Washing Machines

1. Washing machines of various makes are installed in I.M. ships and fleet shore establishments. In general these are of either 30 or 125 cu. ft. inner cage capacity.

SIDE OPENING TYPE

2. Description of a typical machine (Figs. 6 and 7)

The outer casing is securely attached to the end frames and is provided with a sliding door giving access to the inner cylinder. The inner cylinder is of perforated construction, carrying internal lifter designed to tumble the load and so arrange for maximum penetration by the washing liquor. A hinged lid of ample size to permit easy loading and unloading of the machine, and usually secured by means of spring type locking catches, is incorporated into the construction of the inner cylinder. A metal apron is hinged to the outer casing, and during loading and unloading it covers the annular space between the outer casing and inner cage, thus preventing small articles from falling between the cages.

The inner cylinder is supported on trunnions, and suitably sealed arrangements are provided to prevent water passing into the bearing housing, or grease passing to the inner cylinder. The drive to the inner cylinder is effected by an electric motor, normally mounted on the top of the machine, through vev belt or chain and spur gearing. In some machines the drive is arranged through a patent clutch.

To prevent the “reaping” of the load, all machines are provided with a reversing gear which causes reversal of the inner cage every two or three revolutions. Reversal can be effected by various means, namely crosswise belting, mechanical, reversing gearbox of reversing motor with control panel, knitting gears, usually hand operated, is provided to bring the inner cylinder door to the loading position, and means are provided for locking the cylinder door in this position. Safety interlocking is provided to prevent the opening of the outer casing door while the machine is in motion, and alternatively to prevent starting the machine with the doors in the open position, or with the hand turning gear engaged. Safety catches are fitted to keep the door open when loading and unloading.

To facilitate the control of the washing process, a meter of the distance reading type, and a dip gauge, which may be of either the direct reading or float type, are provided. A process clock, which provides a ready method of recording the various stages in the washing process, is fitted on some types of machines.

To provide hot and cold water valves, with in some instances an additional connection for hot water, are provided. The waste is drained from the machine by means of a foot or hand operated dump valve of large area.

Many machines as present in service are of the side-opening type, but end-opening type, which are largely of fabricated construction, are now being included in future installations.

3. Operation

The construction of individual types of machines varies, but the following instructions refer generally.

(1) Move the starting lever to the “stop” position, thus releasing the interlock on the outer casing door, and enabling the hand turning gear to be engaged.

(2) Slide the outer cylinder door to the open position.

(3) Engage the hand turning gear and rotate the inner cylinder until the door is in the loading position.

(4) Lock the hand turning gear in position to prevent further movement during the loading operation.

(5) Open the inner cylinder door and secure it in the open position by means of the spring clips provided.

(6) Swing the metal apron into position to bridge the gap between the inner and outer cages.

(7) Load the machine to the rated capacity (see remarks below).

(8) Turn the metal apron back.

(9) Close the inner cylinder door making sure that no work is trapped and that the securing catches are firmly engaged.

(10) Close the outer door.

(11) Disengage the hand turning gear.

(12) Switch on the motor and start the machine by moving the starting lever to the “starting” position.

(13) Proceed with the washing process in accordance with the approved formula.

Note:—(i) The doors of all machines can be opened, or the hand turning gear engaged, only when the machine is brought to rest.

(11) Steam must on no account be admitted unless there is water in the machine.

4. Loading rate

In Admiralty practice the accepted loading rate for cotton and linen work is 33 pounds per cubic foot, and for woollens 35 pounds per cubic foot. The rated capacity should not be exceeded because overloading reduces mechanical action resulting in poor results.

Underloading reduces total production and wastes time, degreases and water.

5. General maintenance

The motor should always be stopped when the machine is standing idle including the loading and unloading periods.
Steam and water valves should be maintained in an efficient condition, particular attention being directed to leaky glands.

All bearings should be efficiently lubricated and the oil in gear-houses, where fitted, maintained at the correct level.

If the cylinder tends to lag under load, this can usually be attributed to the slipping of the clutches.

Fig. 6—30 cu. ft. side opening type washing machine, motor driven.
in the gearbox (or belts in the case of belt-driven machines). These should be adjusted immediately.
Interlocking gear and door safety catches and clips should be inspected at regular intervals and
adjusted if necessary to ensure their efficient working.
The end covers should be removed periodically,
and a little grease smeared on the face of the pinion
and gearwheel teeth.
Driving belts or chains should be constantly
maintained at the correct tension.

