INSTRUCTIONS FOR THE INSTALLATION, CARE AND OPERATION

—OF—

ELLIOTT TYPE CY

MECHANICAL DRIVE TURBINES

INSTRUCTION BOOK No. 60

JUNE 1943

ELLIOTT COMPANY

STEAM TURBINE DEPARTMENT—JEANNETTE, PA.

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INDEX

YOUR Elliott turbine has been carefully designed, accurately built, thoroughly tested and inspected. Every effort has been made to place this unit in your hands in perfect condition, so that you may receive the many years of trouble-free service that have been built into it.

When this turbine reaches you, it is expected that you will assume your full responsibility, by adequately protecting it during any period of storage, by providing skilled workmen for moving the unit to and upon its foundation, by aligning and piping it up correctly and by providing proper attendance for routine operation. This instruction book provides such cuts and text as will best illustrate and describe how the above may be accomplished. These recommendations are based on many years of turbine building experience and should be followed as closely as possible to obtain the best operating results from your Elliott turbine.

SPECIAL NOTICE

Your turbine is protected against corrosion for the period of shipment and installation only.

Remove slushing oil before starting up.

Provide turbine casing drainage.

IF NOT USED IMMEDIATELY

Store in clean dry place, in an approximately level position, to avoid distortion.

Open turbine, remove carbon rings from rotor and leave them off. Slush the rotor all over.
(Refer to Section II, page 11, item "Casing")

Slush all finished exterior and interior parts with heavy, non-corrosive oil.

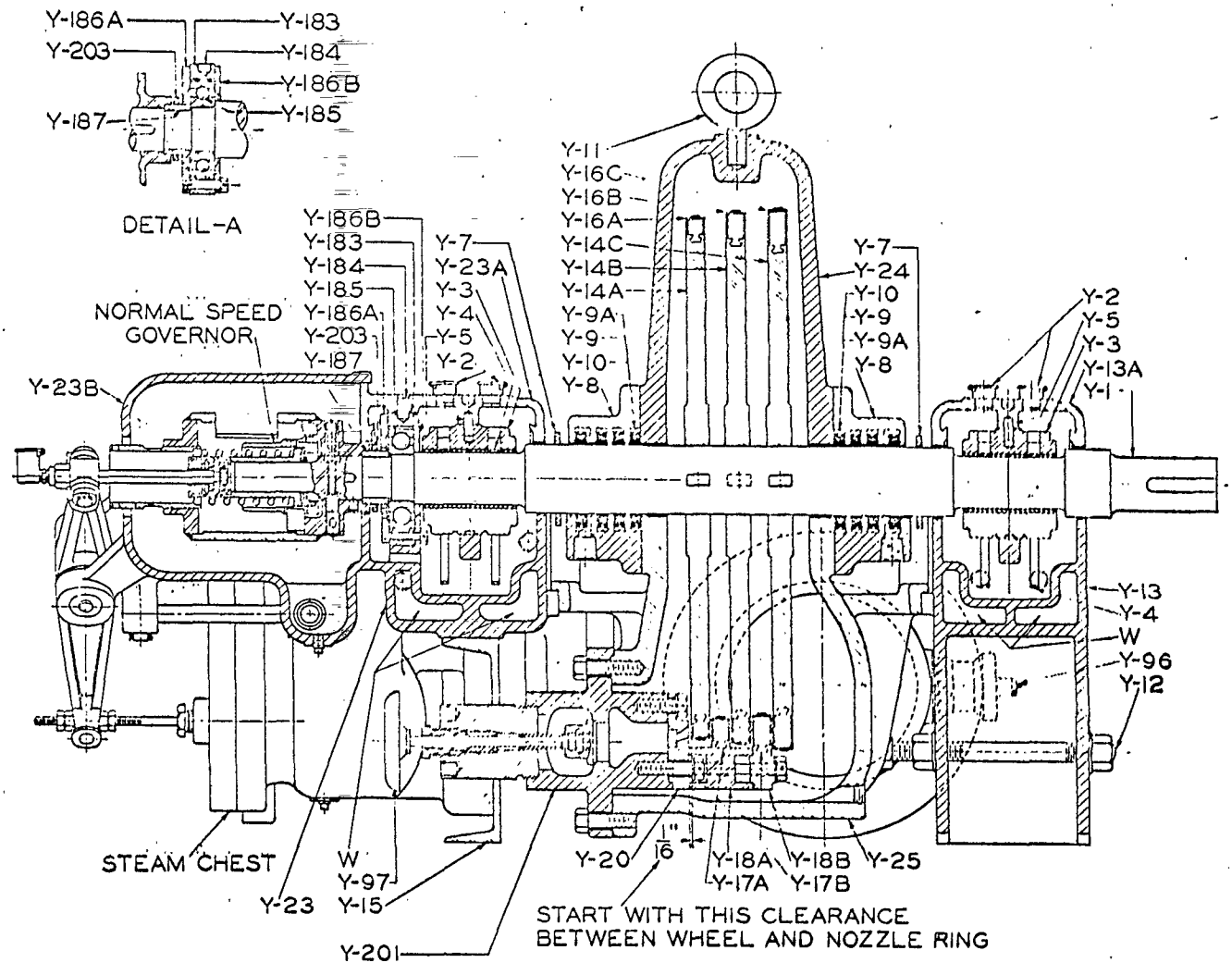
Cover complete unit to protect from dust.

Inspect periodically and renew slushing oil where necessary.

Before starting, slight corrosion should be carefully removed with fine emery cloth.

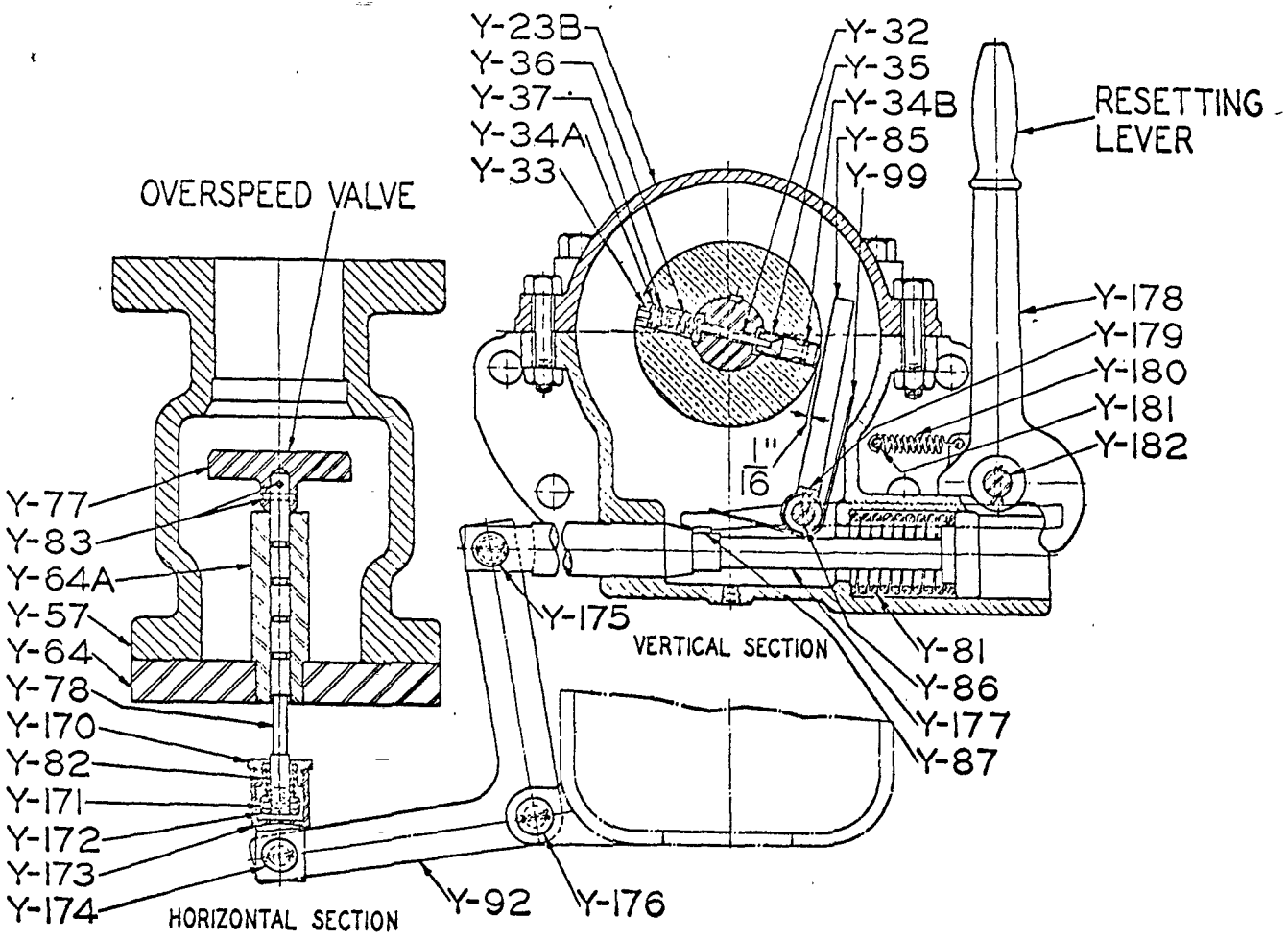
Before using, clean thoroughly with lint-free rags.

