EMERGENCY-BAR OPERATION OF STEAM CONTROL VALVES

RIGGING THE EMERGENCY BAR

If the control mechanism becomes inoperative for any reason, such as loss of control oil pressure, the ahead and astern control valves may be opened or closed by use of the emergency bar.

Refer to Fig. 1. During normal operation (control oil pressure available) the link is unhooked from the valve lever and may be hung on the bracket at POSITION A; the emergency bar is removed from the socket and stored in a location near the turbine where it will be readily available when needed.

If control oil pressure fails, the steam control valves (ahead and astern) will close by the action of the springs on the valve levers. The links for both the ahead and astern valves should then be moved from POSITION A to POSITION B and hooked over the ends of the valve levers. The emergency bar should be inserted in either ahead or astern socket, depending on which valves are to be opened, and the bar pulled downward to open the valves.

> **CAUTION:** When operating under this emergency condition there is no overspeed protection from the overspeed pumps on either turbine. Do not leave the emergency bar unattended.

If the ship is underway and control oil pressure fails, the only means of controlling the speed of the turbines is by use of the emergency bar. It is strongly recommended that this equipment be kept in operating condition and that the bar be available in case of emergency.

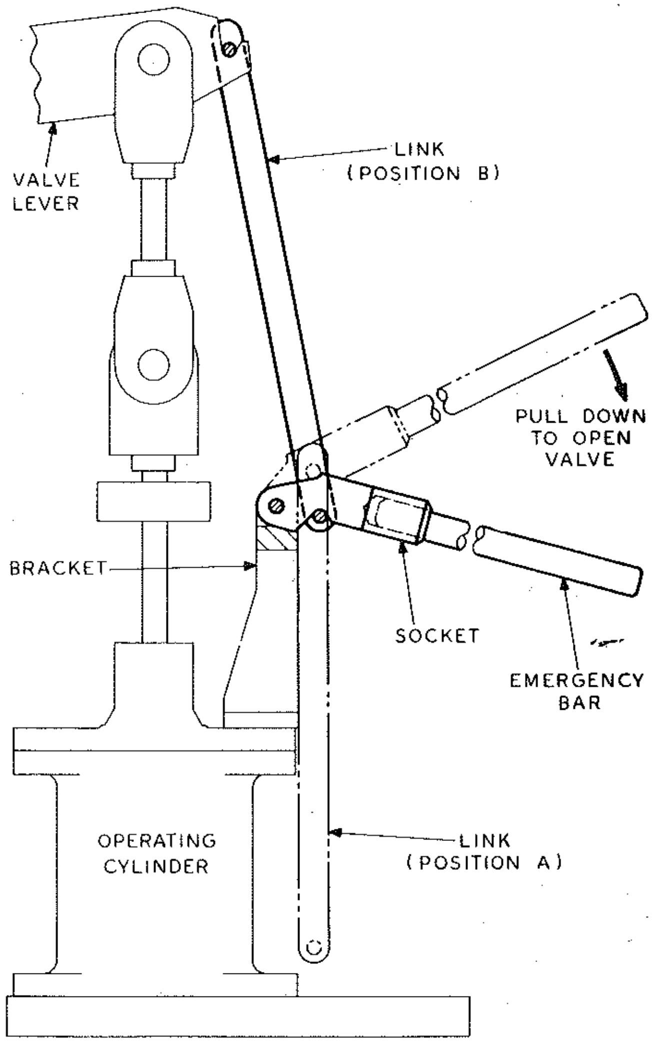


Fig. 1 Emergency bar for steam control valves

TROUBLE ANALYSIS GUIDE

As the name of this Section implies, the following Tables are guides, only, to the possible problems that could arise during operation. As guides, they are not intended to be specific as some problems can only be solved by a detail analysis of the cause. Nor do they purport to cover each and every problem, as some may not be foreseeable. The Tables have been devised to cover various types of installations but, in general, will apply to all installations.

* When control oil is supplied from the ship's oil system.

TABLE TA-1

Loss or Reduction of Bearing Oil Pressure

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Low oil pressure on gage (between 4 and 8 psi at remote bearing) Low pressure trip switch operated (below 4 psi at remote bearing) Loss of main lube oil pump discharge pressure	(1) STAND BY TO STOP SHAFT (2) Restore oil pressure if possible. Be sure oil is available in the sight flow. (3) If oil pressure cannot be restored STOP THE SHAFT	(a) Plugged Strainer (b) Failure of pumps, or pump power (c) Oil header reducing valve stuck (d) Low oil level (e) Lube supply line valving improperly set (f) Defective monitor (g) Broken oil line-excessive leakage	(a) Switch to clean strainer (b) Restore pumps to service (c) Regulate by hand until reducing valve is repaired (d) Refill tank and check for leaks (e) Adjust valves (f) Check pressure switches (g) Secure pumps. Do not allow oil to contact hot parts. Repair leaks.