6. Cleaning the internal surface
The use of hard water for laundry purposes
results in the formation of a scale on the cage and inner
surfaces of the washing machine. The hardness
elements in the water is precipitated by the alkali used
in the washing process and the chemical action of the
soap on the precipitate causes it to be deposited in the
form of a hard scale (e.g., lime soap deposits). The
presence of even small quantities of this scale is
troublesome inasmuch as minute particles become
detached and settle on the work with resultant deteri-
oration in whitewash; heavy scaling may cause partial
blocking of the perforations in the cage and so interfere
with the efficient circulation of water through
the machine.
It is essential therefore that such scaling be re-
moved periodically, and this can be done by a suitable
acid treatment, followed by an alkali boil.

Note.—Great care must be exercised in the use of
acid to prevent damage to the metal of the machine.

Procedure:
(1) Revolve the cage by means of the hand
turning gear and scrape and brush off as much scale
as possible from the external surface.
(2) Remove the cage door and turn the cage
gradually by hand turning gear so enabling the inside

Fig. 7.—30 cu. ft. side opening type washing machine, motor driven.
of the cage and as much as possible of the inside going to be similarly scraped and brushed by a man inside the cage. Lock the cage each time before closing.

Note.—In operations (1) and (2), great care must be taken to ensure that the power applied to the machine is not sufficient to raise the hose on the surface of the cage, as this will cause tearing of the fabric.

(1) Replace the cage door and set the machine ready for running.

(2) Thoroughly rinse the machine.

(3) Run hot water at a temperature of about 160°F. into the machine to a dip of 6 in. Add small quantities of acid, about 2 oz., at a time, at intervals until the water remains acid to litmus after 5 min. running. Glacial acetic acid should be used, as this has the minimum corrosive effect on the metallic construction of the machine.

(4) Run out the acid liquid and rinse thoroughly with soft water.

(5) Add hot water at a temperature of about 170°F. into the machine to a dip of 6 in. Add 1 lb. of soda ash, and boil for 15 minutes.

(6) Run out the solution and rinse the machine thoroughly.

(7) Repeat processes 7 and 8 if the cage still appears greasy.

(10) If possible, descaling should be done prior to some period at which it may be anticipated that the machine will be idle. After cleansing as above, a solution of sodium silicate (water-glass) should be left in the machine overnight to protect the cage against subsequent corrosion; 1 oz. of syrupy sodium silicate in a full 110 lb. capacity machine is sufficient for this purpose. The cage should be revolved at intervals.

GEARS

7. Typical Interlocking Gear

(As fitted on the Smith & Paget 26 in. diameter motor driven washing machine with gearbox drive) (Fig. 8)

In the position shown, in Fig. 8, the machine is idle and is started by moving the machine control lever (1) to the left. The machine control lever (1) operates the door interlock bracket (2) which operates in conjunction with the striking piece (3) mounted on the

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Fig. 8.—Diagrammatic arrangement of interlocking gears for Smith and Paget washing machine.
8. The "Crow" Reversing Gearbox

This gearbox, Figs. 9 and 10 is fitted on the Smith & Page syringing machines.

![Diagramatic arrangement of Crown reversing gearbox.](image)

The unit comprises an assembly of three shafts two upper and one lower. The two upper shafts, namely the front or input shaft and the back or lay shaft, are directly engaged and so rotate in opposite directions; drive is communicated by vee belting from the motor to a gearwell, which is mounted on an extension to the input shaft.

The input and lay shaft each carry a second smaller wheel free to rotate on the shafts and both engaging with a large gearwheel mounted on the lower or output shaft, the extension to which carries the main driving pinion wheel. This third shaft is positioned immediately below and centrally between the two upper shafts. Each of the two upper shafts also carries a multigrip friction clutch capable of separate engagement with the secondary gear wheels previously referred to.

Automatic engagement of the clutches is effected by spring loaded plungers controlled by a cam so arranged that the clutches cannot both be engaged at the same time. The cam is circular and is freely mounted on the lower shaft. The cam is driven by a two-stage worm reduction timing gear and causes engagement of the clutches alternately, disengaging one before permitting engagement of the other, thus imparting reversal of motion to the output shaft.

Assuming the clutch on the input shaft to be engaged, the lower shaft would be directly driven and would rotate in a direction opposite to that of the input shaft. When the clutch on the lay shaft becomes engaged, the lower shaft is driven through the laywheel with a resultant reversal of motion.

