CHAPTER VI

Drying Equipment

HYDRO-EXTRACTORS

1. General notes

When taken from the washing machine, the clothing is saturated with water which can be partially removed by spinning the clothes at high speed in a hydro-extractor. This process leaves the clothes in a "damp only" condition, the moisture content after hydro-extraction being from 40 to 50 per cent of the weight of the dryweight article.

In general, two types of hydro-extractors are manufactured, the fixed bearing type and the self-balancing type. These types are capable of further subdivision dependent upon the mode of drive, namely, direct, by underslung or overhead mounted motor, or by belting from a separate vertical or horizontally mounted motor. Only machines of the self-balancing type are accepted for H.M. Ship laundry service. For use in Shore Establishments, machines may be directly driven by underslung motor or through vee belting from a separately mounted motor.

All machines installed in H.M. ships must be of the separately-mounted motor-driven type. On some machines already in service the motor is horizontally mounted and drive to the machine is effected by flat belting. Conversion of the flat-belt drive from the vertical to the horizontal plane is arranged by a system of jockey pulleys. This type of drive necessitates a long belt, and as the humidity condition in H.M. ships is subject to considerable variation, difficulty is experienced in maintaining a constant belt tension with this arrangement. Later machines have therefore been provided with a motor mounted vertically adjacent to the outer casing of the machine thus enabling the drive to the spindle to be arranged by a comparatively short length of vee belting.

The size of a hydro-extractor is denoted by the diameter of the inner basket; machines in general use in H.M. ships are 18, 21, 27, 30 and 36 in. diameter. Larger machines, 42 in. diameter and above, are in some instances installed in shore establishments.

Capacities of types of machines in general use:

Diameter of cage ..	21 in.	27 in.	30 in.	36 in.	42 in.
Cubic capacity	2·25	3·5	6	8·5	11
r.p.m. ..	1700	1500	1300	1150	900
Dryweight per load in lbs.	27	42	72	102	132

The accepted loading for all hydro extractors is 12 lbs. dryweight per cubic ft. cage capacity.

2. Description

The description should be read in conjunction with Figs. 30, to 33, illustrations of typical extractors used in H.M. ships and shore establishments.

The hydro-extractor consists of an inner perforated cage or basket of fabricated construction, capable of revolution at high speed within an outer casing or shell fitted with a hinged cover. The work is placed in the inner basket. As the basket revolves, the water is expelled by centrifugal force through the perforations and into the annular space between the cage and the outer shell. The water is drained from this space by a pipe.

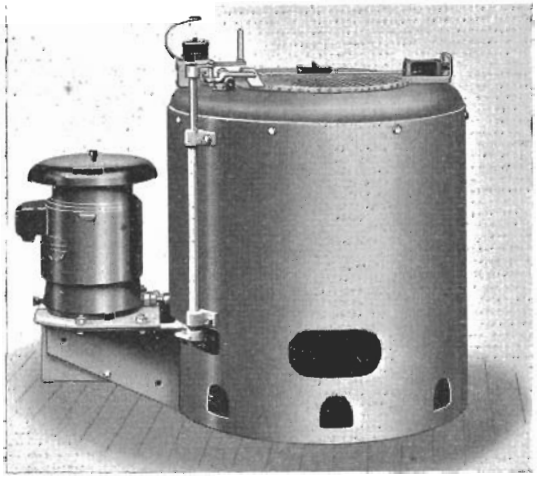


Fig. 30.—External view of Watson Laidlaw 27-in. hydro extractor.

The inner cage is securely attached to a vertical spindle revolving in ball or roller bearings, which in turn are located in a footstep bearing. The footstep bearing is housed on a conical rubber seating (also known as a conoidal rubber buffer) set in the footstep block. A typical assembly is shown in Fig. 34. Drive to the central spindle is by vee-belting from a motor vertically mounted on the outer casing of the machine. When the basket is empty, or if it contains a perfectly balanced load, the basket spindle will revolve in a true vertical plane. If loaded unevenly, the basket will tend to "wobble" at speed but the method of suspension previously described is designed to permit the combined high speed revolution and "wobble" within reasonable limits—hence the term self balancing.

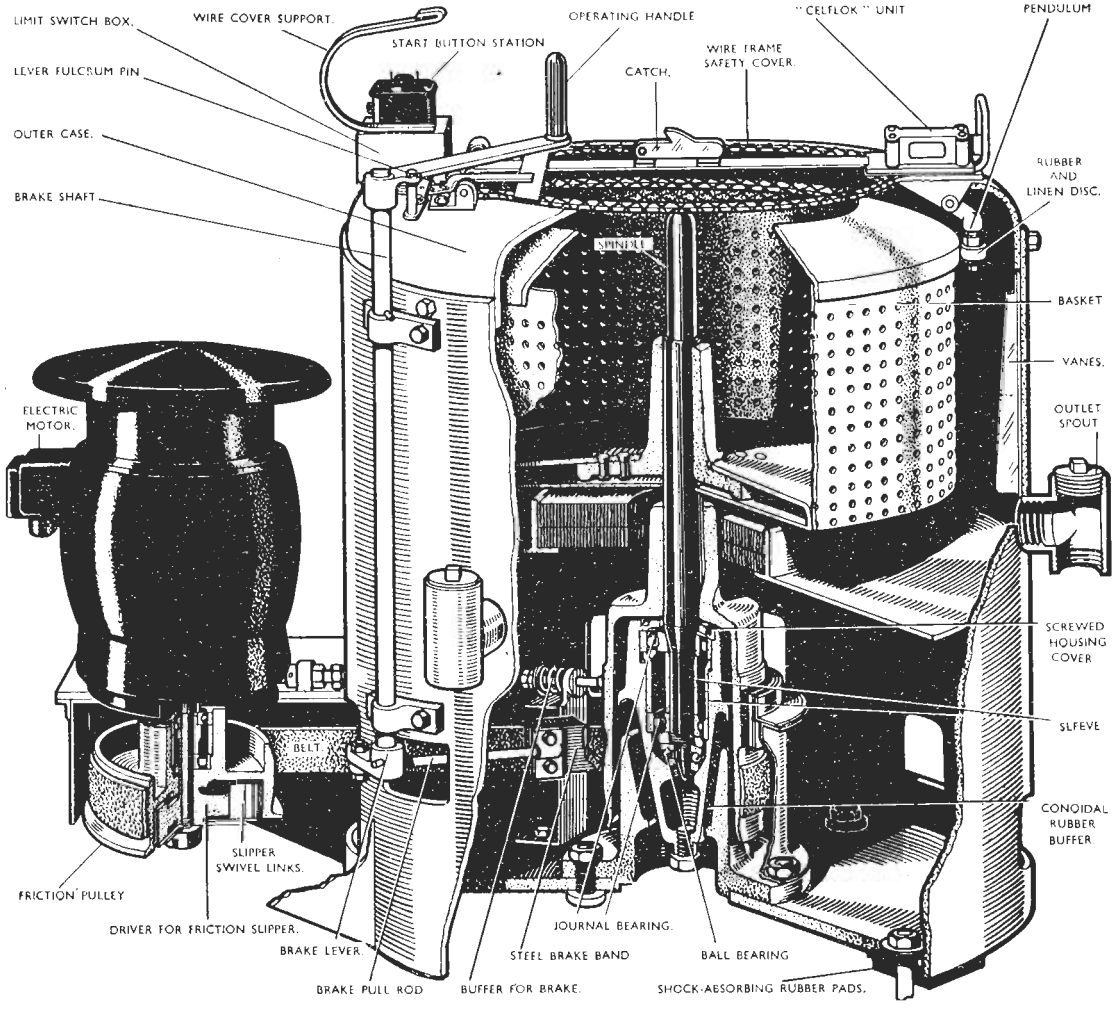


Fig. 31.—Sectional arrangement of Watson Laidlaw 27-in. hydro extractor.

Fig. 32.—External view of Broadbent 30-in. hydro extractor.