TABLE TA-2

Loss or Reduction of Control Oil Pressure

(When control oil is supplied from the ship's oil system)

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Low oil pressure on gage Steam control valves move toward the closed position Steam seal pressure rises (steam blow at shaft ends)	(1) Check bearing pressure - if not satisfactory see TABLE TA-1. (2) If bearing pressure is satisfactory, reduce speed and operate steam control valves manually. Operate the steam seal regulator manually.	(a) Failure of pump, or pump wear (b) Control oil header relief valve stuck (if a gear pump) (c) Bearing header regulating valve stuck open or shut (d) Excessive air in the oil (e) Defective monitor (f) Broken oil line (g) Low oil level	(a) Check power to pump. Make sure pump is free. (b) Start other pumps to furnish oil, and free up valves (c) Start other pumps to furnish oil, and free up valves (d) Check oil for excessive water that may have washed out foam inhibitor. Check for salinity in oil (e) Replace gage (f) Repair oil line (g) Fill sump

TABLE TA-3

High Oil Temperature

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Local bearing thermometer reads high- or alarm indication Lube-oil thermometer reads high- or alarm indication	(1) SLOW DOWN to 50% of full speed, and: Adjust the cooler valves See if oil is still at the bearings Check the bearing oil pressure Check vibration Check the temperature of the discharge oil from the cooler Check the thermometers Check the strainer for babbitt Check the rotor position indicator reading (2) Increase the water flow through the cooler	(a) Wiped bearing Improper oil inlet temperature Reduced oil pressure Dirt in the oil Plugged feed line Improper bearing clearance (b) Improper adjustment or position of the water or oil valves Water flow to cooler interrupted Water or oil side of cooler air bound Change of inlet water temperature	(a) SHUT DOWN and inspect the bearings Correct oil inlet temperature Readjust oil feed pressure Check bearing clearances (b) Check for proper adjustment or position of valves Check cooler tubes for plugging

TABLE TA-4

No Oil in Sight Flow

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
No oil in sight flow	(1) SLOW DOWN to 50% of full speed, and: Check the bearing oil pressure Check vibration Check the rotor position indicator reading Check the strainer for babbitt (2) If an abnormal condition exists in any of the above, STOP THE SHAFT	Reduced oil pressure Wiped bearing Dirt in the oil Plugged feed line Improper bearing clearance	Readjust oil feed pressure SHUT DOWN and inspect the bearings

TABLE TA-5
Oil Leakage

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Oil on equipment, and smoke from hot oil lines Gradual lowering of oil level in the supply tank Oil in gland evacuator drain Oil running out of oil deflectors Oil on top of supply tank	(1) Prevent oil from getting on to hot lines, and from soaking insulating material - Remove oil soaked insulating material - and reinsulate (2) Maintain supply tank level and determine reason for loss of oil (3) Reduce gland evacuator suction (4) Check gear casing vent pipes for plugging (5) Check for high level in the supply tank	(a) Leak in the system (b) Gland evacuator suction too high (c) Plugged gear casing vents (d) Incorrect supply tank level	(a) Check lube system for the following, and correct: Leaking cooler tubes Open drains from cooler or strainer Leaking oil deflector Open oil sampling connections Unusual oil losses from oil purifier (b) Reduce gland evacuator suction (c) Clean out gear casing vents (d) Correct supply tank level

TABLE TA-6
Oil Level in Supply Tank

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Supply tank indicator shows HIGH Supply tank indicator shows LOW NOTE: With single plane gears this may be normal as a result of oil trapped in the gear casing during turning gear operation.	(1) Check for excess water in the oil - if present STOP THE SHAFT (2) If below the minimum point STOP THE SHAFT and correct the oil level	Water in the oil Oil transfer or purifying system operating improperly Oil level gage defective, or sticking Oil leaking from system, or drains open Leaking oil cooler heads or tubes Improper trim of ship	Determine the cause and correct the problem

TABLE TA-7

Oil Contamination

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Foaming Emulsion with water Scoring of bearing Plugged strainers (suction or discharge) Excessive rusting of the system Sludging Chemical analysis shows incorrect oil condition	(1) Check for high bearing temperature and low pump discharge pressure - if temperature is high or pump discharge pressure is low, STOP THE SHAFT. Check for excess water. (2) Drain excess water and operate purifiers - Increase the temperature of the oil system to the point where the oil temperature is no more than the hottest allowable at the hottest bearing (3) Replace bearing if scoring is excessive and clean the system (4) Clean the strainer and system (5) Raise the oil temperature to the bearings to no less than 110 F (6) Drain, if possible, and run the purifiers (7) Correct oil condition in accordance with Oil Company's instructions	Water removal of inhibitors, improper oil chemistry. Oil supply tank level too high Leak in the cooler, oil temperature too low, excessive steam seal pressure, insufficient vacuum in gland evacuator Dirt or use of chlorine additives in the oil Dirt, wiped bearings, lint, sludge Oil temperature too high, or too low. Water in the oil Oil temperature too low (causing condensation or not driving water off the oil). Improper oil chemistry. Check Oil Company	Determine the cause and correct the problem

