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Laundry Manual

ENGINEER-IN-CHIEF'S DEPARTMENT

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B.R.1277, Laundry Manual, having been approved by My Lords Commissioners of the Admiralty, is hereby promulgated for information and guidance.

By Command of Their Lordships,

J. F. Long

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Contents

Page

Chapter I

ADMINISTRATION AND ORGANIZATION

INTRODUCTION: Priority of Equipment—Flow of Work—Conditions affecting output 1

ADMINISTRATION: Duties of the Laundry Officer—The Laundry Crew—Operators required—Typical Scheme of Working—Watch Bill for laundry crew 1

ORGANIZATION: The Laundry Bundle—Limitation of work—Standard weekly bundles—Bulk work—Organizing journeys—Examples of processing necessary—Weekly programmes—Limitation of size of journey—Limitation following temporary breakdown 4

Chapter II

RECEIPT AND PREPARATION OF WORK

RECEIPT: Receipt of soiled clothing at the Laundry—The Laundry Chit—Use of the Laundry Chit—Collection of bulk work 6

MARKING: The marking system—Marking woollens—Correct positions for marking—precautions—marking machine 7

PREPARATION: Sorting and marking—Classification—Fabrics—Dyes—Types of clothing and Nature of soiling—Typical classifications—Classification bins 8

Chapter III

WASHING MACHINES

SIDE OPENING TYPE

Description of a typical machine—Operation—Loading Rate—General Maintenance—Cleaning the internal surface 12

GEARS: Typical interlocking Gear—" Crown " reversing gearbox—" Lightburn " patent reversing clutch—maintenance 15

BELT-DRIVEN MACHINES: Striking gear—Door-locking device 19

OPEN END TYPE

Description—Safety device—Drive—General Maintenance—Replacement and Adjustment 22

OTHER TYPES

Dual Electric and Steam-heated type—Domestic Washing Machines 28

STEAM AND WATER MIXING VALVES: Action—Maintenance—Regulation of temperature—Operation—Scheme of piping 29

Chapter IV

MATERIALS

IN GENERAL USE IN R.N. LAUNDRIES

WATER: Soft water—Hard water—Water supplies 32

SOAPS: Action of soaps—Stock solutions—Preparations of Stock solutions 32

ALKALIS: Measurement of Alkali strength—Alkalis used in H.M. Ships 33

ACIDS: Glacial Acetic Acid—Oxalic Acid 34

BLEACHES AND BLEACHING: Sodium Hypochlorite—Bleaching powder—Preparation of stock solution—Quantity—Method—When to use Bleach 34

STARCHES AND STARCHING: Types of starch—Density—Method of application—Starch stock solutions—Cold starch method .. ..

Page

Chapter V

THE WASHING PROCESS

Principles—Washing coloured goods—Washing woollens—Washing requirements for woollens—Silks and Rayons 37

WASHING FORMULAE: Formulae I to IV—Conservation of fresh water—Alternative formulae 38

Chapter VI

DRYING EQUIPMENT

HYDRO-EXTRACTORS

General Notes—Description—Safety devices—friction clutches—General maintenance—Operation—Time required for extraction—Hydroing hammocks 44

OTHER EQUIPMENT

DRYING TUMBLERS: Description—Lint traps—Operation—Process notes—Part drying—General maintenance 51

ELECTRICALLY-HEATED DRYING-CABINETS: Description—Automatic temperature control—Operation 58

ELECTRICALLY-HEATED DRYING-TUMBLER : Description—Temperature control—Safety devices 59

Chapter VII

FLATWORK IRONING MACHINERY

General remarks—Types of machines—Conditions required for processing flatwork 61

STRAIGHT-THROUGH-FEED TYPES: Description—Roller-construction—Pressure adjustment—Drive—Stripping-gear—Safety devices—Operation—Cleaning the bed—Roller-clothing materials—Reclothing the rollers—Tests after reclothing—Double roll machines—General maintenance 62

RETURN-FEED TYPE: Description—Ventilated roller with flexible covering—Automatic finger-guard—Reclothing the roller—Operation—Adjustments—General maintenance—Preparation of work—Processing 68

ASBESTOS CLOTHING: 120 in. × 24 in. Double-roll ironing machine—Single-roll machines—Intermediate clothing—Care of clothing 75

Chapter VIII

PRESSES AND PRESSING

PRESSES ETC.

Types of presses used—Classification 77

STATIONARY LOWER-BUCK PRESSES: Description of typical press—Action of hand-operated presses—Action of air-operated presses—General maintenance .. 80

TWIN PRESSES: Description—Operation—Maintenance 83

OTHER APPARATUS: The Sleeve form—Shirt folding table 85

LAYOUT: Arrangement of Presses on installation—The Shirt unit 85

PRESSING & FOLDING

Sequence of Pressing operations—Shirts—Coats—Officers' mess jackets—Trousers—Pyjamas 86

PRESSING LAYS FOR TWIN RAPID TYPE PRESSES 90

Page

Chapter IX

COLLAR AND DRESS-SHIRT PROCESSING

THE COLLAR UNIT: Starch cooker—Starching machine—Hydro-extractor—collar ironing and polishing machines—Collar seam damper—Collar edge ironing machine—Collar hot tube 96

THE COLLAR PROCESS: Washing and Starching—Faults in starching and remedies—Finishing 101

PROCESSING DRESS-SHIRTS: Starching—Ironing—Ironing where no shirt and collar ironing machine is installed 103

Chapter X

RACKING AND PACKING PROCESSED ARTICLES

Packing or issue room—Procedure—Final checking—Missing articles—Final delivery 104

Chapter XI

DECONTAMINATION OF CLOTHING AND EQUIPMENT

Definitions 106

METHODS: Essentials of decontamination—Effecting decontamination—Processes used—Precautions—Notes on the process 106

PROCEDURE: Sorting and classifying—Apportionment of duties—Preparation of laundry 108

DECONTAMINATION USING WASHING MACHINES: General notes—Side-opening machine—End opening machine 109

FINISHING: Hydro-extraction—Drying—Deodorization 110

LEATHER & OILSKIN: Decontamination of Leather articles—Drying—Decontamination of oilskin 111

IMPROVISATION 112

APPENDIX

TABLE

1 Scale of operators 113

2 Timetable 114

3 Fleet Carrier 115

4 Town Class Cruisers 116

5 Repair and Depot Ships 117

6 Positions for marking 118

7 Volumetric capacity of washing machines 119

8 Ready Guide to machine loads 120

9 Asbestos clothing for flatwork ironing machines 121

10 Decontamination processes 122

Illustrations

		Page
1	Diagrammatic Arrangement showing the Sequence of Laundry Operations	1
2	Arrangement of " British " type marking machine with lubricating points[1]	8
3	Diagrams showing the method of operation of the marking machine	9
4	Classification and Soiled Bundle Bins	10
5	Double Compartment Sorting Booth	10
6	30 cu. ft. side opening type washing machine, motor driven[2]	13
7	30 cu. ft. side opening type washing machine, motor driven[3]	14
8	Diagrammatic Arrangement of Interlocking gears for Smith and Paget washing machine	15
9	Diagrammatic Arrangement of Crown reversing gear box	16
10	Assembly arrangement of Crown reversing gear box[3]	17
11	Diagrammatic arrangement of Lightburn reversing clutch	17
12	Assembly arrangement of Lightburn reversing clutch[4]	18
13	Diagrammatic arrangement of the B.L.R.A. Interrupter gear[5]	19
14	Arrangement of Ritchie No. 2 CHH Belt driven washing machine[6]	20
15	Belt Striking and reversing gear[6]	21
16	Door locking and hand turning gear for Ritchie No. 2 washing machine[6]	22
17	External view of the Amazon 38 in. × 44 in. open end type washing machine[7]	23
18	Arrangement of No. 3 " Cosmo " type Steam Injector[7]	23
19	Outlet valve operating machanism[7]	24
20	K.G.D. Hydrostatic depth gauge[7]	25
21	Gear box lubricating diagram[7]	26
22	Trunnion and bearing assembly[7]	27
23	Front bearing assembly[7]	28
24	Arrangement of seal on the trunnion housing[7]	28
25	Sectional arrangement of thermostatic steam and water mixing valve[8]	29
26	Exploded view of thermostatic steam and water mixing valve[8]	29
27	Piping arrangement of steam and water mixing valve with fresh and salt water washing connections	30
28	Piping arrangement for 2 in No. mixing valves working with Bendix domestic washing machines	31
29	Arrangement of soap and soda boiler	33
30	External view of Watson Laidlaw 27 in. hydro extractor[9]	44
31	Sectional arrangement of Watson Laidlaw 27 in. hydro extractor[9]	45
32	External View of Broadbent 30 in. hydro extractor[10]	46
33	Sectional Arrangement of Broadbent 30 in. hydro extractor[10]	47
34	Spindle bearing assembly for 27 in. Watson Laidlow hydro extractor[9]	48
35	Safety interlocking gear for 30 in. Broadbent hydro extractor[10]	49
36	Friction clutch for 30 in. Broadbent 23 R.V. hydro extractor[10]	50
37	Method of Loading a hydro extractor	51
38	Rear view of cylinder for I. Braithwaite 50 in. × 32 in. tumbler dryer[11]	52
39	Arrangement of fan for 50 in. × 32 in. tumbler dryer[11]	53
40	Driving gear and lubricating points for 50 in. × 32 in. tumbler dryer[11]	54
41	Front view of 50 in. × 32 in. tumbler dryer with covers removed[11]	55
42	Front external view of 50 in. × 32 in. tumbler dryer[11]	56
43	Front view of 36 in. × 32 in. J. Armstrong drying tumbler[7]	57
44	Rear view and drive for 36 in. × 30 in. drying tumbler[7]	57
45	Lint trap for 36 in. × 30 in. drying tumbler	57
46	Arrangement of Prachitt type electrically heated drying cabinet[12]	59
47	Arrangement of 36 in. × 24 in. Manlove Flatwork ironing machine, driving end[13]	61
48	Arrangement of 36 in. × 24 in. flatwork ironing machine, showing spring roller[13]	62
49	Arrangement of T. Bradford 90 in. × 24 in. single roll flatwork ironing machine[2]	63
50	Arrangement of T. Bradford 120 in. × 24 in. double roll flatwork ironing machine[2]	63

51 Section of ventilated roller for 36 in. × 24 in. flatwork ironer[13] 64
52 Section of ventilated roller for 90 in. × 24 in. flatwork ironer[2] 64
53 Full section of ventilated roller for 90 in. × 24 in. flatwork ironer 64
54 Spring padding for 36 in. × 24 in. Flatwork ironer[13] 64
55 Fingerguard device for 90 in. × 18 in. flatwork ironing machine.. 65
56 Fingerguard device for 36 in. 24 in. flatwork ironing machine 65
57 Method of waxing a sheet for cleaning the machine bed 66
58 Typical method for reclothing the roller 67
59 Arrangement of T. Bradford 56 in. × 25 in. return feed flatwork ironing machine[2] 69
60 Arrangement of gear drive for 56 in. × 25 in. return feed flatwork ironing machine[2] 70
61 Arrangement of non gear end for 56 in. × 25 in. return feed flatwork ironing machine[2].. 71
62 Ventilated roller for 56 in. × 25 in. return feed flatwork ironing machine[2] .. 72
63 Automatic fingerguard device for 56 in. × 25 in. return feed flatwork ironing machine[2].. 72
64 Method of folding flatwork 75
65 Typical shapes of press bucks[14] 78–79
66 General purpose press with rectangular buck[15] 77
67 General purpose press with tapered buck [15] 77
68 Shirt bosom press with neckband attachment[15] 80
69 Triple head, collar and cuff press[15] 80
70 Typical build up of lower buck[15] 80
71 Sectional arrangement of Tullis Imperial type press[14] 81
72 Sectional arrangement of Jaxon type press[15] 82
73 Method of cutting out a press cover 83
74 Twin Rapid type shirt press[16] 83
75 Twin Rapid type general purpose press[16] 84
76 Double Sleeve Form [15] 84
77 Shirt folding table[16] 85
78 Arrangement of shirt unit[14] 86
79 Typical Arrangements of presses in H.M. Ships 87
80 Shirt pressing and folding operations using limited facilities 88
81 Method of pressing and folding white tunic coats 89
82 Method of folding officers' mess jackets 90
83 Method of pressing and folding trousers and shorts 91
84 Method of pressing and folding pyjamas and underclothing 92
85 Coat pressing sequence using a twin type press[16].. 93
86 Shirt pressing sequence using a twin type press[16] 94
87 Starch cooker[3] 95
88 Starching machine[3] 96
89 Collar and dress shirt ironing and polishing machine[2] 97
90 Fingerguard safety device for collar ironing machine[2] 99
91 Collar seam dampener 100
92 External view of collar edge ironer[3] 101
93 Sectional arrangement of collar edge ironer 101
94 External view of collar hot tube[3] 101
95 Sectional arrangement of collar hot tube 101
96 Nest of issue racks 104
97 Siting of a temporary gas proof screen 109
98 Use of long bath for decontamination purposes 111

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Foreword

Though the provision of laundries to H.M. ships is a comparatively recent development sufficient experience has been gained to show that, efficiently run, they can make a substantial contribution to the well-being of a ship's company.

The efficiency of any laundry service depends upon good equipment, and the knowledge, skill and organization of the laundry staff. This Manual is designed to provide the officers in charge of laundries with the basic information necessary to establish an efficient laundry service, and the operating and maintenance personnel with a guide to standard practice. The principles of operation and maintenance of the machines described are generally applicable to all types of equipment installed in H.M. ships and establishments, but details will vary according to manufacturers. The Manual does not supersede detailed makers' instructions.

The process charts and washing formulae included are the most suitable developed to date for general service conditions ; these should be followed to obtain the best results. The Admiralty is aware of the constant development of synthetic detergents and the Fleet will be informed through the normal channels of any variations in formulae and materials.

CHAPTER I

Administration and Organization

INTRODUCTION

1. A large number of H.M. ships are now equipped with power-operated laundries, and the instructions contained in this manual are to be used as a basis for their organization, administration and operation.

The installation of laundry equipment in H.M. ships is governed by many factors including the area available, the shape of the space and the acceptability of top weight.

2. Priority of equipment

If the factors preclude the provision of full laundry facilities, equipment is installed in the following order of priority:

Washing machines Hydro extractors Dryers (tumbler or cabinet type)	Washing and drying equipment.
General purpose and shirt presses Flatwork ironing machines Sleeve forms and shirt folding tables Starching machines and collar polishing machines	Finishing Equipment.

These machines are provided on the maximum scale possible and in cruisers and above are capable of an output of approximately 5 to 8 lb. of laundry work per man of the total complement in a 48-hour laundry working week.

A balanced equipment catering for washing, drying and finishing is installed as far as possible.

In all modernization schemes the maximum space possible is allocated for laundries, and limitations in the scale of equipment must be accepted. After modernization, increased output if required must be obtained by working increased hours of duty in the laundry.

3. Flow of work

A diagrammatic arrangement of an ideal layout of laundry equipment showing the flow of work from the receiving room through the various laundry stages to the issue room is illustrated in Fig. 1. Though possible in shore laundries, an ideal arrangement is difficult to attain in H.M. ships.

4. Conditions affecting output of work

The total output obtainable from the laundry installation is dependent upon the following main factors :

(*a*) The capacity of the machinery and the type of plant installed.

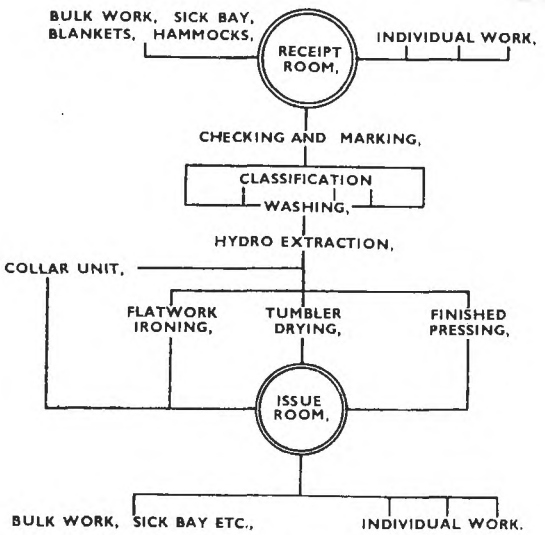


Fig. 1.—Diagrammatic arrangement showing the sequence of laundry operations.

(*b*) The availability of sufficient personnel from the ship's company to enable the whole plant to be worked at once, and for the receiving, marking, classification, final sorting and issuing to be effectively undertaken.

(*c*) The total hours worked by the laundry staff.

(*d*) The efficient operation of all equipment. Basic training both theoretical and practical is given at the R.N.B. Laundry, Devonport, and increased efficiency should be evident as operators gain actual working experience with the various machines and processes.

ADMINISTRATION

5. The officer appointed for duty as Laundry Officer is to be directly responsible to the Commanding Officer for the detailed organization and operation of the laundry.

The Engineer Officer is in charge of all laundry equipment and jointly responsible with the Electrical Officer for its efficient maintenance.

6. Duties of the Laundry Officer

(*a*) To establish the laundry crew preferably on a volunteer basis (the personnel required to work the equipment can be estimated from Table I).

(*b*) To establish the number of hours per working week for the laundry and prepare the watch bill.

(*c*) To assess the total weekly output of the laundry based on the capacity of the equipment, the crew available and the hours of working.

(*d*) To draw up the scale of the weekly bundle which can be accepted from officers and ship's company, bearing in mind sick bay and other bulk requirements.

The size of the weekly bundle may be established as follows:

(i) Formulate the composition of a desirable weekly bundle based on reasonable requirements and assuming laundry capacity to be available.

(ii) Assess the total laundry output requirements, *i.e.*, personal washing and bulk work.

(iii) Assess from Table I the crew necessary to work the machinery installed and for receipt and issue duties.

(iv) Assess the number of hours during which the laundry would be required to work to produce the total output at (ii).

(v) If the capacity of the laundry is insufficient to meet the estimated total requirements, the composition of the individual bundle and the amount of bulk work per week must be adjusted accordingly.

Note.—The above procedures will enable an initial set-up to be obtained. Actual outputs will, however, only be assessed as the result of experience.

(*e*) To prepare a scale of charges to be applied, assuming the laundry to be run on a non-profit-making basis.

(*f*) To establish the accounting system to be adopted.

7. The Laundry Crew

The Laundry Crew is to consist as far as possible of staid hands, including representatives of each main department of the ship, under the direction of a Chief Petty Officer, Petty Officer or Leading Hand. A full and uninterrupted day's work is important if maximum efficiency is to be achieved and the crew should therefore be excused as many other duties as possible.

Duties of the Crew

(*a*) The senior rating is to be thoroughly conversant with all laundry processes and with the method of operation of all machines. Normally his duties should be supervisory, but if sufficient men are at any time not available to work the machines the senior rating must assist.

He will be directly responsible under the Laundry Officer for:

(i) The classification of the various fabrics.

(ii) Maintaining ready use stocks of all materials and stores for the laundry.

(iii) Training new ratings in all aspects of the work.

(iv) Reporting defects in equipment which may arise during the normal course of working, to the appropriate authority.

(v) Dealing with loss or damage complaints as they arise and referring them to the laundry officer when arbitration is needed.

(vi) Administration and welfare of the laundry crew.

(*b*) When it is necessary to work in watches a Second Hand is needed to take charge of a watch and deal with general queries.

(*c*) Operators are to be generally conversant with all laundry duties but should normally be allotted specific functions in their watch.

(*d*) In order to keep the laundry crew practised in all aspects of laundry work and to maintain a lively interest, a periodic change of duty is highly desirable.

8. Operators required

The number of ratings required to operate the laundry plant must be sufficient to receive, mark and sort the work, supply the washing machines with soiled clothing, feed and work each machine to its designed capacity and re-sort, pack and issue the completed work. The amount of soiled clothes which can be effectively dealt with at one time is called a " Journey " and is dependent upon:

(*a*) The sorting and classifying facilities.

(*b*) The washing machine capacity.

(*c*) The re-sorting and issuing facilities.

Large receipt and issue rooms are most desirable but owing to space limitations they cannot always be provided in laundries afloat. In such circumstances makeshift arrangements have to be resorted to. Factors (*a*) and (*c*) are therefore largely influenced by the conditions existing in individual ships.

Limitation of size of Crew

In all circumstances both in the interest of the conservation of man power and of efficiency, the Laundry officer should maintain the composition of the laundry crew at the minimum number possible to deal with the required output.

As far as possible, the output is to be met by one team working extended hours rather than by two complete crews working in shortened watch periods. Before adding to the strength of the laundry crew, the laundry officer must be satisfied:

(*a*) that increased output is essential.

(*b*) that the increased output cannot be met by working extended hours.

9. Typical scheme of working

Table 2 shows a laundry organization based on the two-watch system, suitable under peace-time conditions.

Consideration must be given to the working conditions when formulating a time-table. These are capable of considerable variation, both as climates vary from temperate to tropical, and in conformity with the ventilation arrangements. Careful attention is always given to the provision of adequate ventilation in the laundry compartments.

Production will be assisted if operators are permitted to spend 10 minutes in the fresh air occasionally.

10. Watch Bill for the laundry crew

A typical day may be organized on the following lines:

(*a*) The duty watchmen commence the operation of the laundry at 0730 and work until 1200 when they become non-duty watch and proceed to dinner until 1300. They turn-to again from 1300 to 1600 and may then be free to proceed on shore leave.

(*b*) The non-duty watchmen commence operation at 0800 and work until 1100 turning-to after the dinner break (1100-1200) as Duty Watch.

Work is continued until 1800 or until the journeys for the day are complete, with a break for tea from 1530 to 1600. The non-duty part of the watch should also turn-to again from 1630 to 1800 if pressure of work demands.

THE LAUNDRY BUNDLE

11. Limitation of work

To ensure a steady and even flow of work and to enable all members of the ship's company to obtain a fair share of the laundry service it is essential to limit the amount of personal laundry work. The weight of work which can be accepted from officers and from each class of rating must be predetermined and fixed by the laundry officer and will comprise the standard bundle. The composition of the bundle should be made as flexible as possible by the inclusion of alternative items.

12. Assessing composition of bundle

The controlling factor in assessing the permitted weight of the laundry bundle is the overall capacity of the laundry. The scale of "fully finished" laundry output is dictated solely by the capacity of the ironing and pressing machinery installed. Where capacity does not exist for the complete processing of all work, finished ironing must be done personally with the hand ironing facilities normally provided in the various messes for this purpose.

Except in isolated instances it will be found that the capacity of the laundry equipment, even when long hours are worked, is sufficient only to cater for the *essential* requirements of each member of the ship's company.

In fixing the composition of a standard bundle it will readily be appreciated that officers and chief and petty officers in Class I and III uniforms require more laundry to be done per week than personnel dressed in Class II uniform.

While the principle of fixing a standard bundle is generally satisfactory and provides a fair solution for the major portion of the ship's company, flexibility should be allowed in the case of men employed on specific duties. For example, a petty officer while doing duty as a quartermaster requires a different quantity and different types of washing than a similar rating employed in charge of the side party.

13. Standard weekly bundles

TEMPERATE CLIMATES

Representative bundles for officers, men dressed in Classes I, II and III uniform, with the dry weight of new article are tabulated below and form a guide from which a standard bundle can be selected, up to the weight allowed.

OFFICERS

		lb.	*oz.*
3 shirts at 10 oz. ..	=	1	14
5 collars at 1·3 oz. ..	=		6·5
4 handkerchiefs at ·75 oz.	=		3
2 towels at 5 oz.	=		10
1 pr. pyjamas at 1 lb. 8 oz.	=	1	8
3 prs. of socks at 2 oz. ..	=		6
2 sets of underwear at 8 oz.	=	1	
1 sheet at 2 lb.	=	2	
1 pillow case at 5·9 oz. ..	=		5·9
1 pr. of overalls at 2 lb.	=	2	
Total.. ..		10 lb. 5 oz. approx.	

MEN DRESSED IN CLASS II UNIFORM

2 blue jeans at 5·6 oz.	=		11·2
4 handkerchiefs at ·75 oz.	=		3
2 towels at 5 oz.	=		10
1 pr. pyjamas at 1 lb. 8 oz.	=	1	8
3 prs. of socks at 2 oz. ..	=		6
2 sets of underwear at 8 oz.	=	1	
1 working shirt at 12 oz.	=		12
1 working trousers at 1 lb. 4 oz.	=	1	4
1 flannel front	=		14·8
1 sheet	=	2	
Total.. ..		9 lb. 5 oz. approx.	

MEN DRESSED IN CLASS I AND III UNIFORM

2 shirts at 10 oz. ..	=	1	4
4 collars at 1·3 oz. ..	=		5·2
4 handkerchiefs at ·75 oz.	=		3
2 towels at 5 oz.	=		10
1 pr. pyjamas at 1 lb. 8 oz.	=	1	8
3 prs. of socks at 2 oz. ..	=		6
2 sets of underwear at 8 oz.	=	1	
1 working shirt at 12 oz.	=		12
1 working trousers at 1 lb. 4 oz.	=	1	4
1 sheet	=	2	
Total.. ..		9 lb. 4 oz. approx.	

TROPICAL CONDITIONS.—In tropical climates the composition of the standard bundle will vary. Typical bundles are as follows, but these will require adjustment as necessary in relation to the total laundry capacity.

OFFICERS

		lb.	*oz.*
2 sets underwear at 8 oz.	=	1	
1 pr. pyjamas at 1 lb. 8 oz.	=	1	8
1 sheet at 2 lb.	=	2	
1 pillow case at 6 oz. ..	=		6
2 towels at 5 oz.	=		10
2 tropical shirts at 13 oz.	=	1	10
2 tropical shorts at 15 oz.	=	1	14
2 white suits (No. 10) at 2 lb. 7 oz.	=	4	14
Total.. ..		14 lb.	4 oz.

MEN DRESSED AS SEAMEN

2 sets underwear at 8 oz.	=	1	
1 pr. pyjamas at 1 lb. 8 oz.	=	1	8
2 towels at 5 oz.	=		10
1 shirt, No. 8, at 12 oz. ..	=		12
1 trousers, No. 8, at 1 lb. 4 oz.	=	1	4
2 tropical shirts at 12 oz.	=	1	8
2 tropical trousers at 12 oz.	=	1	8
1 No. 6 suit at 2 lb. 6 oz.	=	2	6
1 sheet	=	2	
Total.. ..		12 lb.	8 oz.