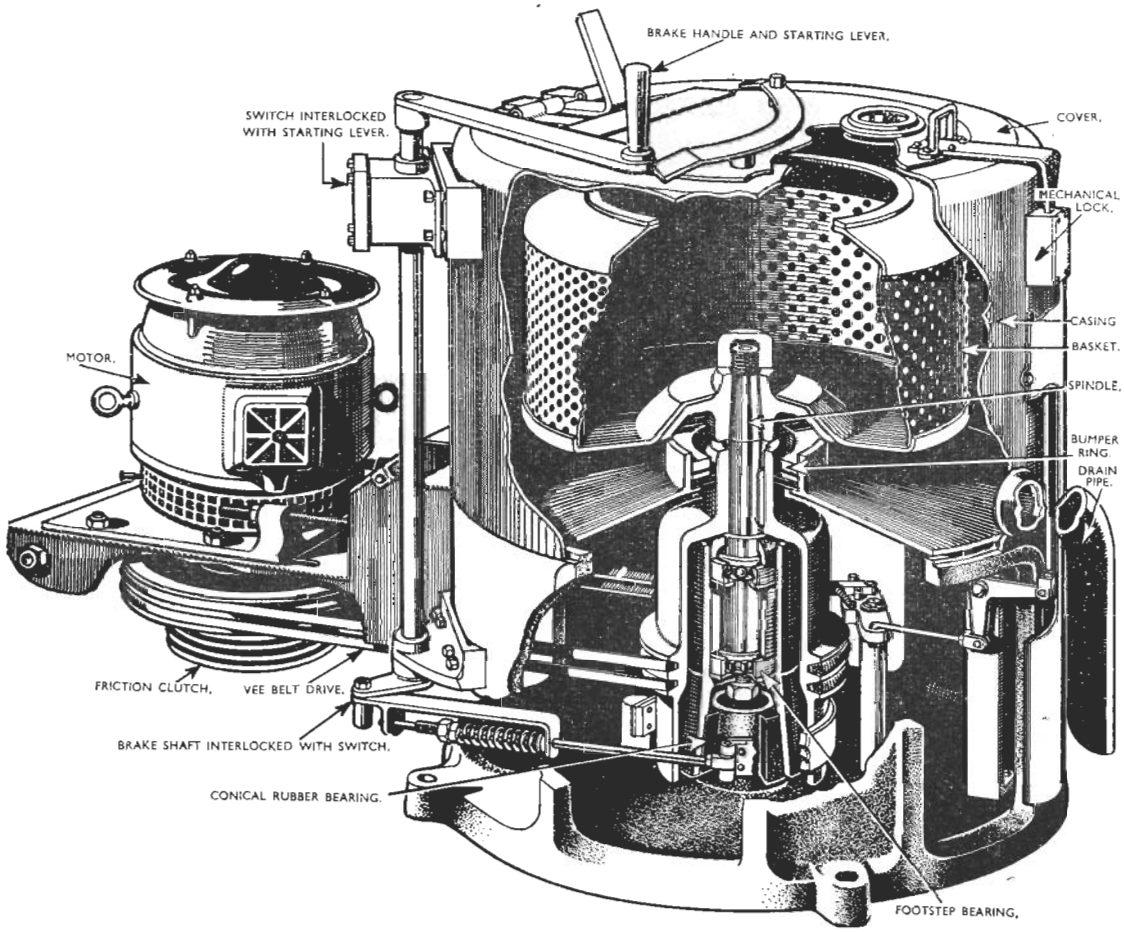


Fig. 33.—Sectional arrangement of Broadbent 30-in. hydro extractor.

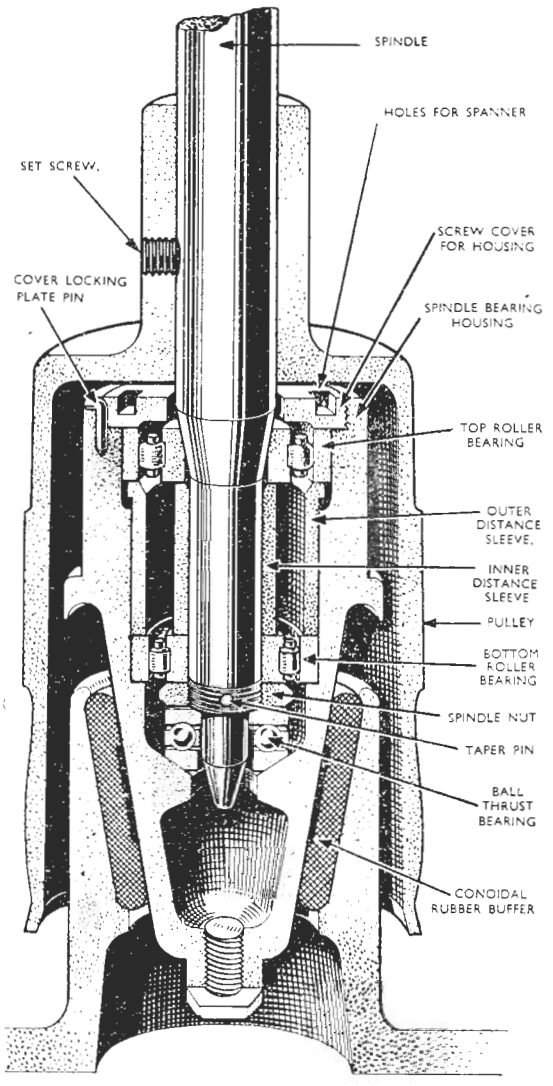


Fig. 34.—Spindle bearing assembly for 27-in. Watson Laidlaw hydro extractor.

The self-balancing characteristic of the machine should never be abused and the utmost care should be taken at all times to ensure an initial balanced loading. In most extractors installed in H.M. ships a buffer ring is provided, sited immediately underneath the basket. If the machine is started with too great an unbalanced load, the cage spindle bumps against the buffer ring as it revolves and thus prevents the machine reaching speed. In these circumstances the machine must be stopped immediately and the load readjusted to give balance.

A hand or foot-operated brake is provided to assist in stopping the machine when the process is complete and the motor is " off." In most makes of machine the brake is spring loaded, thus limiting the load which may be applied and so preventing too fierce a braking action.

Belt stenting gear is provided to enable the belt drive to be maintained at the correct tension.

3. Safety devices

In addition to the buffer ring previously mentioned, interlocking gear is provided to prevent the cover being opened when the inner cage is in motion, and to prevent the machine being started when the cover is in the open position.

Mechanical gear of various patent types is used to preserve the first condition. To fulfil the second condition, the cover is usually electrically interlocked with the push-button starter mounted on the machine.

In some types of machine the brake lever is also interlocked with the starter-button so that the cover must be closed and the brake be in the off position before the machine can be started. Similarly, the current must be switched off before the brake can be applied and the safety cover opened.

A clip is provided to maintain the cover in the open position when loading and unloading.

TYPICAL SAFETY DEVICES

(*a*) *As adopted by Messrs. Broadbent*

Fig. 35 with the description, illustrates the mechanical interlocking device on the Broadbent type 23 R.V. hydro extractor which prevents the cover being opened while the inner basket is in motion. When in the running position, the combined brake handle and starting lever extends over the cover of the machine, and thus provides a secondary mechanical lock.

The starting lever and brake shaft are interlocked with the starting switch. Clockwise movement of the lever automatically switches off the electric power supply to the machine, thus ensuring that the current is " off " before further clockwise movement of the lever applies the brake. Similarly, the starting lever cannot be returned to the " on " position before the cover is shut.