TABLE TA-8

Excessive Oil Strainer Differential Pressure

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Oil differential pressure reads 2 psi more than clean strainer differential pressure	Switch strainers and check basket removed	Plugged strainer	Detect the source of foreign material and take proper action

TABLE TA-9

Lube Oil Pump Shutdown Indication

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
"MOTOR RUNNING" light shows pump stopped	If oil pressure is dropping (pumps not sequenced properly) - manually start the standby pump If oil pressure is not dropping, determine the cause of the pump stopping	Electrical power failure Motor starter failure Indicator failure Motor overload	Check the electrical system, motor, and pump

TABLE TA-10

Material in Oil Strainer

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
High oil strainer differential pressure Material found in strainer Babbitt, as finely divided particles, making a surface coating on the strainer, or as gray mud. (See Table TA-24)	(1) Quickly determine the type of material - if it is babbitt, in quantity, STOP THE SHAFT (2) If it is not babbitt, slow down and: Check pump suction strainer Change baskets at frequent intervals Check the turbine and gears for correct bearing oil pressure and temperature Check turbine and gears for vibration	(a) Dirt in the system (b) Bearing failure	(a) Remove the source of foreign material and clean the system (b) Clean the system and replace the bearing

TABLE TA-11

Drop in Vacuum

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Vacuum dropping Exhaust temperature rising Reduction in number of propeller turns Sentinel valve operates	(1) If vacuum is less than 10 in. SHUT-DOWN; if between 10 in. and 20 in. run at no more than 40% speed; if above 20 in. run at no more than 60% speed until the vacuum is restored to no less than 1.5 in. Hg Abs. poorer than the specified backpressure. (2) Start the standby air removal equipment (3) Try to restore vacuum to no less than 1.5 in. Hg Abs. poorer than the specified maximum backpressure	(a) Air leakage (b) Failure of air removal system (c) Loss or reduction of sea water (d) Icing or plugging of the condenser (e) High condensate level (f) Loss of turbine seals	Correct "a" through "e" by referring to the Condenser manufacturer's manual, or ship's operating manual For "f" refer to Table TA-12

TABLE TA-12

Loss of Turbine Steam Seals

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Steam seal regulator gage shows less than 1/2 psi Loss of condenser vacuum	(1) Ensure there is steam to the regulator (2) Restore steam seal pressure by manual override of the regulator, or operate bypass	(a) Loss of steam supply pressure (b) Sticking regulator (c) Damage to turbine seals (packing rings)	(a) Check steam supply and restore pressure Check valve lineup - correct if necessary Check steam strainer in supply line for plugging - clean strainer (b) Check sensing line to make sure it is not broken or plugged, or that valve in line is not closed Check steam seal regulator (c) Increase seal pressure to restore seals - repair packing rings

TABLE TA-13

Gland Seal Regulation

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Steam blowing from shaft end	None required	(a) Worn shaft packing (b) Gland exhauster system not working properly (c) Steam seal regulator	(a) Replace worn shaft packing (b) Determine cause and repair (c) Check the steam seal regulator to determine if cause is (a) (b) or (c) Make sure sensing line to manifold is open. If manifold pressure is normal (1 to 3 psig) the cause is (b) If manifold pressure is higher than normal, remove regulator cover and note position of dump valve. If dump valve is wide open, cause is (a) or (b) If dump valve is not wide open, displace pilot valve to see if regulator responds. If response is smooth, reset the regulator to a lower pressure setting. If regulator does not respond to displacement of pilot valve, either foreign material is deposited on the moving parts, or the surfaces of the valves, stems, piston, or pilot valve have been damaged. Manually jack open the dump valve, and at the earliest opportunity clean and lubricate, or replace the moving parts.
Hunting of the regulator	None required	(a) Linkage has worked loose, upsetting the adjustment points (b) Foreign material in joints causing friction in lever system	(a) Check and make sure that all adjustments are correct and that locknuts are secure (b) Clean all joints, eliminate friction in the parts, and lubricate

(continued)

TABLE TA-13 (continued)
Gland Seal Regulation

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Low pressure in manifold of steam seal regulator	None required	(a) Pressure in gland exhauster system too low (b) Steam seal regulator	(a) Increase pressure in gland exhauster system (b) Check the inlet valve in the steam seal regulator. Make sure the sensing line to manifold is open. If inlet valve is wide open, check pressure of make-up steam to see if it is lower than specified on the Seal and Drain Diagram. Correct pressure, if necessary. If inlet valve is not wide open, displace the pilot valve to see if the regulator responds. If the response is smooth reset the regulator to a higher pressure setting. If regulator does not respond to displacement of pilot valve, either foreign material is deposited on the moving parts, or the surfaces of the valves, stems, piston, or pilot valve have been damaged. Clean and lubricate, or replace the moving parts.