INDEX



No.	NAME OF PART
Y-1	Shaft
Y-2	Oil Filler and Sight Cups
Y-3	Bearing
Y-4	Oil Ring
Y-5	Bearing Stop
Y-7	Deflector Ring
Y-8	Packing Case
Y-9	Carbon Packing Ring
Y-9A	Packing Ring Spring
Y-10	Packing Ring Stop
Y-11	Eyebolt
Y-12	Pedestal Stud
Y-13	Exhaust End Bearing Pedestal
Y-13A	Pedestal Cap
Y-14A	First Wheel
Y-14B	Second Wheel
Y-14C	Third Wheel
Y-15	Steam End Bearing Case Flexible Support
Y-16A	First Row of Revolving Buckets
Y-16B	Second Row of Revolving Buckets
Y-16C	Third Row of Revolving Buckets
Y-17A	First Row of Stationary Buckets
Y-17B	Second Row of Stationary Buckets
Y-18A	First Row Stationary Bucket Holder
Y-18B	Second Row Stationary Bucket Holder
Y-20	Nozzle Ring
Y-23	Steam End Bearing Case
Y-23A	Bearing Case Cap
Y-23B	Governor Cover
Y-24	Upper Half Casing
Y-25	Lower Half Casing
Y-96	Sentinel Valve
Y-97	Auxiliary Hand Valve
Y-183	Thrust Bearing Cage Ring
Y-184	Thrust Bearing Dowel
Y-185	Ball Thrust Bearing
Y-186A	Thrust Bearing Clamping Ring
Y-186B	Thrust Bearing Clamping Ring
Y-187	Thrust Bearing Retainer
Y-201	Steam Ring
Y-203	Oil Slinger
W	Water Cooling Chambers

Fig. 1—Section Through Type 3-CY Turbine

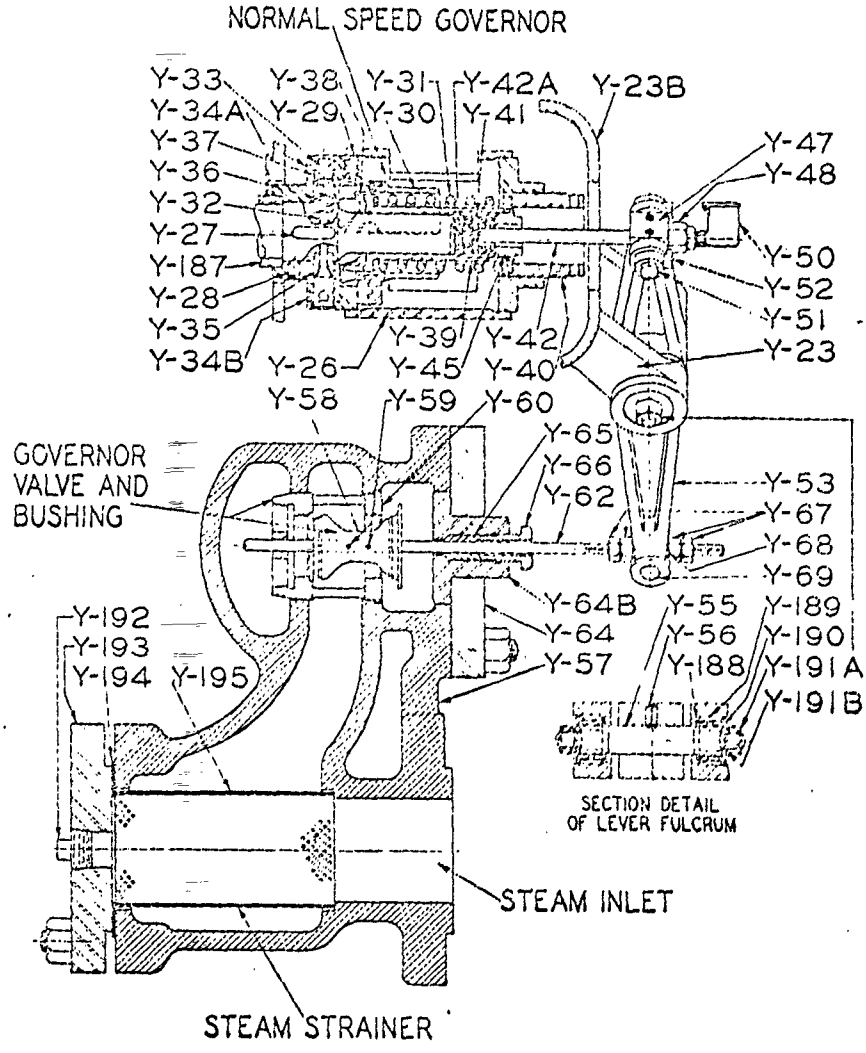


No.	NAME OF PART
Y-23B	Governor Cover
Y-32	Overspeed Governor Trip Pin
Y-33	Trip Pin Adjusting Nut
Y-34A	Adjusting Nut Lock Staple
Y-34B	Trip Pin Lock Staple
Y-35	Trip Pin Auxiliary Weight
Y-36	Trip Pin Spring
Y-37	Trip Spring Washer
Y-57	Steam Chest
Y-64	Steam Chest Cover
Y-64A	Valve Stem Guide
Y-77	Overspeed Trip Valve

No.	NAME OF PART
Y-78	Trip Valve Stem
Y-81	Trip Plunger Spring
Y-82	Trip Lever Connection Spring
Y-83	Trip Valve Pins
Y-85	Trip Lever
Y-86	Hand Trip Lever
Y-87	Knife Edge Block
Y-92	Trip Bell Crank Lever
Y-99	Trip Lever Spring
Y-170	Spring Retainer
Y-171	Valve Stem Nut Pin

No.	NAME OF PART
Y-172	Valve Stem Nut
Y-173	Trip Lever Connection
Y-174	Trip Lever Connection Pin
Y-175	Trip Plunger Pin
Y-176	Trip Lever Fulcrum Pin
Y-177	Trip Plunger
Y-178	Resetting Lever
Y-179	Trip Lever Set Screw
Y-180	Resetting Lever Spring
Y-181	Resetting Lever Spring Pin
Y-182	Resetting Lever Fulcrum Pin

Fig. 2—Section Through Overspeed Governor and Valve



No.	NAME OF PART
Y-23	Steam End Bearing Case
Y-23B	Governor Cover
Y-26	Governor Cage
Y-27	Governor Cage Key
Y-28	Set Screw
Y-29	Knife Edge Seat
Y-30	Governor Weight Assembly
Y-31	Governor Spring
Y-32	Overspeed Governor Trip Pin
Y-33	Trip Pin Adjusting Nut
Y-34A	Adjusting Nut Lock Staple
Y-34B	Trip Pin Lock Staple
Y-35	Trip Pin Auxiliary Weight
Y-36	Trip Pin Spring
Y-37	Trip Spring Washer
Y-38	Governor Collar
Y-39	Governor Spring Sleeve
Y-40	Governor Spring Adjusting Nut