9. A "Lightburn" patent reversing clutch

In certain makes of washing machines the reversing motion of the motor cage is obtained by drive from the motor pinion through a "Lightburn" patent reversing clutch (see Figs. 11 and 12). The clutch mechanism comprises a central driving or output shaft at each end of which is secured a central driving plate capable of engagement by alternately the right or left hand driving plates, the latter being freely mounted on the central shaft.

Clockwise motion to the left hand driving plate with the latter reduction is communicated from the motor pinion to a chain wheel mounted on the end of the boss of the right hand driving plate. The extended boss also carries an intermediate chain wheel and reverse motion to the back shaft is effected through a jockey wheel by drive from the intermediate wheel. Anticlockwise motion is communicated from the back shaft to a wheel mounted on the extended boss of the right hand driving plate.

In the central position of the clutch, therefore, the central output shaft and driving plates remain stationary while the right and left hand driving plates run independently in their respective clockwise and anticlockwise directions.

A spring-loaded central bobbin is freely supported on the central output shaft between the two central-driven plates and lateral movement of the bobbin exerts a gradual pressure by means of a wedge action to the driving plates, and parts of the clutch plate and lining-rings engaging with the associated fixed-driven plates. The clutch is thus virtually inoperative and reversed motion is thus communicated to the output shaft through the right or left hand driving plates, and hence by direct drive to the main gearwheel of the washing machine.

A worm mounted on the back shaft drives a worm-wheel, mounted concentrically with which is a roller
Fig. 10.—Assembly arrangement of Crown reversing gearbox.

The number of machine reversals is capable of variation through a train of gearwheels mounted behind the wormwheel assembly, the central spindle of which carries the spindle of the engagement roller referred to above.

Fig. 11.—Diagrammatic arrangement of Lightburn reversing clutch.
UNIT controlling the reversing motion of the inner cage, produces an interruption or "pause" of predetermined period to the rotation of the cage.

The device is illustrated diagrammatically in Fig. 13, and the following should be read in conjunction with the description of the belt striking gear and Fig. 14.

The cam is mounted on a toothed wheel, motion to which is activated by a pawl attached to the wiper arm. The toothed wheel is provided with six teeth so that it carries the cam one-sixth of a revolution each time the wiper arm makes a complete to-and-fro movement. The cam is also divided into six sections. The belt striking gear rod carries a quadrant which when engaged with the wiper arm moves the open or crossed belts to the driving pulley, producing clock or anti-clockwise motion to the inner cylinder.

The position of the quadrant is determined by spring loading so that when disengaged from the wiper arm the quadrant drops and engages with the wiper arm which then moves the belts to the driving position causing revolution of the inner cylinder.

When the raised portion of the cam is in contact with the cam follower the quadrant is lifted clear of the wiper arm and the springs return the belts to the neutral position; during this period the inner cylinder is at rest and motion is therefore interrupted.

Three ratios of rest and motion are normally incorporated in the construction of the interrupter gear, and the appropriate cam is selected by a sliding mechanism.

In the 1:1 ratio the six portions of the contour of the cam are alternately high and low. In the 1:2 ratio the contour of the cam follows one-sixth of a sine curve high, one-sixth of a sine curve low. In the 1:5 ratio the cam has one-sixth of its circumference low and the remaining five-sixths high. The normal clockwise and anti-clockwise motion of the cylinder is retained as the interrupter gear operates irrespective of the direction in which the cylinder is rotating.

Fig. 15.—Diagrammatic arrangement of the B.L.R.A. interrupter gear.
With this type of machine the motor is separately mounted on the dock or clock head and driven through countermeshing, the "fast" and "loose" pulleys being mounted on the machine driving shaft. A pinion, on the driving shaft transmits the drive through an intermediate wheel to the main gearwheel mounted on the trunnion of the inner cylinder. Reversal of the motion of the inner cylinder is obtained by open and crossed belting. The construction of the machine and the names of component parts are generally similar to those previously described.