TABLE TA-14
High Exhaust Temperature

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Exhaust thermometer shows high temperature Odor of burning paint	(1) Make sure that opposite rotation throttle valve is shut (2) Restore vacuum if it is low (3) If continued operation is required, monitor the turbine for rubbing, and reduce speed to the lowest practical value while continuing to monitor	(a) Steam leaking into the opposite rotation turbine (b) Drop in vacuum (c) Operating not in accordance with the standard propeller/speed power curve (d) Turbine internal damage	(a) Restore tightness of the turbine steam control valves. Make sure that steam is not entering turbine through the drains (b) Drop in vacuum - see TABLE TA-11 (c) If possible, return to operation in accordance with the power curve - if not possible, because of towing, single turbine operation, foul bottom, heavy seas, damaged propeller, etc., reduce speed to stay within the temperature level (d) See TABLE TA-16

TABLE TA-15

High Hot-well Level

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Condensate level alarm or gage glass indication Reduction of condenser vacuum	Lower the condensate level - if level cannot be lowered STOP THE SHAFT	Failure of condensate pump, or pump power Condensate strainer plugged Level-control failure Condenser tubes leaking Condensate makeup valve improperly adjusted Air leakage into condensate pump at pump suction High condensate temperature	Refer to Condenser manufacturer's manual for remedy

TABLE TA-16

High or Low Stage or Extraction Pressure

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
A change in pressure from preceding observations, when other steady state and normal operating conditions (inlet, exhaust, extraction, etc.) remain the same	(1) If a gradual change: Monitor stage pressure and rotor position indicator to avoid damage while determining causes for the change (2) If a sudden and large change not due to changes in operating conditions: SHUT DOWN	Buildup of deposits in the turbine Internal damage to the turbine Off standard operating conditions such as: Heaters out of service Damaged propeller Fouled bottom Change in ship's draft or sea water depth Instrument errors Rough seas	Take corrective action, depending on the cause. Do not exceed rated power and torque during this period

TABLE TA-17

Variant Steam Inlet Conditions (pressure or temperature)

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Instrument readings higher than the permissible limits listed under DESIGN CONDITIONS AND OPERATING LIMITATIONS. Instrument readings lower than normal resulting in Reduced power capacity Internal erosion in turbine Loss of efficiency	(1) Reduce speed and power and take steam off the turbines (2) As soon as possible, restore proper inlet conditions to avoid damage to the turbines	Defective boiler controls, improper operation, or instrument errors	Check and reset the controls and instruments. Correct operating methods.

TABLE TA-18

Leaking Steam Valves

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Steam Inlet Valves: High astern temperature when running ahead Shaft rolling with steam valves closed Excessive corrosion within turbine Non-Return Valves: Severe turbine vibrations on changes in load	SLOW DOWN below 60% speed	(a) Valves not closing (b) Valves not adjusted properly (c) Steam cutting (d) Foreign material (e) Steam leaking back through drains	(a) Close the valves and reset the handwheel stops (b) Readjust the settings of the valves (c) Repair or replace valve discs or seats (d) Clean valves and repair seats (e) Correct drain system

TABLE TA-19
Ahead and Astern Control Valves Not Operating Properly

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Valves not responding properly to control system Valve stems binding or sticking in the bushings Operating cylinders not responding properly Control input devices not functioning properly	(1) Prepare to control steam flow with the main steam line valve (2) Attempt to move the valves at the local station to determine if the problem is in the equipment supplied with the turbine, or in some external control system. Attempt to free the parts by working the controls alternately one way and then the other. Limit the applied forces and torque to prevent deformation of the parts. (3) If unsuccessful with step 2, secure the turbines by means of the main steam line control valve and repair the mechanism	(a) Deposit of foreign materials between valve stems and bushings. Misalignment of lift rods, if bar lift type (b) Worn parts causing misalignment and binding. Loss of oil pressure (c) When motor drive is used, problem may be in electrical input signal, or slippage of the motor clutch. Binding or misalignment of the reach rods	(a) Disassemble and remove deposits. Realign the lift rods (b) Replace and realign parts. See TABLE TA-2 (c) Check electrical circuit and motor clutch and repair. Realign the parts