No.	NAME OF PART
Y-41	Governor Spindle Ball Bearing
Y-42	Governor Spindle
Y-42A	Ball Bearing Retaining Nut
Y-45	Governor Spindle Bearing Retainer
Y-47	Governor Spindle Block
Y-48	Governor Spindle Nut
Y-50	Governor Spindle Bearing Lubricator
Y-51	Governor Spindle Block Pins
Y-52	Set Screw
Y-53	Governor Lever
Y-55	Governor Lever Fulcrum Pin
Y-56	Set Screw
Y-57	Steam Chest
Y-58	Governor Valve
Y-59	Governor Valve Pins
Y-60	Governor Valve Bushing
Y-62	Governor Valve Stem

No.	NAME OF PART
Y-64	Steam Chest Cover
Y-64B	Valve Stem Packing Box
Y-65	Ring Packing
Y-66	Packing Nut
Y-67	Valve Stem Locknuts
Y-68	Valve Stem Block
Y-69	Governor Lever Blocks
Y-187	Thrust Bearing Retainer
Y-188	Ball Bearing Inner Dust Washer
Y-189	Governor Lever Fulcrum Ball Bearing
Y-190	Ball Bearing Outer Dust Washer
Y-191A	Ball Bearing Nut
Y-191B	Lock Washer
Y-192	Pipe Plug
Y-193	Steam Strainer Cover
Y-194	Gasket
Y-195	Steam Strainer

Fig. 3—Section Through Steam Strainer, Governor Valve and Governor

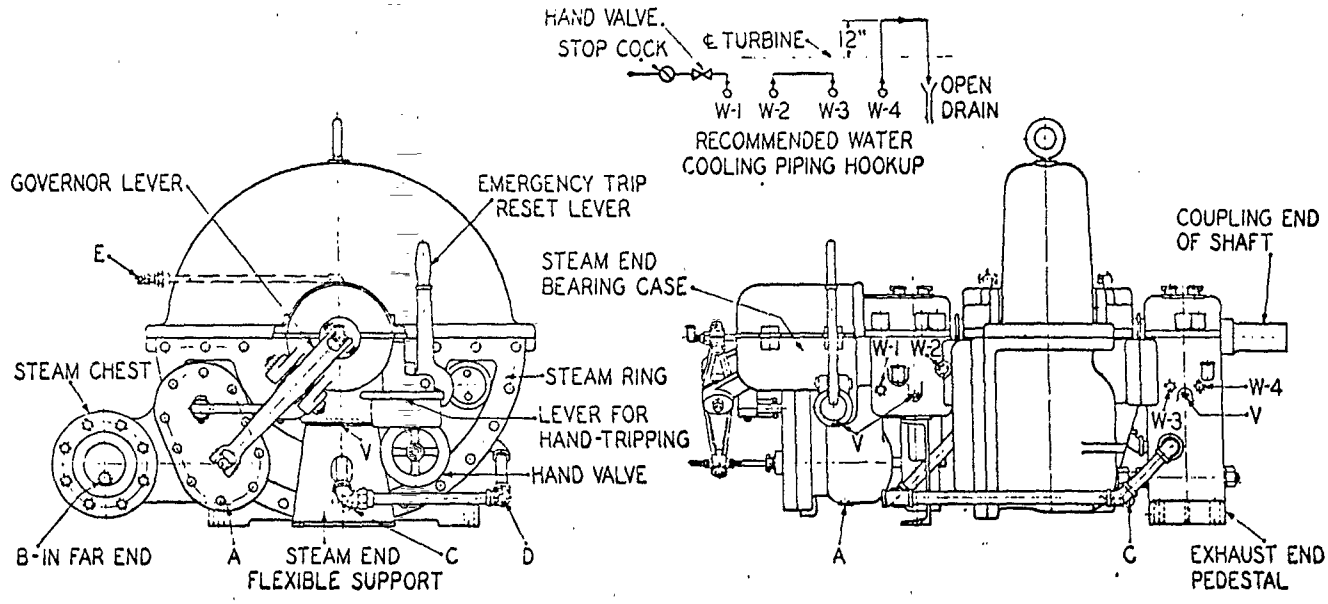


Fig. 4—Piping Connections

No.	NAME OF PART	No.	NAME OF PART
A	Steam Chest Drain	V	Oil Drains
B	Steam Strainer Blowoff Connection	W-1	Cooling Water Connections
C	Casing Drain	W-2	
D	Leakoff from Packing Glands	W-3	
E	Steam Seal Connection	W-4	

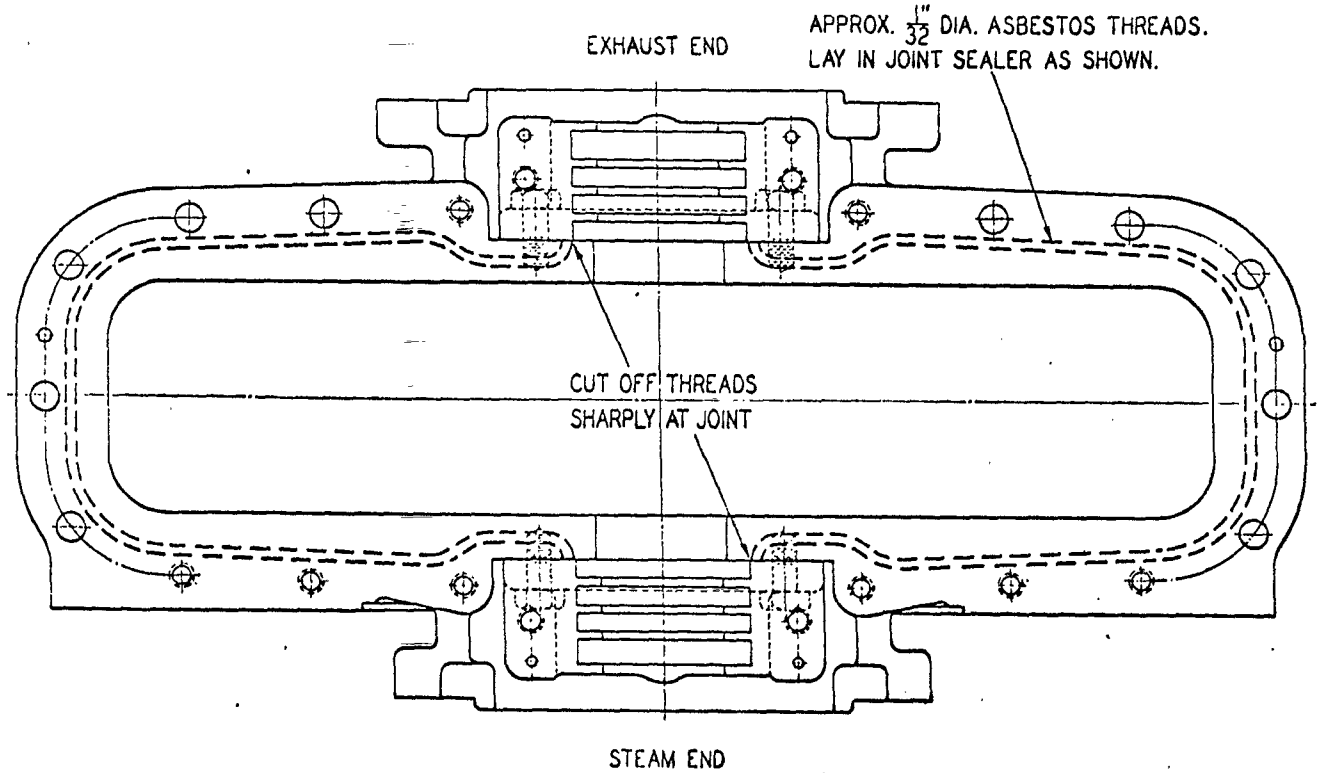


Fig. 5

SECTION I—GENERAL INSTRUCTIONS

SHIPMENT

The type CY turbine is shipped as a complete unit, mounted on substantial skids and covered with an open framework of light crating. The purpose of the latter is to indicate to the riggers the outside limits of the turbine and provide a means of visually identifying the contents of the crate. It is not considered to be a protective casing. All vital parts of the turbine are so protected by the skids or adjacent members as to withstand considerable rough handling. Partial collapse of the open crating does not, in general, indicate damage to the turbine.