13. Striking gear

The belt striking gear is illustrated in Fig. 15 which shows the assembly with the gear in the neutral position and with one belt running on their associated free pulleys. A worm, sleeve mounted on the main driving shaft imparts circular motion to a worm wheel and hence reciprocating motion to the wiper arm, the foot of which engages with the face profile of the cam. The worm is secured to the boss of the open-belt-driven free pulley. The open belt when moved to its driving position on the fixed pulley, overlaps its free counterpart, thus permitting continuous rotation of the free pulley and maintaining the constant reciprocating motion of the wiper arm. The reciprocating motion is transferred to a quadrant mounted on the belt striking gear spindle, thus resulting in the alternate engagement of the "open" and "crossed" belting with the fixed driving pulley, with the consequent transmission of clock or anti-clockwise motion to the inner cylinder.

Motion of the inner cylinder is controlled by the engagement or disengagement of the quadrant with the wiper arm. To stop the inner cylinder, the quadrant is lifted clear of the wiper arm by means of the operating lever provided. The quadrant carries a Vee-shaped projection and when the quadrant is lifted clear, the Vee portion slides into a central position between two snags cast on the gear arm, thus drawing the belts into the neutral position on the free pulleys. The belts remain in this position until the machine is restarted by the operating lever.

13. Door Locking Device

A typical arrangement with a description of the mechanism appended is illustrated in Fig. 16.
Fig. 15.—Belt striking and reversing gear.
Fig. 16.—Door locking and hand turning gear for Ritchie No. 2 washing machine.

This drawing shows the machine in the neutral position, i.e., the driving belt is on the free pulley and the machine cylinder is idle. In this position the outer door can be opened as the door locking cam has been lifted by its lever. The sliding bar has been drawn from the eccentric housing thus enabling the eccentric to be turned so that the plunger engages with the spur wheel. The plunger pin locates this new position and the inner cylinder can now be revolved by means of the handwheel.

To start the machine, the hand turning gear must be disengaged, i.e., the plunger is removed from the eccentric and by means of its control lever, the eccentric is turned in the bracket thus disengaging the pawl from the spur wheel. The plunger locates this new position. The starting handle is pulled by the operator. This action (a) drops the door cam, (b) operates the sliding bar which enters rid locks the eccentric in the disengaged position, and (c) pulls over the ball weight lever which in turn engages the stop and startsquashen with the stoper arm.

OPEN END TYPE

14. Description

The machine shown in Fig. 17 consists of a perforated monad metal or brass internal cage of open end construction. The rear end of the cage is fitted with a trunnion housing of the sleeves type which revolves on roller bearings mounted on the trunnion. The trunnion is supported in a trunnion bearing bracket and can be withdrawn externally without completely removing the main drive assembly.
by mild steel discs, the front disc being bored to receive a gummed paper ring on which the outer foot, giving access to the cage, is hinged. The door is fitted with a toughened glass panel and watertightness is preserved by means of a rubber joint ring. A seal of the split ring type (Fig. 24) is mounted on the trans- mission housing and preserves watertightness at the back of the machine. The seal serves the dual purpose of preventing leakage of water from the machine and conveniently presents oil and grease from entering the cage with consequent contamination of the load.

A solution hopper is placed in the front of the machine and the predetermined quantity of stock solution, starch, bleach or Blue, required by the washing formula is measured and placed in the hopper at each individual stage of the washing process. The solution is then injected into the machine by means of a steam injector (Fig. 18) controlled by a foot operated valve.

Machines are arranged with both hot and cold water inlet valves or alternatively with a "T" piece to take a thermostatic steam and user mixing valve and associated fittings. A separate steam boiling connection fitted with a fine adjustment valve is provided. A 3 in. vapour outlet pipe is fitted at the top of the machine and a 6 in. diameter outlet or dump valve controlled by a hand operated lever mechanism (Fig. 19) is supplied.

Machines supplied for Admiralty use are also fitted with a solenoid clock, a thermometer of the distant reading type and a hydrostatic depth gauge for indicating the depth of the machine (Fig. 20).

15. Safety device

The outer casing door is electrically interlocked with the motor; immediately the door is opened the motor is switched off, thus bringing the inner cage to rest. Similarly the machine cannot be re-started until the outer door is positively shut.

16. Drive

All machines are arranged for washing 10th main classes of work, namely "cottons and linens" and "woollens." It depends upon the preference of the user in respect of the method employed for washing woollens, two distinct types of mechanical drive and electrical control gear are supplied by the makers. Both types of drive are fitted in machines 10 Admiralty service.