TABLE TA-20
Drains Not Working Properly

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Excessive vibration on coming back up to speed after reducing load Deterioration of turbine performance Temperatures in the drain lines not normal Overheating of drain tanks	(1) Slow down and do not increase speed until vibration is within acceptable limits, (see TABLE TA-22). Ensure water is completely removed from the turbines. (2) Avoid large rapid load changes, if possible, until the drain system can be corrected. Make sure that water cannot enter the turbines.	Improper lineup of the drains and/or clogged drains and orifices, open traps, leaking check valves or shut off valves	Correct the drain system

TABLE TA-21

Unexpected Change in Propulsion Power

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Increase or decrease in speed without a change of valve position or handvalve position Increase or decrease in speed without a change of control levers or handwheel position Change in pitch or tone of propulsion engine sound Extraction and crossover pressures do not agree with expected values	(1) Determine if plant operation has changed in these areas: Boiler pressure Condenser vacuum Extraction valve lineup and heaters Tachometer Main gears and main thrust Determine the relation between control lever and valve position Extraction and crossover pressures (2) Determine if ship's environment has changed because of: Sea conditions Shallow water Wind Damaged propeller Stern tube bearings	Should be determined as a result of the SYMPTOMS and the analyses under IMMEDIATE ACTION	Determined by the cause

TABLE TA-22
Vibration

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Excessive vibration (levels above 3 to 5 mils double amplitude) on the shaft Increase in vibration of 25% more than previous experience at the same speed and power	Slow down until vibration is 3 mils or below	(a) Bowed rotor, or rubbing of internal parts (b) Rotor unbalance (c) Loss of flexibility in coupling teeth due to damage or foreign matter (d) Lack of pinch fit at the vertical centerline between the ball of the bearing and the ball seat of the bearing cap (e) Damaged bearing (f) Water backing up in the turbine (g) Water carryover from boiler or sudden change in steam conditions (h) Change in alignment of the turbine to the gear (i) Steam leaking into the astern element of the turbine when running ahead, or steam leaking into the ahead element when running astern (j) Turbine being vibrated by ship or other component	(a) Run at reduced speed (below vibration point) until the shaft straightens (b) Run at reduced speed (below vibration point) until vibration stops. If vibration level is not normal after increasing speed, shut down the turbine, and inspect the rotor for damage or foreign material. Repair and balance the rotor (c) Disassemble, inspect, and repair (d) A temporary remedy is to install a star shim between the ball and ball seat at the vertical centerline to produce a pinch of .002 in. to .004 in. However, as soon as possible, machine the horizontal joint of the bearing cap a sufficient amount to produce the pinch fit (e) Replace the bearing (f) Check and correct the drain system (g) Stabilize boiler operation (h) Check and correct alignment (i) Leaking steam control valves (see TABLE TA-19) (j) Check other components for vibration that may be transmitted to the turbine

TABLE TA-23

Unusual Noise

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Unusual noise in turbines	Slow down to half speed, or until the noise disappears. Use a listening rod and try to determine the source of the noise Check the following: Vibration of rotating or stationary parts, or vibration of a structural nature, loose equipment, etc. Oil pressure and temperature Rotor position indicators Sight flows	Unusual noise can be caused by: Rubbing of parts in turbine Vibration of a structural nature, loose equipment, etc. Bowed rotor Loose parts on attached components (heaters, condensers, etc.)	Determine the cause of the noise and take appropriate action to eliminate it

TABLE TA-24

Babbitt in Strainer

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Babbitt found in the strainer during inspection	(1) SLOW DOWN to half speed (2) Inspect the machinery serviced by the strainer to determine: If oil flow and temperature are normal If abnormal vibration exists If rotor position indicator reading has changed from readings logged previously for the same load condition If any of the above conditions are abnormal, STOP THE SHAFT (3) Clean the strainer, replace, switch strainers and inspect the other basket NOTE: It is possible for babbitted bearings to be self-healing. If inspection shows nothing abnormal, and the unit appears to perform satisfactorily, operation may continue with frequent inspection of the machinery. At the earliest possible time the bearings should be inspected.	Babbitt in the strainer is usually caused by: High temperature in the bearing Heavy vibration Loss of oil Misalignment of the bearing	To be determined as a result of investigation

TABLE TA-25
Loss of Electric Power

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
Loss of electric power	(1) STOP THE SHAFT (2) Determine if you have lost lube pumps - if so: Restore oil pressure. Be sure oil is available in sight flows If oil pressure cannot be restored continue to operate the ship on manual control and local monitoring (3) Determine if you have lost turbine controls and monitoring devices - if so: Operate the turbine at the manual control station Monitor locally at the turbine NOTE: When electric power is lost, the emergency trip devices for the turbine will be inoperative	Failure of a system external to the turbine	Restore electric power as soon as possible