(*b*) *As adopted by Messrs. Watson Laidlaw*

(To be read in conjunction with Fig. 31.) The mechanical lock is the firm's patent spring loaded " Celflock " device. The spring loaded locking catches are directly coupled to a cranked pendulum the roller of which is in light surface contact with the periphery of the basket when the " Celflock " is in the locked position. Any attempt to open the lock when the machine is running results in closer engagement of the roller with the basket; the pendulum is thrown outward by centrifugal force, thus automatically maintaining the " Celflock " in the locked position. When in the running position, the cover is further secured by a lever which is directly linked with the brake and starting handle. The brake lever is directly coupled by a sliding bar with the limit switch and starter button. Anti-clockwise movement of the brake lever automatically switches off the electric power supply to the machine, thus ensuring that the current is " off " before further anti-clockwise motion of the lever

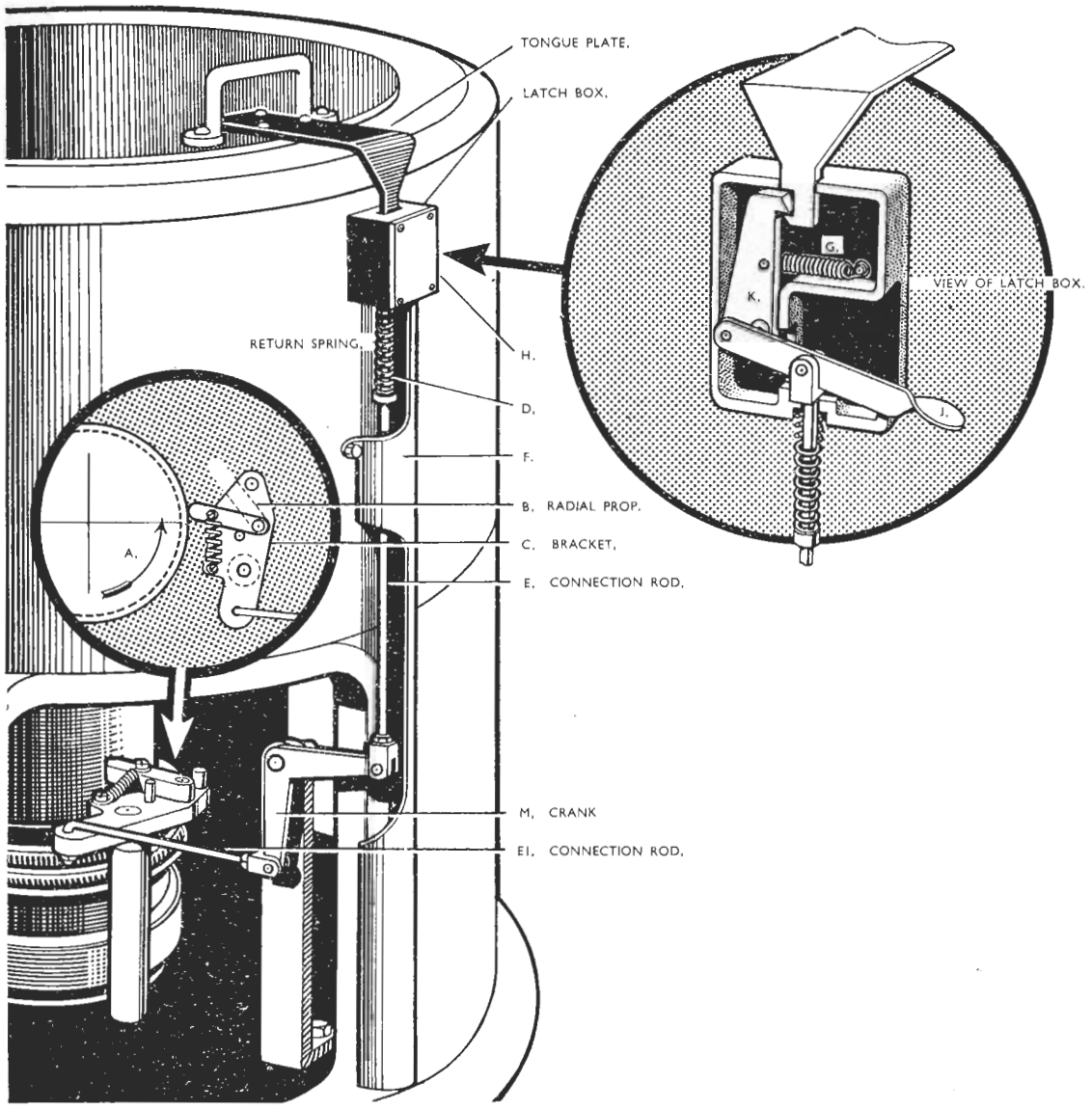


Fig. 35.—Safety interlocking gear for 30-in. Broadbent hydro extractor.

The Latch Box " H " is fixed to the casing of the machine and the latch " K " engages with a tongue plate " L " which is secured to the cover.

The radial prop " B " operates on the spindle pulley, and the supporting bracket " C " is pivoted to a stationary portion of the machine, connection being made between " C " and the latch by means of two connection rods " E " and " E1," and a bell crank lever " M." The vertical connecting rod is enclosed by a guard " F."

The interlock is of the dead stop type, rotation of " A " preventing the cover being unlatched.

To open the cover when the machine is at rest, the thumb lever " J " is lifted. This first puts rods " E " and " E1 " under tension, and this presses " B " against " A " forming a fulcrum. Further pressure on " J " will then release the latch " K," the cover can then be opened.

If, however, the machine is running, the radial prop " B " will be kicked out, as shown dotted, the instant it comes in contact with " A," and the latch will not be moved, being held in place by the catch spring " G."

When pressure on " J " is released, the supporting bracket " C " will be brought back to its normal position, by means of the return spring " D."

The whole of the interlock is manufactured from rust-proof material.

applies the brake. Similarly the return of the starting lever to the starting, position, automatically returns the cover lever thus locking the cover.

4. Friction clutches

A friction clutch which enables the load to be gradually taken by the motor when the machine is started, is incorporated into the construction of most machines.

A typical friction clutch is illustrated in Fig. 36.

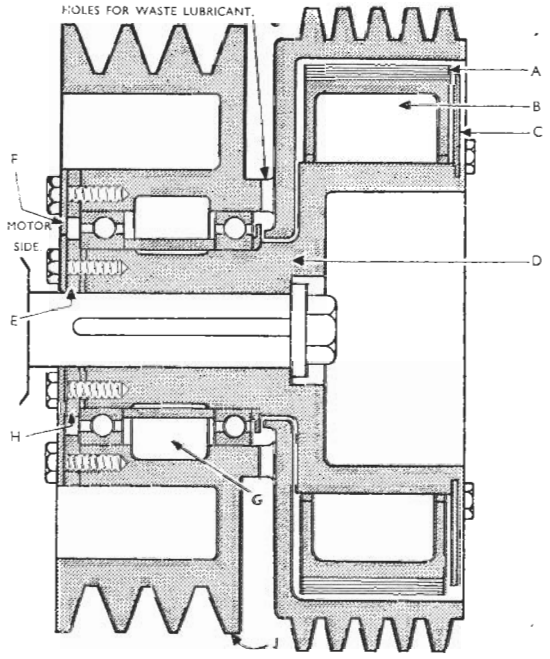


Fig. 36.—Friction clutch for 30-in. Broadbent 23 R.V. hydro extractor.

A central spider D carrying 4 in No. lined brake shoes is keyed to the motor shaft. The driving pulley J, the lower half of which forms the clutch driving plate, is free to revolve on ball bearings about D.

When the motor is started, the shoes are thrown outwards by centrifugal force. As the motor increases speed the load is gradually taken by the clutch, thus ensuring that no sudden electrical load is placed on the motor when starting up.

5. General Maintenance

Unless properly loaded and efficiently maintained, the hydro extractor may, by reason of its high speed of revolution, form a possible source of danger. Constant attention should therefore be paid to this machine and the maker's instructions rigidly adhered to.

All bolts, nuts, screws etc., should be properly secured.

The central spindle bearings are grease packed and should provide efficient lubrication for approximately 12 months. The spindle should be examined at 12-monthly intervals and repacked with grease if necessary. All external moving parts should be lubricated daily, or in accordance with maker's instructions, care being taken to ensure that no oil comes into contact with clothing, brake and clutch linings.

Each day, before it is loaded the basket should be rocked by hand in various radial positions to test that the spindle-bearing housing is correctly located and is not slack in the conoidal rubber buffer. Resistance to rocking, and the return of the spindle to the vertical position, will denote that the bearing housing is correctly sited and ensure the exercise of the self-balancing property of the machine. If any slackness is apparent in the conoidal rubber buffer, the machine should be thoroughly examined before further use.

Belts should be maintained at the correct tension by means of the belt stenting gear. Slackness of the belt will reduce the speed of the machine and result in inefficient water extraction.

The safety interlocking gear and braking devices should be maintained constantly in a state of efficiency.

The basket should be wiped clean after each day's use and the perforations kept free from matter which may obstruct the flow of water.

If when starting it is observed that the load is badly balanced, the machine should be stopped immediately and the load readjusted.

The machine should be stripped and thoroughly examined after every 12 months running.