MEN NOT DRESSED AS SEAMEN

2 sets underwear at 8 oz.	=	1	
1 pr. pyjamas at 1 lb. 8z.	=	1	8
2 towels at 5 oz.	=		10
1 No. 8 shirt at 12 oz. ..	=		12
1 No. 8 trousers at 1 lb. 4 oz.	=	1	4
2 tropical shirts at 12 oz.	=	1	8
2 tropical shorts at 12 oz.	=	1	8
1 suit, No. 10, at 2 lb. 7 oz.	=	2	7
1 sheet		2	
Total.. ..		12 lb.	9 oz.

14. Bulk work

To deal with large articles not included in the bundle, namely overalls, bedcovers, blankets and hammocks, a system of bulk washing is necessary.

To permit this work being undertaken, the changing of bedding should be organized in separate divisions or mess-decks at fixed periods throughout the ship. Blankets should, if possible, be washed at least once in three months, but where sheets are used this period may be extended up to six months.

ORGANIZATION

15. Organizing journeys

The organization of the weekly programme in the form of journeys is entirely dependent upon the bulk and class of work received.

The laundry work for officers, chief petty officers and men dressed in Class III uniform will include a large proportion of white shirts and collars, whereas that for seamen and stokers and men dressed in Class II uniform will include a large percentage of blue jean collars and white cotton flannels. It follows therefore, that a suitable balance has to be maintained to ensure the continuous employment of all equipment.

Manning proportions vary with the class of ship. An aircraft carrier normally carries a higher percentage of officers and men dressed in Class I and III uniform, than does a cruiser or battleship and the organization of work to ensure constant full use being made of all equipment will require detailed consideration by the laundry officer. In this connection, Tables 3, 4 and 5 cater for Class I and III uniforms to be dealt with at the beginning of the day's work. This allows for a possible work lag on the pressing operations; it also enables pressing to be continued during the processing of the afternoon load, since the latter is largely comprised of items which do not require a press finish, or which need not be pressed if time does not permit. When considering journeys in terms of bundles, as an ideal the maximum number of bundles should not exceed the number of sorting racks available. The amount handled will also be affected by the standard of finish required for a particular article.

When necessary, special arrangements must be made to deal with certain types of articles for the ship's company, *e.g.*, blankets, hammocks, etc.

16. Examples of processing necessary

White shirts.—These articles need pressing and folding after hydroing and particular care in handling and sorting.

Underwear—(Vests or pants).—It is preferable to have these articles pressed or calendered. In the absence of such facilities these items need only be dried and folded.

White stiff collars.—These need a special process of starching and polishing after leaving the hydro.

Overall suits.—These need drying and folding only.

17. Weekly Programmes

Tables 3 to 5 give typical examples of a weekly routine for different classes of ships, showing the intake and balance of work related to various types of clothing.

18. Limitation of size of journey

The importance of relating the total intake of work to an amount which can be readily dealt with by the laundry crew cannot be overstressed. The capacity of the laundry plant varies for each and within each class of ship and it is impracticable therefore to lay down a fixed scale for the acceptance of work. The actual total capacity (as opposed to the theoretical capacity) depending as it does on numerous factors, can be determined by experience only and the composition of the standard bundle and the frequency of dealing with bulk work must be adjusted accordingly.

As a guide output should be catered for in the following order of weight priority.

SICK BAY.—Full requirements.

COOKS, GALLEY RATINGS, STEWARDS, ETC.—In the interests of hygiene men employed in these duties should at all times be provided with clean occupational clothing.

STANDARD BUNDLE.—The permissible overall weight of the personal bundle can be varied by the laundry officer at any time as conditions demand. The inclusion of alternative items as recommended in articles 18 and 19 will normally enable personnel to regulate their own requirements in respect of personal washing within the weight limit.

BULK WORK

Overalls.—As necessary by reason of occupational duties; engine room personnel will in general require overalls to be washed more frequently than, say, E.A.s.

Blankets.—Once in three months but where sheets are used, the frequency of washing may be extended so that each individual is issued with a clean blanket once in 6 months.

Hammocks and bed covers.—If practicable these should be cleaned for each man once in 4 weeks.

In view of the varying conditions existing in laundries in H.M. ships no standard formula for the limitation of work to a scale within the capacity of the laundry crew and plant can be established. The restrictions on the type and bulk of work accepted must necessarily be enforced by internal organization.

It should be noted that:

(*a*) A complete ban may be necessary in consecutive weeks in rotation on the acceptance of

Coloured cottons and linens
Coloured woollens

(*b*) In all instances operators engaged in checking should be instructed not to accept personal bundles in excess of the weight allowance.

19. Limitation following temporary breakdown

Should the laundry schedule become temporarily disrupted because of drills, breakdowns or other unforeseen causes it is not advisable to make up the time lost by hard and continuous work. In these circumstances the best solution is obtained by the cancellation for a week of the next journey due to be handed into the laundry. This procedure will allow time to make good defects, if any, and cause minimum interference with the planned weekly schedule. To compensate personnel whose bundles were not accepted under such circumstances, it may be possible to fit in an extra journey of limited amount at the end of the week.

CHAPTER II

Receipt and Preparation of Work

RECEIPT

1. Receipt of soiled clothing at the laundry

The handing in of bundles should be arranged to ensure that the work reaches the laundry at the scheduled time. Odd bundles arriving after the journey has started should not be accepted as these upset the planned flow of work. The method of receipt employed should be adjusted to fit into the ship's routine. If lack of handling spaces does not permit the acceptance of clothes in the laundry, a central collecting point must be established elsewhere in the ship.

Two satisfactory methods of arranging receipt are:

(*a*) Bundles may be handed to the laundry by the individual owner. With this method a queue is inevitable. It does, however, allow the owner to satisfy himself that his bundle is handed in, and to raise any queries or impart information to the laundry staff regarding his bundle.

(*b*) A canvas bag may be provided in each mess and one rating in that mess be made responsible for the delivery of the laundry for the whole mess. The mess number should be attached to the bag.

Method (*b*) is preferable as it reduces the number of ratings attending the laundry and ensures the delivery of the journey in suitable sub-lots with attendant advantages to the laundry crew on marking and classifying duties.

In the case of officers' laundry the stewards concerned should deliver the bundle to the laundry, or to a central collecting point. In the case of special services, *e.g.*, cooks, bakers, special dutymen, etc., an individual of the party concerned should deliver the occupational clothing to the laundry in one lot.

2. The laundry chit

Each article of clothing must be clearly listed by the owner on the laundry chit, which must be attached to, or placed inside the bundle.

Note.—The bundle should be made up as small as possible and placed in a pillow slip (if included) or alternatively rolled into one of the larger items.

Service pattern laundry chits, Forms S.1279 *a*, *b*, *c*, *d*, are available.

S.1279*a* (buff) for use by officers.

S.1279*b* (pink) for use by men in Class I and Class III uniform.

S.1279*c* (blue) for use by men in Class II uniform.

S.1279*d* (white) for use by Sick Bay, Naval Stores, etc.

The forms are produced in different colours to aid identification and contain a few blank lines to allow for the addition of special articles.

It is essential that the owner's name and official number be completed by him in block capitals on the laundry chit in order that the laundry number can be correctly computed by the laundry staff. The columns marked "Received" and "Checked Out" must be checked by the laundry staff at the receipt and issue stages respectively and the signature or initials of the checker(s) inserted at the bottom of the appropriate column. (*See also* Sorting and Marking). Queries regarding discrepancies can then be dealt with by the operator(s) who checked the bundle.

3. Use of the laundry chit

An example of a completed laundry chit form S.1279*b* is indicated below.

In the example given, it is observed that a discrepancy exists in the list of articles. The owner indicated that 2 vests were included in his bundle, whereas 1 only was found at the checking stage. The checker has made a notation of the discrepancy in the "Received" column.

P/JX129622

Established September, 1946
S.1279b

LAUNDRY CHIT

Class I and III
Uniform

NAME: J. F. Smith Date: 1.1.50

MESS: E.R.A's Laundry No.: J. S. 9622

ARTICLES	REC'D	CHECKED OUT
Shirts (white)	2	
Shirts (working)		
Collars (soft and semi stiff)	2	
Collars (stiff)	1	
Vests	~~2~~ 1 only E.J.V.	
Pants	2	
Pyjamas (suit)		
Cap covers		
Handkerchiefs	4	

ARTICLES	REC'D	CHECKED OUT
Towels (hand)	1	
Towels (bath)	1	
Sheets		
Pillowcases		
Overalls		
Hammock		
Bedcover		
Work'g dress shirt	1	
Work'g dress trousers		
TROPICAL		
Shirt		
Shorts		
Trousers		
Tunics		
White stockings		
White scarf		
Socks		
Pullover		
BY WHOM	E.J.V.	

4. Collection of bulk work

Each unit should appoint a senior hand to muster the articles, preferably into bundles of ten for ease in counting, and deliver them to the laundry receipt room. The articles should be similarly collected from the issue-room when clean. These items are already marked in accordance with normal service procedure and further personal identification of individual articles by means of the laundry marking system is unnecessary. The collection and subsequent re-issue to the owner is the responsibility of the division representative. Overalls can be similarly delivered and collected from the laundry in lots.

MARKING

5. The Marking System

The responsibility for marking and identifying articles rests with the laundry, and a marking machine is supplied for this purpose in cruisers and larger ships. A standard marking system has been established based on a man's name and official number, which will serve an individual throughout his service career.

Example: John Frank Smith Official No. P/JX.129622. The initials of his first christian name and surname " J.S. " and the last four figures of his official number 9622 are used for purposes of laundry marking. Hence his laundry Number is J.S.9622. This number will not change during his career unless he is transferred from one branch to another. The chance of duplication of identity is negligible.

For officers the figures to be used in lieu of the official number are those on the National Registration Card (S.1151).

The Laundry marking system does not relieve individuals of the responsibility for marking their clothing in accordance with the Uniform Regulations.

6. Marking Woollens

By reason of the comparatively loose texture and absorbent properties of wool, the marking machine cannot be used for marking woollens, blankets etc., similarly the black marking ink used is not readily visible on navy blue or other dark garments.

To overcome this difficulty two methods of marking can be resorted to:

(*a*) A piece of white tape to carry the mark may be sewn on the garment. The time factor will not permit the laundry crew to undertake this work and the tape should be sewn on by the owner of the article.

(*b*) The alternative system involves the use of numbered safety pins which are attached to the article by the laundry staff during the sorting process. The number of the pin is then entered on the owner's laundry chit.

Method (*a*) is preferable and should be used wherever possible as this provides a permanent mark.

7. Correct positions for marking

When selecting the position for marking individual garments two requirements must be satisfied. Firstly, the laundry mark must be readily visible to the sorter and packer without the article needing to be unfolded and secondly, the mark must not be visible when the article is being worn.

Table 6 indicates the correct place to mark each garment.

8. Precautions

(*a*) Make sure that the correct number is set.
(*b*) Make sure that the article is plainly marked.
(*c*) Make sure that old markings are obliterated.

9. Marking Machine

The hand operated marking machines installed are capable of developing a mark having six characters. Six type wheels are provided, the first two of which each bear the complete alphabet and the other four, each the figures 0-9, together with additional symbols.

The machine in general use in H.M. Ships is the "British" marking machine manufactured by Messrs. A. & C. Jenner Ltd., and illustrated in figure 2.

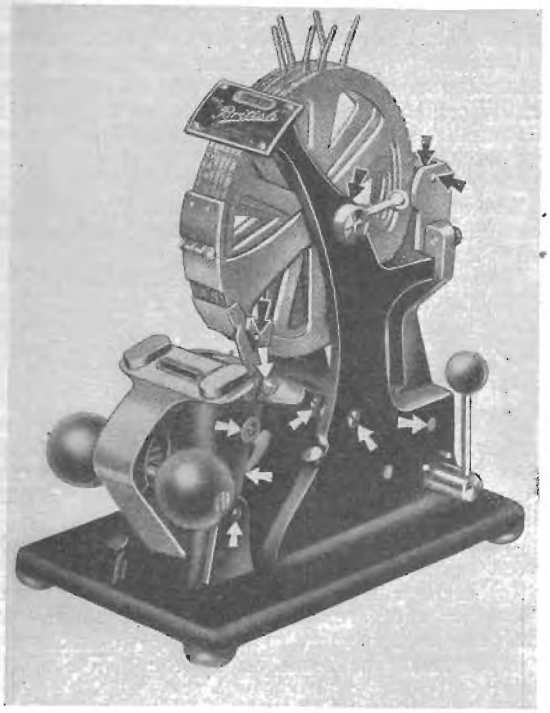


Fig. 2.—Arrangement of "British" type marking machine with lubricating points.
Lubricating points shown thus →

OPERATING THE MARKING MACHINE

The method of operation is illustrated and described in Fig. 3.

(*a*) *To remove the inkwell.*—Close the machine by pressing the handles towards the type until the hammer strikes, then press down the thumbpiece at the back of the inkwell carriage and lift out the inkwell by the handles provided.

(*b*) *To fill the inkwell.*—Fit a new felt pad with the face marked TOP upward, remove the screw plug and fill with ink, wait until the ink has soaked into the pad and then replace the screw plug reasonably tight. Care must be taken to ensure that no leakage occurs as this allows too much ink on the pad. If the pad appears wet, the surplus ink should be wiped off; the pad should have a "matt" appearance.

Replace the inkwell in the machine taking care that the projection in front of the inkwell fits snugly in place in the carriage, and finally release the spring-clip at the back of the carriage.

To fit a new pad. Remove the inkwell, and without removing the screw plug, lift out the old pad with the hook provided. Fit a new pad. If the screw plug is left, screwed tightly in position, the ink will not flood the pad chamber.

The inkwell must not be removed or replaced when machine is in the open position.

(*c*) *To clean the type.*—By moving the lever at the side of the machine to the back the register bracket is released. By then removing the rubber pressure block and closing the machine it is possible to move the type wheels freely and to clean them with a brush and methylated spirit.

The type wheels can be easily removed by unscrewing the nut at the side of the machine with the spanner supplied and removing the bolt. The type wheels will then be freed.

Cleaning is essential at least once a day, and if possible the type should also be brushed during the day while the ink is still wet.

(*d*) *Lubrication.*—Efficient lubrication should be maintained at the lubrication points indicated by arrows in Fig. 2.

(*e*) *Precautions.*—The undermentioned precautions should be observed at all times:

DON'T start the day without a new pad.

DON'T go on marking when the pad is getting dry.

DON'T close the machine without fabric in it.

DON'T move the type wheel when the machine is closed without first removing the printing block, or the rubber will tear.

DON'T leave the machine open for any length of time.

DON'T use a steel pin for cleaning types; a soft brass pin is supplied.

DON'T use corrosive marking ink.

DON'T forget to put the cover on at night.

DON'T forget that clear marking is the key to accurate packing.

DON'T use inferior inks.

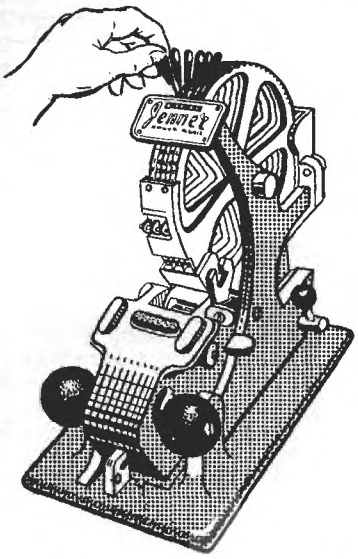
PREPARATION

10. Sorting and marking

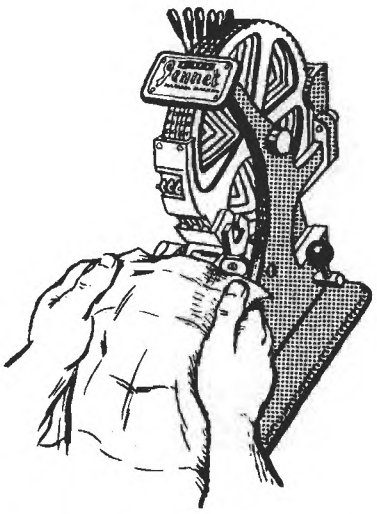
The laundry process begins with the receipt of the soiled articles in the laundry and ends when clean, neatly folded articles are collected by or delivered to the owner.

On receipt in the laundry, the bundles containing dirty clothing are placed into dirty-bundle bins (see Fig. 4). The bundles are then individually checked by the laundry "checker" in the sorting and marking booth provided for this purpose. The size of the booth may vary with different installations, but the principles of construction are illustrated in Fig. 5.

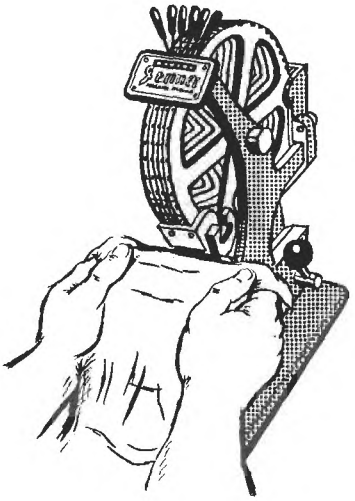
The bundle should be placed in the left-hand compartment of the marking booth and the laundry chit clipped on the board provided over the marking machine. The owner's laundry number should be set on the marking machine. The contents of the bundle should then be checked against the contents list and correct items "ticked off" in the received column. Each item should be marked if necessary



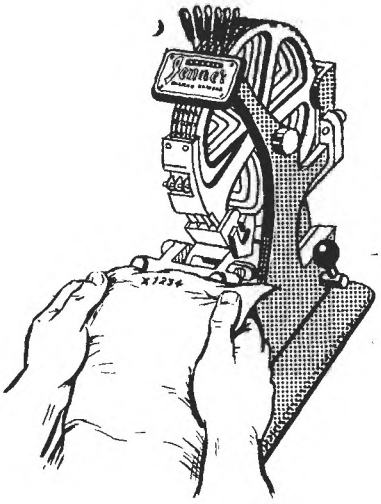
SELECT THE MARK BY ROTATING TYPE WHEELS IN SUCCESSION.
CHECK AT METAL SIGHTING PLATE.



PLACE ARTICLE IN POSITION OVER RUBBER PRINTING BLOCK, MEANWHILE HOLDING ROUND HANDLES AT EITHER SIDE IN THE PALMS OF THE HANDS.



STRETCH FABRIC BY HOLDING IT WITH THUMBS ON RUBBER SIDE-PADS AND MOVE FORWARD TILL STOP IS REACHED.



DEPRESS HANDLES UNTIL LATCH IS DISENGAGED, DRAW HANDLES FORWARD, AND LIFT CLEARLY MARKED ARTICLE OUT.

Fig. 3.—Diagrams showing the method of operation of the marking machine.

and old laundry marks, *i.e.*, those marks not in conformity with the correct marking system, obliterated. Articles should then be placed in the right-hand compartment, care being taken to search clothing having pockets for extraneous articles.

When he is satisfied that the bundle is correct,

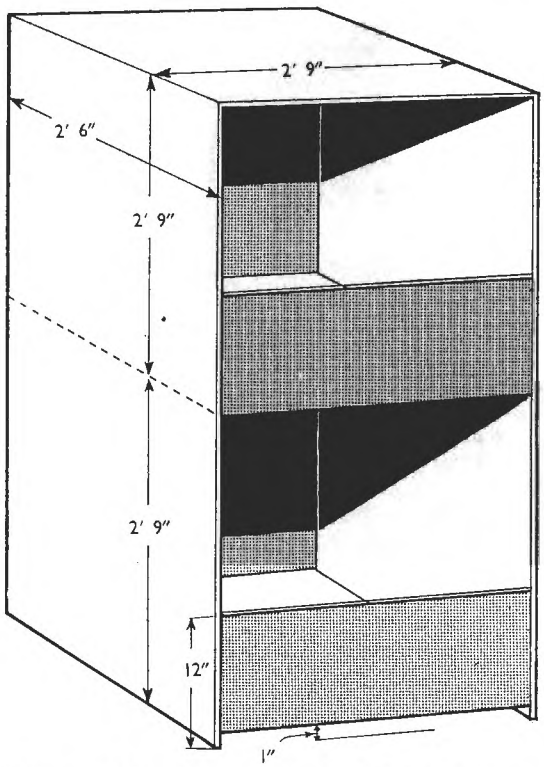


Fig. 4.—Classification and soiled bundle bins.

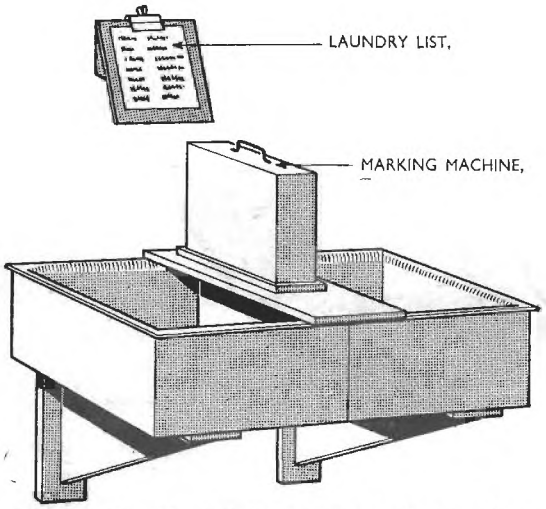


Fig. 5.—Double compartment sorting booth.

the " checker " should sign or initial the chit at the bottom of the " received " column and pass the articles to the " classifier." If there are discrepancies a note of these should be made on the chit and the chit set aside.

When the checking of bundles for the whole journey is complete, the chits should be transferred to the sorting and packing section; those bearing discrepancies should be placed on top and the details communicated to the senior hand of the laundry.

11. Classification

The classifying of work is one of the most important and essential steps in the whole laundry process and involves the sorting of the articles into " lots " having similar fibre construction. In view of its important nature, the senior rating must in all instances constantly supervise ratings engaged on this duty. Articles of clothing in general use cannot all be washed together in a common process, as irreparable damage to many, and the discoloration of others by loose dyes from coloured goods, would result.

It is essential, therefore, to classify all articles of clothing into groups which can be safely washed together in a single process. The determination of these groups must be based on the following factors:

(*a*) The nature of the material (*i.e.*, the fibre from which the article is manufactured).

(*b*) The colour and type of dye.

(*c*) The type of clothing or general use to which the article is put.

(*d*) The degree and nature of soiling.

12. Fabrics

The materials used in the manufacturing of clothing can be classified into three main groups, namely vegetable, animal and synthetic (or artificial) fibres.

(*a*) VEGETABLE FIBRES, *e.g.*,
- (i) Cotton.
- (ii) Flax.
- (iii) Jute, hemp and rami (China grass).

(*b*) ANIMAL FIBRES, *e.g.*,
- (i) Wool.
- (ii) Silk.

(*c*) SYNTHETIC OR " MAN-MADE " FIBRE,
Rayons, etc.

13. Colour and type of dye

Dyes employed can be classified generally under two headings, " Fast " and " Loose " (or " Fugitive "). Fast dyes will wash well, subject to alkali and temperature control. Loose or fugitive dyes are liable to run in the washing processes.

Although some printed shirtings are not completely satisfactory, the majority of dyes used in shirts are quite fast to the white-work washing process. In many instances, particularly with shirts having black stripes, the striping tends to become brown if hyperchlorite bleach is used. Detachable coloured collars should be washed with the shirts to which they belong so that any variation in colour will be uniform in both the shirt body and collar.

Most of the difficulties with dyes arise in the washing of coloured table linen, bed linen, pyjamas, bath towels, and other miscellaneous coloured articles

and are due to the fact that the dyes used are variable in fastness.

In all cases of doubt, therefore, coloured articles should be washed in low temperatures, with little alkali and *NO* bleach.

14. Types of clothing and nature of soiling

The different types of clothing and the use to which individual specialist type garments are put provide an indication of the nature of soiling to be expected and enable the washing process best suited for the removal of that soiling to be readily assessed.

(*a*) PERSONAL CLOTHING

(i) *Underwear.*—Vests and pants will be soiled generally by body exudations, which are acidic.

Pyjamas will be similarly soiled though to a lesser degree, except under tropical conditions.

Shirts and collars will be soiled by both contact with dirt and acidic soiling, the fabric at the neck band, collar and cuffs being more heavily soiled due to rubbing on the body.

(ii) *Top clothing.*—Working dress, white uniform, etc., will be soiled by contact with the work benches, and general dirt in the atmosphere, etc.

(iii) *Overall clothing.*—Overall suits and similar clothing will contain soiling matter peculiar to the trade of the user, in addition to the soiling found in ordinary top clothing.

(*b*) TABLE LINEN, ETC.

This will be subjected to all the stains common to food juices, spices, mustard, etc.

(*c*) BED LINEN

Mostly acidic soiling plus general dust of the atmosphere.

In all cases of heavy soiling the article must be separated from the general classification and given special treatment to prevent the contamination of cleaner articles. Examples of heavy soiling may be expected from the following groups:

Cooks.
E.R.A.'s, O.A.'s, E.A.'s, etc.
Stokers (boiler cleaning).
Men working in boilers, double bottoms, and oil fuel tanks.

15. Typical classifications

WHITES

COTTONS	WOOLLENS	SILKS AND RAYONS
Vests	Socks	Vests
Pants	Mufflers	Pants
Shirts	Pullovers	Shirts
Handkerchiefs	Gloves	Scarfs
Bed linen	Seaboot stockings	Handkerchiefs
Table linen	Vests	
Cap covers	Pants	
Collars	Blankets	
Drill suits		
Tropical suits		
Towels		

COLOUREDS

COTTONS	WOOLLENS	SILKS AND RAYONS
Shirts	Socks	Vests
Working dress	Stockings	Pants
Blue jean collars	Mufflers	Shirts (sports)
Pyjamas	Jerseys	
Handkerchiefs	Cardigans	
Overall suits	Pullovers	
Towels	Seaboot stockings	
	Balaclava helmets	
	Gloves	
	Serge suits	
	Blankets	

16. Classification bins

Classification bins of the type illustrated in Fig. 4 are provided. The number of bins installed is dependent upon the space available but an endeavour is made to provide at least six bins in all installations. Separate bins should be used for each material classification and, if available, for further sub-classification dependent upon the state of soiling.

CHAPTER III

Washing Machines

1. Washing machines of various makes are installed in H.M. ships and fleet shore establishments. In general these are of either 30 or 12½ cu. ft. inner cage capacity.

Many machines at 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.

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 lifters 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 suitable sealing 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 vee belt or chain and spur gearing. In some machines the drive is arranged through a patent clutch.

To prevent the "roping" 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 crossed belting, mechanical reversing gearbox or reversing motor with control panel. Inching gear, 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 inner door open when loading and unloading.

To facilitate the control of the washing process, a thermometer of the distant 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 machine.

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

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.

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

(ii) 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 3½ pounds per cubic foot, and for woollens 2½ pounds per cubic foot. The rated capacity should not be exceeded because overloading reduces mechanical action resulting in poor finish.