TABLE TA-26
Rotor Position Indicator (Abnormal Reading)

SYMPTOMS	IMMEDIATE ACTION	PROBABLE CAUSE	REMEDY
An increase in the reading of the rotor position indicator over that logged previously for the same speed and load conditions - magnitude of increase to be .010 in. for the HP turbine, or .020 in. for the LP turbine	Check the condition of the turbine: Temperature Vibration Unusual noise (1) SLOW DOWN to half speed if: The thrust oil temperature is unusually high The turbine is starting to vibrate There is babbitt in the strainer (2) SECURE THE TURBINE if: The turbine vibration is above the limits shown in TABLE TA-22 Unusual noise in the turbine or thrust bearing	(a) Loss of thrust bearing (b) Damaged rotor position indicator	(a) Repair the thrust bearing (b) Repair or replace the indicator

4

PREVENTIVE MAINTENANCE

GENERAL

Continued reliability of the turbine-gear propulsion equipment is the result of a planned maintenance program. Continual observation of the operation of the set will detect minor problems which should be attended to immediately, in order to prevent outage time for major repairs.

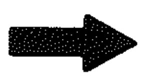
The general appearance of the turbine-gear set should be observed during a voyage. Items such as uncommon heating, oil drips, steam blows, and unusual noises should be investigated and corrective measures taken before the fault becomes serious.

LUBRICATION

In addition to the lube-oil system for control requirements and main turbine bearings, it is necessary to periodically lubricate certain parts of the control devices. The various illustrations in the manual will identify the location where a lubricant is required, and will refer to one of the columns in Table 4-1 for the type of lubricant and the frequency of application.

Table 4-1 is intended as a guide to the type of lubricant. The General Electric Company is not limiting its approval of lubricant suppliers to those listed, but is

TABLE 4-1

			
MANUFACTURER	3 MONTHS	18 MONTHS	WHENEVER PARTS ARE REASSEMBLED
MOBIL OIL CO.	MOBIL TEMP #1	CALREX #1	
TEXACO INCORPORATED	TEXACO HI TEMP	MARFAK O	
MASTER LUBRICANTS CO.	LUBRIKO 452EP	LUBRIKO 452A	
ESSO OIL CO.	ANDOCK 260	NEBULA EP #1	
GULF OIL CORP.	GULF CROWN #2	XXX LUBRICANT #1	
SHELL OIL CO.	CYPRINA #3	AEROSHELL GREASE #6	
DOW CORNING	DC-44		
CONNECTICUT HARD RUBBER CO.			CHR RULON SPRAY

merely establishing a list of typical lubricants which will perform satisfactorily in steam turbine service. If a customer wishes to use a lubricant other than that listed for a particular application, he should obtain the approval for its application from the lubricant manufacturer and not from the General Electric Company.

For lubrication of accessory equipment, manufactured by companies other than General Electric, refer to the manufacturer's bulletin covering the specific equipment.

INSPECTION OF CHECK VALVES

Since check valves are installed in lines for a specific purpose, it is important that they function properly.

Normally, check valves do not require inspection until the regular overhaul period as long as they are operating satisfactorily. During the inspection period they should be checked to make sure that there is good contact between the valve and seat, and that there is proper closure. On valves that have a closing mechanism, make certain that the mechanism is working properly. On valves that have counterweights, check the position of the weights to be sure that they are set properly.

INSPECTION OF HOLD-DOWN AND CASING BOLTS, STUDS, AND NUTS

Loose bolts, studs, and nuts can contribute to vibration, which, if allowed to progress, could result in serious maintenance.

It is recommended that bolts, studs, and nuts be checked at least twice a year to determine if they have worked loose. Of particular importance is the area around the front end, the alignment dowels on the bearing brackets, and the hold-down bolts.

At the regular overhaul period, check the tightness of the foundation bolts and any other bolts that would not normally be removed for inspection purposes. For this check it is sufficient to tap the end of a wrench placed on the nuts and bolts to see if they are snug. This check of tightness is not to be construed as re-torquing the nuts and bolts.

CORRECTIVE MAINTENANCE

LIFTING THE CASINGS

It should not be necessary to lift the turbine casings for inspection purposes until the major overhaul period. The forward and aft bearing caps, and the upper halves of the forward and aft packing boxes may be lifted independently of the turbine casings.

Before lifting any part, refer to the appropriate Lifting Arrangement drawing. These drawings show the method of rigging the part for lifting, along with the weight of the part.