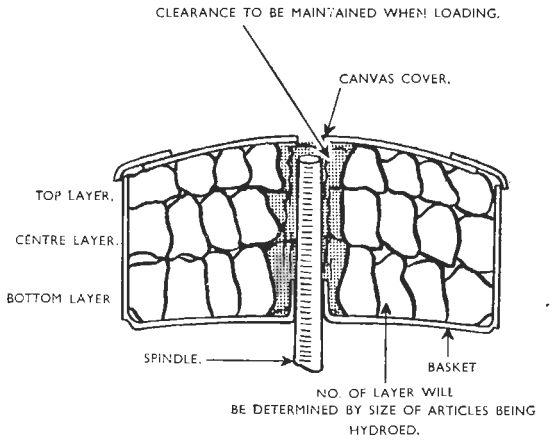
6. Operation (*including loading*)

Before loading, make sure that the basket is clean; if dirty, it should be washed thoroughly with soap and water. Rock, as described in the maintenance instructions.

There is only one way, the right way, to load a hydro extractor, see Fig. 37. The machine must be loaded in layers as follows:

Large articles should be separately bundled concertina fashion into as small a volume as possible and packed side by side tightly against the circumference of the basket. For convenience, small articles should be bundled together, and similarly packed into the machine. Loading should be progressed in this manner until a complete ring is formed at the circumference of the basket, *i.e.*, the outer bottom ring. Loading should continue, by packing in separate inner bottom rings, until the bottom of the basket is covered, but a small clear space should be left in the centre of the basket. Repeat the process by packing in successive layers until the hydro basket is full. Capacity is reached when the level of the clothes reaches the rim of the basket.

It is essential to maintain the clear space around the spindle boss, as clothes left in the centre position will, if in contact with the spindle, have a tendency to tear when the machine revolves. Similar damage will occur if clothes become stretched across the centre of the basket when loading the machine. Cover the load with a heavy canvas cover having a 4-in. diameter hole cut in the centre to permit the entry of air. The cover should be well tucked around and under the rim of the basket, making sure that no loose pieces are



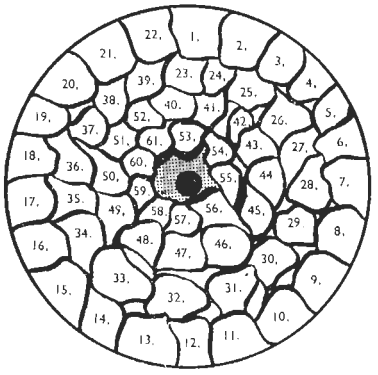


Fig. 37.—Method of loading a hydro extractor.

hanging out. This canvas cover, when properly tucked in, ensures that no piece of any garment can be subsequently drawn out. It also prevents the dust suspended in the atmosphere being deposited on the clean articles in the form of a smear, technically referred to as a fog mark.

Coloured goods need care in selection. If a "loose coloured" article is placed in the load, the loose colour will tend to bleed and stain other materials in close contact.

When loading is completed, the outer basket should be closed (see safety devices) and the machine started.

When extraction is complete the motor should be stopped, and the brake applied gently until the basket is brought to rest. The cover should then be unlocked and raised, and secured in the open position. While by reason of the safety gear provided such action is normally impossible, no attempt whatever should be made to raise the cover until the basket has stopped.

The hydroing operation leaves the clothes tightly packed against the outer rim, with a consequent large clear space in the centre of the basket. To effect their removal, the clothes should first be pulled gently towards the centre of the basket and then carefully unloaded a few pieces at a time.

7. Time required for extraction

The time required for hydro extraction can be determined by the observation of the waste water pipe, it being of little value to allow the machine to continue running after the steady flow of water from the waste pipe has ceased. A guide to the time required to hydro various articles, assuming the basket to be full, is indicated below. The time required differs for various type machines and is dependent upon the speed of revolution of the cage. Accurate times should therefore be determined as the result of experience.

Unstarched goods	7 mins.
Starched goods, table linen	12 to 15 mins.
Starched collars	10 to 12 ,,
White suits and overalls	12 to 15 ,,
Blankets	5 ,,
Woollens	3 ,,

It is important to note that when dealing with woollens careful processing is required, as too long a period of extraction will cause felting of the fabric.

8. Hydroing hammocks

To obtain maximum output when dealing with hammocks it is essential, because of their bulky nature and the stiff material from which they are manufactured, to fold each hammock into as small a bundle as practicable. Uniformly sized bundles can be obtained by first double folding the width and then rolling the hammock lengthwise.

OTHER EQUIPMENT

DRYING TUMBLERS

9. When received from the hydro-extractors the clothes are still damp and, as previously stated, contain an amount of water equal approximately to 50 per cent of the actual dry weight of the clothing. With the exception therefore of articles which are to be ironed or finished-pressed, all work must be further processed to obtain complete drying.

Drying is effected mechanically by means of drying tumblers. The size of the drying tumbler is denoted by the dimensions of the inner cylinder, and the rated capacity by the number of lbs. dryweight clothing which can be dealt with per hour. The rated capacity for woollens is lower, being approximately five-sixths of the accepted loading for cottons.

The approximate drying time per load of cotton goods is twenty minutes for all types and size of steam heated machines.

Typical machines in general use in H.M. ships are:

(*a*) the *Amazon* 36 in. × 30 in. tumbler, rated capacity 90 lb. dryweight per hour.

(*b*) the *Ibis* 50 in. × 32 in. tumbler, rated capacity 150 lb. dryweight per hour.

The rated capacity quoted in both instances is that pertaining to cotton goods.

The generally accepted rate of loading is 1½ lb. per cu. ft. of cage capacity.

10. Description

The construction of drying tumblers varies in detail but in general the machines consist of a perforated internal metal cylinder or cage of the open end type, rotating on a trunnion suitably housed at the back of the machine. In large machines, as a means of providing further support, the front of the cage is arranged to ride on two jockey wheels. The cage revolves in an outer casing, of which the frame is rigidly strengthened and the base is provided with steel channels to carry the holding-down bolts. The outer casing is provided with a hinged door giving access to the inner cylinder for loading. An air heater comprising a battery of steam-heated copper-gilled coils is mounted on the top of the external casing, and a suction fan draws heated air through the inner cage and discharges it through an outlet duct. In some types of tumbler, cool air is first drawn into the the machine and discharged through the heater before passing into the inner cylinder. The steam coils are suitable for a working pressure of 100 lbs. per sq. in. and the coil drain is coupled to a steam trap which can be bypassed. A damper is sometimes fitted allowing air admission to the tumbler to be regulated to give "Hot," "Warm" or "Cold" conditions. This