Underloading reduces total production and wastes time, detergents 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-boxes, 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

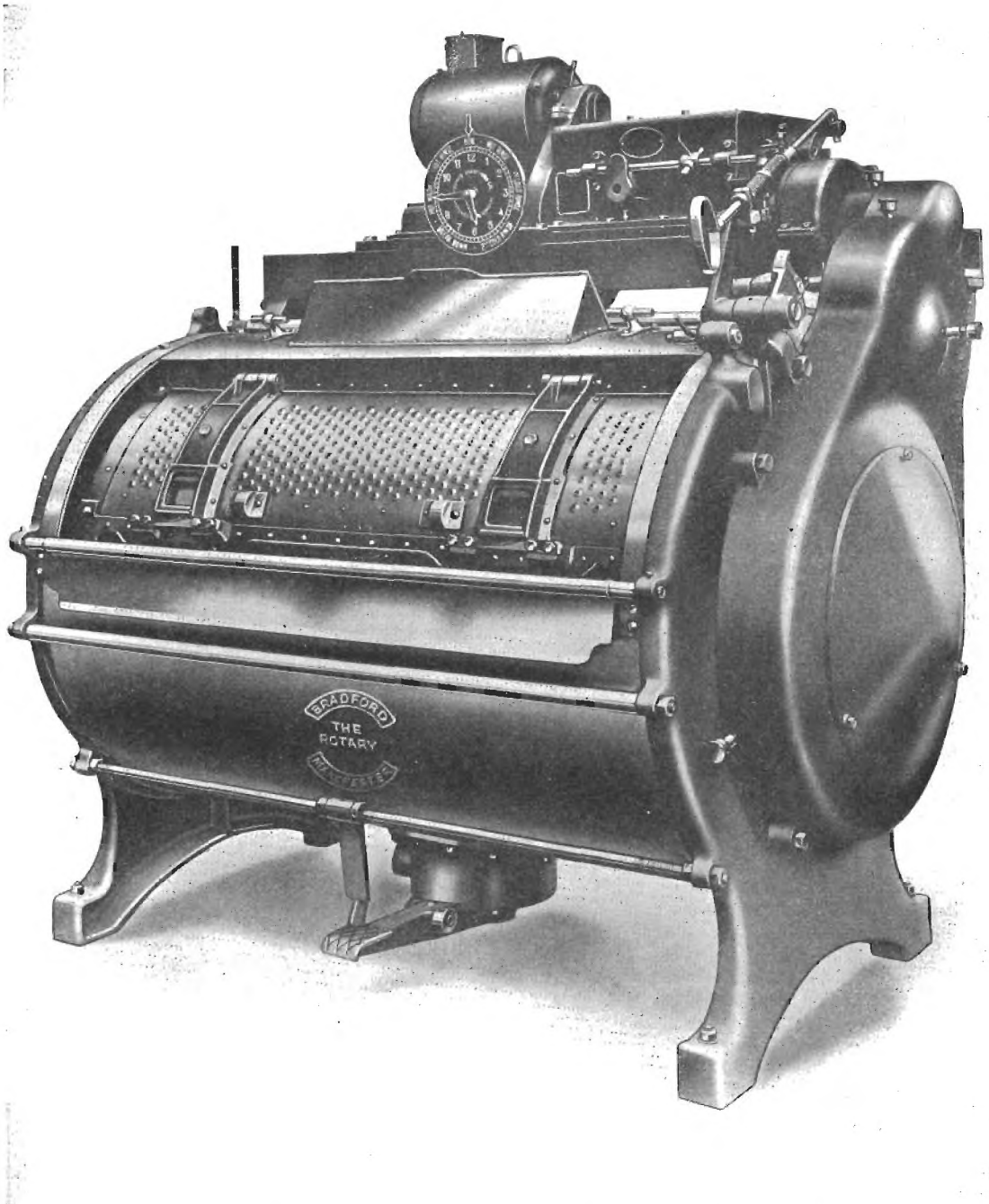


Fig. 6.—30 cu. ft. side opening type washing machine, motor driven.

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 element in the water is precipitated by the alkali used in the washing process and the chemical action of the soap on this precipitate causes it to be deposited in the form of a hard scale (*e.g.*, lime soap deposit). The presence of even small quantities of this scale is troublesome inasmuch as minute particles become detached and settle on the work with resultant deterioration in whiteness; 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 removed 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

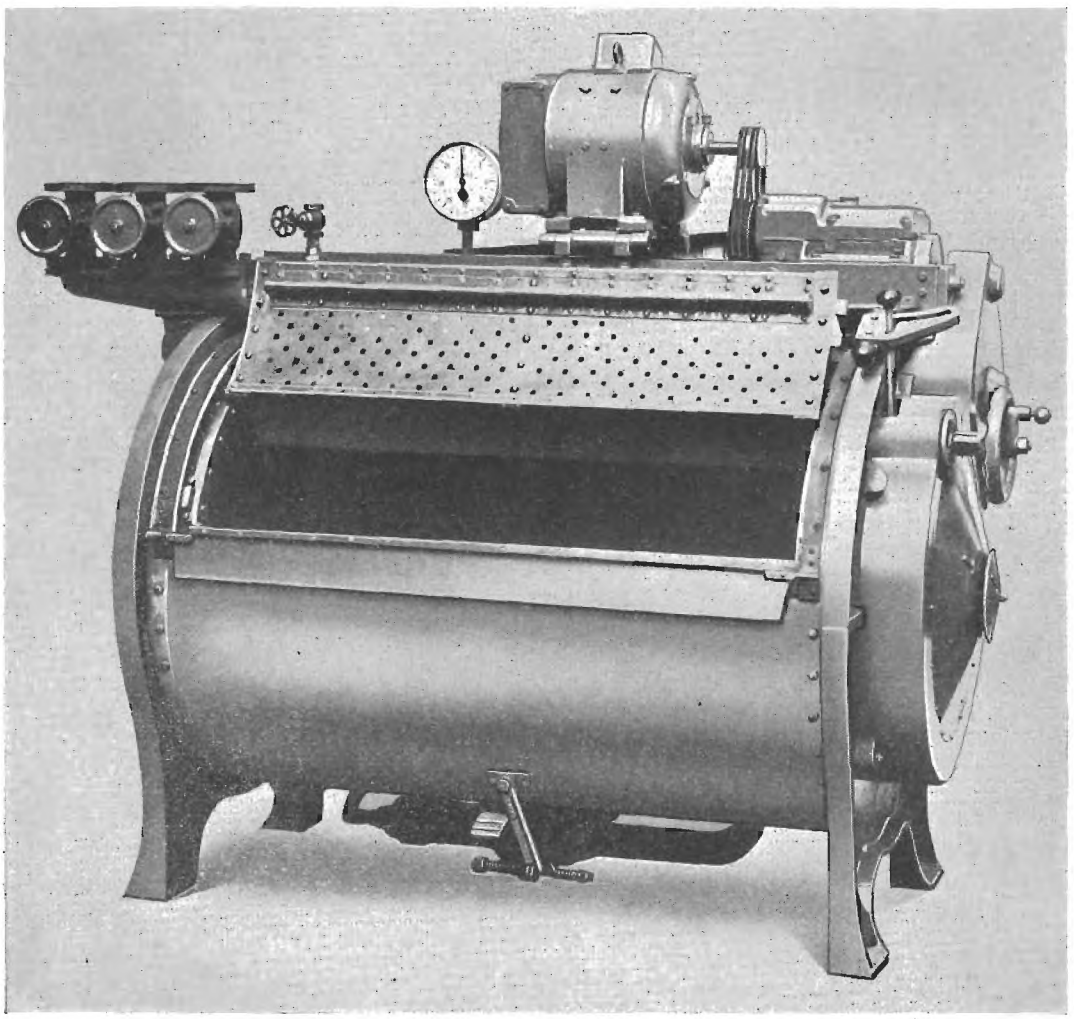


Fig. 7.—30 cu. ft. side opening type washing machine, motor driven.

of the cage and as much as possible of the inside casing to be similarly scraped and brushed by a man inside the cage. Lock the cage each time before cleaning.

Note.—In operations (1) and (2), great care must be taken to ensure that the power supply to the machine is " off "; care must also be taken not to raise " burrs " on the surface of the cage as these will cause tearing of the fabric.

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

(4) Thoroughly rinse the machine.

(5) 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 ozs. at a time, at intervals until the water remains acid to litmus after 5 mins. running. Glacial acetic acid should be used, as this has the minimum corrosive effect on the metallic construction of the machine.

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

(7) Add hot water at a temperature of about 160°F. into the machine to a dip of 6 in. Add 1 lb. of alkali (soda ash), and boil for 15 minutes.

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

(9) 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 100 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* 36 *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 carries the door interlock bracket (2) which operates in conjunction with the striking piece (3) mounted on the

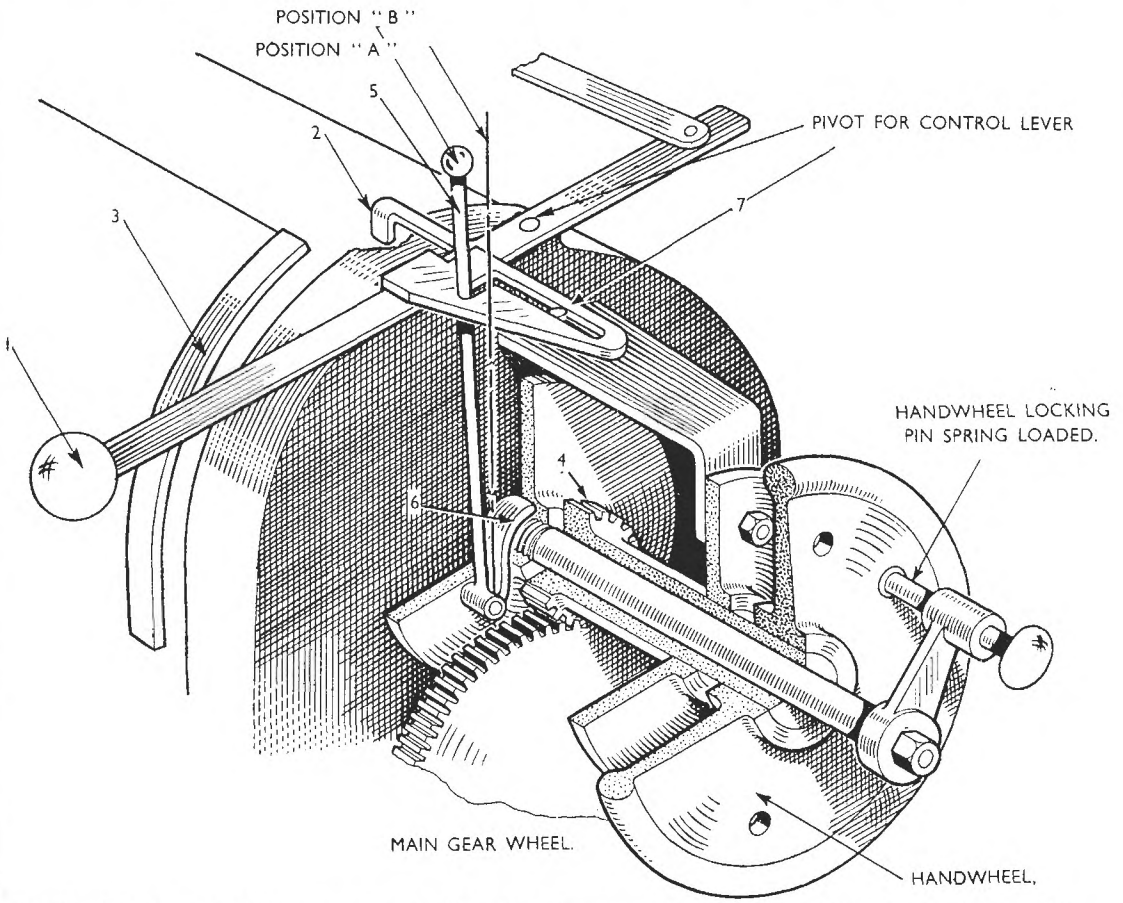


Fig. 8.—Diagrammatic arrangement of interlocking gears for Smith and Paget washing machine.

sliding door of the outer cylinder. Thus with lever (1) in the running position, the interlock bracket (2) passes behind the striking piece (3) and prevents the door from being opened. Similarly, with the door in the open position the striking piece (3) passes in front of the interlock bracket (2) thus locking the control lever (1) in the off position preventing the machine from being started until the door is closed.

The hand turning gear comprises a pinion (4) capable of lateral movement along its shaft into or out of mesh with the main driving wheel. By pulling the handwheel outwards towards the operator the gear is engaged; opposite movement releases it. The position of the pinion (4) is controlled by the lever (5) operating a claw (6) which embraces the pinion. Lever (5) passes through an " L " shaped slot in the connector casting (7) carried on control lever (1). Thus when the pinion (4) is engaged as shown in the sketch the lever (5) cannot be moved since the claw (6) is in line with the pinion (4) and since the lever (5) is engaging the slot in the connector casting (7). As shown in " position A " therefore, the control lever (1) is effectively held in the off position.

If the hand turning gear is pushed out of engagement, lever (5) can be moved to " position B " when the claw (6) falls in front of the pinion (4) thus preventing it from being drawn into mesh with the main gear. In this position, the control lever (1) may be moved to the " on position," lever (5) travelling along the opposite arm of the slot and thus being firmly held in " position B " until the machine is once more stopped. Therefore the hand turning gear cannot be engaged until the machine is stopped and must be disengaged before the machine can be restarted.

8. The 'Crown' Reversing Gearbox

This gearbox, Figs. 9 and 10 is fitted on the Smith & Paget type washing machines.

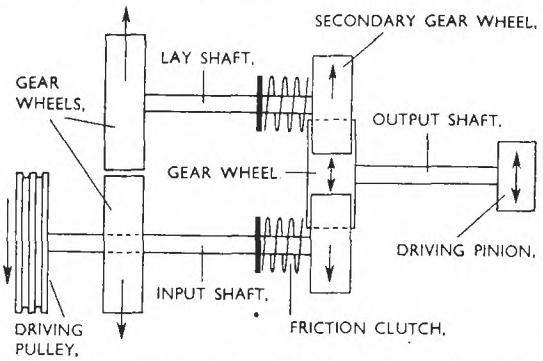


Fig. 9.—Diagrammatic arrangement of Crown reversing gearbox.

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 geared and so rotate in opposite directions; drive is communicated by vee belting from the motor to a grooved pulley wheel 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 the 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 layshaft with a resultant reversal of motion.

9. 'Lightburn' patent reversing clutch

In certain makes of washing machine the reversing motion of the inner 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 driven 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 5 to 1 reduction is communicated by chain drive from the motor pinion to a chain wheel mounted on the extended boss of the left 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 by chain drive to a wheel mounted on the extended boss of the right hand driving plate.

In the neutral position of the clutch, therefore, the central output shaft and driven plates remain stationary while the right and left hand driving plates run independently in their respective clockwise and anti-clockwise 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 presser plates, and in turn to the clutch-plate and lining-rings engaging with the associated fixed-driven plate. The clockwise or anticlockwise 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

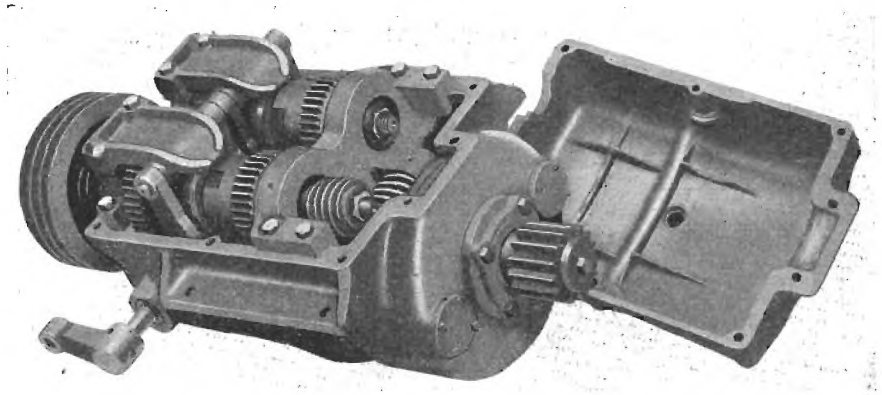


Fig. 10.—Assembly arrangement of Crown reversing gearbox.

and crankpin. Automatic engagement of alternately the right and left-hand driven plates, is obtained by the conversion of the rotary motion of the wormwheel and roller to lateral movement of the central bobbin through a rocker lever and striking arm.

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.

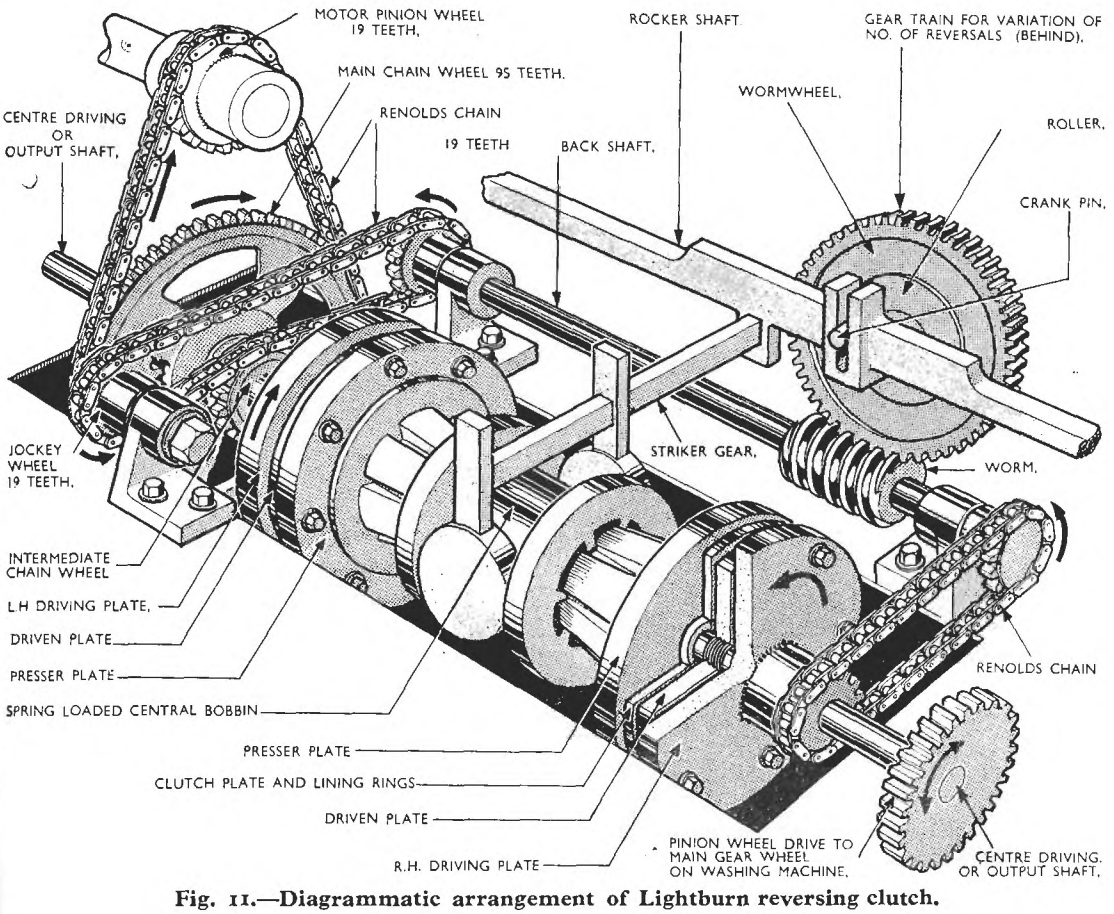


Fig. 11.—Diagrammatic arrangement of Lightburn reversing clutch.

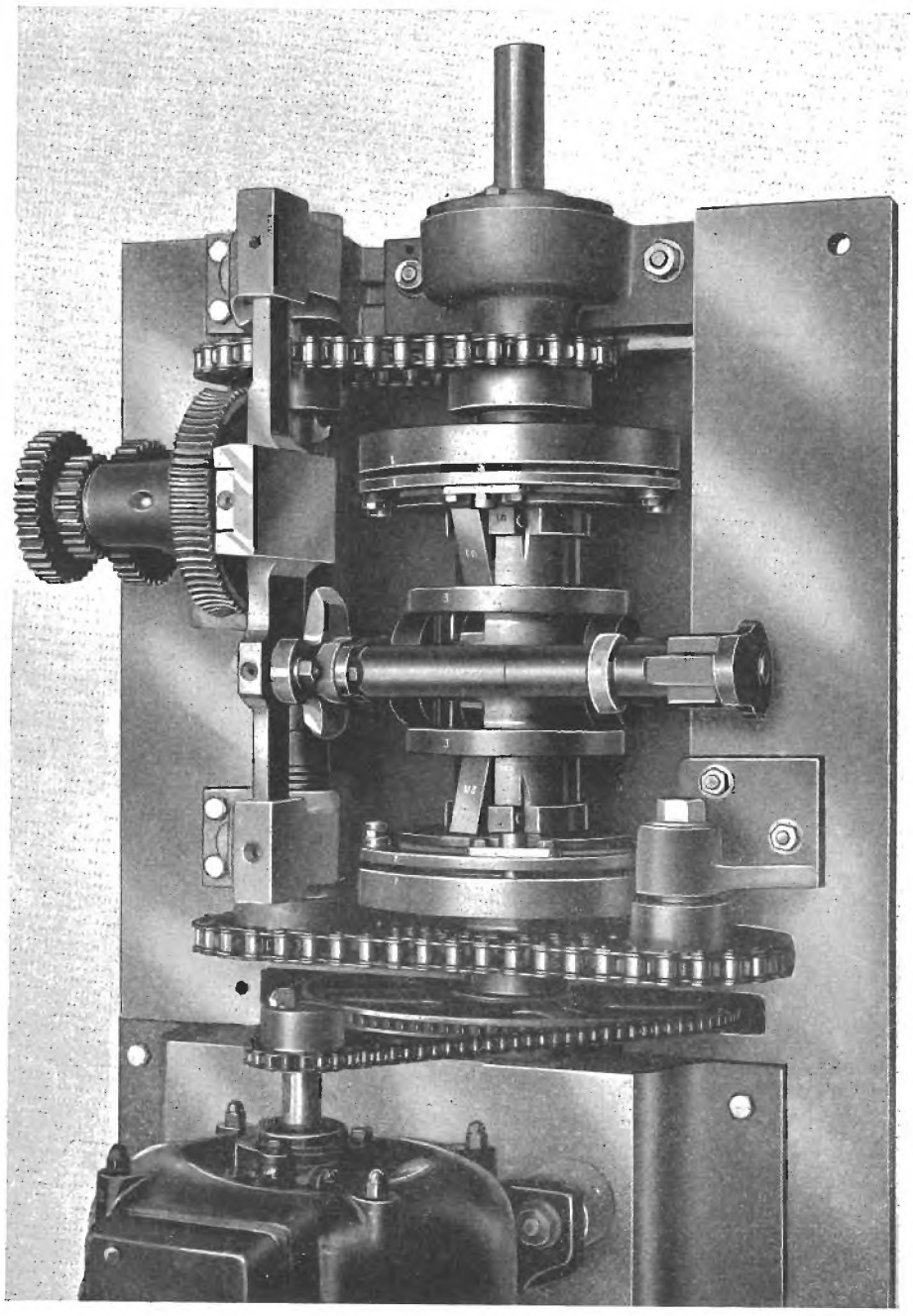


Fig. 12.—Assembly arrangement of Lightburn reversing clutch.

MAINTENANCE

All grease cups should be filled and charged daily, those on the ends of the clutch being most important.

The clutch assembly should be lubricated daily through the nine oil cups provided.

The bearing in the operating-rod bracket should be lubricated daily.

The depth of oil in the chain oil-bath should be tested every three months, the correct level being such that the chain just reaches the oil.

The utmost care should be taken to prevent oil reaching the clutch plates.

The main driving chain should be examined at intervals and any apparent slackness taken up by meant of the adjusting screws on the main motor mounting.

10. Interrupter gear

Excessive mechanical action when washing woollens tends to produce " felting," with consequent damage to the material. To minimise this effect, machines engaged in washing woollens are provided with interrupter gear by means of which the machine is automatically stopped at predetermined intervals, thus enabling the load to soak at rest. One of the most widely applied types in use is the B.L.R.A. Interrupter Gear, developed by the British Launderers' Research Association.

Some machines are provided with a two-speed motor, the lower speed being used (in lieu of interrupter gear) to reduce the mechanical action on the load when washing woollens.

Other machines in Admiralty Service have no positive provision for washing woollens, and in these instances the rest period must be obtained by the hand stopping and starting of the machine.

THE B.L.R.A. INTERRUPTER GEAR

The B.L.R.A. interrupter gear comprises a cam mechanism which, working in conjunction with the unit controlling the reversing motion of the inner cage, produces an interruption or " pause " of predetermined period in 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. 15.

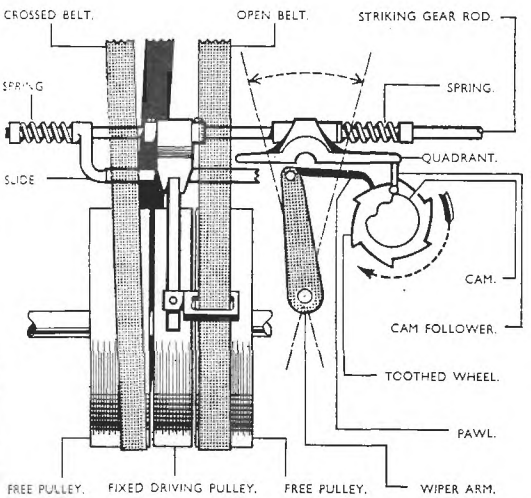


Fig. 13.—Diagrammatic arrangement of the B.L.R.A. interrupter gear.

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 centralizes itself, returning the belts to the neutral position. A cam follower engages the profile of the cam and thus raises or lowers the quadrant. During that period of revolution of the toothed wheel when the cam follower is engaged with the low portion of the cam, the quadrant drops and engages with the wiper arm which in turn 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 as—one-sixth high, two-sixths low, one-sixth high, two-sixths 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.

The interrupter gear is capable of simple disengagement, leaving the machine free for normal washing operations. Individual manufacturers of washing machines adopt designs of the B.L.R.A. interrupter gear suitable to their own products and in such instances the name of the maker is used as a prefix. The interrupter gear brings the machine to frequent " rest " positions which may cause an unsuspecting operator to think that the machine is stopped. In all machines, therefore, the interrupter gear operating lever is incorporated as an integral part of the safety mechanisms which ensures that the outer door cannot be opened until the machine is stopped.