UNPACKING

Remove the crating framework surrounding the turbine and examine the unit for any damage due to very rough or improper handling in transit. If the unit is not to be used at once, follow the directions contained in the special notice attached to the turbine and to the turbine crating. This special notice is also shown on the index page of this instruction book.

If the unit is to be installed at once, remove the coverings from the various openings and carefully clean the slushing oil from the several parts. With the turbine still on the skids move it to the site of the foundation and there remove the skids.

FOUNDATION

The area and depth of foundations for mechanical drive units are, to a considerable extent, dictated by the type of the driven apparatus. A minimum requirement for a foundation for these turbines is considered to be one with sufficient bulk of concrete or steel to absorb minor vibrations and to prevent synchronous vibrations being set up in the concrete or steel building members. Allow provision for accessibility to all parts of both the turbine and the driven apparatus.

INSTALLATION

In some cases the driving half of the coupling is mounted by the manufacturer of the turbine and in other cases it is mounted by the manufacturer of the driven apparatus, or the purchaser. In any case the coupling should be carefully heated and shrunk onto the turbine shaft. Driving the coupling on with a hammer should never be attempted as the force of the hammer blows will damage the turbine thrust bearing.

Move the turbine upon its foundation, and set it level and in alignment with the driven apparatus by aligning at the coupling halves. (Refer to Fig. 1.) Shim under the turbine exhaust end bearing pedestal (Y-13) and under the steam end bearing case flexible support (Y-15) to bring the turbine to the proper height, level and in alignment with the driven apparatus. In no case should the pedestal studs (Y-12) be changed from the factory setting.

With the turbine at the proper height and in final alignment slug up the foundation holding down bolts and dowel the exhaust end bearing pedestal (Y-13) to the soleplate or bedplate.

The work of alignment should be very carefully done as this is one of the most important steps in installation of the turbine and upon the accuracy of this work will largely depend the degree of smoothness with which the unit operates.

TURBINE PIPING

No part of the turbine installation is more important, for future successful operation, than a well-designed and well-executed piping job. There are two definite objectives in a good piping job: to prevent the heated piping from imposing strains on the turbine casing and thus affecting the alignment; to so connect and drain the turbine steam and exhaust lines that dry steam is furnished to the turbine and water accumulation in these pipe lines is prevented.

The high-pressure steam supply line should be taken off the top of the steam header at a point as near the turbine as possible. Drain this header by means of a steam trap, connected near the turbine take-off. As an alternate a steam separator may be put into the high-pressure turbine supply line to prevent water entering the turbine and causing expensive eroding of the turbine buckets.

Lead the turbine steam line through suitable expansion bends to a conveniently located turbine throttle valve preferably located in a vertical line. Proceeding from this point, terminate the supply line with a turbine steam line coupling flange which must be solidly anchored to the floor or foundation, leaving the balance of the line free to move or expand as required. The connection between this flange and the turbine inlet flange is to be made without forcing the pipe line in any direction whatever, in order to make a satisfactory joint. This connection may be considered entirely satisfactory if the supply line, when heated to operating temperature, does not kick out of line with the turbine inlet flange when the bolting is withdrawn.

Cover the turbine supply line with a good grade of pipe covering.

The turbine exhaust flange should be connected to the turbine through a suitable flexible copper or other type of expansion joint. If this line leads to other piping, an exhaust line valve must be installed and a suitable steam trap should be provided at the low point in this line to prevent an accumulation of water in the turbine casing. An exhaust line connection to the turbine which does not contain a flexible joint and a continuously trapped drain is a constant menace to proper turbine operation, and the saving effected by their omission cannot be reasonably justified.

Refer to Fig. 4 for the miscellaneous piping connections to this turbine, all of which are identified and their use described below.

1—"A"—¼" pipe tap—steam chest drain—connect through high-pressure piping and a globe valve, located near turbine throttle valve, to open drain. Open, just prior to starting, to drain water from steam chest. Close when water ceases to emerge from drain line.
When emergency valve is tripped, close turbine throttle valve, open drain "A" to relieve steam chest pressure, reset emergency trip with reset level; close drain "A"; open throttle valve to start turbine.

2—"B"—1" pipe tap on rear side of steam chest—blow-down connection from steam strainer space. Blow down as directed under "Routine Inspection."

3—"C"—½" pipe tap—casing drain—connect through valve to open drain; open just prior to starting turbine; close when casing is fully drained. Open when turbine is shut down and exhaust valve is closed.

4—"D"—¾" pipe tap—leakoff connection from carbon packing rings—connect to open drain without valve. Be sure that no back pressure is applied to this line.

5—"E"—¼" pipe tap—steam seal for carbon packing rings—Furnished only when turbine is operated under vacuum. Connect to a source of steam supply through a throttle valve. Admit steam to glands until a wisp of steam leaks out of "D." This prevents air leakage inwardly. (Not necessary to pipe up "D" on condensing turbine).

6—"W"—½" pipe taps—water cooling connections to the turbine bearings—located on the trip reset lever side of the turbine. Connect with a source of cool water through a stop cock and a globe valve into W-1; out of W-2; into W-3; out of W-4 through a one-foot head loop to an open drain. (Shown diagrammatically in Fig. 4). Adjust stop cock so that a moderate flow of water passes into the open drain with globe valve wide open. Then operate by full opening or closing globe valve when turbine is started or stopped.

STARTING AND STOPPING

(Refer to Fig. 1)

Prepare the turbine for the initial start-up as follows:

1—Remove the governor cover (Y-23B), bearing case cap (Y-23A) and pedestal cap (Y-13A).

2—Remove both upper and lower halves of both bearings (Y-3) for inspection and cleaning.

3—Carefully clean both bearing oil reservoirs and journals and replace lower halves of bearings.

4—Fill reservoirs to overflow height with "heavy medium" turbine oil having a viscosity of 230—330 seconds Saybolt at 100 deg. F. Lubricate coupling if necessary. NOTE:—If turbine is used in connection with a reduction gear and the bearings are **forced feed** follow directions given in gear instruction book for lubrication.

5—See that lower halves of bearings are flooded with oil and that ball thrust bearing (Y-185) is likewise flooded with oil. Fill governor spindle bearing lubricator (Y-50, Fig. 3) with "light" turbine oil.

6—Replace all of the above parts, insert dowels and pull down bearing cap nuts securely into place. Turn unit over by hand to see that everything is free.

7—Open steam chest drain "A" and casing drain "C." If overspeed trip valve (Y-77, Fig. 2) is closed, reset by pulling back reset lever (Y-178).

8—When above drains cease to bleed water, partially open throttle valve and allow turbine to run at about 800—1000 R.P.M. for 10 minutes, meanwhile observing general operation of the unit.

9—Bring the turbine slowly up to speed on the throttle valve, until the governor takes hold, then open the throttle valve wide. Check the speed. The full-load speed is stated on the turbine name plate.

10—Shut down the unit by striking the hand trip lever (Fig. 4) sharply, either with the hand or the foot.

11—Close throttle valve—open steam chest drain "A," and when steam chest pressure has been reduced reset overspeed trip valve as before. Open throttle valve and again bring turbine up to speed.

12—With one operator reading speed on an accurate hand tachometer another should push against the force of the governor, by firmly grasping both ends of the governor lever (Y-53, Fig. 3), until the speed rises 15 per cent or the unit trips out. Tripping will occur at 10 to 15 per cent above operating speed. Close throttle valve and reset trip as before.

13—Unit is now ready for service.

14—Routine starting is accomplished by checking oil levels, opening the drains and bringing the turbine up to speed on the throttle. Close drains when they bleed steam instead of water.

15—When shutting down, trip the overspeed valve by hand or close throttle valve. Open the drains.

OPERATION, ROUTINE INSPECTION

These machines require a minimum of operating attention since they are substantially built to withstand the severe service conditions to which mechanical drive turbines are usually subjected. Providing adequate lubrication is the one really essential and important operating detail. However, any routine system of inspection which anticipates possible operating difficulties before they reach serious proportions is manifestly desirable, and such a routine system is outlined below. The adoption of this system of routine inspection with such modifications or amplifications as are necessary to fit it into the operating schedule of your particular unit is recommended.