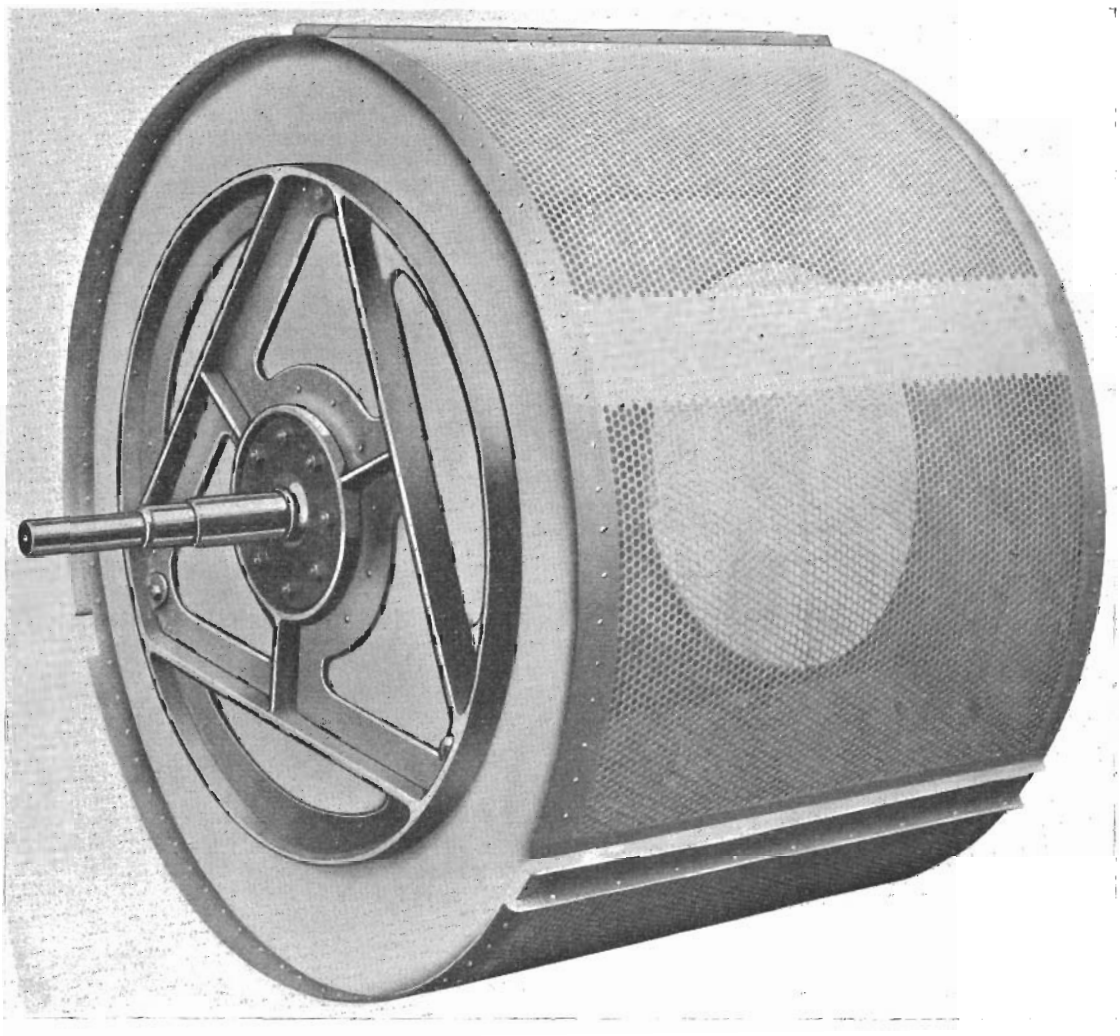


Fig. 38.—Rear view of cylinder for I. Braithwaite 50-in. × 32-in. tumbler dryer.

feature is of particular value when dealing with woollens, for which a lower drying temperature is desirable to avoid possible shrinking. The cage is provided with 3 or 4 lifters designed to pick up the work being processed, which, by opening out the garments, subject them to the maximum contact with heated air.

Drive is arranged by an electric motor, mounted on the base of the machine, through a worm reduction gear and thence by chain or Vee belting to the inner cage; the driven wheel being carried on the cage trunnion. The fan impeller is normally driven from the main motor by chain or belting or by an extension spindle from the worm drive. A separate motor for driving the fan is sometimes incorporated on very large machines.

The outer casing door is electrically interlocked with the driving motor by means of a push-button switch; immediately the door is opened, the motor is switched off thus bringing the inner cage to rest. Similarly the machine cannot be restarted until the outer door is positively shut.

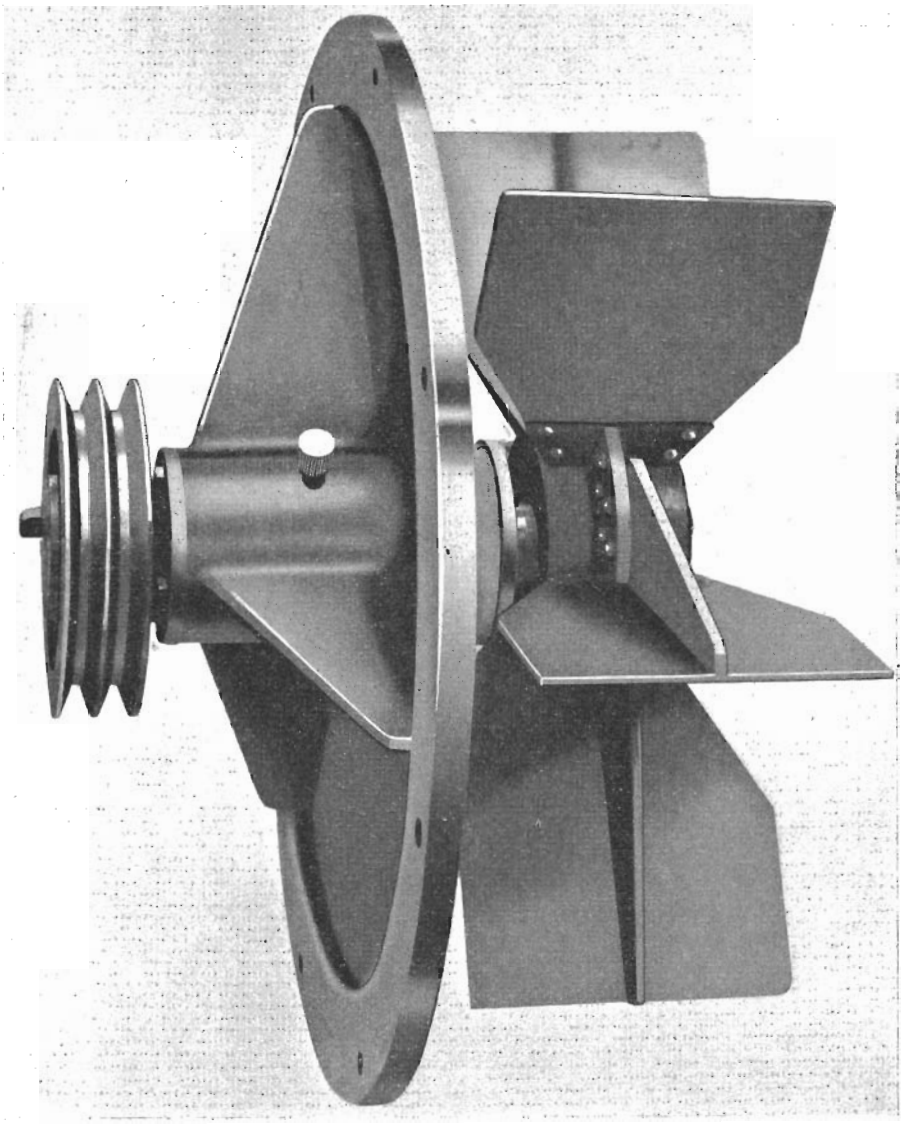


Fig. 39.—Arrangement of fan for 50 × 32-in. tumbler dryer.

11. Lint traps

In the tumbling process the friction caused by the rubbing of the clothes results in the removal of very fine particles (lint) from the material; ready means to isolate this lint and to prevent its accumulation are essential. Free lint, besides being injurious to health, is a fire hazard. To restrict these dangers to a minimum, the exhaust trunking from drying tumblers is not connected to the ship's exhaust system, but is