Whenever parts are disassembled they should be stored in an area where they will be protected from mechanical damage as well as from dirt or foreign matter. All casing openings should be covered, and all exposed machined surfaces should be protected. If cloths are used make sure they are lint-free.

All studs two inches or over in diameter that are used in the high-pressure turbine are drilled to accomodate a stud heater during assembly and disassembly. Refer to the paragraph on Bolt and Stud Tightening. Before remaking a horizontal joint refer to the paragraph on Joint Sealing Compound.

Lifting the Upper Half HP Casing

Remove any obstructions that will interfere with the lifting operation. Disconnect levers and unbolt flange connections where necessary.

If the upper-half casing is to be lifted as a unit, the vertical joint between the high-pressure head and low-pressure head should not be broken. However, the vertical joint may be broken when it is desirable to lift the low-pressure head only. Whenever the high-pressure head and low-pressure head are lifted as a unit, the guide pins should be installed.

Use the gas heater to stretch the drilled studs in the horizontal joint before removing them.

While the casing is being lifted it is IMPORTANT that measurements be taken to ensure that the flanges of the horizontal joint remain parallel.

The upper halves of the nozzle diaphragms, as well as the upper halves of the packing casings and packing, will be retained in the upper-half casing when it is lifted.

When reassembling the upper-half casing the same precaution should be taken against interference. While the upper-half is being lowered measurement should again be taken to ensure that the flanges of the horizontal joint remain parallel. Make sure that the guide pins are used.

The Lifting Arrangement drawing also shows the methods of lifting other components of the turbine, along with the weights of the parts.

Lifting the Upper Half LP Casing

Remove any obstructions that will interfere with the lifting operation. The guide pins should be installed to prevent the casing from swaying. Along with the horizontal joint bolts, the vertical joint bolts at "A" (see Assembly of Low-Pressure Turbine) should be removed. Manholes are provided on the casing for access to internal bolting.

While the casing is being lifted it should be continually checked to ensure that the flanges of the horizontal joint remain parallel.

The upper halves of the nozzle diaphragms, as well as the upper halves of the packing will be retained in the upper-half casing when it is lifted. However, the astern steam ring and reversing head will not be lifted with the upper-half casing. The astern steam ring is a separate internal element that cannot be disassembled until the upper-half casing has been removed.

When reassembling the upper-half casing it should be lowered with the flanges of the horizontal joint kept parallel in order that the astern steam inlet connection will not bind in the seal rings of the astern steam ring. Make sure that the guide pins are used.

JOINT SEALING COMPOUND

When originally assembled, the horizontal joint was made up with uncatalyzed RTV-60 joint compound. RTV-6- is a pourable red silicone compount manufactured by the General Electric Company. Before the joint is made up it should again be given a coat of uncatalyzed RTV-60. The surfaces of the joint should be clean, without any traces of oil or previously used compound. Toluene, zylene, or similar solvents may be used to clean the surfaces of the joint. The RTV-60 should be poured slowly in order to prevent air being trapped in the compound. Only one surface of the joint should be coated. It should be spread immediately by hand, or with an applicator, to a very thin film (approximately .001 to .002 inch thick). Do not spread with a brush as this would result in the coat being too thick. Do not allow the RTV-60 to come in contact with the threaded areas of studs, bolts, or tapped holes. Threads and spot faces should be coated with a non-carbonizing lubricant such as Crane 425A. As soon as the surface of the joint is properly coated, the joint should be closed in order that foreign material will not contaminate the compound.

LIFTING THE ROTORS

The Lifting Arrangement drawings show the methods of lifting the high-pressure rotor and the low-pressure rotor.

A lifting beam is furnished with the equipment and the lifting rig on the beam is adjustable to accomodate either rotor. The drawings show the dimensions to set the lifting cables and fulcrum point for either rotor, together with the lifting plates to be used.

The rotors should be lifted carefully in order to avoid interference with the lower-half diaphragms because of the small clearance. Protect the bearing surfaces from damage.

When lowering a rotor into a casing, coat the bearing surfaces with turbine oil.

BOLT AND STUD TIGHTENING

All studs two inches or more in diameter that are used on steam joints are drilled to accomodate a gas heater in preparation for tightening. During the heating operation, the nuts are tightened until the required amount of stretch has been produced in the stud.

The actual stretch of a stud is determined by measuring the length of the stud with a micrometer before and after tightening. The difference in length equals the amount of stretch.

The Bolt and Stud Tightening Chart is a tabulation of the amount of stretch for each size of bolt and stud. This chart also shows the approximate number of flats that a bolt or a nut must be turned, after hand tightening, to produce the required stretch.