Method 1—Drive to the machine is arranged by a specially designed motor supported on the frame and a vertical worm wheel gear giving a drive ratio of 12:1 (see Fig. 21). The output shaft engages with the main driving wheel, 94 teeth, this main gear wheel is of the split type and is rigidly secured to the cage mounting housing. The overall reduction between the speeds of the motor and the speed of the cage is approximately 83:1. With a speed of motor of 1,200, a speed of 9.5 ft. per minute is produced.

The motor is of the reversing type and reverses the cage six times per minute with a two seconds dwell.
Fig. 19.—Outlet valve operating mechanism.
period between each reversal to allow the cage to come to rest before starting away in the opposite direction.

Movement of the cage is therefore eight seconds clockwise motion, two seconds dwell, eight seconds anti-clockwise motion, two seconds dwell and so on.

The timing of the cycle of operations is controlled by an automatic electrically-operated switchgear known as a reversing panel. The correct sequence of the cycle of operations 8–2–8–2 is obtained by a motor-driven timing relay consisting of an arrangement of cam-operated switches.

(SO 7548)

The requirements for woollen washing are met by the provision of a second timing relay in the reversing panel to give an over-riding cycle of one minute running and two minutes dwell (or any other cycle which may be originally specified). This over-riding cycle is only used when the machine is engaged on woollen washing and can be switched out from the control system when the machine is engaged on the washing of cottons and linens.

Method II.—With this arrangement of drive an additional two-speed gearbox of the Geidt type No. 3A

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giving a 2:1 or 2:1:1 reduction is fitted between the motor pinion and the standard type 15:1 worm reduction gearbox. The purpose of this gearbox is to reduce the roughing speed of the machine by 50 per cent, namely to 115 ft. per minute when the machine is engaged in washing woolens goods. The low speed enables the washing operation to be continuous and the alternative "short washing" and "long dwell" periods normally associated with interrupter gear when used for washing woolens with single speed machines is unnecessary. When washing woolens therefore in a machine fitted with this type of drive, the reduced speed permits the normal (tiring) cycle to be used, namely 8-2-8-2 seconds, as for cottons and linens. Engagement of the two speed gear from the 1:1 ratio for cottons and linens to the 2:1 reduction when washing woolens is effected by a gear change lever operated from the front of the machine.

17. General Maintenance

THUNDER BEARINGS.—A grease nipple is supplied on the trunnion for greasing the trunnion bearings—this should be turned occasionally and recharged at intervals of approximately three months.

MAIN DRIVING WHEEL is lubricated by means of a grease cup mounted on the bearing bridge. This should be given a turn each day and the cup replenished as necessary.

Gear Box (Fig. 21) is fully charged by the makers on assembly. After installation and when the machine has been running for approximately 500 hours, the gear box should be drained and re-filled with new oil to the correct level. Thereafter the gear box should be drained, cleaned and re-filled after each 12 months running. Always fill and check the gearbox when the machine is idle. Filling above the correct level results in excessive heat generation and in loss of power due to the drag of the surplus oil. The remaining grease nipples on the gearbox assembly should be turned occasionally and replenished at three-monthly intervals.

MOTOR.—Two screw-down type greasing connections are provided for the motor bearings (Fig. 24). These should be turned occasionally and replenished at three-monthly intervals.

Hopper.—The strainer in the hopper should be maintained constantly in the fully clear condition.

Inlet.—Should normally require very little maintenance but should be inspected at three-monthly intervals to ascertain the condition of the steam valve discs.
TRUNION BEARING.—Should be inspected at three monthly intervals and all dirt removed. Clearing plugs are also provided in the connecting pipe work for similar removal of silt and lint accumulations.

Doors.—The seal between the door frame and the door is effected by a length of 3 in. diameter rubber tube let into a recess. Should replacement be necessary, the new tubing should be fitted with the joint at the top of the door.

28. Replacements and adjustments

In all cases the detailed instructions contained in maker’s handbooks are to be observed but the following details are included in this manual primarily because the description of the operations involved and the associated sketches illustrate the construction of the machine.

TRUNION BEARING

To remove the trunion bearing (Fig. 25), first remove the gear guards thus exposing the spur wheel. Place hardwood wedges between the bottom of the spur wheel and the bearing bridges. Three wedges should not be driven in unnecessarily force but should be only tight enough to prevent the trunion housing from dropping when the trunion and boxing is removed. Under no circumstances should an attempt be made to remove the trunion without first supporting the gear wheel. Having supported the wheel, both clamping bolts should then be removed from the spur wheel. If not free, the wheel should be moved on the trunion housing by lightly driving a steel wedge into the split hub.