DAILY INSPECTION

1—Check oil level on all bearings.
2—Fill governor oil cup once every 8 hours.
3—Check bearing temperatures by hand.
4—Check smoothness of operation by hand and note any change.
5—Note any unusual noises or conditions and check frequently.
6—If shutdown is made daily, trip emergency valve by striking hand trip lever.
7—Check speed of unit.

WEEKLY INSPECTION

1—Blow down steam strainer connection "B" (Fig. 4).
2—If not on continuous running schedule, trip emergency valve by overspeeding the turbine, as previously described.
3—Oil governor and overspeed trip linkage sparingly with oil can.

MONTHLY INSPECTION

1—Change bearing oil and clean oil reservoirs. If in a very dirty atmosphere make this a weekly duty.
2—Remove governor cover and bearing caps and make visual inspection of governor parts and bearings. Clean as necessary.
3—Check governor linkage and overspeed linkage for lost motion.
4—Remove steam strainer and clean. If very dirty, make this a weekly operation.
5—Oil governor lever fulcrum ball bearings, (Y-189, Fig. 3).
6—Check coupling between turbine and driven apparatus for looseness or wear; if this is a lubricated coupling, check the lubrication.

YEARLY INSPECTION

1—Before disassembling or assembling any of the various units of your turbine, carefully read Section II of this book.
2—Check all clearances and adjustments as directed under Section III. Replace any wearing parts that may be too badly worn for further use.
3—Dismantle speed regulating governor and linkage (Fig. 3), and check for lost motion or worn parts. Clean thoroughly, lubricate and reassembly. Adjust for correct speed.
4—Dismantle overspeed trip governor and linkage shown in Fig. 2. Check for ease of operation; clean and lubricate sparingly.
5—Examine governor valve and bushing (Y-58, Y-60—Fig. 3) and clean. Grind in valve if unevenly worn. Check governor valve stem ring packing (Y-65) and replace if necessary. Be sure packing does not bind when reassembled.
6—Clean stem of overspeed trip valve (Y-78, Fig. 2).
7—Check turbine ball thrust bearing (Y-185, Fig. 1) for end play. Flush out with a pressure stream of clean oil.
8—Check operation of sentinel valve (Y-96, Fig. 1).
9—Lift casing and inspect both the moving and stationary blading; clean out any accumulation of scale and dirt between the buckets.
10—Check carbon rings to see that they are not fouled by an accumulation of scale or rust in packing cases. Carefully remove rings, clean and reassemble. CAUTION: —Read Section II.
11—When again in operation check turbine speed, tripping speed and general operation.
12—It is a good idea to have an Elliott service engineer inspect your turbine once each year.

RENEWAL PARTS AND SERVICE FACILITIES

The Elliott Company maintains a staff of field engineers to supervise the installation and starting up of new units. They are also available for inspecting, adjusting, ordering repairs, and supervising or installing repairs on older units. Their services are available at any time, usually on very short notice. In case of emergency their expert knowledge may be of great assistance in getting the unit back in service without delay.

Order turbine repair parts from the Elliott Company, Steam Turbine Department, Jeannette, Pa., or send the order through the nearest district office when time is available. A list of district offices is given on page 1.

SECTION II—DISASSEMBLY AND ASSEMBLY

GENERAL

Disassembly and assembly of the various parts of your turbine should be a familiar subject to your operating and maintenance personnel, in order that they may accomplish the work of routine inspection and be capable of checking and adjusting those parts which may require this service.

Much of the design of this unit is so clearly shown in the cuts that no description of disassembly or assembly is considered necessary. In general, only such descriptive matter is given under this heading, as is necessary for future replacement of a wearing part or the checking and adjustment of some clearance. Any future major replacement, such as wheels, buckets, shafts, etc., or any future major overhaul should be done under the supervision of an Elliott Company service engineer or at the factory.

CASING

To remove the rotating element or to inspect the interior of the turbine, the upper half turbine casing (Y-24, Fig. 1) must be lifted. First remove both the vertical and horizontal bolting on both upper half carbon ring packing cases (Y-8); break the joints by striking sharply with a lead hammer and carefully lift the cases straight up until they clear the carbon rings. Next remove the turbine cover bolting, break the horizontal joint and lift the cover upward until it clears the wheels. Cover (Y-24) weighs approximately 225 lb.

To reassemble:—

1—Scrape and carefully clean all exposed joints on both the upper and lower halves of the turbine casing (Y-24 and Y-25), as well as those on the upper and lower halves of the packing cases (Y-8). Do not allow scrapings to fall into the lower halves of the packing cases between the carbon rings and the walls. Blow out with air if available.

2—Apply a good coat of graphite and oil mixture, or an equally good steam sealing compound, on the horizontal flange of the lower half turbine casing, and in it lay two asbestos threads (approximately 1/32" dia.) as shown in Fig. 5. CAUTION:—Do not allow threads to be too near studs as clearance holes in cover may expose them; be sure that thread ends do not extend into the carbon packing case horizontal splits.

3—Lower the upper half casing over the turbine wheels and shake to a solid seating.

4—Insert dowels; pull down on horizontal flange bolting, starting nearest the shaft on both sides and working outwardly.

5—Coat both the horizontal and vertical joints of the carbon packing cases with joint sealer. CAUTION:—Do not allow sealer to run down into carbon ring spaces as it will prevent the rings from sealing on the side walls.

Place upper half packing cases in position and insert dowels in horizontal flange and pull up horizontal flange bolts tight. Pull up bolting on vertical split.

PACKING CASES AND CARBON RINGS

To remove the carbon rings and their retaining springs (Y-9, Y-9A and Y-10), lift the upper half packing cases (Y-8), as previously described. Unhook and remove the circular spring assembly surrounding each three-piece carbon ring, after which the separate pieces of the ring may be removed by rolling around the shaft. CAUTION:—Keep the three parts of each ring and spring assembly of each ring together so that they may be replaced together in the same packing case groove from which they were removed.

To reassemble, clean out packing case grooves thoroughly, clean shaft and rings with kerosene. Place springs around shaft and hook ends together. Starting with that segment of the ring into which the dowel fits, force the proper segments under their respective springs. CAUTION:—Be sure that those sections which abutt each other are marked with similar markings so that they are reassembled mark to mark.

Reassemble gland cases as directed above.

ROTOR ASSEMBLY

The rotor assembly consists of the shaft, upon which are mounted the wheels, the driving half couplings, sliders, ball thrust bearing assembly and the mechanical speed governor assembly. To remove the rotor from the casing, disconnect the turbine from the driven machine at the coupling and remove the upper half turbine casing (Y-24), the upper halves of both carbon ring packing cases (Y-8), the pedestal cap (Y-13A), the governor cover (Y-23B) and the steam end bearing case cap (Y-23A). Remove the top halves of both sleeve bearings (Y-3).

Refer to Fig. 3. Disconnect the governor spindle (Y-42) from the governor lever (Y-53) as follows: Remove the ball bearing nut (Y-191), governor lever set screw (Y-56) (mark so that identical replacement can be made) and drive governor lever fulcrum pin (Y-55), together with

lower ball bearing assembly out of bearing case housing (Y-23). Remove governor spindle lubricator (Y-50), governor spindle block pin set screws (Y-52) and pins (Y-51). Swing governor lever away from turbine, pivoting on governor lever blocks (Y-69). Governor lever may then be lifted off and laid aside.

Lift rotor straight upward (weight approximately 250 lb.) being sure to protect shaft journals and carbon rings from damage. Lay rotor aside and prevent from rolling by blocking under wheels. CAUTION:—While rotor is out of casing keep ball thrust bearing assembly tied up in clean rags to prevent the entrance of dirt.

When lowering rotor into position shake lightly so that wheels will not engage the reversing buckets while descending. Cease lowering when carbon rings are about to enter their respective slots. Be sure that rings and slots are lined up before final lowering and that the slots are free from scale or rust. CAUTION:—See that ball thrust bearing positioning dowel (Y-184—Fig. 1) is in position and that the clearance between the first wheel shroud (Y-16A), and nozzle ring (Y-20), is approximately 1/16 inch.

