	15	26	4	7	9	18	4	28	16	13	18	13	4	34	43	41	7	8
SM-4	4	17	21	1	44	18	17	25	4	6	11	18	15	32	19	30	24	19	5	35	46	45	9	10

EXHIBIT K

TORQUE SWITCH ASSEMBLY



GEARED LIMIT SWITCH ASSEMBLY



PHILADELPHIA

LIMITORQUE VALVE CONTROL

LIMIT SWITCHES

There are two limit switches in the Limatorque Valve Operator, the "torque switch" and the "geared limit switch."

The geared limit switch, shown in Fig. 1, governs the valve disc travel in the opening direction and for light indication in both directions.

The torque switch, shown in Fig. 2, controls the travel in the closing direction. These switches are always "in step," in both motor and hand operation.

THE GEARED LIMIT SWITCH

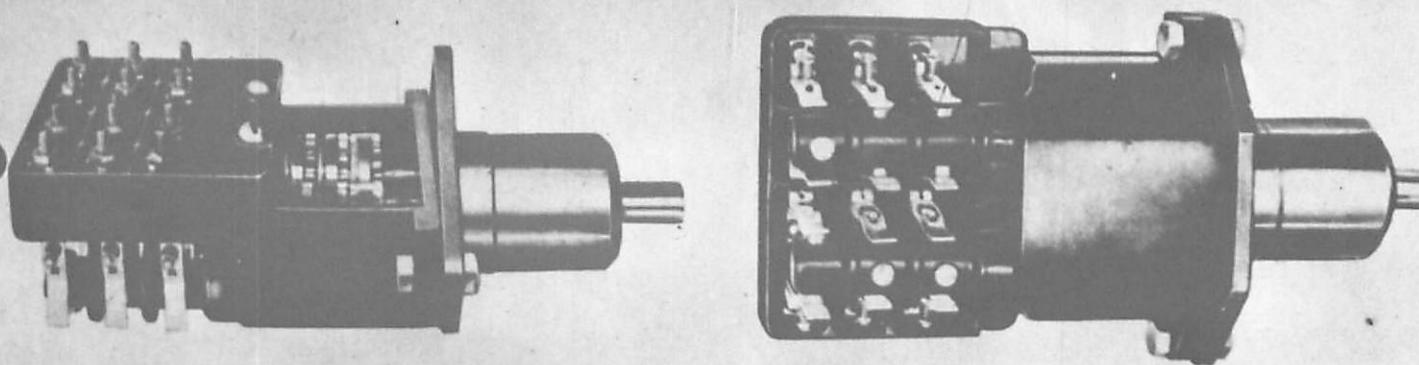


Fig. 1

THE GEARED LIMIT SWITCH consists of two rotary drum switches driven from the operating mechanism through two trains of intermittent gears. Each drum switch can be adjusted independently of the other.

One circuit on one drum is used to open the holding coil circuit of the controller and to operate the "open" indicating light. One circuit on the other drum is used to control the "closed" indicating light.

Additional contacts can be provided to operate interlocks, extra lights or auxiliary equipment as desired.

PROCEDURE FOR SETTING THE GEARED LIMIT SWITCH

1. Make certain that the electric current is turned off.
2. Open the valve by hand until the valve disc strikes the back seat. Note the direction in which the large gears are turning on the drum switch connected to the "open" contactor coil.
3. Back the valve disc down about one inch to allow for coast of the moving parts.
4. With the valve in this position, declutch the drive pinion by depressing the Pinion, Part No. 5, located between the two gear trains in the switch. This allows the gear nearest the pinion to be turned with the fingers.
5. Turn this one gear, in the same direction as noted when the valve was opened, until the drum switch makes a quarter turn and opens the circuit. Release the pinion. This switch is now set.

A PRODUCT OF PHILADELPHIA GEAR WORKS

6. Connect the current and check this setting as follows:
 - (A) Run the valve to mid position by hand.
 - (B) Press the "open" pushbutton — make sure the valve is moving in the "open" direction.
 - (C) Allow the limit switch to stop the motor.
 - (D) After the motor has stopped, turn the valve by hand to be certain that there is sufficient clearance between the point at which the valve comes to rest and the back seat.
7. Run the valve to the closed position, then back off one turn of the handwheel.
8. Set the "closed" light switch following the same procedure as outlined under 4 and 5 above. This switch should open slightly before the torque switch opens. Be careful not to disturb the setting of the opposite gear train.

THE TORQUE SWITCH

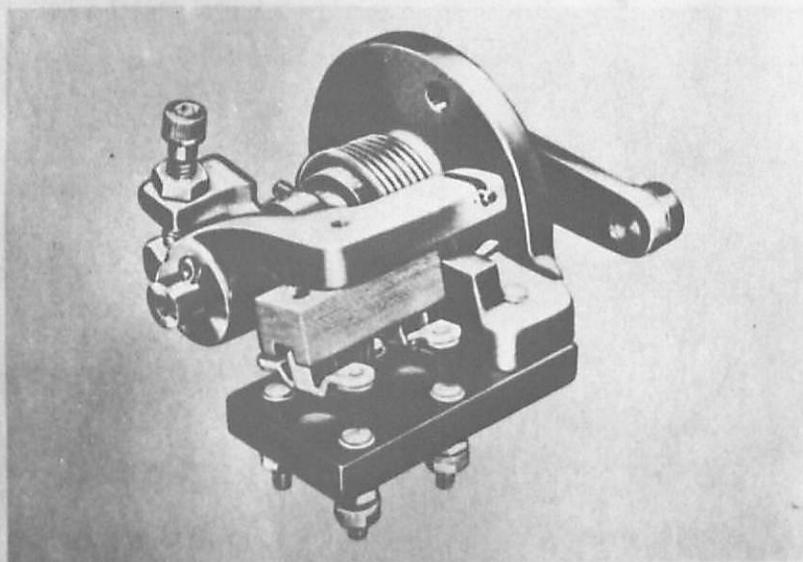


Fig. 2.

THE TORQUE SWITCH is extremely simple, consisting of only a fixed and movable contact. The fixed contact is provided with a micrometer screw adjustment and has a scale to show the setting.

The movable contact is operated by a lever which is actuated by the axial movement of the worm on the worm shaft. The worm is splined to the shaft and is normally held in position by the heavy torque spring. When the valve seats or meets with an obstruction the torque exerted by the worm exceeds the normal torque, causing the worm to slide along the worm shaft and open the torque switch.

The torque switch provides a means of adjusting the amount of thrust exerted on the valve disc. By means of this adjustment the seating thrust may be varied up to forty per cent.

PROCEDURE FOR SETTING THE TORQUE SWITCH

1. Make sure the electric current is off.
2. Loosen the jam nut on the adjusting screw.
3. Move the screw in for light seating.
4. Close the valve by motor and test for tightness of closing. If the valve closes tightly enough, tighten the jam nut.
5. For heavier seating move the screw out and re-tighten the jam nut. The exact setting of the Torque Switch must be determined by trial.

Both the Geared Limit Switch and the Torque Switch carry the control current only. The design is such that a quick break of the contacts is assured.

Two pole or special multiple contact switches can be furnished for oil refinery or similar applications.