A method of approximating the stretch produced involves counting the number of flats and fraction of a flat that a hexagonal nut has been turned down from a handtight position. "Handtight" is defined as that tightness which is necessary to pull the assembled parts together but beyond which results in stretching the stud. As an example, referring to the bolt and stud tightening chart, it will be seen that a one-nut stud with a diameter of two inches, eight threads per inch, and eleven inches long, should be stretched 0.012 of an inch. The chart also shows that this is approximately equivalent to one flat of tightening. One flat on the nut and an adjacent surface on the flange should be marked as shown at "A" and "B" in the sketch on the chart. The stud should be heated and the nut tightened until the marks coincide.

Gas Heating the Studs

The hot-gas stud heater supplied, Fig. 1, is used with an oxy-acetylene torch and is intended for heating bottoming studs and through studs. The heater is designed for use with 1/4 inch and 3/8 inch pipe extensions for stud-tightening holes of 5/8 inch and 7/8 inch diameters.

Compressed air is heated by the flame of the oxy-acetylene torch. The resultant hot gases pass downward through the pipe to heat the stud, and exhaust upward between the heater pipe and the hole in the stud. The gases are vented through the holes at the bottom of the heat chamber. When the heater is used on a through stud, one end of the stud must be plugged.

WARNING: Observe usual safety precautions when using the oxy-acetylene torch. Check all gas lines for leaks. Ventilate the area to prevent the formation of hazardous gas pockets.

Efficient use of the heater requires compliance with the conditions which follow. Under these conditions, uniform heating will be obtained, and an inexpensive carbon-steel heater pipe can be used.

1. With the stud supporting the heater, the length of the pipe extension should be from 70 to 90 percent of the over-all length of the stud. When the pipe extension is longer than the sutd, cut a vee notch in the end of the pipe to prevent the flow of heated air at the bottom of the stud from being shut off.

2. With the heater in position, start the flow of compressed air from introducing the torch.

3. Set a Victor No. 6 weld tip, or equivalent, for complete combustion to obtain the most efficient heating from the oxy-acetylene flame. Avoid too rich a mixture to prevent excessive tip heating and reduced heater efficiency.

4. Insert the torch tip so that the tip end (or flame) extends beyond the air holes in the heater cap.

5. Adjust the air flow (or flame) as required to bring the heater pipe to the desired temperature.

NOTE: When the heater pipe glows cherry red (as observed through the vent holes) the temperature of the heated air leaving the chamber will be very near the correct temperature (1050°F).

With the uniform heating, elongation of the stud will be complete in from 7-1/2 to 10 minutes. During this time, the stud temperature will rise approximately 300°F, and the temperature of the heater pipe will stabilize at 1050°F.

Tighten the nut periodically during the heating operation until the recommended number of flats has been turned.

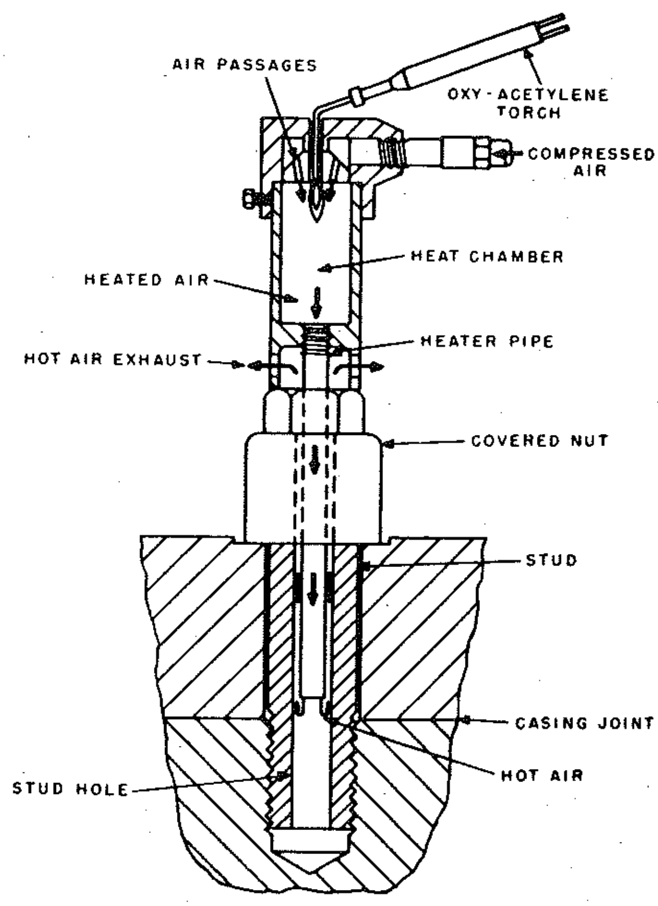


Fig. 1 Hot-gas stud heater

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