SLEEVE BEARINGS

Removal of the sleeve bearings (Y-3) is readily accomplished by removing the bearing caps (Y-23A and Y-13A). Lift out top halves and roll out bottom halves, allowing shaft to rest on packing gland cases.

When replacing make sure that oil rings are correctly placed and free to turn, that the positioning dowels (Y-5) are in place and that the bearing is flooded with oil.

If high spots show in the bearing, scrape them out lightly.

TURBINE BALL THRUST BEARING

The turbine thrust bearing is located in a housing composed of the thrust bearing clamping rings (Y-186A and Y-186B) and the bearing cage ring (Y-183). It is held in position and located axially by dowel pin (Y-184).

To remove this bearing the rotating element must first be lifted from the turbine as previously described.

Refer to Fig. 3. Before removing the governor spring adjusting nut (Y-40), measure the distance from the end of this nut to a convenient point on the governor cage (Y-26), so that on reassembly the nut can be put back into its exact previous setting. Having removed governor adjusting nut (Y-40), grasp the governor spindle (Y-42) and pull outward, which will allow removal of the governor weights (Y-30), the governor spring (Y-31), and the complete spindle assembly.

Remove the overspeed governor trip pin (Y-32) and the complete pin assembly by first taking out the U-shaped adjusting nut lock staples (Y-34A and Y-34B), located at each end of the trip pin. Then unscrew the trip pin adjusting nut (Y-33), after which the trip pin spring (Y-36) and trip pin (Y-32) will come out. If there are auxiliary weights (Y-35) in your machine, these may now be removed.

Having removed all parts of the governor assembly, the governor cage hub set screw (Y-28) should now be removed and the hub in the vicinity of the set screw should be evenly heated with a torch, after which it may easily be bumped off the shaft. CAUTION:—In heating the governor hub, avoid heating the shaft as much as possible. If a puller is used, be sure to pull on the hub rather than at the end of the governor cage. Next, remove the ring (Y-203) by splitting it. Then remove the three-piece retainer (Y-187) after which the ball bearing assembly, including the housing, may be driven off the shaft.

Remove the old bearing from its housing and insert the new one; put on the clamping ring (Y-186A) and secure it with the plate screws, making sure that the bolt head locking wire is threaded through the bolt heads to keep them from backing out. Slip the assembly on the shaft and tap it into place by means of a sleeve which strikes the shaft race of the ball bearing. Drive the bearing into a solid seating against the shoulder on the shaft. The three-piece bearing retainer (Y-187) must fit tight between the bearing (Y-185) and the shoulder on the shaft nearest the governor cage. Obtain this fit by grinding off the end of the retainer next to the bearing. The retainer pieces should be tapped into place to insure a tight fit between the bearing and the shoulder on the shaft. Measure the depth of the recess in the governor cage at the point it slips over the retainers to determine the location of the shrink ring (Y-203). The ring should be heated quite hot to insure adequate expansion for the heavy shrink allowed in the ring fit. Next the governor case hub may be slightly heated and slipped on the shaft. Be sure that the counterbore in the hub covers the ends of the retainer (Y-187) and that the emergency trip pin holes in both the shaft and governor case hub line up. Replace set screw (Y-28), prick punch it to hold in place and replace the governor parts as described below. CAUTION:—Keep the ball bearing clean and flood with oil before use.

NORMAL SPEED GOVERNOR AND LINKAGE

This mechanism is shown in complete detail in Fig. 3. Before reassemblying clean all parts and

the shaft end carefully. If any burrs are present they should be removed.

The governor spindle assembly consists of the governor spring sleeve (Y-39), the governor spindle bearing retainer (Y-45), the governor spindle ball bearing (Y-41), and the governor spindle (Y-42). This assembly may be taken apart for inspection or replacement of the ball bearing by removing the governor spindle bearing retainer (Y-45). When this nut is replaced and pulled up tight be sure that the bearing turns freely and has no perceptible end play. Lock the nut by prick punching the edge of the nut head into saw cut on the sleeve.

Place the governor collar (Y-38) on the end of the spindle assembly and slide this entire mechanism into the shaft end. Insert governor weights (Y-30) and in this operation see that there is no scale or rust between the governor weight knife edges and the knife edge seats (Y-29). Next, insert governor spring (Y-31) and partially screw in adjusting nut (Y-40). At this point pry up each weight with a fulcrumed screw driver to see that the governor operates freely. Screw up on adjusting nut to the setting which has been previously registered by measurement.

To reassemble governor lever (Y-53), engage the lower end governor lever blocks (Y-69) into the governor valve stem block (Y-58). Swing the lever into position with the governor spindle block (Y-47) between the upper lever fork. From the under side tap the governor lever fulcrum pin (Y-55), which is assembled with ball bearings (Y-189), washers (Y-188 and Y-190), lock washer (Y-191B), and nut (Y-191A) up through the governor lever and assemble washer (Y-188), ball bearing (Y-189), washer (Y-190), lock washer (Y-191B), and nut (Y-191A) on the protruding end, in the order named. Screw governor lever set screw (Y-56) into its previous position. Insert governor spindle block pins (Y-51) and set screws (Y-52) into position. Replace governor spindle nut (Y-48) and oil cup (Y-50) into position. CAUTION:—After governor linkage has been disassembled and reassembled check valve travel as described in Section III under "Adjustments."

OVERSPEED TRIP GOVERNOR AND LINKAGE

Refer to Fig. 2 which shows the details of this mechanism. In replacing the trip pin (Y-32), be sure that the trip spring washers (Y-37) are in position since they are a part of the adjustment for determining the speed at which the unit trips. Place U staple wires (Y-34A and Y-34B) in position and with a screw driver placed on trip pin adjusting nut (Y-33) press the pin outward sharply to see that it works freely. Replacement of the linkage is clearly shown in Fig. 2 and needs no description.

STEAM CHEST

Refer to Figs. 2 and 3 for sections and Fig. 4 for external view of steam chest.

The steam chest is composed of three chambers through which the steam flows as follows: steam passes from the steam inlet through the steam strainer basket (Y-195), then through the governor valve and bushing (Y-58 and Y-60), and from this point, through the overspeed trip valve (Y-77, Fig. 2) into the steam ring and thus into the turbine nozzles. All of these parts are housed in one casting which in turn is bolted to the steam ring of the turbine. To inspect the strainer basket, it is only necessary to remove the cover (Y-193, Fig. 3), after which the basket can be taken completely out and cleaned. To inspect the governor valve and the overspeed trip valve, the governor lever (Y-53) and the trip bellcrank lever (Y-92) should be removed, then the steam chest cover (Y-64) may be taken off, exposing both the speed regulating governor valve and the overspeed trip valve. The governor valve (Y-58) may be removed by pulling the valve straight outward. In the event that the valve bushing (Y-60) is to be removed, it must be pulled out with a puller prepared especially for this service. To reassemble governor valve bushing, place bushing in the steam chest and drive into position with a bar of nonferrous metal and punch the edge of the steam chest so that the bushing cannot come out. The governor valve can be replaced and reassembled by sliding the governor valve stem through the packing ring (Y-65). Reassemble the steam chest cover (Y-64). This is a metal-to-metal joint with the steam chest (Y-57), and is made up with graphite and oil, first being sure that the joint surfaces are clean. Place dowels in position and pull down strongly on the holding down bolts.

STEAM RING NOZZLE RING AND REVERSING BUCKET HOLDERS (Fig. 1)

These parts form the path of the high-pressure steam through the turbine. The bucket holder (Y-18A and Y-18B) and nozzle ring (Y-20) may be removed by working on the inside of the turbine after the rotor is lifted, this complete assembly may also be removed by removing the steam chest, the steam end bearing case, and flexible support (Y-15), after which the steam ring can be unbolted from the lower half turbine case and the entire assembly lifted out. All of these steam joint are metal-to-metal and are made up with steam joint sealer when reassembling.

SECTION III—ADJUSTMENTS AND CLEARANCES

NOZZLE RING
(Y-20, Fig. 1)

Adjustments—None.

Clearances—Normally 1/16" between nozzle ring (Y-20), and shroud of first row of moving buckets (Y-16A). Minor variations permissible.