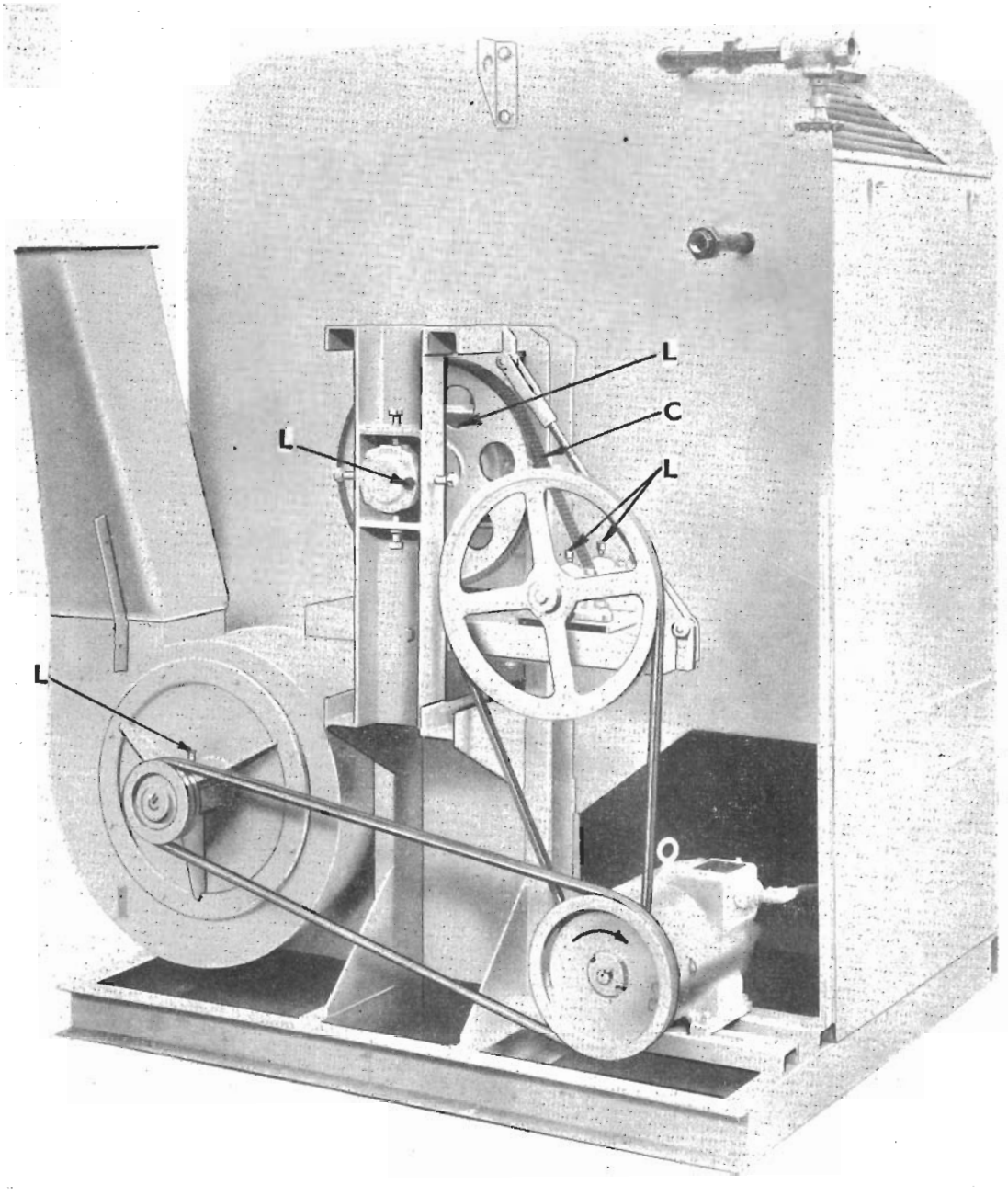


Fig. 40.—Driving gear and lubricating points for 50 × 32-in. tumbler dryer.

separately led to a suitable weather-deck position. Separate trunking is also desirable to ensure full control of the temperature conditions in the tumbler. Lint, if allowed to flow unrestricted, would quickly choke the exhaust trunking, and to prevent this condition arising a lint trap is placed in the exhaust line as close as is practicable to the discharge from the machine. In some makes of drying tumbler the lint

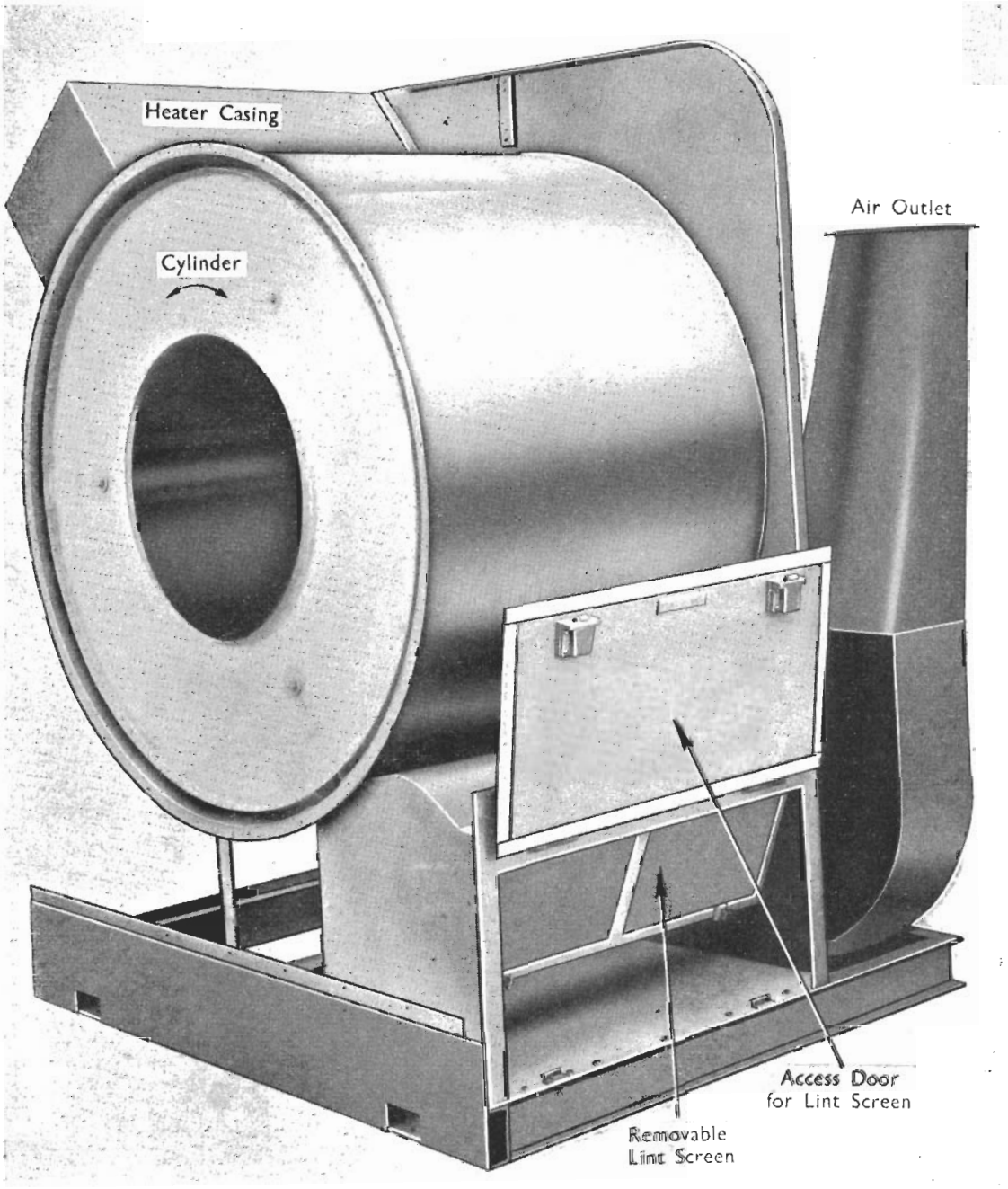


Fig. 41.—Front view of 50 × 32-in. tumbler dryer with covers removed.

(SO 7546)

trap is of the built-in type situated at the base of the machine on the inlet side of the fan. In all cases the lint trap is capable of ready removal for cleaning purposes. An effective lint trap can be produced by the use of No. 10 mesh, 22 or 24 S.W.G. galvanized steel wire.