11. Belt-driven machines

A number of belt driven washing machines are installed in H.M. ships, the Ritchie No. 2 style CHH Dreadnought type as illustrated in Fig. 14 being a typical example.

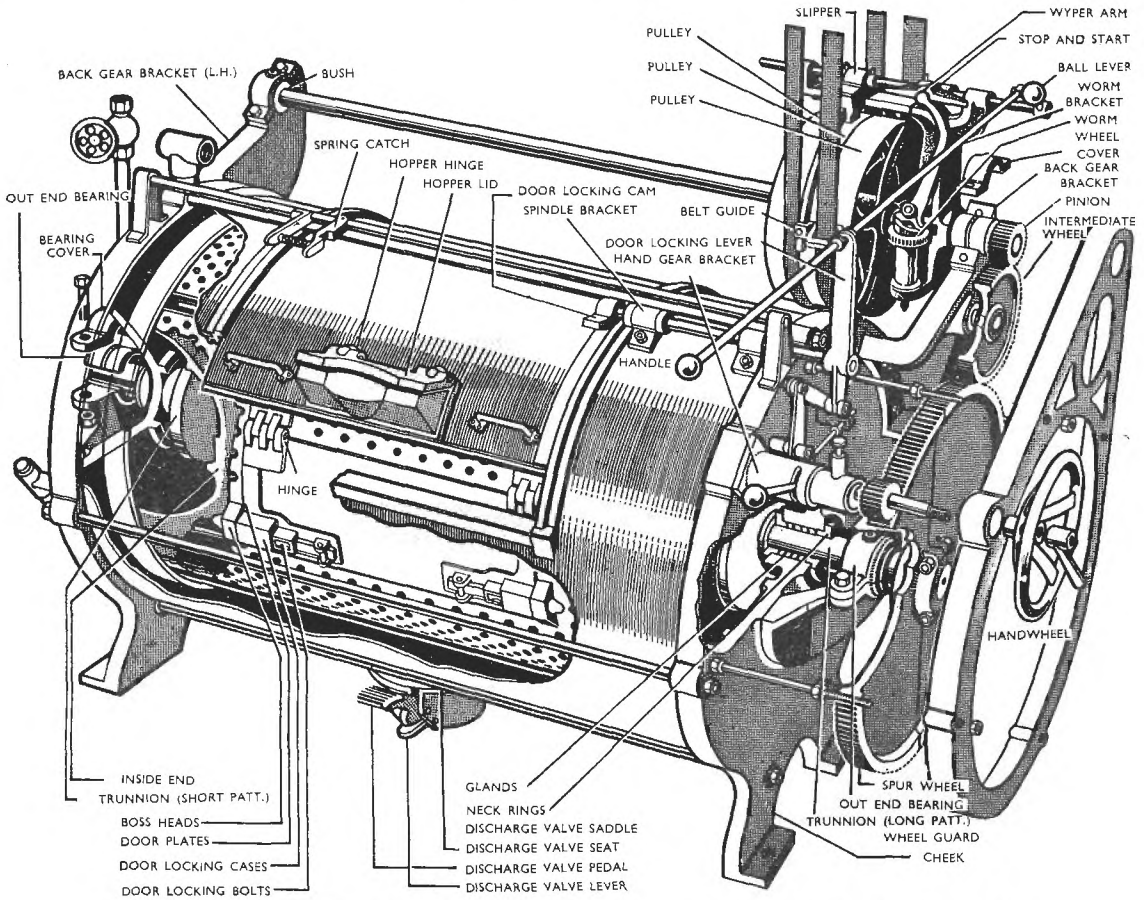


Fig. 14.—Arrangement of Ritchie No. 2 CHH belt driven washing machine.

With this type of machine the motor is separately mounted on the deck or deck head and driven through countershafting, 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.

12. Striking gear

The belt striking gear is illustrated in Fig. 15 which shows the assembly with the gear in the neutral position and with the belts running on their associated free pulleys. A worm, sleeve mounted on the main driving shaft imparts circular motion to a worm cam wheel and hence reciprocal 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 snugs 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.

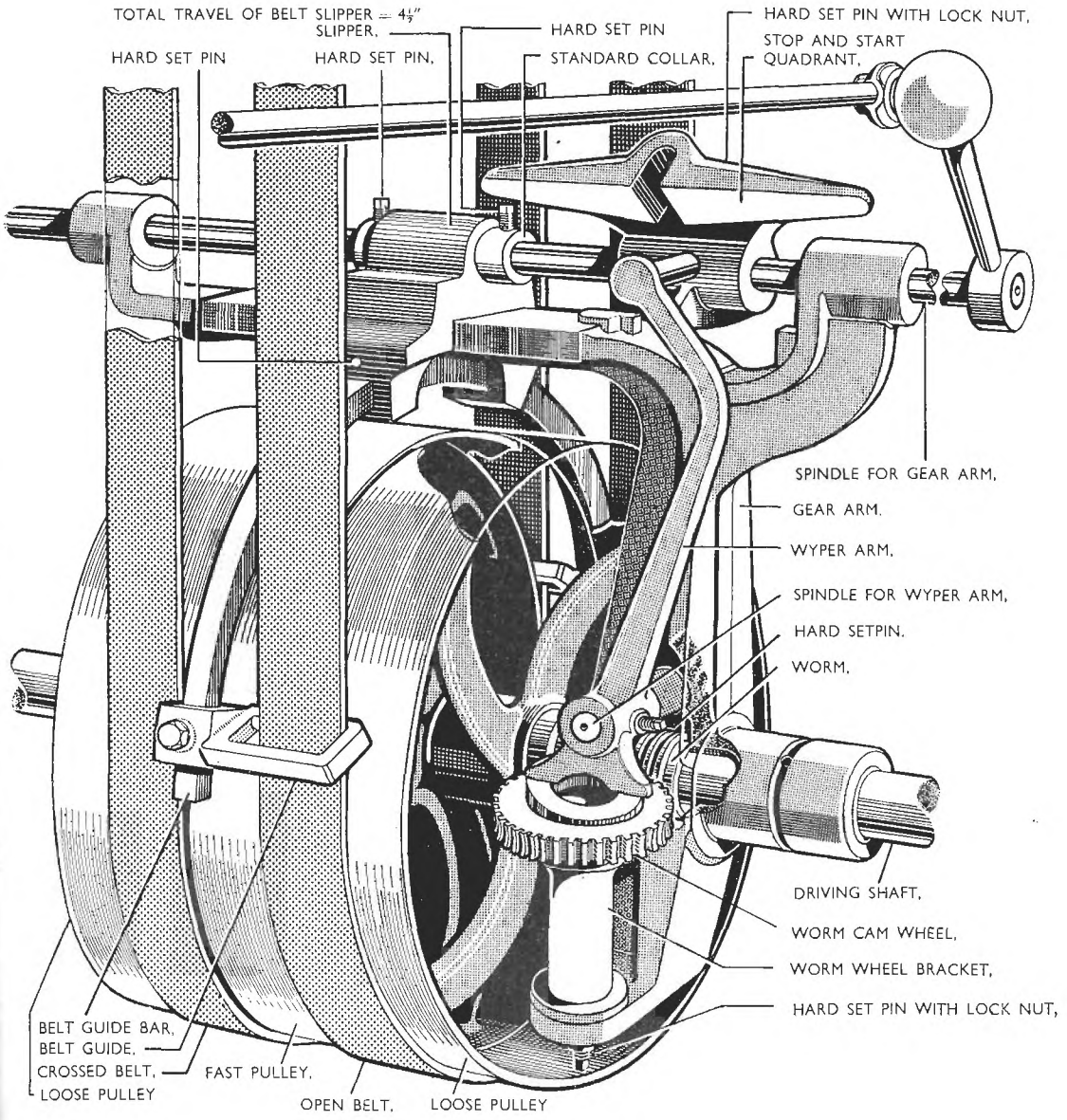


Fig. 15.—Belt striking and reversing gear.

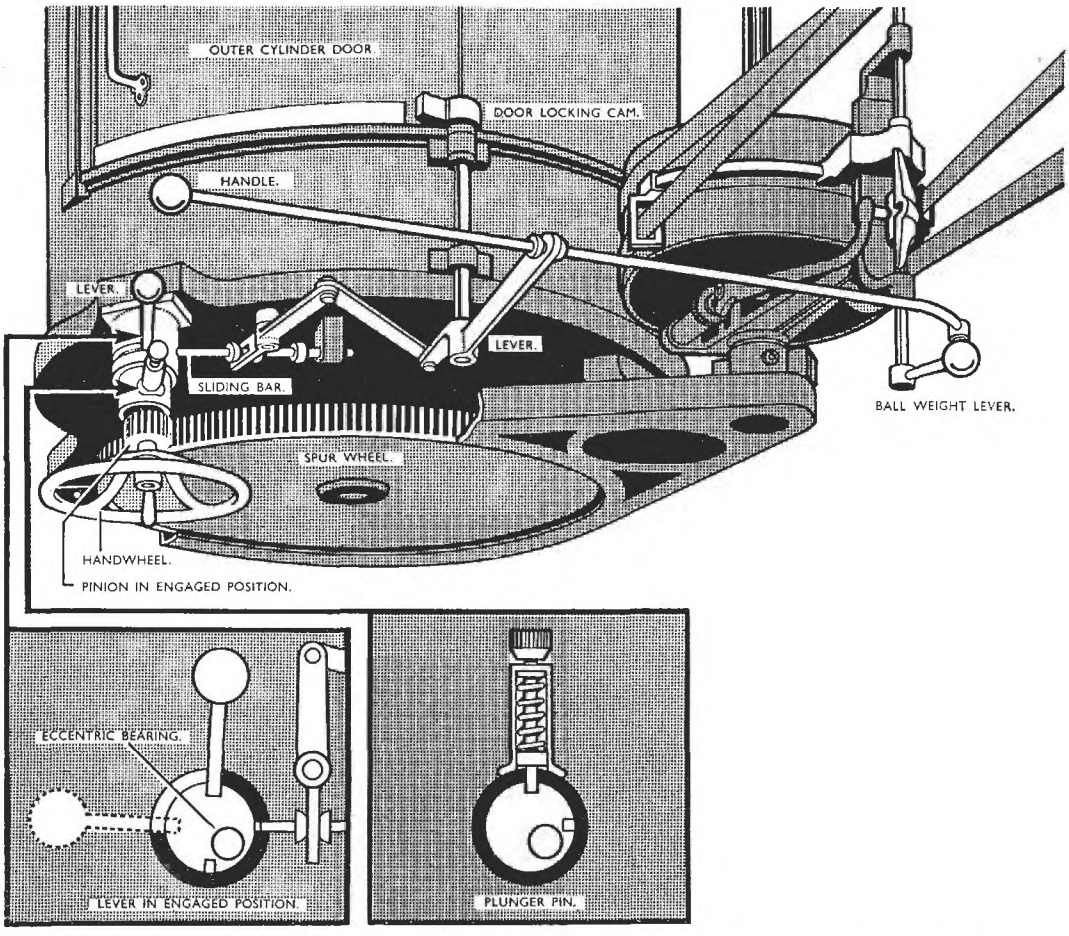


Fig. 16.—Door locking and hand turning gear for Ritchie No. 2 washing machine.

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 bearing thus enabling the eccentric to be turned so that the pinion 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 pinion from the spurwheel. 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 and locks the eccentric in the disengaged position, and (*c*) pulls over the ball weight lever which in turn engages the stop and start quadrant with the wiper arm.

OPEN END TYPE

14. Description

The machine shown in Fig. 17 consists of a perforated monel metal or brass internal cage of open end construction. The rear end of the cage is fitted with a trunnion housing of the sleeve 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.

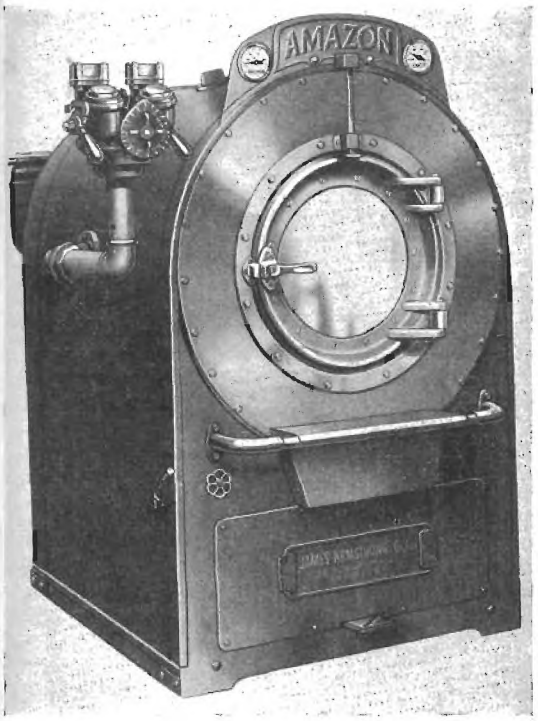


Fig. 17.—External view of the Amazon 38 in. × 44 in. open end type washing machine.

The front of the cage has a 22-in. diameter opening for loading and unloading purposes and carries a deep sectioned ring which acts as the internal track for the roller bearings on which the front of the cage revolves. The cage carries four internal beaters which continuously lift and drop the work so as to cause the maximum penetration of the washing liquor into the load.

The cage revolves in an outer steel shell which is largely of fabricated construction and supported on end frames. In some machines installed in H.M. ships this steel shell is sprayed with monel metal to a thickness of ·016 in. as a protection against corrosion. The ends of the outer shell are reinforced externally by mild steel discs, the front disc being bored to receive a gunmetal door ring on which the outer door, 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 trunnion 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 conversely prevents oil and grease from entering the cage with consequent contamination of the load.

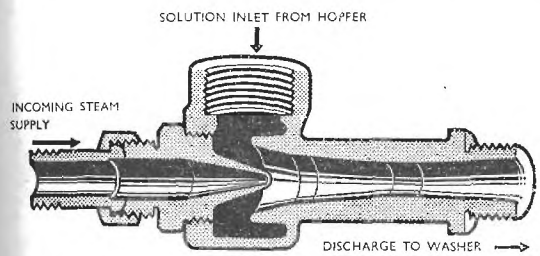


Fig. 18.—Arrangement of No. 3 "Cosmo" type steam injector.

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 "Tee" piece to take a thermostatic steam and water mixing valve and associated fittings. A separate steam boiling connection fitted with a fine adjustment valve is provided. A 2-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 dummy clock, a thermometer of the distant reading type and a hydrostatic depth gauge for indicating the dip reading in 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 both main classes of work, namely "cottons and linens" and "woollens." Dependent 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 in Admiralty service.

METHOD I.—Drive to the machine is arranged by a vertically-mounted motor supported on the outer shell at the back of the machine, through a Croft $3\frac{1}{2}$-in. type "D" vertical worm reduction gearing giving a drive ratio of 15 : 1 (see Fig. 21). The output pinion, 22 teeth, engages with the main driving wheel, 94 teeth. This main gear wheel is of the split type and is rigidly secured to the cage trunnion housing. The overall reduction between the speed of the motor and the speed of the cage is approximately 64 : 1. With a speed of motor of 1,500 r.p.m. an average rubbing speed of clothing of 238 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

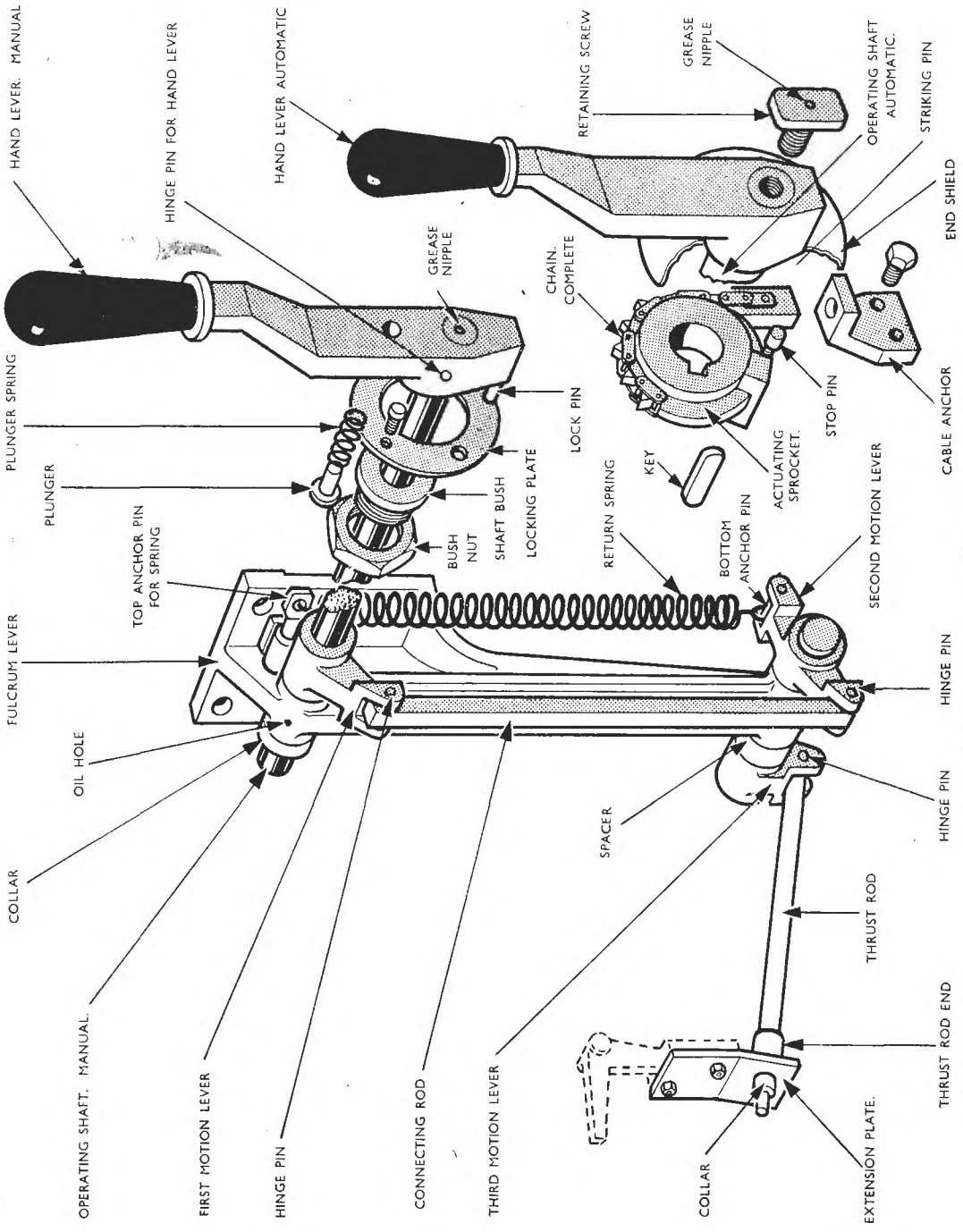


Fig. 19.—Outlet valve operating mechanism.

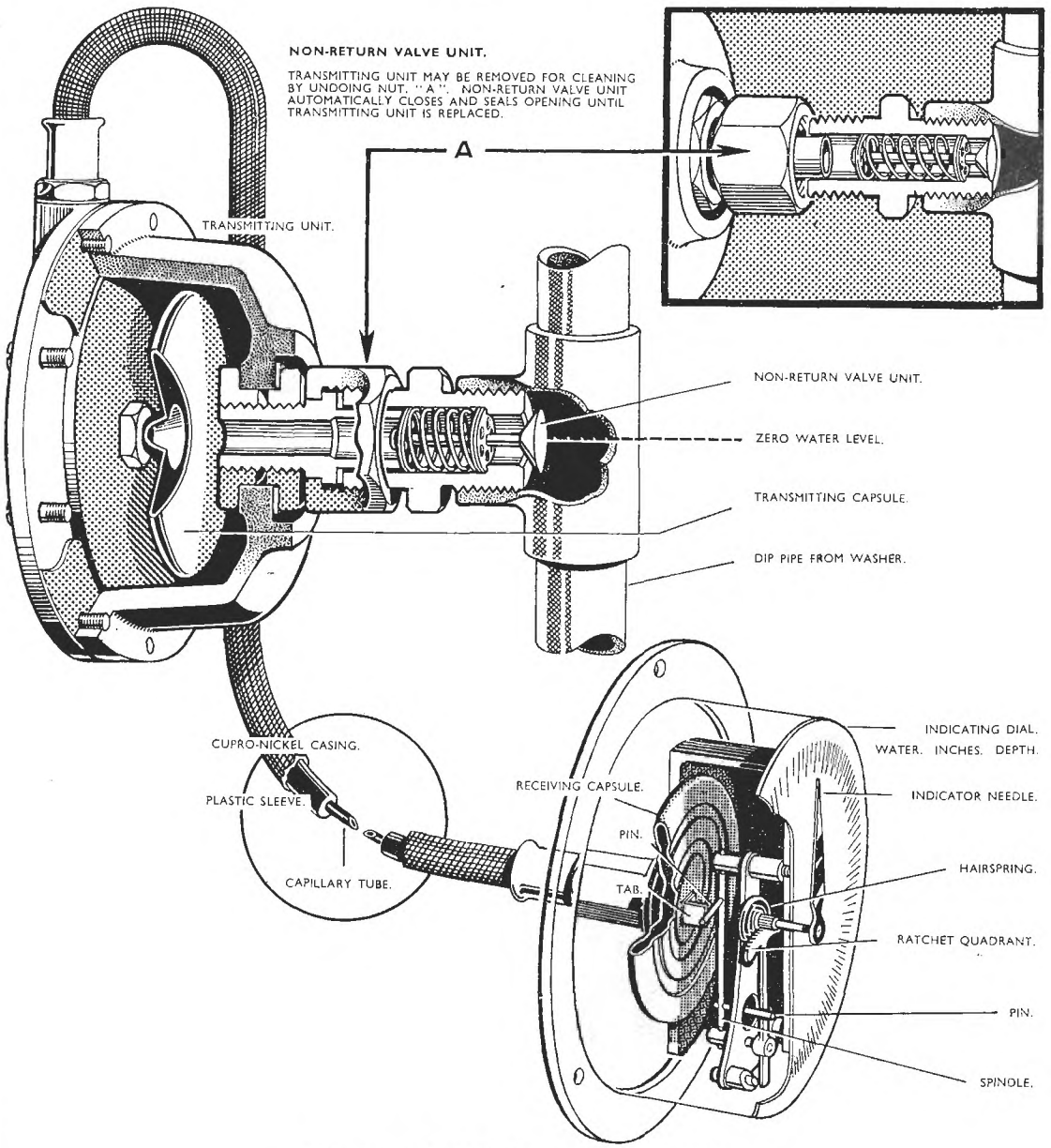


Fig. 20.—K.G.D. hydrostatic depth gauge.

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.

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 Croft type No. 3A

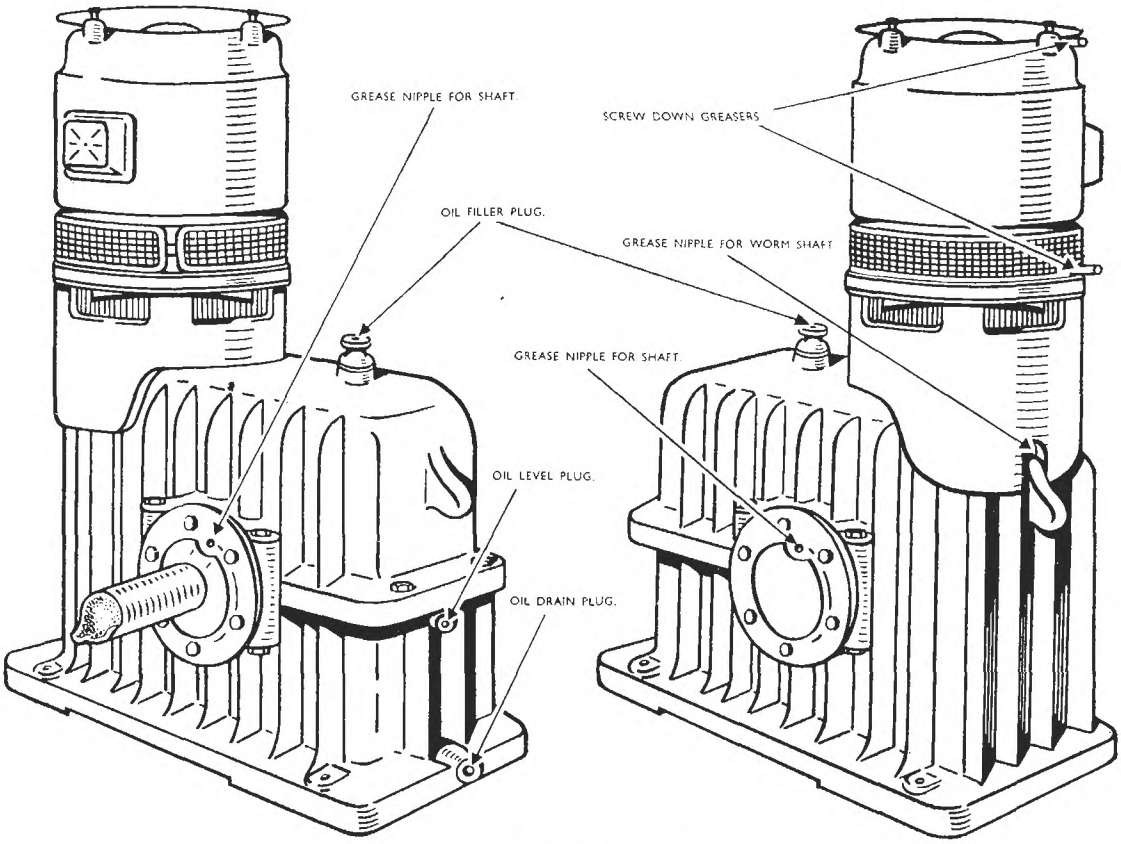


Fig. 21.—Gear box lubricating diagram.

giving a 1:1 or a 2:1 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 rubbing speed of the machine by 50 per cent., namely to 119 ft. per minute when the machine is engaged in washing woollen 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 woollens with single speed machines is unnecessary. When washing woollens therefore in a machine fitted with this type of drive, the reduced speed permits the normal timing 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 woollens is effected by a gear change lever operated from the front of the machine.

17. General Maintenance

TRUNNION 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 gearbox should be drained and re-filled with new oil to the correct level. Thereafter the gearbox 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 screwdown type greasing connections are provided for the motor bearings (Fig. 21). These should be turned occasionally and replenished at three-monthly intervals.