Obtained by feeler gage measurement. Check whenever rotating element, nozzle ring, or steam ring is removed from the turbine and is reassembled.

To vary, change location of positioning dowel (Y-184) in thrust bearing cage ring (Y-183).

TURBINE BALL THRUST BEARING
(Y-185, Fig. 1)

Adjustments—This thrust bearing locates the axial position of the rotating element with respect to the stationary parts. It carries no radial load. To change the axial position of the rotating element remove bearing case cap (Y-23A), and turn the thrust bearing cage ring (Y-183) into a new position so that the present dowel hole will not register with the hole in the cap. Make sure that the oil drain hole in the thrust bearing clamping ring (Y-186A) is on a vertical and below the shaft. Block the rotating element into the desired position and replace bearing case cap (Y-23A). Drill a new ½" dowel hole into the thrust bearing cage ring (Y-183), using the hole in the cap as a drill jig—do not drill deeper than ¼" into ring. Replace dowel.

Clearances—Large radial clearance—it carries no radial load. Negligible axial clearance or end float—not adjustable—if excessive, replace ball bearing.

SLEEVE BEARINGS
(Y-3, Fig. 1)

Adjustments—When necessary scrape high spots lightly to give contact the full length of the bearing. The sleeve bearings are interchangeable. Bearing halves are positioned relative to each other by two blind dowels on the horizontal split and are positioned in the casing by locating pins (Y-5). Rebabbitting of these bearings should not be attempted in the field—return them to the factory for this operation.

Clearances—These bearings are factory fitted to give a cold clearance of .002" to .006" larger than the shaft. Check at long intervals (unit not running) by placing a short strip of soft fuse wire in center of bearing on top and shaft and clamping bearing into position. Measure thickness of flattened fuse wire by micrometer.

Excessive bearing clearance may lead to turbine vibration. Clearances in excess of .015 are generally considered excessive.

To correct excessive clearance replace the bearing. When putting a new bearing into service, place it in position, clamp bearing cap lightly and run for 5 or 10 minutes or until bearing becomes hot. Remove the bearing and scrape high spots, repeating this operation until full length contact is obtained after which the bearing may be put into permanent service.

CARBON PACKING RINGS
(Y-9, Y-9A, Y-10, Fig. 1)

Adjustments—The shaft under these carbon rings is prepared with a hard non-corrosive sleeve which makes possible very close running clearances. All rings, when newly installed must be "run in" to achieve the highly polished, glossy surface required for a minimum of wear. These rings are impregnated with oil for lubricating purposes during the "run in" period and may smoke considerably during the first 24 hours of service, which condition need give the operator no concern.

At times steam leakage along the shaft is caused by improper seating of the ring against the sides of the packing ring case grooves due to deposits of foreign material between the rings and their side seats. The only remedy is to clean out this foreign matter.

So called "fitting" of carbon rings in the field, the operation wherein the butt ends of the segments of a ring are filed down to reduce the bore of the complete ring, can only be considered satisfactory as an emergency measure. When rings are "fitted," prepare a mandrel 3.000" diameter and use this mandrel as a guide for the bore of the ring segment while fine sand paper or a file is held or clamped radially against the mandrel and thus by axial movement of the ring segment the butt end is worn down radially to reduce the bore.

The most satisfactory correction is to replace the ring with a new one.

Clearances—The cold clearance between new rings and the shaft is .001" to .003". Worn in clearances may be considerably higher with satisfactory results. Measurements of ring clearances are unreliable without recourse to proper "go" and "no go" gages. In the final analysis ring fits are always satisfactory if steam does not leak out of the packing case along the shaft, and even a light blow here is not considered unreasonable.

NORMAL SPEED GOVERNOR
(Y-40, Fig. 3)

Adjustments—The turbine nameplate states the normal speed at which your turbine should operate under full load and contract steam conditions. Any substantial variation from these conditions should only be attempted after consulting the nearest Elliott Company district office.

Minor variations of speed adjustment to suit minor changes in operating loads are obtained by tightening the governor spring adjusting nut (Y-40) for an increase in speed, and slacking off on this nut to decrease the speed.

The governor spindle ball thrust bearing (Y-41) is designed to take the thrust of the governor valve and is self-aligning by reason of the spherically seated collars on each end of the bearing. The end play in this bearing should be very slight but at all times the bearing must rotate freely. There are no adjustments on this bearing.

Clearances—The clearance between the governor spring sleeve (Y-39) and the shaft end should be an easy sliding fit. Governor spindle block pins (Y-51) are to be an easy fit in spindle block (Y-47). Governor lever blocks (Y-69) should be free fitting in the valve stem block (Y-68).

GOVERNOR LEVER
(Y-53, Fig. 3)

Adjustments—When this lever has been removed and replaced, set the center hub of the lever approximately central between the two ball bearing housings and insert set screw (Y-56). With the turbine operating, loosen set screw and move governor lever (Y-53), first towards one ball bearing and next towards the other. At the point where vibration on governor oil cup (Y-50) is a minimum tighten set screw.

Governor Valve
(Y-58, Fig. 3)

Adjustments—The travel of the governor valve should be the minimum required to enable the turbine to carry full load under the lowest steam pressure condition. In no case should this travel be greater than 5/8". The factory setting may be determined and recorded as follows:

With unit not running measure from the inside valve stem lock nut (Y-67) to the valve stem packing gland hub of the valve cover (Y-64B). Record this dimension. Loosen all the lock and check nuts (Y-67) and turn valve stem clockwise until the valve seats. With valve in this position screw inside lock and check nut against valve stem block (Y-68) and again measure the above distance. The difference between the above two measurements is the governor valve travel. Reset as before.

Clearances—Governor valve stem (Y-62) must at all times move freely in packing (Y-65). After screwing up on packing nut (Y-66) try movement of valve stem in packing.

OVERSPEED TRIP GOVERNOR
(Y-32, Fig. 2)

Adjustments—The speed at which the overspeed trip pin (Y-32) flies out and trips the overspeed valve may be increased by removing U staple (Y-34A) and screwing up adjusting nut (Y-33). If this is insufficient add washers (Y-37). To reduce the speed reverse this process. CAUTION:—Replace U staple and check speed carefully as described in Section I.

Clearances—Linkage pins (Y-174, Y-175, Y-176) and plunger (Y-177) are to be free sliding fits. Overspeed valve stem (Y-78) about .010" clearance in bushing—clean out scale if sticky. Maintain the 1/16" clearance shown between trip pin (Y-32) and trip lever (Y-85).

WATER COOLING OF BEARINGS

Hook up as shown on Fig. 4.

HAND-OPERATED NOZZLE VALVES
(Y-97, Fig. 1) (Fig. 4)

Adjustments—Extra banks of nozzles, when ordered, are furnished to increase the turbine power for an overload condition, to carry normal full load with a reduced steam pressure, or for part-load steam economy. Operate either full open or full closed. For maximum efficiency operate as much as possible with hand valves closed tightly.

Clearances—None requiring checking.

HAND SPEED CHANGER
(Fig. 6)

Adjustments—Done at the factory and should not require further attention. If, however, governor valve or valve stem (Y-62) is being replaced, record original dimensions "A" and "B," from actual measurements on the turbine. Then make new setting as follows: With turbine not running, close governor valve by screwing stem inward until valve is on its seat. Then set distance "A," and pin checknut in place. Unscrew valve stem until checknut is against valve block. Assemble handwheel and locknut, and set distance "B." Pin handwheel in place.

Operation—With valve stem in latter position (checknut against block), adjust compression of main governor spring until the speed of the turbine is the maximum desired. The speed may now be decreased by turning the hand wheel clockwise until stopped by locknut and block. For any intermediate position, the turbine speed is increased by turning the handwheel counterclockwise, and decreased by turning clockwise, locking stem in place by knurled locknut. Any required operating speed beyond the range of the speed changer must be obtained by shutting down the turbine and readjusting the compression of the main governor spring.

Dual Drive Units—For dual drive units, adjust speed changer to give a turbine no-load speed slightly less than the speed of the motor at full load. If motor fails and turbine takes the load, bring turbine speed up to normal full-load unit speed with the speed changer. When motor again takes the load, reduce turbine speed with hand speed changer.