The trunion bearing is located by three internal segments which in turn are maintained in position by three slotted studs (grub screws) which pass through the housing. To expose these, the inner cylinder should be gently turned by hand until the head of the grub screw can be seen through the split hub of the spur wheel. This grub screw should be removed and the procedure repeated for the removal of the remaining two.

The nuts holding the trunion to the bracket should then be removed and set bolts inserted in the holes provided for this purpose to “start” the trunion from the bracket face. When the trunion is completely withdrawn from the housing, the roller bearing should be removed in the normal manner for examination.

FRONT BEARING (Fig. 23)

(a) To inspect.—Unscrew the door switch from the outer door frame and remove the door switch unit. To this end, the set screws on the outer door frame should first be removed. The whole door assembly can then be withdrawn, leaving the front bearing exposed.

(b) To remove.—First remove the triangular cover plate on the front end frame in order to gain access to two in number horizontal head boss plugs fitted on the bottom rim of the outer drum. The two brass plugs should be removed and replaced by hexagon headed steel set screws (1/4 in. Whitworth, 3 in. long). Screw up gently on the set screws until they are snug in contact with the underside of the inner cylinder. When contact is established, no further tightening should take place as the purpose of these bolts is merely to hold the inner cylinder in position when the front bearing is removed. Undue tightening will cause distortion.

Important.—The cylinder must be supported in the manner described before attempting to withdraw the bearing as otherwise sagging of the cage with consequent damage to the trunion assembly will result.

(c) To remove outer track.—The outer track is attached to the front end plate. The front angle
leaking (if necessary) and the hopper should first be removed. The hexagonal screws holding the front end plate should then be taken out. The front end plate can then be withdrawn. The outer track can be dismantled independently.

(c) Reverse the procedure for re-erection taking care to make good all joints.

Note.—The brass filling plugs for the locking screw holes must be reinserted when the steel locking screws are removed.

If water is detected on the bearing face of the outer track (normally at the lowest position), this can be countered each time by turning the track round on its fixing screws in steps of 15° through a full circle of 180°—thus preventing twelve fresh contacting surfaces to minimise wear.

Seals
Sealing is effected by an external seal of the split type which is automatically compensated for wear. The seals are located behind the main driving wheel (Fig. 24) and form contact with the truncated housing. To remove the seal, first ease back the spur wheel. Remove the nuts holding the seal in position and pull forward until clear of the track. Remove the two cheese-headed screws thus allowing the seal to be disconnected in two halves.

To replace, reverse the procedure.

OTHER TYPES

19. Dual electric and steam-heated type

One of the main difficulties associated with the installation of laundry facilities in destroyers, frigates, etc., is the provision of equipment which will cater for harbour conditions when no steam is available. With the maker's co-operating the Admiralty has developed a dual-purpose 40 lb. capacity end-opening type machine for

![Diagram of front bearing assembly.](image)

![Diagram of seal arrangement on the truncated housing.](image)
heating of the water is arranged by means of heating elements having a total loading of 12 kW, and contained in a tank fitted to the bottom of the outer cage of the machine. A magnetic type flow switch is fitted in this tank to protect the heating elements. When the water is discharged from the machine, the float lowers and the switch automatically breaks the electric power circuit to the elements. Similarly, on refilling the machine, the float is raised and the switch connects in and completes the power circuit to the heater. The electrical supply to the heating elements can also be hand controlled by a direct on-and-off switch mounted on the front of the washing machine. This hand control should be used in all circumstances thus leaving the float switch to act in the capacity of a safety device only. A pilot lamp fitted to the front of the machine indicates the heater “on” or heater “off” condition.

20. The washing process using electric heating is slower than with steam heating. The effective use of the machine depends upon the availability of an adequate supply of hot water from external sources. An electrically heated calorifier 16 kW. heating and capable of an output of 30 gallons per hour at 150°F is provided. Care must be taken to draw off only such quantities of hot water into the washing machine as are actually required throughout the various stages of the cycle in order to preserve a continuous supply of hot water. Because of the time factor and in view of the need for balanced draw off from the calorifier.

Fig. 25.—Sectional arrangement of thermostatic steam and water mixing valve.

detailed instructions in the use of the unit have been compiled for separate issue to the “users.”