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

INJECTOR.—Should normally require very little maintenance but should be inspected at three-monthly intervals to ascertain the condition of the steam valve discs.

DIP CHAMBER.—Should be inspected at three monthly intervals and all silt removed. Clearing plugs are also provided in the connecting pipe work for similar removal of silt and lint accumulations.

DOOR.—The seal between the door frame and the door is effected by a length of ½ 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.

18. Replacement 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.

TRUNNION BEARING

To remove the trunnion bearing (Fig. 22), first remove the gear guards thus exposing the spur wheel. Place hardwood wedges between the bottom of the spur wheel and the bearing bridge. These wedges should not be driven in with unnecessary force but should be only tight enough to prevent the trunnion housing from dropping when the trunnion and bearing is removed. Under no circumstances should an attempt be made to remove the trunnion 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 eased on the trunnion housing by lightly driving a steel wedge into the split hub.

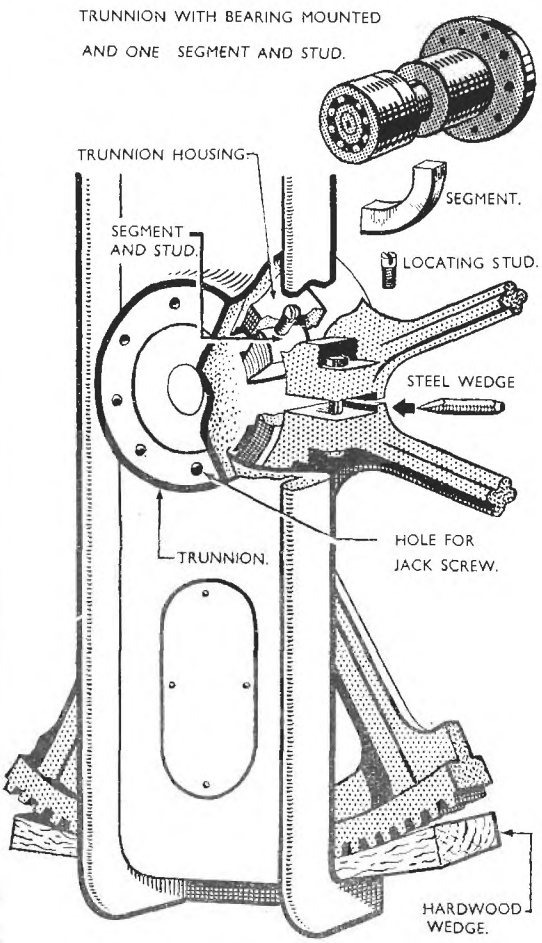


Fig. 22.—Trunnion and bearing assembly.

The trunnion bearing is located by three internal segments which in turn are maintained in position by three slotted studs (grub screws) which pass through the trunnion 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 trunnion to the bracket should then be removed and set bolts inserted in the holes provided for this purpose to "start" the trunnion from the bracket face. When the trunnion is completely withdrawn from the housing, the roller bearing should be removed in the normal manner for examination.

Important.—The locating segment studs must be removed before attempting to withdraw the trunnion, as bursting of the trunnion flange will otherwise occur.

To replace the trunnion, reverse the procedure.

After running for a few hours, the nuts on the spur wheel should be tested and further tightened if necessary.

FRONT BEARING (*Fig.* 23)

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

(*b*) *To remove.*—First remove the rectangular cover plate on the front end frame in order to gain access to two in number hexagon head brass plugs fitted on the bottom rim of the outer drum. The two brass plugs should be removed and replaced by hexagonally headed steel set screws (½-in. Whitworth, 3 in. long). Screw up gently on the set screws until they are just 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 trunnion assembly will result.

(*c*) *To remove outer track.*—The outer track is attached to the front end plate. The front angle

beading (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.

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

Note.—The brass filling plugs for the jacking screw holes must be re-inserted when the steel jacking screws are removed.

(*e*) If wear is detected on the bearing face of the outer rack (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.

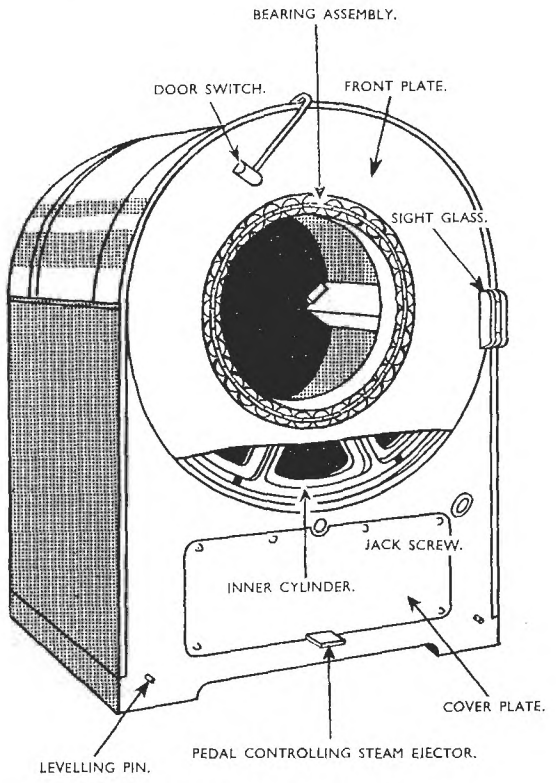


Fig. 23.—Front bearing assembly.

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 trunnion 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 studs. Remove the two cheese-headed screws thus allowing the seal to be disconnected in two halves.

To replace, reverse the procedure.

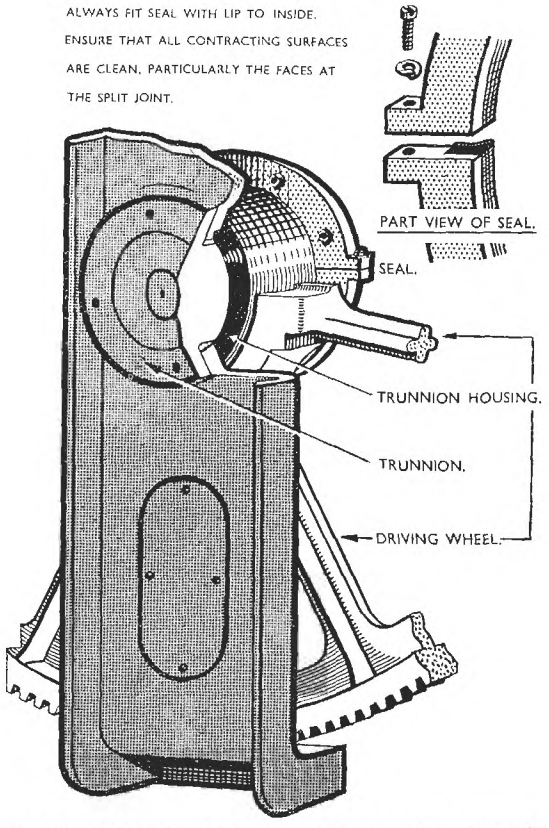


Fig. 24.—Arrangement of seal on the trunnion housing.

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-operation the Admiralty has developed a dual-purpose 40 lb. capacity end-opening type machine for

(*a*) Steam heating of water at sea
(*b*) Electric heating of water in harbour.

The machines are similar to the end-opening type washing machine previously described. The main drive, method of reversing and provision for woollen washing by the electrical interruption of the timing cycle is as detailed in paragraph 19(*a*).(*b*).

Steam heating of the water is arranged in the normal way by means of a boiling nozzle. Electric

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 underside of the outer cage of the machine. A magnetic type float 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 contacts 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.

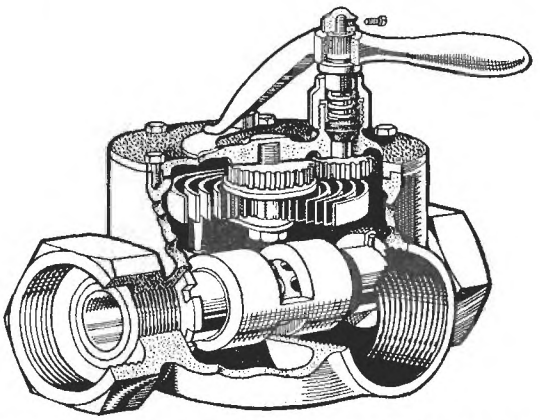


Fig. 25.—Sectional arrangement of thermostatic steam and water mixing valve.

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. loading and capable of an output of 50 galls. per hour at 160° 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 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. thermostatic steam and water mixer. The T.S.50 is used in small vessels equipped with domestic washing machines and the T.S.200 in major vessels in

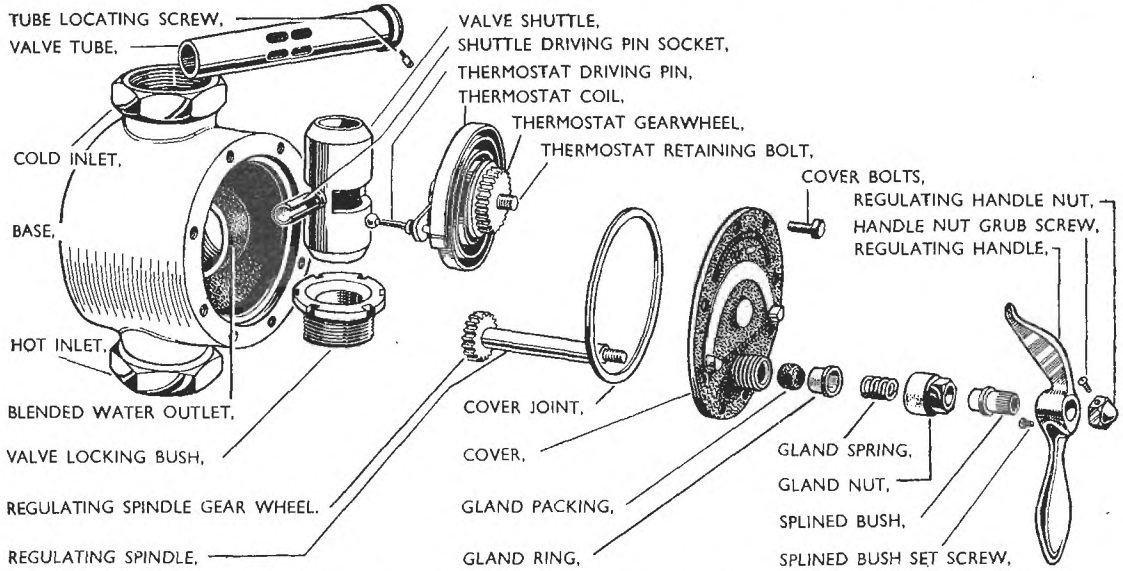


Fig. 26.—Exploded view of thermostatic steam and water mixing valve.

association with the " fresh and salt water washing equipment " fitted to washing machines of 12½ 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 180°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 winds or unwinds according to the temperature of the water in the mixing chamber and in so doing, 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 factors. Should the valve shuttle become sealed 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 180° F. or lower as required) cannot be obtained with the regulating handle against the HOT stop, proceed as follows:—

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

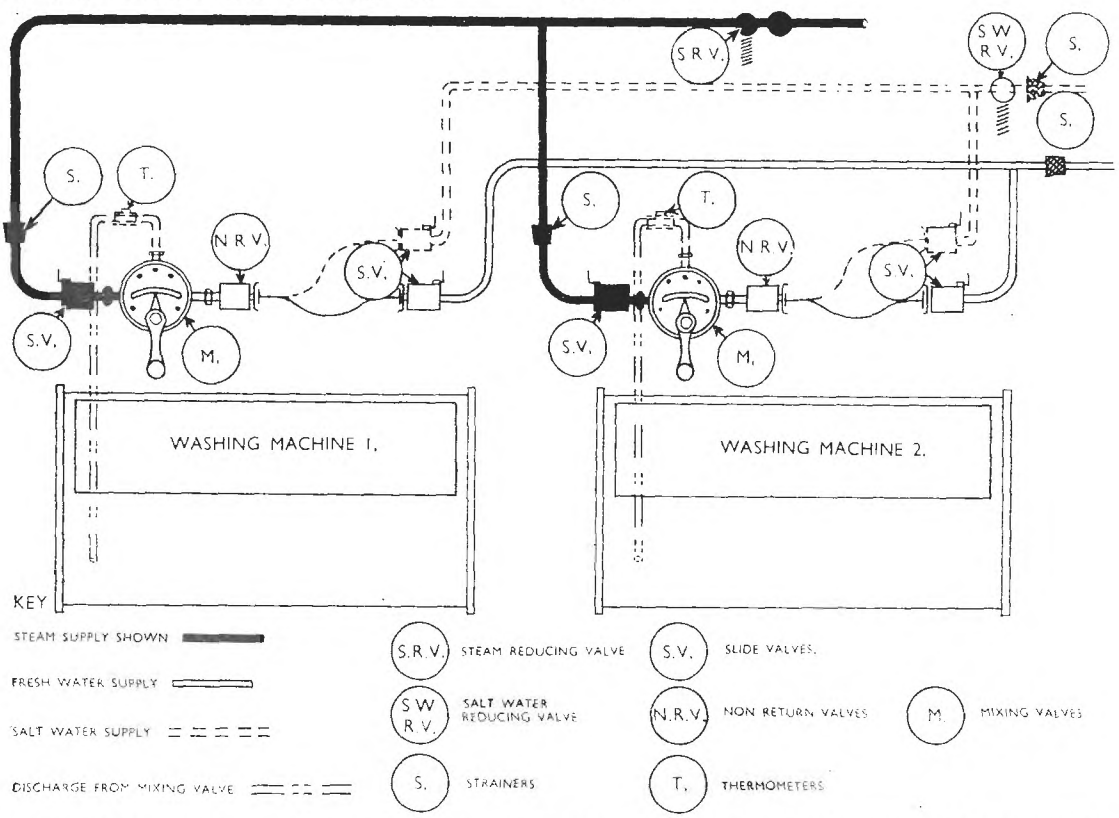


Fig. 27.—Piping arrangement of steam and water mixing valve with fresh and salt water washing connections.

The mixer will then deliver the required maximum setting of blended water.

26. Operation (*in connection 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) Opening the slide valve on the steam supply to the mixer.

(4) Adjust to the required temperature by means of the regulating handle on the mixer. The temperature reading can be obtained from the thermometer on the outlet pipe.

(*b*) 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.

(5) Open the steam supply valve.

(6) Adjust to the required temperature by means of the regulating handle on the mixer.

Note.—The details contained in this para. are for possible future information only as it is not intended to introduce sea water washing formulae in the immediate future—see also Chapter IV, para. 6 (*b*) (iii).

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.

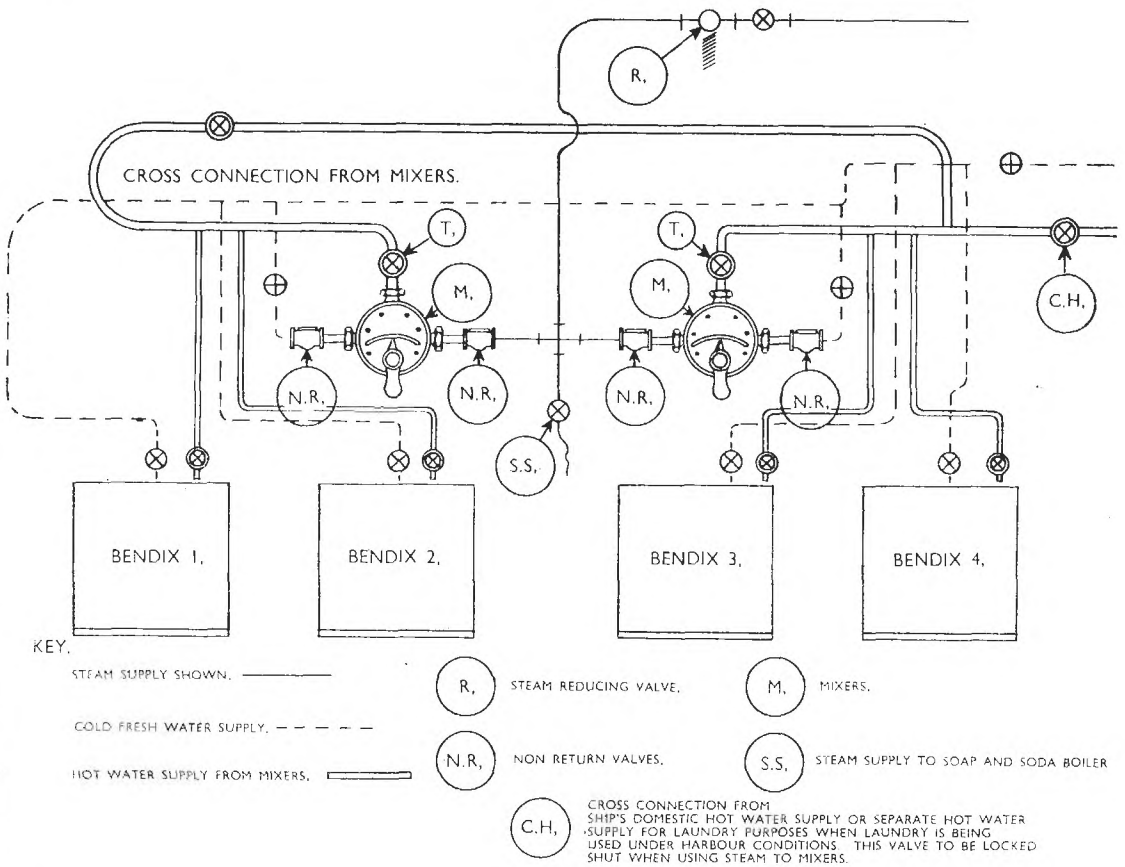


Fig. 28.—Piping arrangement for 2 in No. mixing valves working with Bendix domestic washing machines.

CHAPTER IV

Materials
In General Use in R.N. Laundries

1. In order to obtain good results it is important that the operator be familiar with the materials used in the washing process and the reasons for their use. The principal materials used are:

(*a*) Water:
  (i) Soft and hard fresh water.
  (ii) Sea water.
(*b*) Soaps and detergents.
(*c*) Alkalis.
(*d*) Acids.
(*e*) Bleach.

WATER

2. Fresh water can be described as either soft or hard, depending upon its freedom or otherwise from substances held in solution.

3. Soft water

A good example of soft fresh water is rain water. As the rain soaks into the earth, however, it absorbs and holds in solution numerous substances which vary with the geological structure in different parts of the country—limestone, chalk, etc. The amount of the substances held in solution, determines the degree of hardness of the water.

4. Hard water

Water hardness is of two kinds, temporary and permanent, both kinds usually being present in any given sample. The types of hardness depend upon the nature of the substances held in solution.

(*a*) TEMPORARY HARDNESS is usually due to the presence of calcium bicarbonate, *i.e.*, calcium carbonate (chalk) combined with carbonic acid and thus held in solution. This type of hardness can be removed by boiling; the heat decomposes the carbonic acid, the carbon dioxide gas is expelled and the calcium carbonate precipitated as a white chalk sludge. Temporary hardness can also be removed very efficiently by the use of lime. (The Lime Process.)

(*b*) PERMANENT HARDNESS is due to the presence of calcium or magnesium compounds other than the bicarbonate, such as calcium sulphate or chloride. These substances do not respond either to boiling or treatment with lime, but require sodium carbonate for their removal. (The " Soda " Process).

5. Water softening

Hard waters cause considerable waste of soap and also rinse badly. Hardness in water is remedied commercially by means of water-softening plants using either the " Lime-Soda " or the Base Exchange " Zeolite " methods.

When required for laundry purposes, water having a hardness index greater than 6° should be softened if possible. It is therefore necessary to be able to measure readily the hardness of water in the first instant, and the apparatus for doing so is the " Water Hardness Testing Equipment Pattern 2542."

6. Water supplies

(*a*) SHORE ESTABLISHMENTS are supplied from local sources and if required for laundry purposes, hard water must be softened by one of the above methods.

(*b*) H.M. SHIPS. The water supply for laundry purposes may be from:

(i) *The ship's distilling plant.* Distilled water should be of zero hardness, and is ideal for laundry purposes.

(ii) *Shore fresh water.* This will normally be untreated and of the hardness of the local supply. As ships have no water-softening plant, allowance must be made in the washing processs if the water is hard by the use of increased amount of detergent and alkali.

(iii) *Sea water.* With a view to effecting the conservation of fresh water, trials were conducted over a period of 12 months using a sea-water washing process, but, following a detailed analysis of the results achieved, the process was not recommended for general use. Reasons against the use of sea water include:

Unsuitability for use in harbour, due to the risk of contamination.

The high potential risk of corrosion in washing machines.

SOAPS

7. With a few exceptions the soaps used for laundry purposes are manufactured from fatty acids and soda. The fatty acids provide the detergent properties of the soap, and according to the fatty acid used, some soaps produce a greater lathering effect and some are more soluble in water than others.

The " titre " of a fatty acid is its solidifying point and, when related to soaps, it gives the temperature above which the fatty acid content is liquid. The titre value therefore gives a useful indication of the suitability of the soap for a particular process.

As a general rule low titre soaps are oil soaps; true oil soaps have a titre value of less than 25°C. (77°F.). These wash well at low temperatures and rinse easily and are therefore most suitable for use with silks, woollens and other delicate fabrics.

For a normal white work requiring high temperature washing, high titre soaps are more efficient. High titre soaps 30°C. (86°F.) to 35°C. (95°F.) are usually hard soaps; they wash well at high temperatures but require hot water for easy rinsing.

The high titre soaps are suitable for washing through a wide range of temperature and are therefore of greater general value under normal conditions than low titre soap. High titre soap, usually in hard bar form, is in general use at present in H.M. ships; and a partial substitute known as " Teepol " or a Detergent Solution Patt. 862, which is a by-product of petroleum, is also used when making up the stock solution.

8. Action of soaps

The soap solution added to the machine gives the mixture a much greater power of penetration, and the particles of dirt in the fabric are thus more readily loosened and held in suspension.

9. Stock solutions

Soap should be added to the washing machine in liquid form. The necessary stock solution can be prepared in the steam-heated soap and soda boiler, usually of either 25 or 50 gallons capacity, provided for this purpose. A typical stock solution tank (soap and soda boiler) is illustrated in Fig. 29.

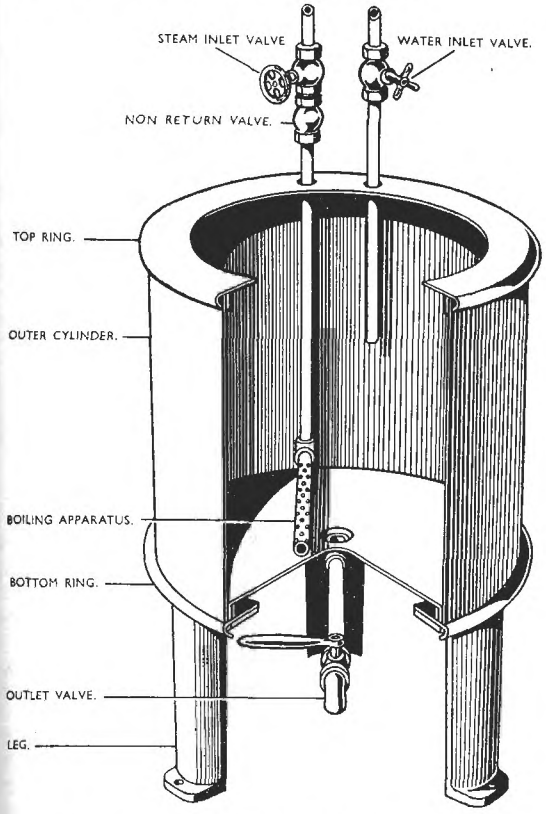


Fig. 29.—Arrangement of soap and soda boiler.

10. Preparation of stock solutions

(*a*) Bar soap and Teepol

Material required:

30 lb. of bar soap.

10 lb. of " Teepol " (this is in liquid form and 1 gallon weighs 12 lb.).

Method:

(1) Half fill the soap tank with water.
(2) Add the soap, cut into small pieces.
(3) Turn on the steam and heat the water until all the soap is dissolved.
(4) Turn off the steam.
(5) Add the " Teepol."
(6) Fill the tank to the 40-gallon level.
(7) Mix thoroughly.

(*b*) Detergent solution patt. 862

It is probable that in future, supplies of detergent solution will not be restricted to the proprietary brand known as Teepol. Detergent solutions will be purchased in bulk to a general specification T.S. 195B and may be Teepol or any other equivalent product. The Admiralty Patt. No. 862 is, however, being retained for this classification.

(*c*) Strength of stock solutions

(*a*) The strength of the stock solution can be varied to suit individual requirements, but should always be of a known value. The solutions described have a strength of 1 lb. soap in 1 gallon of water, and are suitable for all general work. Smaller quantities of the solution can be made by using proportionately smaller weights of detergents.

(*b*) Soap may be supplied in powder, flake or bar form. In whatever form it is supplied, a percentage of water exists, thus leaving something less than 100 per cent. of pure soap. As a rough guide, the soap content of average commercial soaps is as follows:—

A very dry powder	..	95 per cent. soap.
An average flake soap	..	90 per cent. soap.
Good quality bar	..	75 per cent. soap.
A moist bar ..	..	70 per cent. soap.

ALKALIS

11. Alkalis increase the detergent power of the soap and protect it against the acid conditions arising from the materials being washed. The soiling in clothes is usually acid in nature, and because soap will not emulsify even in slightly acid conditions, it is necessary to introduce an alkali to neutralise the acid and, in fact, to render the washing water slightly alkaline.

Alkalis neutralize acids, and the alkalinity of a solution is tested by its effect on certain indicators such as litmus or methyl orange. If red litmus turns blue the solution is alkaline. An alkaline solution has a characteristic soapiness to the touch.

12. Measurement of alkali strength

The mixture of an alkali and an acid solution in the correct proportions results in the formation of a " neutral," which has neither acid nor alkaline properties. Such a compound is called a salt.

The alkalinity or acidity of any solution can be estimated and is known as its *p*H value.

Neutral solutions have a *p*H value of 7.

Acid solutions have a *p*H value less than 7.

Alkaline solutions have a *p*H value more than 7, the maximum being 14.

The extent by which the *p*H value of a solution exceeds 7 gives an indication of its alkaline strength.

The following list shows the approximate values of the most common alkalis when dissolved in water to give a concentration of the same order as that usually attained in laundry wash liquors.

	pH value
Sodium hydroxide (caustic soda) ..	12·7
Sodium carbonate (soda ash) ..	11·10
Tetra sodium pyrophosphate ..	10·2
Borax	9·15
Sodium bicarbonate	8·4

Alkalis most generally used commercially give solutions which have *p*H values between 8·0-11·5. Alkalis which give solutions of over 11·5 are considered too strong to be used with safety in normal washing processes and their use is only justified in the case of heavily soiled materials such as greasy overalls, etc.