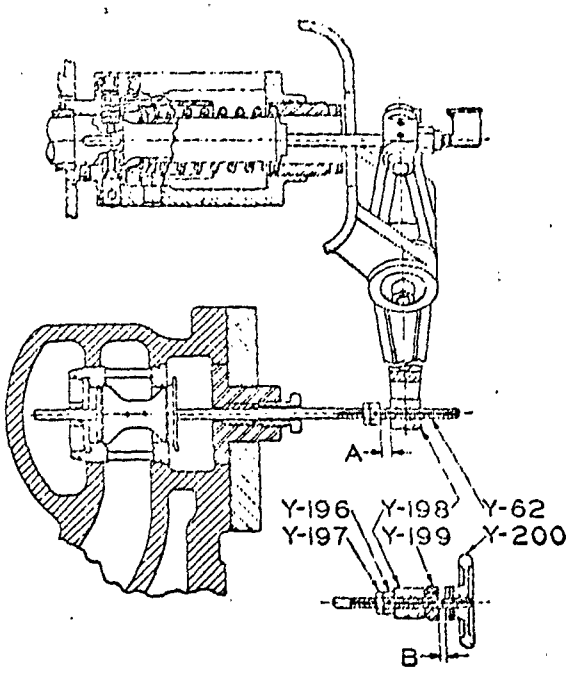


Fig. 6

No.	NAME OF PART
Y-62	Governor Valve Stem
Y-196	Stop Nut
Y-197	Check Nut
Y-198	Valve Stem Block
Y-199	Knurled Nut
Y-200	Handwheel

SECTION IV—SPARE PARTS

In order to insure long periods of uninterrupted service, freedom from shutdown due to mishaps of operation or improper usage, it is recommended that the following spare parts be carried:—

(FIG. 1)

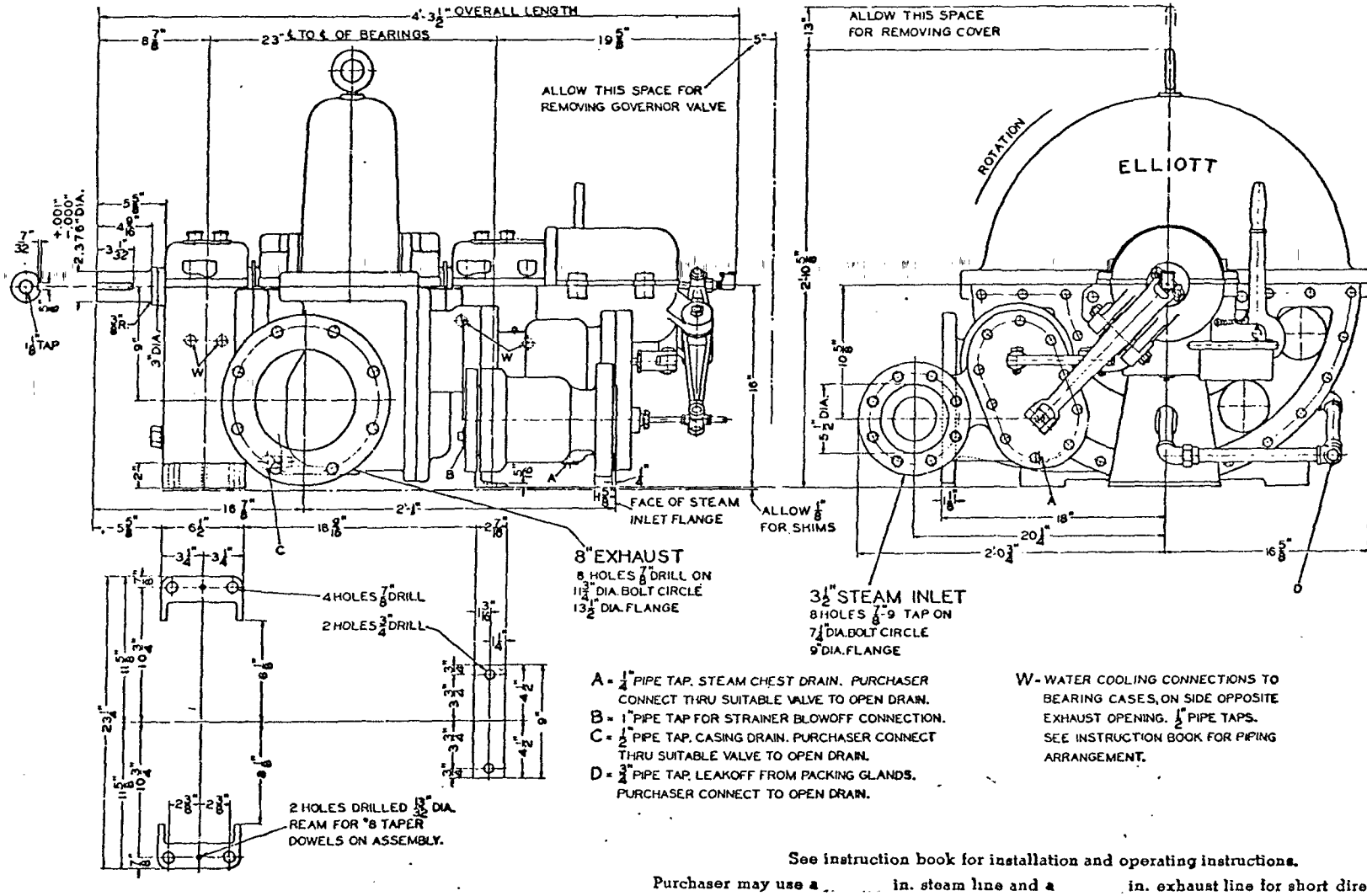
1 Sleeve Bearing, Y-3.
1 Set (4) Carbon Rings and Springs, Y-9, Y-9A and Y-10.
1 Turbine Ball Thrust Bearing, Y-185.
1 Thrust Bearing Retainer, Y-187.
1 Oil Slinger, Y-203.

(FIG. 2)

1 Emergency Trip Pin Assembly, Y-32, Y-33, Y-34A, Y-34B, Y-35, Y-36, Y-37.
1 Additional Trip Pin, Y-32.
1 Set Trip Linkage Pins, Y-174, Y-175, Y-176.
1 Reset Lever Pin, Y-182.
1 Knock-off Lever Latch Plate, Y-87.
1 Set of Springs, Y-81, Y-82, Y-99, Y-180.

(FIG. 3)

1 Set Governor Valve Stem Packing, Y-65.
1 Governor Spindle Assembly, Y-39, Y-41, Y-42, Y-42A, Y-45, Y-47.
1 Governor Sleeve Collar, Y-38.
1 Set Governor Lever Block Pins, Y-51.
1 Set Valve Stem Block Slides, Y-60.



A = ¼" PIPE TAP. STEAM CHEST DRAIN. PURCHASER CONNECT THRU SUITABLE VALVE TO OPEN DRAIN.
B = 1" PIPE TAP FOR STRAINER BLOWOFF CONNECTION.
C = ½" PIPE TAP. CASING DRAIN. PURCHASER CONNECT THRU SUITABLE VALVE TO OPEN DRAIN.
D = ¾" PIPE TAP. LEAKOFF FROM PACKING GLANDS. PURCHASER CONNECT TO OPEN DRAIN.

W - WATER COOLING CONNECTIONS TO BEARING CASES, ON SIDE OPPOSITE EXHAUST OPENING. ½" PIPE TAPS. SEE INSTRUCTION BOOK FOR PIPING ARRANGEMENT.

See instruction book for installation and operating instructions.

Purchaser may use a ..... in. steam line and a ..... in. exhaust line for short direct runs.

Certified
for Construction
Elliott Company
Jeannette, Pa

By.....
Date.....

Purchaser.....
Purchaser's Order No..... Req. No.....
Elliott S.O. ..... E- ..... Turbine No.....
H.P. ..... R.P.M. ..... Steam Pressure ..... Lb. Gage
Temperature ..... Deg. F. Exhaust Pressure ..... Lb. Gage In. Vacuum
Handvalve For .....

Type CY Turbine

Do not use this print for construction unless certified.

Elliott Company 806310