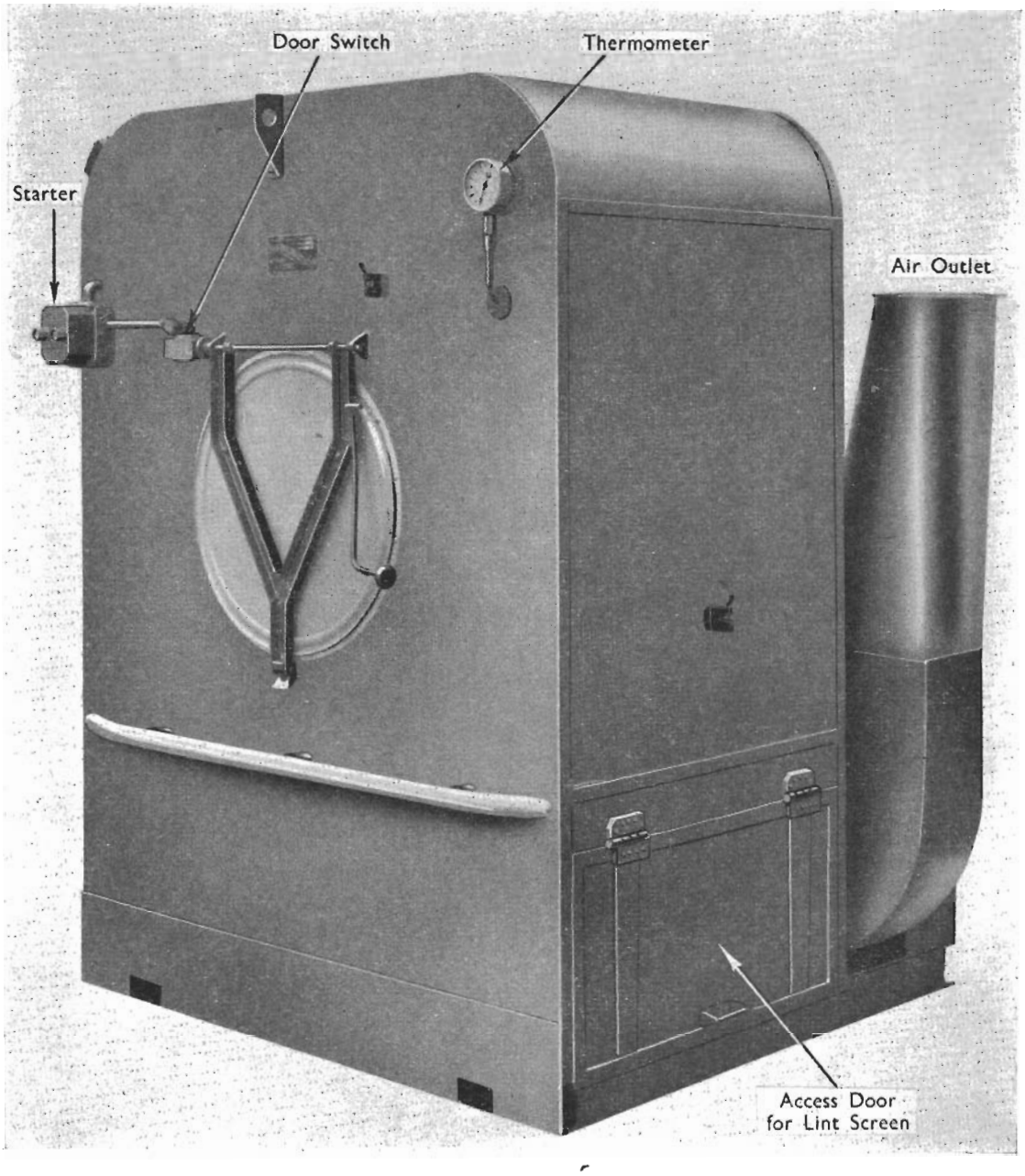


Fig. 42.—Front external view of 50 × 32-in. tumbler dryer.

12. Operation

The machine is started by the push-button control switch mounted on the outer casing door, and stopped manually by the hand operation of the push button, or automatically by opening the machine door.

When starting up, it is necessary to preheat the tumbler before tumbling the first load, and the steam trap by-pass should be opened until the machine is warmed through. On no account must the by-pass be left open while the machine is in operation.

Before loading for the first time each day the cylinder and fan should be allowed to run with the cylinder empty, thus allowing any dust which may have accumulated to be drawn from the cylinder. The cylinder should be wiped out with a clean cloth before loading.

On receipt from the hydro-extractor the clothes are tightly packed and must therefore be shaken out by hand before loading into the tumbler. The capacity of the tumbler is reached when the level of the damp

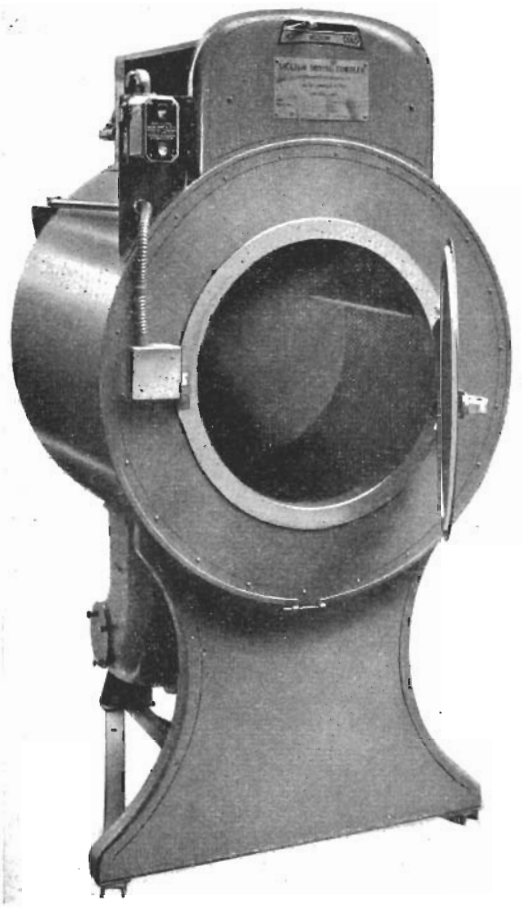


Fig. 43.—Front view of 36 × 30-in. J. Armstrong drying tumbler.
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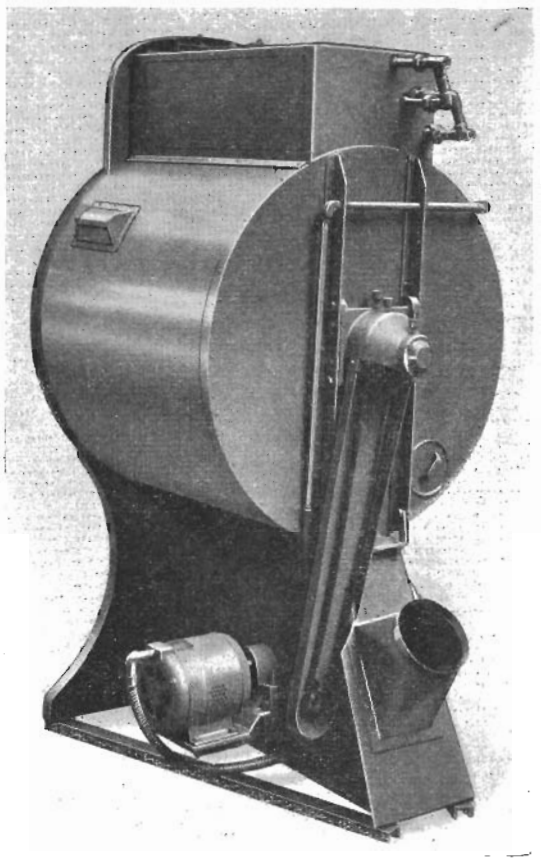

Fig. 44.—Rear view and drive for 36 × 30-in. drying tumbler.

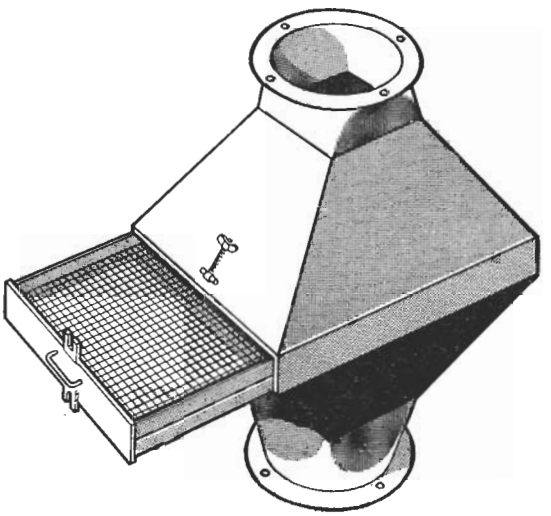

Fig. 45.—Lint trap for 36 × 30-in. drying tumbler.

clothing reaches the centre line of the cylinder, *i.e.*, when the cylinder is half full. The rated capacity of the tumbler should never be exceeded. If it is too heavily loaded, the passage of air through the tumbler is restricted, reducing drying efficiency, and undue mechanical strain is placed on the machine.

The lint trap should be removed and cleaned once every 2 or 3 hours when dealing with normal work and hourly when drying blankets.

13. Process Notes

(*a*) MACHINES FITTED WITH DAMPERS

(i) For drying soft woollens the machine damper should be set at COLD.

(ii) For drying coarse or part woollens the machine damper should be set at WARM.

(iii) For drying cottons the machine damper should be set at " hot."