13. Alkalis used in H.M. ships

The alkali now generally used is soda ash. This should be added to the machine from a stock solution made up in the strength of 1 lb. of soda ash per 1 gallon of water.

Where stock tanks are not available, the stock solution should be prepared in buckets and quantities added as specified in the washing formulae.

ACIDS

14. Acids are substances which have for the most part reverse properties to those of alkali turning, for example, blue litmus red. Widespread use is made of acids in the commercial laundry industry for various " spotting " and stain removal processes, for brightening colours and for the removal of lime soap deposits from fabrics and washing machines, etc. Infinite care must be exercised at all stages when using acids in any form because of their corrosive effect on fabric and metal. The use of acids in H.M. ships' laundries is at present confined to two main requirements; the internal cleaning of washing machines and the removal of rust stains from white uniform, but an increased application will be introduced in due course.

15. Glacial acetic acid

Its primary use is for removing the lime soap deposits from the internal surfaces of the washing machine (see Chapter 3, para. 6). It is purchased as a concentrate in liquid form and should be diluted with distilled water in the proportions of 3 of water to 1 of acid before use.

16. Oxalic acid

Used for removing rust stains from white uniforms and other white cotton goods, oxalic acid is purchased in crystal form and should be diluted to a 1 per cent. solution before use. A suitable solution can be prepared by dissolving ½ oz. of oxalic acid crystals in 2½ pints of distilled water.

PROCEDURE FOR USING OXALIC ACID

Prepare a 1 per cent. solution in a non-metallic container and raise the temperature of the solution to 100° F. Immerse the rust-stained garment in the solution for a period of 10 to 15 minutes. Remove the garment and thoroughly rinse it.

Notes.—The temperature of 100° F. must not be exceeded—any higher temperature will cause weakening of the fibre resulting in eventual rupture.

Before treating articles, all metal buckles and buttons must be removed.

Oxalic acid must not be used on woollen or silk articles.

BLEACH AND BLEACHING

17. The normal methods of washing, using soap and alkalis only, are effective in removing the ordinary soiling matters. It is frequently found, however, that, as a result of the conditions to which fabrics have been exposed during use, they become discoloured or stained by substances which cannot be removed by the normal washing process alone. It is then necessary to employ bleaching agents which, by their oxidizing or reducing action, remove the staining substances. Furthermore, white goods which have been in use for some time, and which have been subjected to repeated washing operations, tend to develop a faint yellow tint. This slight discolouration should also be removed by bleaching treatment.

18. Sodium hypochlorite bleaches (*chlorine bleaches*)

The sodium hypochlorite breaks down chemically into sodium chloride (common salt) and nascent oxygen. The nascent oxygen, which is unstable, combines with the colouring matter forming colourless oxides. Hence the article is bleached.

Sodium hypochlorite is a liquid, and is not carried in H.M. ships because of the difficulties of storing liquid bleaches. If stored in metal containers the bleach decomposes and corrision of the containers takes place.

19. Bleaching powder (*chloride of lime*)

As liquid bleach cannot readily be carried in bulk, arrangements are made for the manufacture of liquid bleach from bleaching powder (chloride of lime). The powder contains about 35 per cent. of available chlorine and can be easily stored.

Bleaching powder is a hypochlorite bleach, but because of its lime content it should not be used in conjunction with soap, and therefore must not be added to the machine direct. Sodium hypochlorite bleach liquor can be prepared from the powder by the addition of a suitable alkali (soda ash); the lime content of the powder becomes precipitated in the form of chalk.

20. Preparation of stock solution

Because of its loss of strength if stored for any length of time and the difficulty in storing it, stock solutions of bleach should be made as required.

(1) Cream 1 lb. of fresh bleaching powder with 1 gallon of cold fresh water.

(2) Completely dissolve 1 lb. of soda ash in 1 gallon of cold water and add this to the bleach powder solution previously mixed.

(3) Make up to 8 gallons, *i.e.*, add a further 6 gallons, with cold water and stir well.

(4) Allow the precipitated chalk to settle, then decant or filter the clear resultant bleach liquid into a non-metallic container.

21. Quantity

(*a*) The above stock solution contains about 40 grains of available chlorine per pint. The permissible concentration of bleach added to the machine must never exceed 5 grains per gallon of wash liquor.

Bleach is normally added during the second wash. Table 7 gives details of the volumetric capacity of various types and sizes of machine corresponding to the dip in inches.

Assume a 30 cu. ft. machine and that bleach is to be added at a 3-in. dip.

Volume of water corresponding to a 3-in. dip = 58 gallons.

Total amount of bleach required = $58 \times 5 = 290$ grains.

Number of pints of bleach stock solution to be added assuming a concentration of 40 grains per pint = $\frac{290}{40} = 7\frac{1}{4}$ pints.

(*b*) The correct quantities of bleach can also be calculated by allowing 3 grains of available chlorine per 1 lb. of work provided the machines are loaded at the rate of $3\frac{1}{2}$ lb. per cu. ft. and the bleach is added to the wash (temperature 140° F.).

22. Method

The following rules must be strictly adhered to when using bleach in order to avoid damage to the fabrics being washed:

(*a*) Never bleach at a temperature higher than 140° F.

(*b*) Never use a bleach of unknown strength.

(*c*) Never add strong bleach direct to the machine.

(*d*) Always measure out bleach; quantities should not be guessed.

(*e*) Always pour bleach into the machine slowly with the cage revolving downwards.

(*f*) The quantity of bleach added to a machine must never exceed 5 grains per gallon of wash liquor, *i.e.*, 1 pint of stock solution to 8 gallons of wash liquor.

(*g*) Bleach liquor should be used only for bleached cotton or linen goods and then subject only to these having been stained, *e.g.*, tablecloths stained with tea, coffee, etc.

(*h*) Indiscriminate use of bleach liquor rapidly damages and rots the fabrics and bleach MUST NOT be used when washing dyed articles or articles containing wool.

23. When to use bleach

The production of good quality white work by means of the normal washing processes and without the use of bleach should always be aimed at. *Bleach should be used as the exception and not as the rule in the washing process.* Rigid control of the bleaching agent at all times is important, as incorrect use or the use of too strong a concentration may cause irreparable damage to the fabric. The wash is the safest stage at which to do the bleaching, as excess bleaching agent may possibly then be removed during subsequent washing and rinsing processes. For this reason revised Admiralty washing formulae direct that the bleach be added at the first wash.

STARCHES AND STARCHING

24. White suits, shirts, collars and table-linen are starched before pressing. The process enables a high standard of finish to be imparted and the slight stiffening of the fabric assists in maintaining the correct shape of the garments for a longer period. Loose dirt cannot adhere so easily to the polished surface produced by starching, hence work so processed keeps clean for a longer period.

25. Types of starch

Starch is present in practically all plant life, but is especially abundant in cereals (rice, wheat, corn etc.) Wheat and rice starches, because of their fine grain, penetrate fabric more thoroughly and promote a smooth flexible finish, but the coarser corn starches tend to produce a stiff brittle finish. Corn and wheat can be combined with other ingredients, *e.g.*, talcum and borax, to produce a general purpose starch which combines the flexibility of the wheat with the stiffness of the corn starches. A combination starch known as National Blended Starch (N.B.S.) having a rice base has been extensively used in H.M. ships and establishments. (*see* para. 28). N.B.S. can be used cooked or raw, and is classified as a semi-thick boiling starch.

26. Density

To obtain a constant standard in starch work it is essential that the stock solution be made up to a predetermined density. A Twaddell hydrometer, graduated from 0 to 12 and designed to indicate the correct density at a temperature of 60° F., is used for this purpose. The starch should be made up to give a Twaddell reading of 5 to 7.

27. Method of application

There are three main operations, each requiring a separate process, namely:

(*a*) STARCHING OF WHITE SHIRTS, TABLE-LINEN, BED-LINEN

Starching is done during the washing process as follows:

(1) Cream 1 lb. N.B.S. in 2 gall. water

(2) Reduce the dip in the washing machine after the last rinse to 3-in.

(3) Add creamed starch as mixed and allow to run for 10 minutes.

(*b*) COLLAR STARCHING

This is normally undertaken in the machine provided for the purpose (see Chapter IX).

(*c*) STARCHING OF DRESS-SHIRT CUFFS AND FRONTS; STIFF CUFFS ON HOSPITAL UNIFORMS.

28. Starch stock solutions

(*a*) COLLARS

A 15 gallon capacity steam heated starch cooker is provided in large ships to facilitate the preparation of the starch stock solution.

(1) Cream 1 lb. of N.B.S.

(2) Dilute to 2 gallons.

(3) Bring slowly to the boil and maintain at the boil for 15 minutes.

(4) Allow to cool to 120°F.

(5) Thoroughly stir in 5 lb. of N.B.S. previously creamed in cold water.

(6) Prepare 3 oz. of wax with about 1½ oz. of white soap, ⅓ pint of glycerine, and a small measure of blue.

(7) Pour this mixture into a bucket with about 2 gallons of water and slowly boil until the mixture has completely emulsified.

(8) Add the mixture to the stock solution.

(9) Add cold water until a Twaddell reading of 5-7 is obtained.

(10) Allow the solution to stand for not less than 72 hours. (Very important).

(11) Before using starch solution, stir well, strain through muslin, and check density.

N.B.—Distilled water of zero hardness should be used wherever possible. The general finish and appearance of starched collars can be varied by the addition of borax, wax, glycerine and Teepol to the basic rice or National Blended Starch.

(i) *Borax.*—Introduction of borax into the starch stock solution allows a higher finishing temperature to be used and collars so processed are less affected by atmospheric conditions. Collars with a pure starch film are apt to become limp particularly in a humid atmosphere and the addition of borax reduces this tendency.

The amount of borax added should not exceed 1 to 2 oz. per 1 lb. of starch. If larger amounts are used, excessive brittleness results thus rendering the material fibres more liable to damage.

(ii) *Wax.*—Is added to the stock solution to give the articles a high glossy finish.

Several types of wax can be used for this purpose but Japan wax is the most suitable. This wax is readily soluble in water and can therefore be completely removed from the soiled article during the washing process.

If the wax available does not emulsify easily, a small quantity of white soap (1 oz. of soap to 2 oz. of wax) should be added to the stock solution.

(iii) *Glycerine.*—When wax is used in the starch solution glycerine may also be added. The glycerine assists the wax by enabling a smoother finish to be imparted and in addition promotes flexibility.

Glycerine should be added in the proportion of ⅓ pint of glycerine to 8 gall. of stock solution.

(iv) *Teepol.*—Is used in the stock solution to assist in obtaining the maximum penetration of the starch into the material.

The quantity used should not exceed ¼ pint per 8 gallons of total stock solution. Teepol is not essential; any detergent solution pattn. 862 may be used.

(*b*) DRESS SHIRT CUFFS AND FRONTS

As for collars, except that borax should be omitted and the glycerine content slightly increased to give flexibility without cracking.

29. Cold Starch method

Proprietary brands of high-grade starch which enable a stock starch solution to be prepared direct by the addition of warm and cold water only are now available. The additional initial cost is more than offset by the simplicity of preparation as compared with the methods detailed in the previous paragraphs. The need for the separate addition of wax, borax, glycerine etc. is completely eliminated as all the ingredients necessary to produce high quality starched work, *i.e.*, stiff collars and dress shirt fronts and cuffs, are incorporated in the starch manufacture. The need for boiling, settling and straining the stock solution is also dispensed with.

A satisfactory stock solution using high-grade starch can be prepared for collar and dress shirt work as follows:

Cream 3 lbs. of starch in about ¼ of a bucket of warm water.

Add cold water until a Twaddell reading of 6 to 7 is obtained.

This solution can be used in the starching machine direct for collar work and in a suitable bowl for the starching of dress shirt fronts and cuffs.

Smaller quantities can be prepared as required, the only important factor being that the resultant stock solution should have a Twaddell reading of 6 to 7.

CHAPTER V

The Washing Process

1. Principles

The prime object of the washing process is to remove all soiling matter from the material being washed and in so doing to sterilize the garment The process should be so designed as not to damage the fabric, and should be as economical as possible in the use of detergents. These requirements are met by:

(*a*) Removing the soiling matter in stages comprising a preliminary breakdown followed by a series of washes and rinses. The breakdown subjects the load to a thorough initial wetting; the loose surface dirt is also removed at this stage before the actual washing processes are begun. In view of the need to conserve fresh water, the breakdown is omitted from the revised washing formulae used in H.M. ships.

(*b*) Mechanically controlling the rubbing action on the clothing throughout the whole process by varying the " dip," or depth of water in the machine.

As the cage of the washing-machine revolves, the internal lifters constantly lift the clothes and drop them back into the water, producing agitation or mechanical rubbing of the fabrics. This action helps to loosen the dirt, but also subjects the clothing to wear and tear. With a low dip the clothes are subjected to a high lift and consequently more rubbing takes place. Low dips are only used therefore in the early stages of the wash to remove the initial heavy soiling. High dips are used in the rinsing stages.

(*c*) Varying the proportions of the soap and alkali content of the detergent throughout the process and adjusting the temperature of the water as necessary at each stage to obtain the best results from the detergent.

Soap is a good suspender, *i.e.*, as a washing medium it possesses the property, particularly at low temperatures, of holding in suspension the dirt removed froma fabric. Soap does not by itself, however, readily remove the more resistant dirt from a fabric.

Alkali possesses opposite properties, *i.e.*, it readily removes the dirt from a fabric, particularly at high temperatures, but it does not hold it in suspension so well.

In the early stages of the wash the dirt is comparatively easy to remove, and the washing liquor employed should therefore contain a high soap content to enable the dirt to be held in suspension without redeposition on the fabric.

As the wash progresses the more resistant soiling matter has to be dealt with, and the washing liquid should contain a higher alkali content.

2. Washing coloured goods

The washing of coloured cotton and linen goods introduces a new factor, namely, the possible effect of the wash liquor on the colouring matter. It is necessary, therefore, to control the process employed to prevent either fading or bleeding of the colours.

Coloured goods are as a whole satisfactory in respect of " fastness " under normal washing conditions. The greatest care must be exercised at all times, however, to take into account the possibly fugitive nature of some dyes which may be slightly soluble in the wash liquor, or even in water.

As far as possible the goods should be carefully sorted into classes, according to their quality. If any doubt exists regarding the fastness of dyes, a washing process to prevent or reduce the running of the colours should be used. The tendency of a dye to run can be reduced, considerably, and in some cases prevented altogether, by simply adding common salt to the wash liquor (about 2 oz. per load).

All coloured articles should classified into light and dark groups. Whenever possible, blues and greys should be washed separately from reds, pinks, tans, etc.

Good temperature control is always essential.

Colours in shirts are generally fast, but printed shirts should be treated with caution. The collars of coloured shirts should *always* be washed with the shirt. Where necessary, starch should be removed from such collars before washing. In cases where cuffs and neckbands are heavily soiled, hand washing pre-treatment in the form of hard rubbing, or light scrubbing with a soapy solution, may be necessary.

3. Washing Woollens

When viewed under a microscope, raw wool appears as a fine hair with saw-like edges, which are in fact a series of minute overlapping scales. Wool possesses the property of elasticity, is a relatively poor conductor of heat, and is more easily damaged by heat than is cotton. It tends to yellow in contact with alkali but is more resistant than cotton to acid conditions.

The difficulties experienced in washing woollens are attributable to these characteristics, and necessitate a special washing process designed to preserve the structure of the fabric in its original form.

Coloured woollen articles can be processed in accordance with the general washing formula for this classification. The arrangements made in the normal woollen-washing process to control friction, temperature, alkalinity, and dips to minimise felting, automatically reduce the risk of alteration in colour. It is good practice, however, to classify and wash coloured woollens separately from white woollens.

(*a*) YELLOWING.—When immersed in an alkali solution, wool becomes yellow and the alkali absorbed cannot be readily rinsed out, as it penetrates the fibre. When subsequently heated during the drying process, the yellowing becomes intensified.

(*b*) FELTING.—Wool possesses the property of elasticity, *i.e.*, when stretched it returns to its original shape. If strongly alkaline detergents are used, softening and swelling of the fibres takes place, and this

damage is intensified at higher washing temperatures. The individual scales become matted together and lose their resiliency. The garment when dry loses the soft feel associated with wool and becomes hard. This hardening process is known as " felting." Each fibre becomes reduced in area with consequent overall shrinkage of the garment.

(*c*) MANUFACTURING PROCESSES DESIGNED TO PREVENT SHRINKING.—Many woollen garments are given an unshrinkable finish during manufacture. In this process the fabric construction is " set " or stabilised by the complete removal or bedding down of the scales, with resultant reduction in the liability to felting arising during washing. If the garment is not set under the correct conditions, the stabilisation is purely temporary and shrinkage occurs during washing. Shrinkage of the fabric resulting from incorrect manufacturing conditions is an entirely separate consideration from shrinkage caused by felting, and cannot be prevented during any washing process.

4. Washing Requirements for Woollens

In order to produce soft articles of good colour, and to reduce the possibility of felting and shrinking to a minimum, it is necessary:

(*a*) To wash at low temperatures—The temperature should never exceed 100°F. at any stage during the washing or rinsing process.

(*b*) To avoid friction, by reducing mechanical agitation to a minimum—by automatic or manual interruption of the washing cycle.

(*c*) To counteract the natural tendency of wool to absorb alkali—while some authorities state that a mild alkali has no harmful effect particularly in the case of heavily soiled articles such as blankets no alkalis are used in the Admiralty washing formulae for woollens. In this connection it should be borne in mind that the soap stock solution is in itself mildly alkaline.

5. Silks and Rayons

Pieces composed of silk rayon, and mixtures of these two fibres, should be washed by hand. White pieces should be separated from the coloured ones. Natural light coloured silk and rayon articles should be further separated from those of dark colour and handled at different times, even though the washing formula used may be the same. This practice is necessary to avoid any possible bleeding into light colours or white pieces.

As there is always a likelihood of encountering fugitive shades or tints as well as colours of reasonable fastness to washing, every attempt should be made to control the washing temperature to a maximum of 120°F. If rayon or silk articles are laundered by hand, they should never be twisted or wrung. Rubbing of any sort should avoided and the washing done by a gentle squeezing action.

Mixtures of wool and rayon or silk should be handled as for woollens.

NOTE.—Bleach should never be used on silks and rayons.

6. Washing Processes

SIDE OPENING TYPE MACHINES

All formulae included are based on a standard 30 cu. ft., *i.e.*, 34 in. × 54 in.—100 lb. capacity washing machine of the side opening type.

For smaller capacity side opening type machines, *e.g.*, 50 lb., the quantities of stock solution should be reduced to one half the quantities specified in the formulae.

To obtain good results the machine should be loaded in accordance with the approved loading rate (a guide to appropriate loading is given in Table VIII):

(*a*) 3 ½ lbs. dryweight of clothing per cu. ft. cage capacity for cottons and linens.

(*b*) 2 ½ lb. dryweight of clothing per cu. ft. cage capacity for woollens.

(*c*) the approved washing formulae should be adhered to, and care exercised in the weighing of materials required for, and in the making up of, all stock solutions.

END OPENING MACHINES

(*a*) A number of ships are now fitted with 38 in. × 44 in. end opening type washing machines of cage capacity 28 ½ cu. ft. The loading rate for cottons and linens can be increased from 3 ½ to 4 lb./cu. ft., (114 lb. total) for this type of machine; and the formulae used as in the side opening machines. The quantities of stock solutions should, however, be increased by approximately one-seventh.

(*b*) 34 in. × 18 in. end opening type washing machines, loading capacity 40 lb. dryweight, have been introduced in certain A/S Frigates. Formulae as detailed should be used, but it may be found practicable to reduce dips for the process by 1 in. or 2 in., and so compensate for the reduction in output compared with the standard 50 lb. side opening type machine. The quantities of stock solution should of course be reduced to amounts directly proportional to those specified in the formulae for 100 lb. capacity machines.

WASHING FORMULAE

7. Formulae I to IV

The following formulae cover for the main classifications of work:

Important.—These formulae have been especially designed for use in H.M. ships, and are based on the minimum consumption of fresh water per washing cycle.

Formula I	White cotton and linen work, lightly soiled (L)
Formula I	White cotton and linen work heavily soiled (H)
Formula II	Coloured cottons and linens
Formula III	White woollens
Formula III	Coloured woollens
Formula IV	Engineers' overalls

NOTE.—For hard water conditions, which may be met during continued periods in harbour, or from ships tanks during the first few days at sea, the soda ash solution should be added in the washing cycle before the soap stock solution; *e.g.*, (*a*), interchange instructions (2) and (4).

FORMULA I

CLASSIFICATION

White work, cottons and linens comprising body linen, white shirts, collars, cooks gear, bath towels, sheets and pillow-slips, tropical rig, No. 10's Officers, No. 6's, Classes I and III etc., Table linen and napkins.

Nature of soiling—Light (L); Heavy (H).

(*a*) FIRST WASH

(1) Retain the last rinse water from the previous load to a standing dip of 8 in.
(2) Add soap stock solution 6–8 pints
(3) Load machine and start
(4) Add soda ash solution (L) 4 pints
(H) 8 pints
(5) Run for a total time of 10 minutes warming to 140°F.; discharge the wash liquor.

(*b*) SECOND WASH

(1) Add soap stock solution 1 pint
(2) Add water at 140°F. to give a running dip of 3 in.
(3) Add soda ash solution (L) 4 pints
(H) 8 pints
(4) Raise temperature to above 200°F. over a period of 7 to 8 minutes and maintain at this temperature for a further 7 to 8 minutes *i.e.*, 15 minutes in all. If necessary add soap stock solution to maintain lather. Discharge the wash liquor.

(*c*) FIRST RINSE

(1) Add water at 150°F. to a running dip 9 in.
(2) Run for a total time of 4 minutes; discharge

(*d*) SECOND RINSE

(1) Add water at 110°F. to a running dip of 14 in.
(2) Run for a total time of 4 mins.; discharge.

(*e*) THIRD RINSE

(1) Add cold water to a running dip of 14 in.
(2) After 4 minutes running unload the machine and retain water for the first wash process of the next load.

(*f*) NOTES

(i) Bleach may be added at the first wash stage but is only to be used if considered essential. The procedure regarding the limitations and conditions for bleach (*see* paras. 19–22) is to be rigidly adhered to.

(ii) Starching of No. 10's (Officers); No. 6's (Classes I and III) tropical rig and shirts: During the last rinse, decrease dip to 2 in.; cream 1 lb. of National Blended Starch, add to the machine and run the machine for 5 minutes.

For collars see special starching formula.

FORMULA II

CLASSIFICATION:

Coloured cottons and linens.

(*a*) FIRST WASH

(1) Retain the last rinse water from the previous load to a standing dip of 8 in.
(2) Add soap stock solution 4 to 6 pints
(3) Load the machine and start.
(4) Raise the temperature slowly to 120°F.
(5) Run for 10 minutes; discharge the wash liquor.

(*b*) SECOND WASH

(1) Add water at 120°F. to give a running dip of 4 in.
(2) Add soap stock solution to maintain a good lather 2 to 3 pints
(3) Raise temperature slowly to 140°F.
(4) Run for 10 minutes and discharge the wash liquor.

(*c*) FIRST RINSE

(1) Add water at 120°F. to a running dip of 9 in.
(2) Run for 4 minutes; discharge.

(*d*) SECOND RINSE

(1) Add water at 100°F. to a running dip of 14 in.
(2) Run for 4 minutes; discharge.

(*e*) THIRD RINSE

(1) Add cold water to a running dip of 14 in.
(2) Run for 4 minutes and unload.

(*f*) NOTES

(i) If "marking off" occurs a fourth rinse will be necessary.

(ii) Retain the water from the last rinse if a further load of coloured work is to be processed. If changing over to white work the whole of the water from the last rinse should be discharged.

(iii) The temperature must not exceed 140°F.

(iv) Soda ash (alkali) must not be used.

(v) Bleach must not be used.

(vi) Wash light colours first, ending with dark colours.

(vii) The tendency of a dye to run (bleeding) can be largely minimized by the addition of 2 oz. of common salt to the load at the commencement of the first wash.

FORMULA III

CLASSIFICATION:

Woollens. Loading rate 2 ½ lbs. per cu. ft. of cage capacity.

(*a*) INITIAL PROCEDURE

(1) Add water at 100°F. to a dip of 10 in.
(2) Add soap stock solution 6 to 8 pints
(3) Run the machine to build up a good lather.

(*b*) FIRST WASH

(1) Load the machine (loading rate 2 ½ lb. per cu. ft. of cage capacity).

(2) Process by running the machine for 1 minute then idling for 2 minutes.

(3) Repeat (2) a further three times then discharge the wash liquor.

(*c*) SECOND WASH

(1) Add water at 100°F. to a dip of 10 in.

(2) Add soap stock solution 6 to 8 pints

(3) Repeat action as at (*b*) (2) and (3).

(*d*) FIRST RINSE

(1) Add water at 100°F. to a dip of 12 in.

(2) Each rinse to be of 2 minutes duration the machine being run for ½ minute and stopped for 1 minute then run again for ½ minute and stopped before discharging the wash liquor.

(*e*) SECOND RINSE

Repeat as (*d*) above.

(*f*) THIRD RINSE

Repeat as (*d*) above, retaining the rinse water except if changing from coloured to white work.

(*g*) NOTES

(i) White woollens and coloured woollens should be washed separately.

(ii) Temperature must not exceed 100°F. for any stage of the washing cycle.

(iii) Mechanical agitation to be reduced to a minimum. This is normally catered for automatically by mechanical or electrical interruption of the cycle or by a slow-speed gearing. Where such facilities are not provided the machine must be stopped periodically by hand as described above.

FORMULA IV

CLASSIFICATION:

Engineers overalls: 100 lb. dryweight = approximately 50 overalls.

(*a*) FIRST WASH

(1) Retain the last rinse water from the previous load to a standing dip of 8 in.

(2) Add soda ash solution 5 gal.

(3) Raise temperature to 180°F. and run the machine for 15 minutes maintaining at 180°F. Discharge the wash liquor.

(*b*) SECOND WASH

(1) Add water at 180°F. to a running dip of 8 in.

(2) Add soap stock solution 1 gal.

(3) Add soda ash solution 5 gal.

(4) Run for 15 minutes maintaining temperature at 180°F. and adding soap stock solution to maintain lather.

(*c*) FIRST RINSE

(1) Add water at 180°F. to a running dip of 9 in.

(2) Run for 4 minutes; discharge.

(*d*) SECOND RINSE

(1) Add water at 140°F. to a running dip of 9 in.

(2) Run for 4 minutes; discharge.