21. Domestic washing machines

Domestic washing machines of the fully automatic type are at present installed in certain destroyers and minor vessels. Full details of the method of operation and of the maintenance of these machines are contained in the maker’s comprehensive servicing manual copies of which are issued to all vessels in which such machines are installed.

STEAM AND WATER MIXING VALVES

22. Increased use is being made in H.M. ships’ laundry installations of steam and water mixing valves, the valve in general use being the Leonard Type T.S.

![Exploded view of thermostatic steam and water mixing valve](image)

Regulating Spindle Gear Wheel

Regulating Spindle

Valve Locking Screw

Valve Tubing

Cold Water

Cooling Water

Blended Water Outlet

Valve Locking Bush

Regulating Spindle Gear Wheel

Thermostat Retaining Bolt

Thermostat Gear Wheel

Thermostat Coil

Thermostat Driving Pin

Shuttle Driving Pin Socket

Shuttle Driving Pin

Fig. 26.—Exploded view of thermostatic steam and water mixing valve.
association with the fresh and salt water washing equipment is fitted to washing machines of 121 cu. ft., capacity and above.

The mixing valve is capable of providing an instantaneous flow of water at temperatures ranging from cold to a maximum of 160°F., thus ensuring the means to conduct each washing or rinsing process at the temperature prescribed in the washing formula.

23. Action

Variation in temperature is controlled by movement of the regulating handle between the cold and hot positions. Within the mixer, a bimetallic coil which is wound according to the temperature of the water in the mixing chamber and in 10 degrees, opens or closes the ports admitting the steam and cold water.

If the outlet temperature tends to rise, the thermostat cuts down the steam supply and thus increases the admission flow for the cold water, alternatively, if the outlet temperature tends to decrease, the thermostat control cuts down the cold water supply, thus increasing the area for steam admission.

24. Maintenance

Scale deposit on the moving parts of the mixer may occur through various causes. Should the valve shuttle become seized up, it will be necessary to remove the cover, tube, and shuttle, and clean the bearing surfaces with a suitable scale removing fluid.

When re-assembling it is extremely important that the thermostat driving-pin is correctly meshed in the shuttle driving-pin socket. The closing up of the cover and thermostat should be carried out separately by fitting the thermostat before replacing the cover and not both together as one unit.

25. Regulation of temperature

It should be noted that the regulating handle controls the temperature only and cannot be used to control the outflow of hot water. If it is found that the maximum temperature of 160°F. or lower as required cannot be obtained with the regulating handle against the HOT stop, proceed as follows:

1. Slacken the grub screw, remove the regulating handle nut and draw the handle off the thermostat spindle.
2. Replace the small set screw which holds the split bush in the handle. Remove the split bush and slip it back on to the thermostat spindle.
3. Replace the handle and move this split bush around until the required maximum temperature is being delivered by the mixer. Slight the regulating handle back on to the split bush without altering this setting so that the handle comes up against the HOT stop screw. Remove the handle and split bush simultaneously. Tighten down the set screw.
4. Place the handle and split bush in the spindle and tighten down the regulating handle nut and grub screw.

Fig. 79.—Piping arrangement of fresh and salt water mixing valve with fresh and salt water washing connections.
26. Operation (in conjunction with the salt and fresh water washing equipment (Fig. 27)).
(a) To supply hot salt water.
   (1) Couple the flexible hose from the slide valve on the salt water line to the N.R.V. on the inlet side of the mixer.
   (2) Open the slide valve and allow salt water to flow into the mixer. BEFORE
   (3) Open the steam supply valve.
   (4) Adjust to the required temperature by means of the regulating handle on the mixer.
   (5) The temperature reading can be obtained from the thermometer on the outlet pipe.
   (6) To change from salt to fresh water supply:
      (1) Close the steam slide valve BEFORE
      (2) Closing the slide valve on the salt water supply pipe.
      (3) Disconnect the flexible hose from the salt water supply valve, and
      (4) Reconnect the hose to the fresh water supply line.

27. Scheme of piping (for mixing valves working in conjunction with a battery of Bendix domestic washing machines).

The diagrammatic arrangement of piping, Fig. 28, permits:

- The operation of all four machines with hot water from the mixing valves.
- The operation of any individual machine with hot water from either mixing valve.
- The operation of all four machines or any individual machine with hot water from the ship's domestic system or from the separate hot water supply for laundry purposes when working under harbour conditions, i.e., with no steam available.

Fig. 28.—Piping arrangement for a in No. mixing valves working with Bendix domestic washing machines.