When the load is dry, machines fitted with dampers should be allowed to run for about 3 min. with the dampers adjusted at the cold position, thus cooling the clothes before their removal from the tumbler.

(*b*) MACHINES WITHOUT DAMPERS

Where no damper is fitted, the time for processing the various types of fabrics must be determined by experience. As soon as the articles are dry they must always be removed from the machine; if fabrics, especially woollens, are subjected to a baking process after drying, irreparable damage may result.

14. Part drying

Under normal process conditions all flat-work, shirts, coats, etc., are not tumbled, but are dried during the ironing or pressing process.

It may be expedient on occasions, however, to " part dry " certain items of clothing before calendering or pressing, particularly those of double thickness. Such a procedure enables production on the presses and ironing machine to be speeded up by permitting the operation to be completed in one pass.

A pillow case, for instance, being of double thickness (with four thicknesses at the hems) will not be sufficiently dried if passed only once through the normal type single roll calender. The item may require to be passed at least twice and possibly three times through the machine with a resultant bottleneck.

Partial drying of such items in the tumbler will tend to prevent this bottleneck in ironing arising, but the practice of part drying must be governed by local conditions and the standard of finish required.

15. General Maintenance

The steam trap should be maintained in an efficient state at all times; the correct functioning can be checked by observation of the sight glass. Faulty working can sometimes be corrected by slightly opening the bye-pass valve for a few minutes, thus clearing the trap.

The heater coils and fan impeller should be kept free from external accumulations of lint and dirt.

Accumulations of lint in the outer shell should be removed after every 200 hours of working or before if necessary.

All bearings should be kept clean and efficiently lubricated, particular attention being directed to the oil level in the gear box.

The damper mechanism should be checked after every 200 hours running to ensure that the damper is in the correct position when registering " hot," " warm " or " cold."

Driving belts and chains should be periodically inspected and adjusted as necessary.

ELECTRICALLY-HEATED DRYING CABINETS

16. The steam-heated type of drying tumbler cannot be used to full advantage in destroyers and minor vessels because.

(*a*) under normal harbour conditions no steam is available, or

(*b*) numerous vessels are fully I.C. Engine driven.

To obtain the maximum output from the laundry machinery the equipment must be capable of being worked under all conditions of ship routine, and with this object in view electrically heated laundry drying cabinets are, at present, installed where adequate diesel dynamo power is available.

Consideration has now been given, however, to the development of an electrically heated drying tumbler.

17. Description

The cabinet (Fig. 46) is of simple box construction and contains 15 hanging rods, supported horizontally, on which the work to be dried is placed. The cabinet is designed for a maximum internal working temperature of 200°F. and is suitably lagged to conserve heat within the machine and to reduce heat emission into the laundry compartment to a minimum. The electric heating elements are disposed on either side of the cabinet and are separated from the clothes-drying section by vertical partition plates.

Two air inlet ducts positioned at about mid height are arranged on either side of the cabinet. A self-contained motor-driven fan on the top of the cabinet draws cold air from the laundry compartment past the heating elements and circulates the hot air downward through the damp clothes. The damp air is exhausted from the bottom of the cabinet. The air circulating system is designed to prevent the loss of useful heat which would occur were a straight through passage of air arranged. A limited amount of air is released after passing through the damp clothing and a corresponding volume of dry air admitted, thus maintaining most satisfactory drying conditions inside the cabinet. Dampers are provided on the inlet ducts and on the exhaust branch and the amount of opening can be adjusted as experience determines, to give the most efficient drying conditions in the cabinet for various materials being processed.

The exhaust trunking from the cabinet is not connected to the ships exhaust (ventilation) system, but is led separately to a suitable weather deck position.

A thermometer of the distant reading type, is fitted to the cabinet.

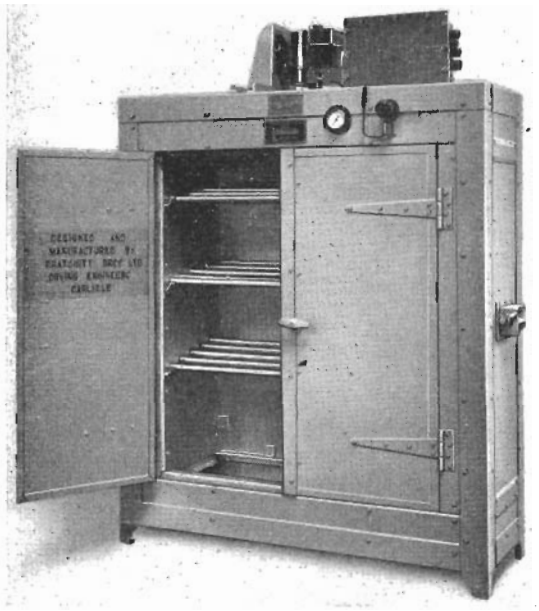

Fig. 46.—Arrangement of Prachitt type electrically heated drying cabinet.

18. Automatic temperature control

The working temperature can be adjusted to suit the varying drying conditions required in the cabinet for different materials. The required temperature is maintained by thermostatic control. The thermostat is of the non-indicating type and automatically controls the temperature at any setting between the limits of 140°F. and 200°F.

The cabinet is designed for a maximum temperature of 200°F. and this figure must not be exceeded.

CONTROL PANEL

An indicator lamp is fitted in the control panel as a means for showing the operator when the current is switched on. A further switch by means of which current to the heating elements may be cut off without stopping the fan, is placed on the side of the panel. This permits cool air to be circulated through the cabinet if such action is required.

The control panel contains a contactor switch. When the set working temperature is reached, the contactor which is controlled by the thermostat, automatically cuts off the electric power supply to the heating elements.

OPERATION OF THE THERMOSTAT

Turn the knurled knob on the thermostat head until the pointer reaches the required temperature setting. Switch on the current to the heating element. When the selected temperature has been reached a sharp click can be heard, this denotes that the contactor, operated by the thermostat, has cut off the power supply to the heating elements. It may be found that the thermostat reading at which the contactor opens does not coincide exactly with the reading on the thermometer dial, but due allowance for any slight difference can be made to offset this, as the result of experience.

FAN DRIVE

The fan is driven by a direct coupled motor, and starts up immediately the main switch is closed.

The cabinet can dry approximately 16 lb. dry weight of clothing in one hour. Clothing should be hung on the rods, and adjusted to give as clear a circulation of air as possible through the cabinet.

19. Operation

Set the thermostat regulator to the required temperature. Close the main switch. This action automatically starts the fan and switches on the current supply to the heating elements. When the required temperature is reached in the cabinet, the air inlet and outlet dampers should be adjusted to maintain the most suitable drying conditions.

ELECTRICALLY-HEATED DRYING TUMBLER

20. Reference has already been made to the difficulties associated with the provision of laundry equipment in ships in which steam is not normally available in the harbour condition.

21. Description

As a development from the electrically-heated drying cabinet previously described, electrically-heated drying tumblers having an output of approximately 40 lb. dryweight per hour from the hydro-extractor damp condition (one load of 20 lb. per half hour), are now installed in certain ships. The construction and method of operation is generally similar to that of the 90 lb. per hour steam-heated drying tumbler previously described, and illustrated in Figs. 43, 44 and 45. The steam-heated gilled coils are, however, replaced by a battery of electric heating elements having a total loading of 12 kW.

22. Temperature control

Temperature control of the air supply to the machine is afforded by two thermostats, the higher set at 310°F. and the lower, of the self-resetting type, at 290°F. The maximum temperature condition of the air-flow with the machine empty has been found with these settings to be 180°F. to 200°F. this is the normal

drying temperature for drying tumblers. On introduction of the load the machine temperature falls rapidly to approximately 120°F. with a gradual build up to 150°/160°F. Pilot lamps, fitted in an inset panel on the front of the machine in the heater and thermostat circuits, indicate the " heater on " or " heater off " condition.

23. Safety devices

The following safety devices against burning out of the heating elements are fitted:

(*a*) The heating circuit is electrically interlocked, so that the heater cannot be switched on until the main driving motor and fan are running.

(*b*) The door of the machine is electrically interlocked with the power and heating circuits, so that on opening the door

(i) the main driving motor is switched off

(ii) the heater is switched off.

(*c*) After action at (*b*), manual restarting of the machine and heater controls is necessary.