(*e*) THIRD RINSE

(1) Add cold water to a running dip of 9 in.

(2) Run for 4 minutes and retain the wash liquor if a further load of overalls is to be processed.

(*f*) NOTES

(i) The addition of 2 oz. of common salt to the load at the beginning of the first wash, will largely minimize the tendency of the colours to run.

(ii) If necessary, soda ash should be added to the last rinse water, and the machine boiled out to remove possible internal contamination before commencing to process normal work.

8. Conservation of fresh water

The supply of fresh water available for all purposes in H.M. ships is limited and every possible precaution should be taken to avoid waste.

As an illustration, the following quantity of water is used in the complete cycle of operations for washing heavily soiled linen to Formula I in a typical 30 cu. ft. capacity washing machine loaded to 3 ½ lb. per cu. ft.

PROCESS	DIP	ACTUAL WATER ADDED TO THE MACHINE IN GALLS.
Wash 1	8 in. static (last rinse water retained)	
,, 2	3 in. running	32
Rinse 1	9 in. running	49
,, 2	14 in. running	63
,, 3	14 in. running	63
		207

In arriving at the above figures the undermentioned factors have been taken into account:

Water from the final rinse is retained for the first wash.

2 ½ lb. of water are retained in each 1 lb. of clothing, *i.e.*, 25 gall. in the case of a 100 lb. capacity machine, at each washing and rinsing process.

The figure for a commercial shore laundry operating on a recommended formula for similar work and using comparable washing materials is 350 to 375 gall. Adequate water supplies are normally available at shore laundries but the consumption figure is included as an indication of the extent to which attempts have been made and are still progressing to reduce fresh water consumption in laundries in H.M. ships to a minimum. The following are important points in the exercise of economy in fresh water:

(*a*) Operators must exercise a rigid control on the use of water at each stage of the process; a 4 in. dip means 4 in. and not 5 in. Heavy water consumption occurs particularly at the higher dips.

(*b*) Machines must not be operated with leaky discharge valves.

(*c*) Starched work must be dealt with in bulk, as the starching procedure, necessitating a reduction in dip, precludes the saving of the " last rinse " water.

9. Alternative formulae for use

Important.—The following formulae (Nos. V to X) are only to be used if adequate supplies of shore water are available.

FORMULA V

Fresh-water washing process using standard stock solutions of hard soap, Teepol and soda ash.

CLASSIFICATION:

White work, cottons and linens comprising body linen, white shirts, collars, cooks gear, bath towels, sheets and pillow-slips, tropical rig, No. 10's Officers, No. 6's Class I and III, etc.

Nature of soiling—Light (L); Heavy (H).

(*a*) BREAKDOWN

(1) Retain last rinse water from previous load, (white wash), to a running dip — 8 in.

(2) Load machine.

(3) Start machine and run for 5 minutes.

(*b*) FIRST WASH

(1) Run out breakdown water until a running dip is reached of — 4 in.

(2) Add soda ash solution — (L) ½ lb. (4 pints); (H) 1 lb. (8 pints)

(3) Add soap stock solution to maintain a heavy lather — 6–8 pints

(4) Run for a total time of 10 minutes warming to 140°F. then discharge the wash liquor.

(*c*) SECOND WASH

(1) Add hot water at 140°F. to give a running dip of — 3 in.

(2) Add soap stock solution to maintain a lather — 3 to 4 pints

(3) Add soda ash solution — (L) ½ lb. (4 pints); (H) 1 lb. (8 pints)

(4) Run for total time of 15 minutes warming to 200–212°F., adding soap stock solution if necessary to maintain lather. Then discharge the wash liquor.

(*d*) THIRD WASH

(1) Add water at 180°F. to give a running dip — 3 in.

(2) Add soap stock solution to maintain lather — 1–3 pints

(3) Add soda ash solution — (L) Nil; (H) ½ lb. (4 pints)

(4) Run for total time of 15 minutes warming to 200°F. in 8 minutes. Maintain at 200–212°F. for a further 7 minutes, adding soap stock solution if necessary to maintain lather. Then discharge the wash liquor.

(*e*) FIRST RINSE

(1) Add water at 180°F. to give running dip of — 6 in.

(2) Run for total time of 5 minutes then discharge the water.

(*f*) SECOND RINSE

(1) Add water at 150°F. to give running dip of — 9 in.

(2) Run for total time of 5 minutes, then discharge the water.

(*g*) THIRD RINSE

(1) Add water at 120°F. to give a running dip of — 14 in.

(2) Run for total time of 4 minutes, then discharge the water.

(*h*) FOURTH RINSE

(1) Add cold water to a running dip of — 14 in.

(2) Run for a total time of 4 minutes.

(*j*) UNLOAD

Unload machine and retain water for the breakdown process of the next load.

(*k*) NOTES

(i) If essential bleach liquor may be added to the second wash maintaining the temperature at 140°F.

(ii) Where the load is not too heavily soiled the third wash may be omitted.

(iii) Starching of No. 10's (Officers), No. 6's Class I and III), tropical rig, and shirts:— During the last rinse, decrease the dip to 2 in.; cream 1 lb. of National Blended Starch, add to the machine, and run the machine for 5 minutes.

(iv) For collars see special formula.

FORMULA VI

Fresh water washing process using standard stock solutions of hard soap, Teepol and soda ash.

CLASSIFICATION:

Hammocks and bed covers.

Use Formula I with the following variations:

(*a*) BREAKDOWN

Add soda ash solution — (L) 4 oz. (2 pints); (H) 8 oz. (4 pints)

(*b*) FIRST WASH

Increase soda ash solution to — (L) 1 lb. (8 pints); (H) 2 lbs. (16 pints)

FORMULA VII

Fresh water washing process using standard stock solution of hard soap, Teepol and soda ash.

CLASSIFICATION:

Table linen and napkins.

(*a*) BREAKDOWN

(1) Use the last rinse water from the previous load (white wash). Dip — 8 in.

(2) Load the machine.

(3) Run for 5 minutes. Temperature 90–100°F.

(*b*) First Wash

(1) Add soda ash solution 3 pints, and soap stock solution 6 pints.
(2) Lower the dip to 6 in.
(3) Raise temperature, slowly, up to 140°F.
(4) Run for 10 minutes.
(5) Discharge wash liquor.

(*c*) Second Wash

(1) Add hot water at a temperature of 140°F.
(2) Add 5 pints soda ash solution, and 5 pints of soap stock solution
(3) Raise temperature slowly to 200°F., then shut off steam.
(4) Run for 10 minutes.
(5) Discharge wash liquor.

(*d*) First Rinse

(1) Add hot water at 180°F. to give a running dip of 6 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*e*) Second Rinse

(1) Add hot water at 140°F. to give a running dip of 9 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*f*) Third Rinse

(1) Add warm water at 100°F. to give a running dip of 12 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*g*) Fourth Rinse

(1) Add cold water to a dip of 14 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*h*) Notes

(i) If essential, bleach may be added to the 1st wash, maintaining the temperature at 140°F.
(ii) Starch (see general notes Formula I) may be added the last rinse.

FORMULA VIII

Fresh water washing process using standard stock solution of hard soap and Teepol.

Classification:

Coloured work having average soiling.

(*a*) Breakdown . .

(1) Retain the last rinse water from the previous load (if white wash) to a running dip of 8 in.
(2) Load machine.
(3) Run for 5 minutes, then discharge the water.

(*b*) First Wash

(1) Add cold water dip 6 in.
(2) Add soap stock solution to form a good lather 4–6 pints
(3) Raise temperature slowly to 120°F
(4) Run for 10 minutes, then discharge the wash liquor.

(*c*) Second Wash

(1) Add water at 120°F. Dip 4 in.
(2) Add soap stock solution to maintain a good lather 2–3 pints
(3) Raise temperature slowly to 140°F.
(4) Run for 10 minutes, then discharge the wash liquor.

Note: DO NOT EXCEED 140°F.

(*d*) First Rinse

(1) Add warm water at 140°F. to give a running dip of 9 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*e*) Second Rinse

(1) Add warm water at 120°F. to give a running dip of 12 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*f*) Third Rinse

(1) Add warm water at 100°F. to give a running dip of 14 in.
(2) Run the machine for 4 minutes.
(3) Discharge the water.

(*g*) Fourth Rinse

(1) Add cold water to give a running dip of 14 in.
(2) Run the machine for 4 minutes.
(3) Retain the water if a further load of coloureds is to be dealt with next.

(*h*) Notes

(i) Do not use last rinse water from coloured work when changing to white work.
(ii) Wash light colours first, ending with dark colours.
(iii) Remember that as the temperature of the wash is increased the greater will be the tendency for the colour to bleed.
(iv) Alkali (Soda Ash) should not be used.
(v) Bleach stock solution should *never* be used.

FORMULA IX

Fresh water washing process using standard stock solution of hard soap and Teepol and soda ash.

Classification:

Engineers' Overalls.

(*a*) Breakdown

(1) Retain last rinse water from previous load to a running dip of 8 in.
(2) Load the machine.
(3) Run for 5 minutes then discharge the water.

(*b*) First Wash

(1) Hot water at 180°F. —Dip 8 in.
(2) Add soda ash in solution 5 lbs. (5 galls.)
(3) Run for 15 minutes keeping temperature at 180°F., then discharge the wash liquor.

(*c*) Preliminary Rinse

(1) Hot water at 180°F. Dip 10 in.
(2) Run for 4 minutes, then discharge the water.

(*d*) Second Wash

As for First wash but add soap stock to produce a good lather 1 gall.

Second Preliminary Rinse

As for First preliminary rinse above.

(*e*) Third Wash

(1) Hot water at 180°F. Dip 6 in.
(2) Add soda ash 1 lb. (8 pints)
(3) Add soap stock solution 1 gall.
(4) Run for 15 minutes keeping at 180°F. then discharge the wash liquor.

Rinses

Four, each to run 4 minutes after the water is in.
(*f*) 1st Hot water at 180°F. Dip 9 in.
(*g*) 2nd „ „ „ Dip 9 in.
(*h*) 3rd warm water at 120°F. Dip 14 in.
(*j*) 4th cold water. Full.

(*k*) Note.

The second wash and succeeding rinse may be omitted if the load is not very greasy.

FORMULA X

Fresh water washing process using standard stock solution of hard soap and Teepol.

Classification:

Woollens.

(*a*) First Wash

(1) Fill the machine to 10 in. with water, at a temperature of 100°F. add the required soap stock solution (6–8 pints) and run the machine to build up a lather.

(2) Stop the machine and place in the load.

(3) Start the machine and run for ONE MINUTE. Stop the machine for a period of TWO MINUTES. Repeat this process three times, then stop the machine. This action ensures that the machine is running for 4 minutes only and resting for 6 minutes during a ten minute cycle, thus reducing friction in the washing process to a minimum.

(4) Discharge the water from the machine.

(*b*) Second wash

The load should remain in the machine and the process at 1, 3 and 4 above be repeated.

(*c*) First Rinse

With the machine stationary, add water at 100°F. to a dip of 12 in.

Run the machine for ½ minute
Stop the machine for 1 minute
Run the machine for ½ minute
} Total time 2 minutes

Stop the machine and run out the water.

(*d*) Second Rinse

Repeat as for first rinse.

(*e*) Third Rinse

Repeat as for first rinse, but retaining water for use with the next load.

(*f*) Note

A reduced loading rate of 2½ lb. per cu. ft. cage capacity must be used. Where mechanical interrupter gear is not fitted, the necessary interruptions must be obtained by the manual interruption of the washing cycle.

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.

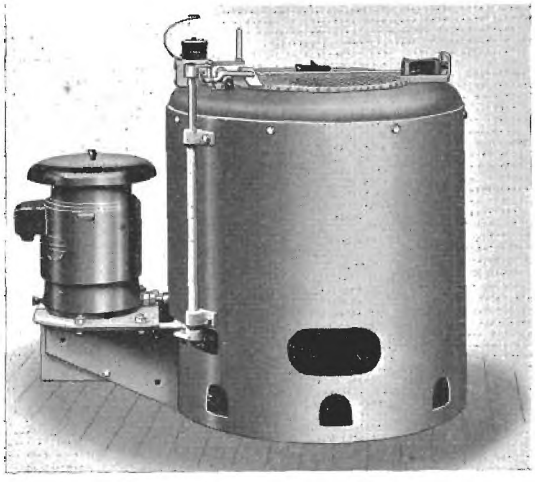


Fig. 30.—External view of Watson Laidlaw 27-in. hydro extractor.

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.

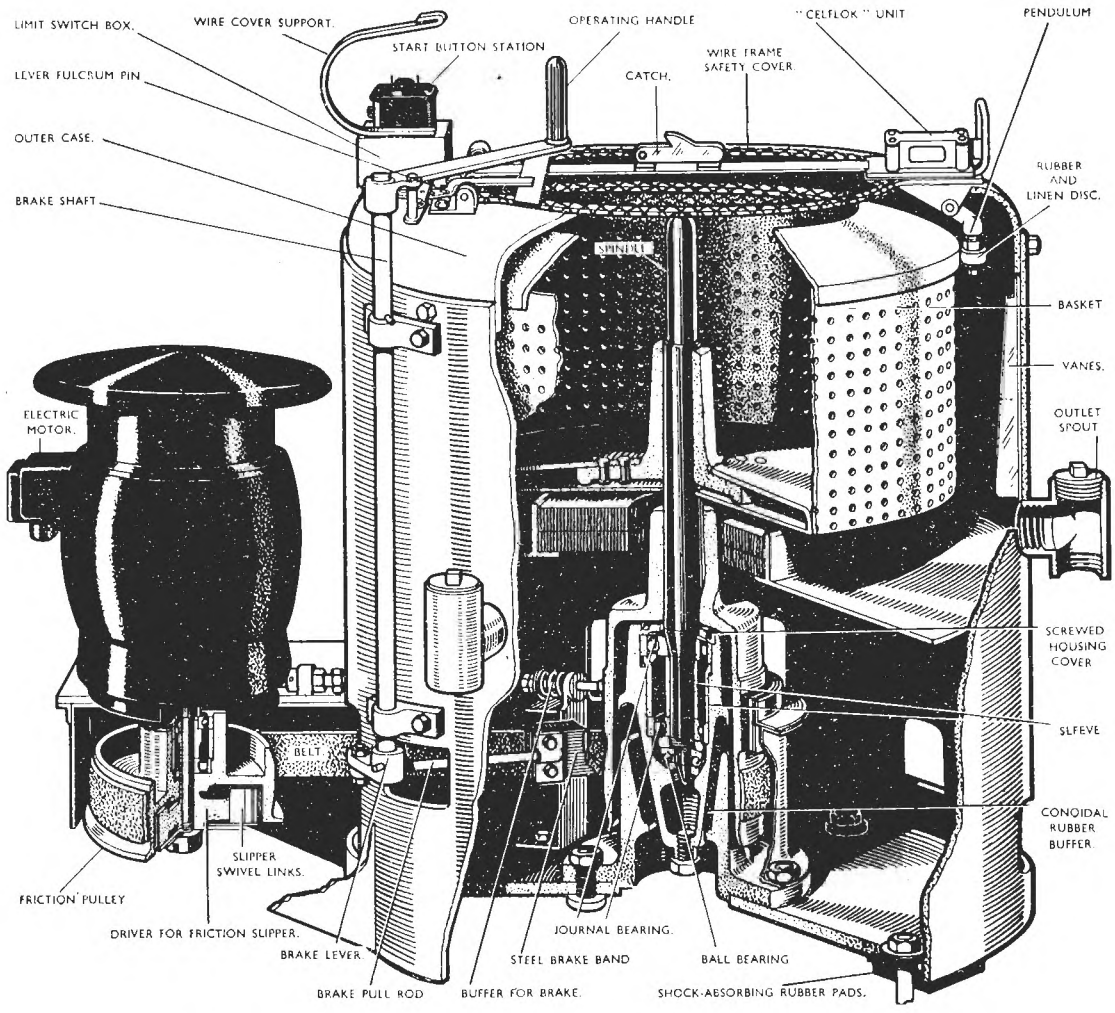


Fig. 31.—Sectional arrangement of Watson Laidlaw 27-in. hydro extractor.



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

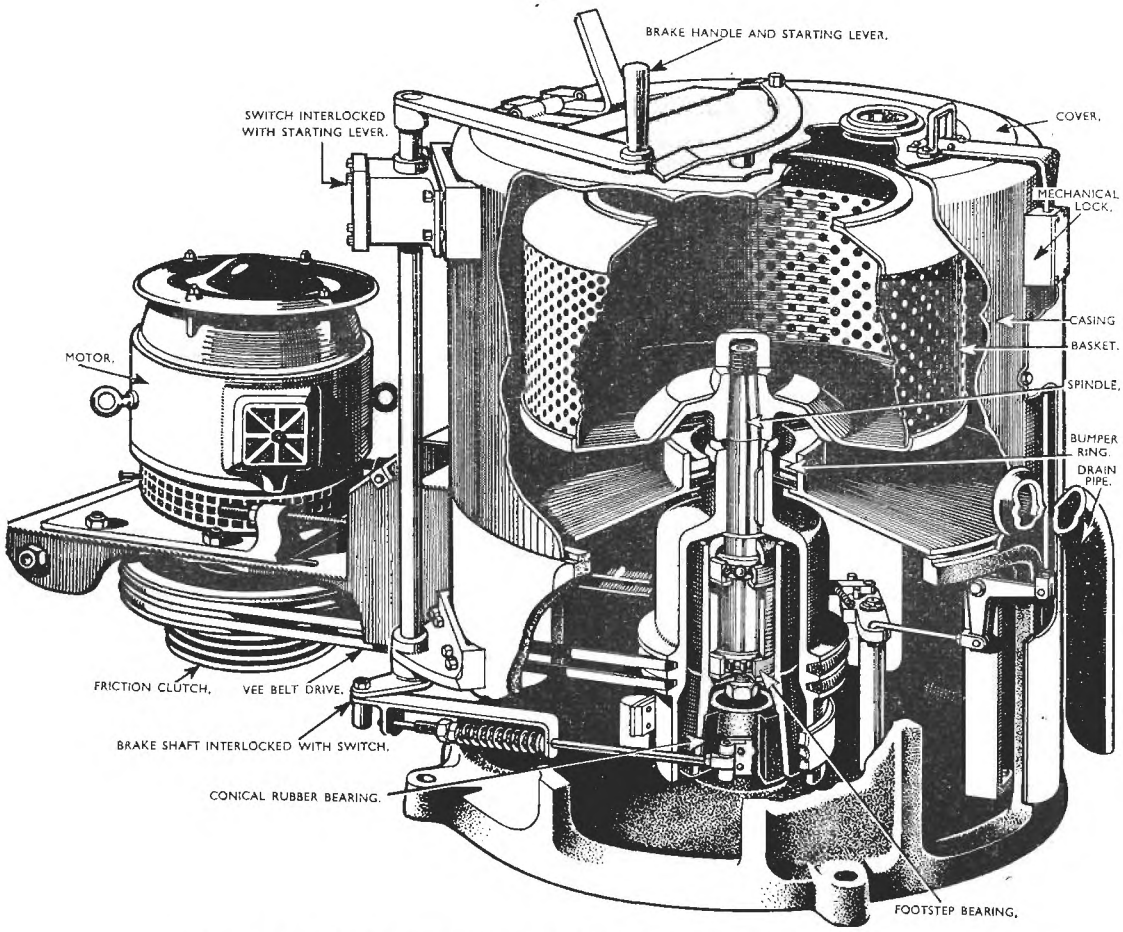


Fig. 33.—Sectional arrangement of Broadbent 30-in. hydro extractor.

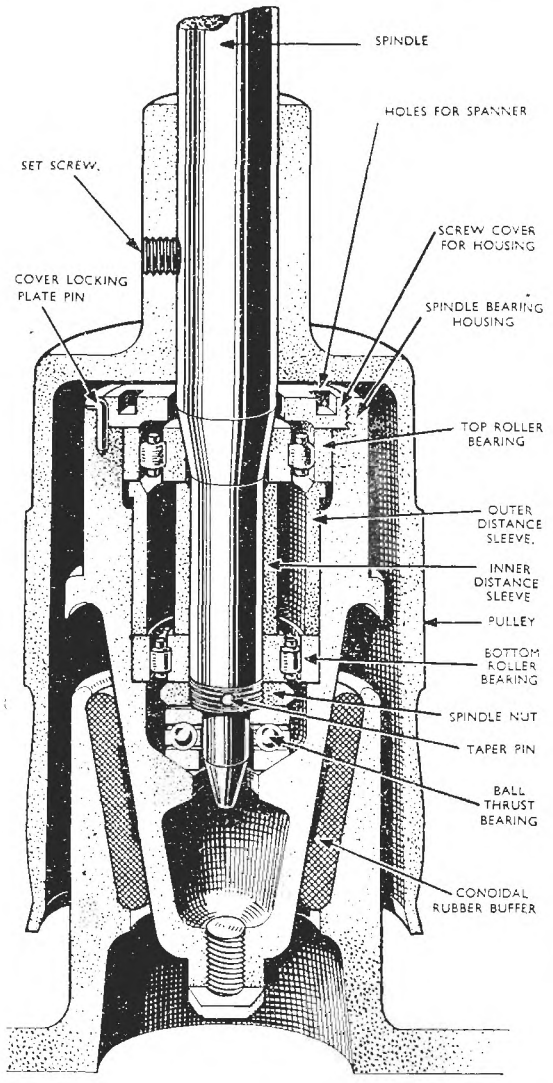


Fig. 34.—Spindle bearing assembly for 27-in. Watson Laidlaw hydro extractor.

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

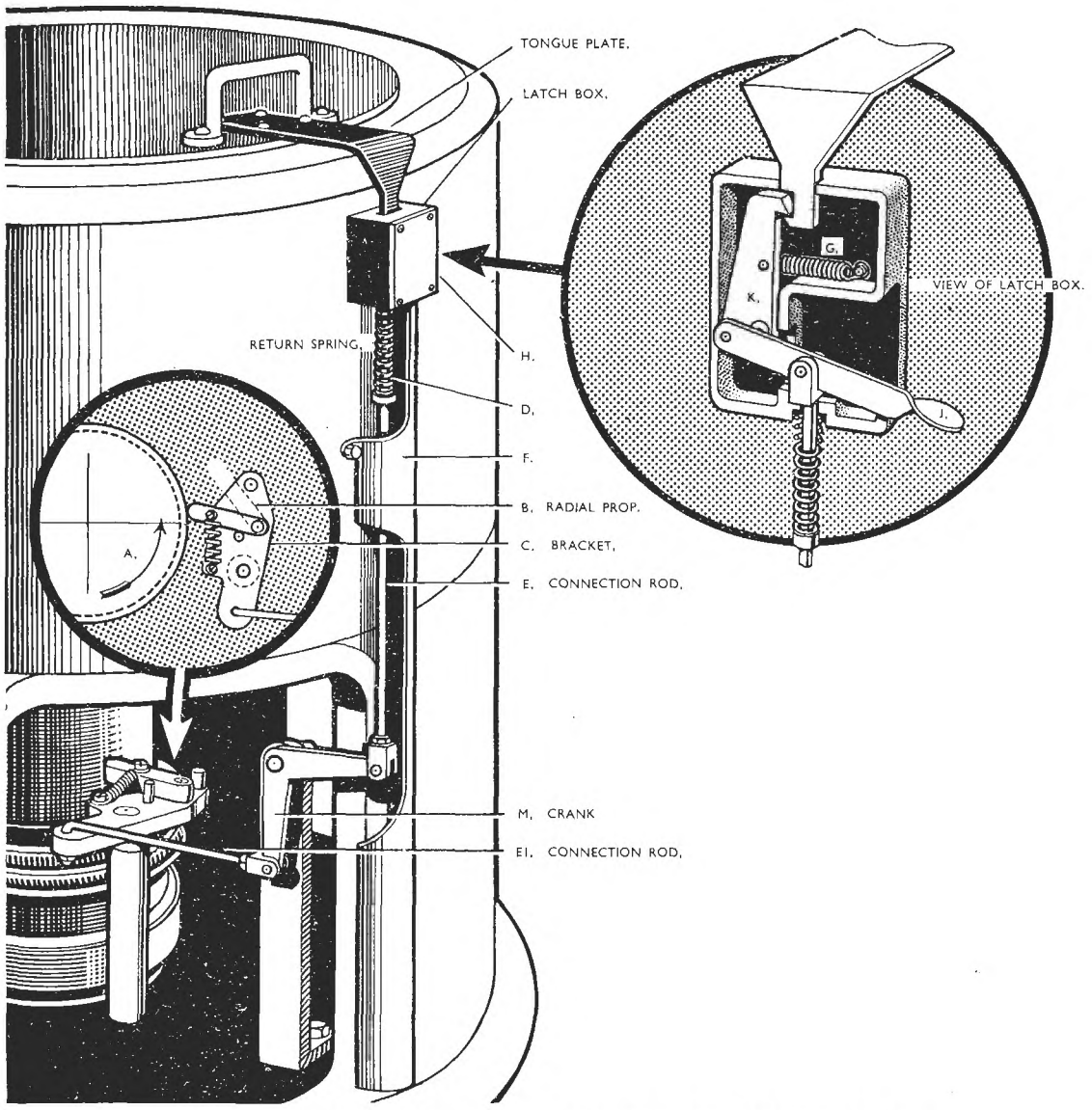


Fig. 35.—Safety interlocking gear for 30-in. Broadbent hydro extractor.

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.

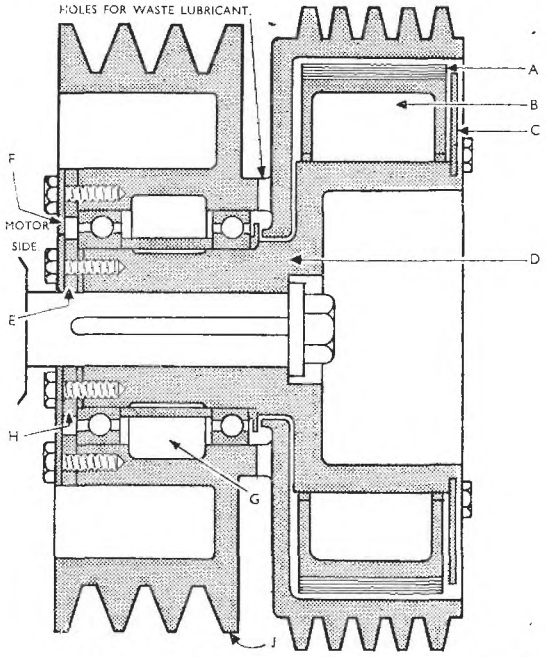


Fig. 36.—Friction clutch for 30-in. Broadbent 23 R.V. hydro extractor.

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

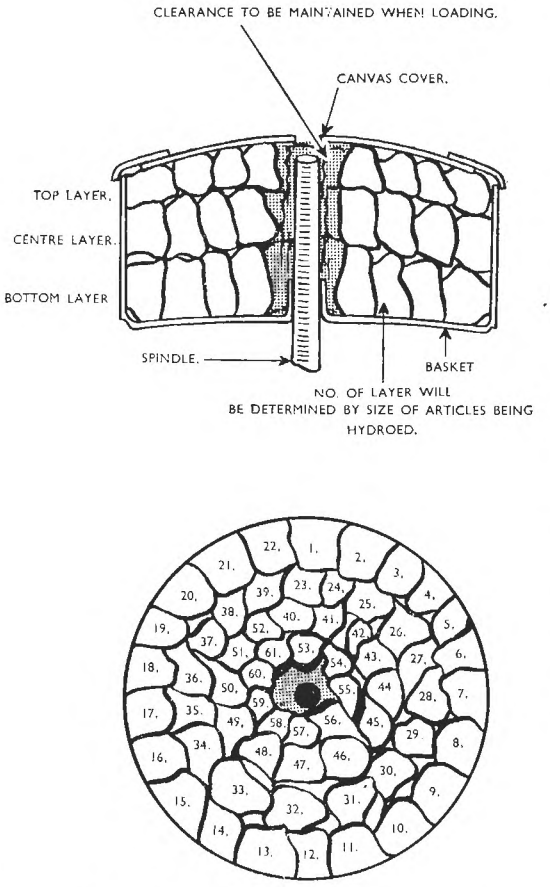


Fig. 37.—Method of loading a hydro extractor.

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 $1\frac{1}{2}$ 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

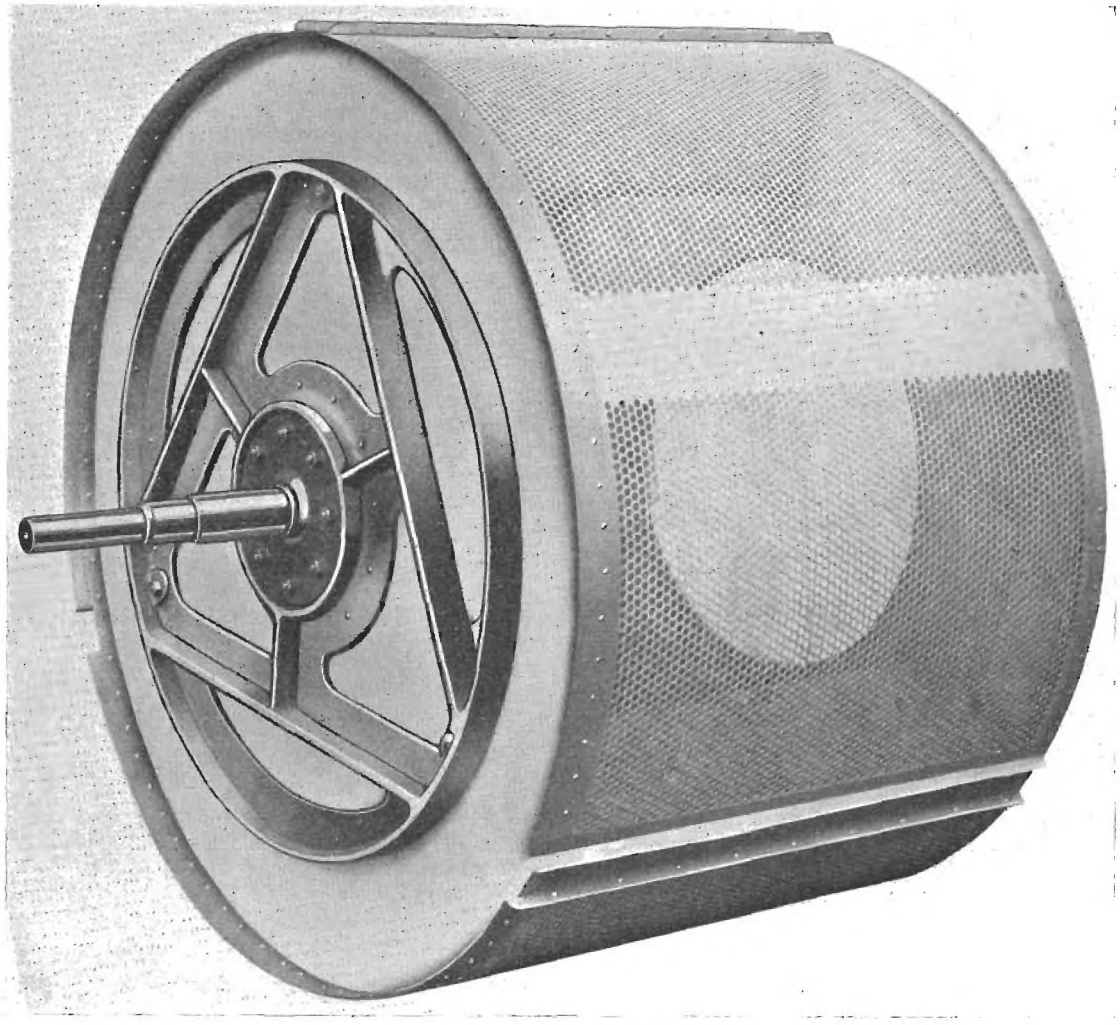


Fig. 38.—Rear view of cylinder for I. Braithwaite 50-in. × 32-in. tumbler dryer.

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.

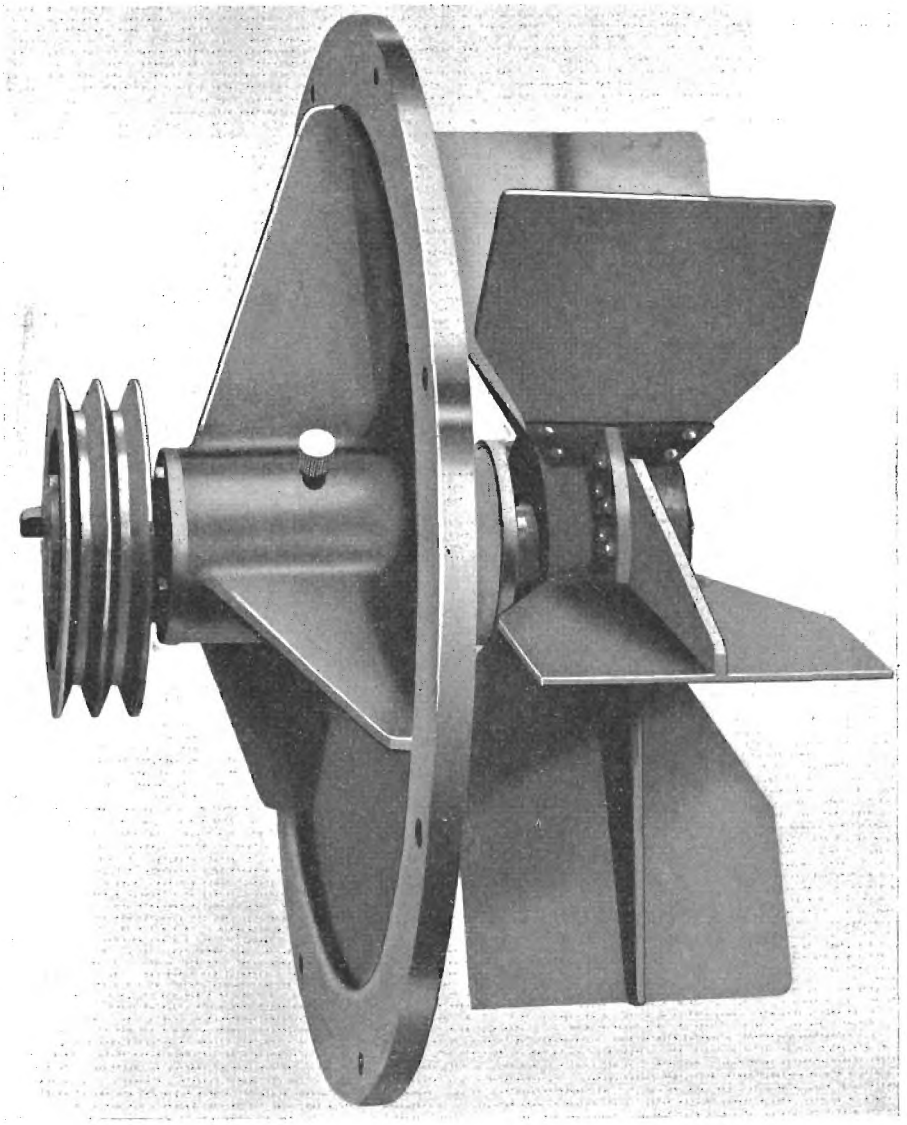


Fig. 39.—Arrangement of fan for 50 × 32-in. tumbler dryer.

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

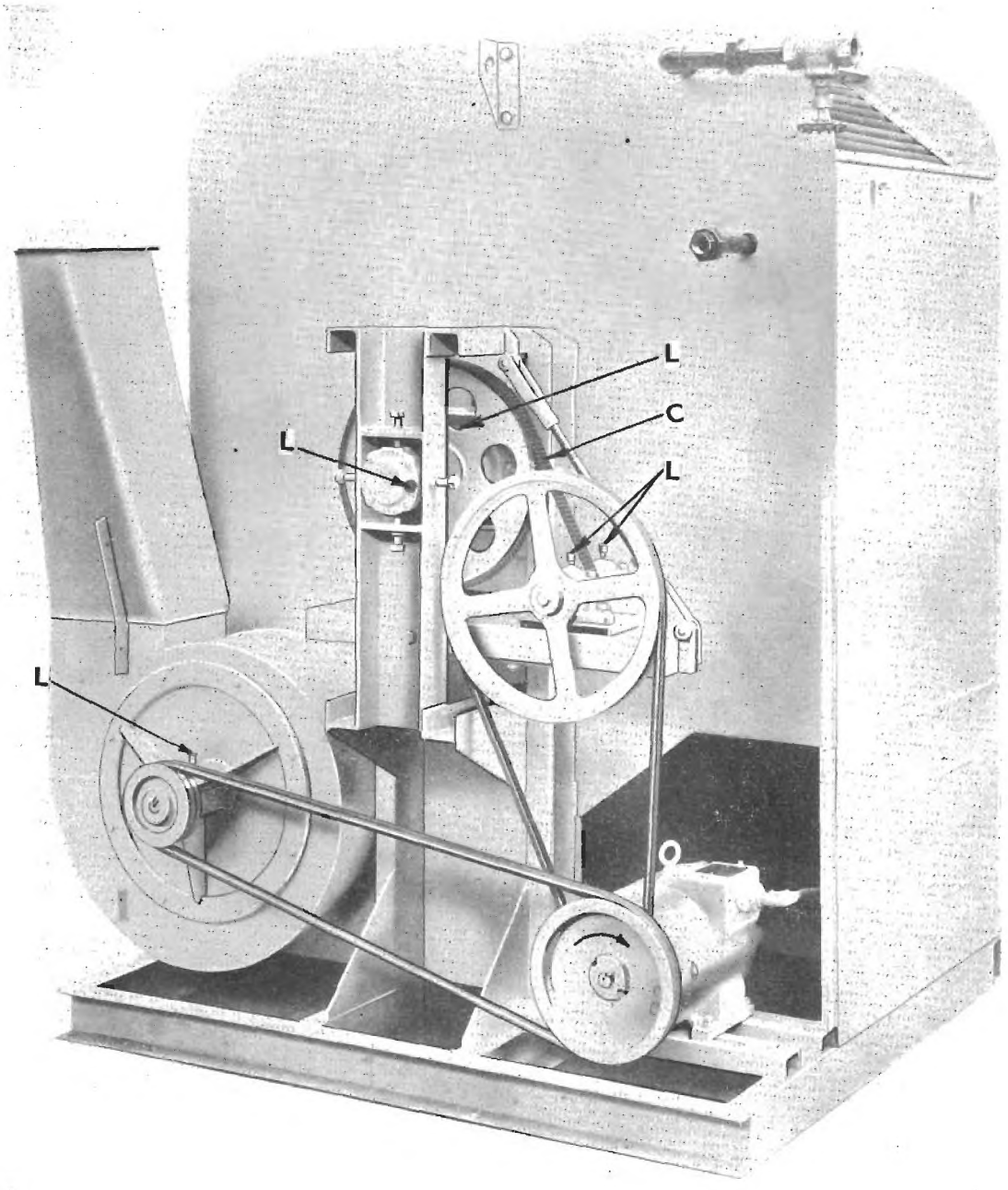


Fig. 40.—Driving gear and lubricating points for 50 × 32-in. tumbler dryer.

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

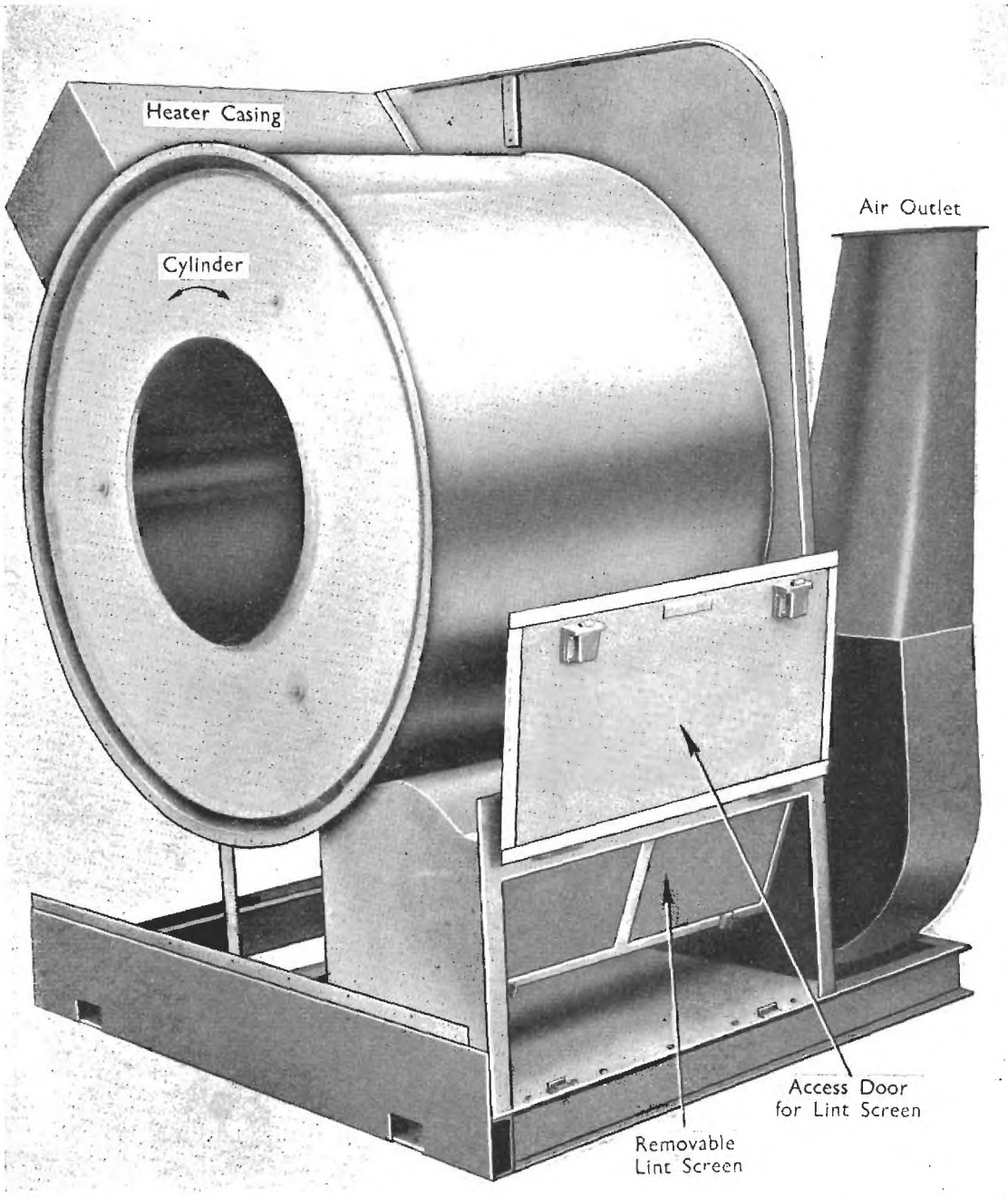


Fig. 41.—Front view of 50 × 32-in. tumbler dryer with covers removed.

(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.

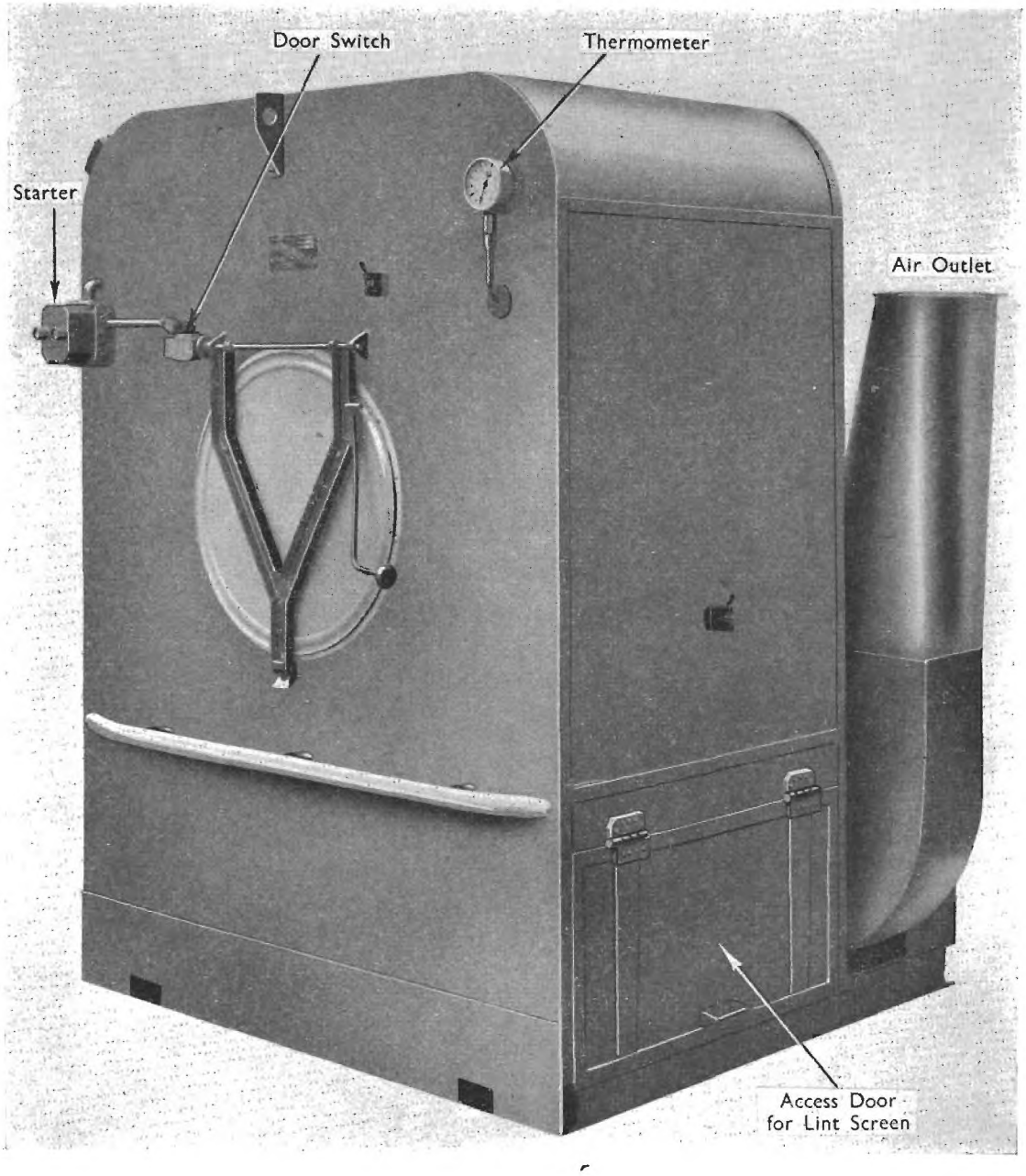


Fig. 42.—Front external view of 50 × 32-in. tumbler dryer.

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

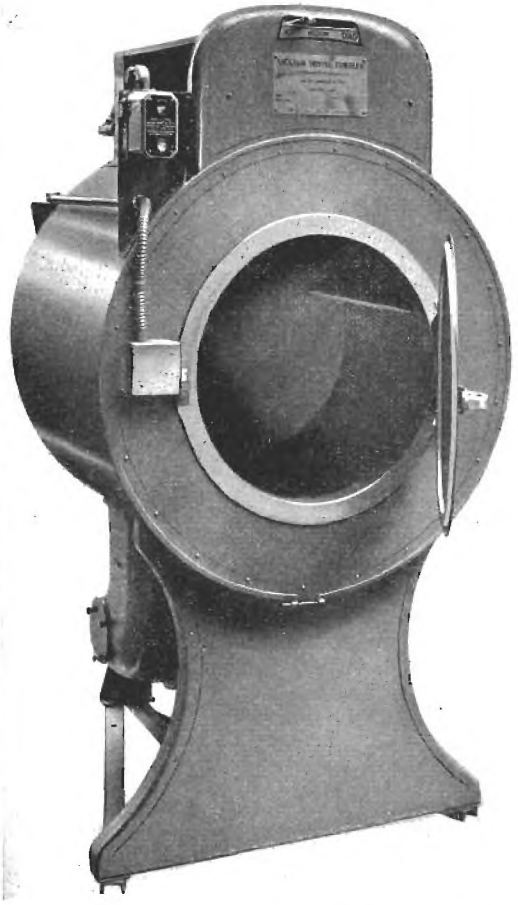


Fig. 43.—Front view of 36 × 30-in. J. Armstrong drying tumbler.
(SO 7546)

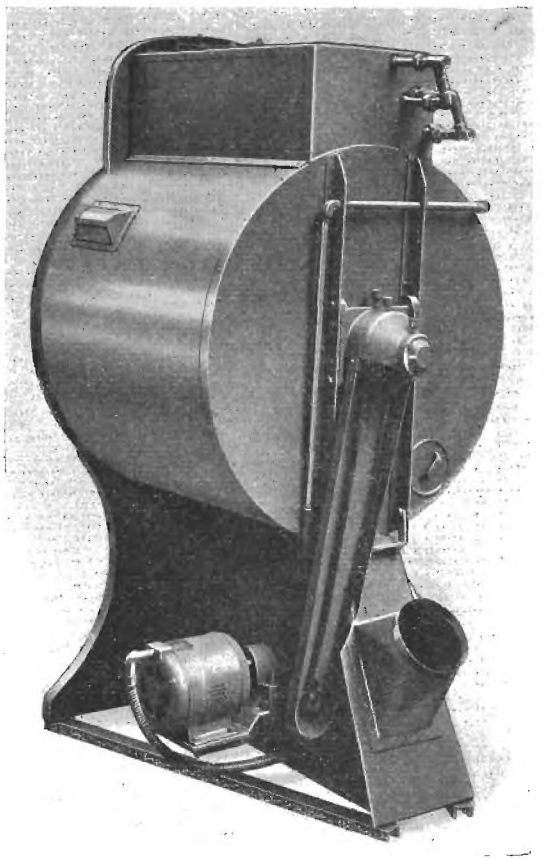


Fig. 44.—Rear view and drive for 36 × 30-in. drying tumbler.

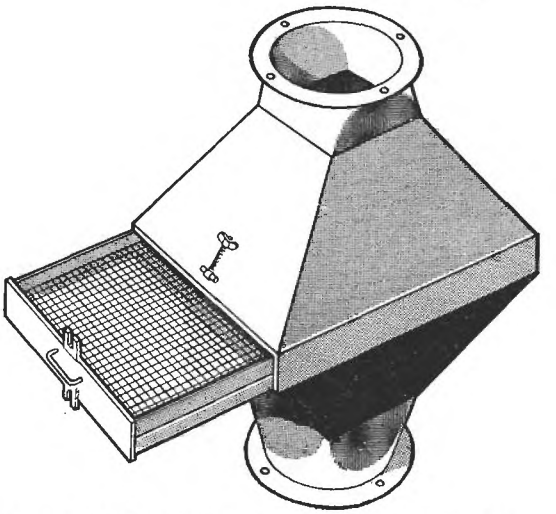


Fig. 45.—Lint trap for 36 × 30-in. drying tumbler.

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.

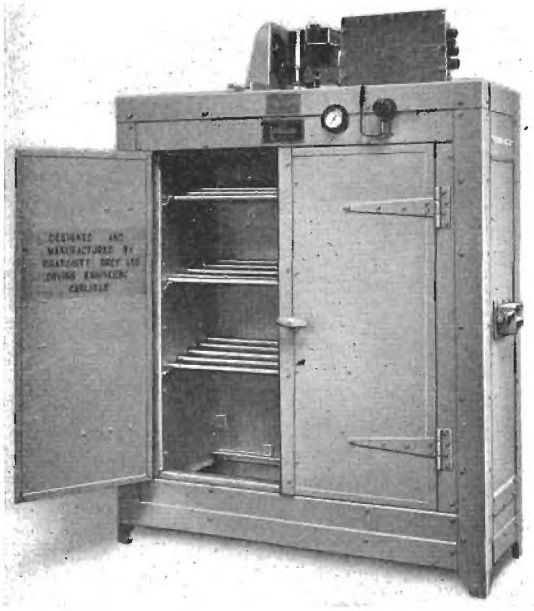


Fig. 46.—Arrangement of Prachitt type electrically heated drying cabinet.

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.

CHAPTER VII

Flatwork Ironing Machinery

1. General remarks

After damp drying in the hydro extractor, the next stage in the laundry process is to achieve the finished drying and pressing of such work as demands this attention, namely, bed linen, table linen, handkerchiefs, and certain classes of body linen. This work is accomplished mechanically in a flatwork ironing machine also known as a calender ironer. Single roll ironing machines are also termed "Decoudun" ironers. The work is passed through the machine in the damp condition as received from the hydro extractor, and both starched and unstarched work can be processed. The machine has a double function:

(*a*) To dry the work completely, and, in so doing,
(*b*) impart a finished surface to the work being processed.

2. Types of machines

Numerous types and makes of machines are available, ranging from small single roll machines especially designed for handkerchief work, to machines having eight or more rolls each of 15 in. diameter by 160 in. long.

Single plain roll ironers, of sizes ranging from 72 in. by 18 in. diameter to 90 in. by 24 in. diameter, were at first installed in H.M. ships, and many of

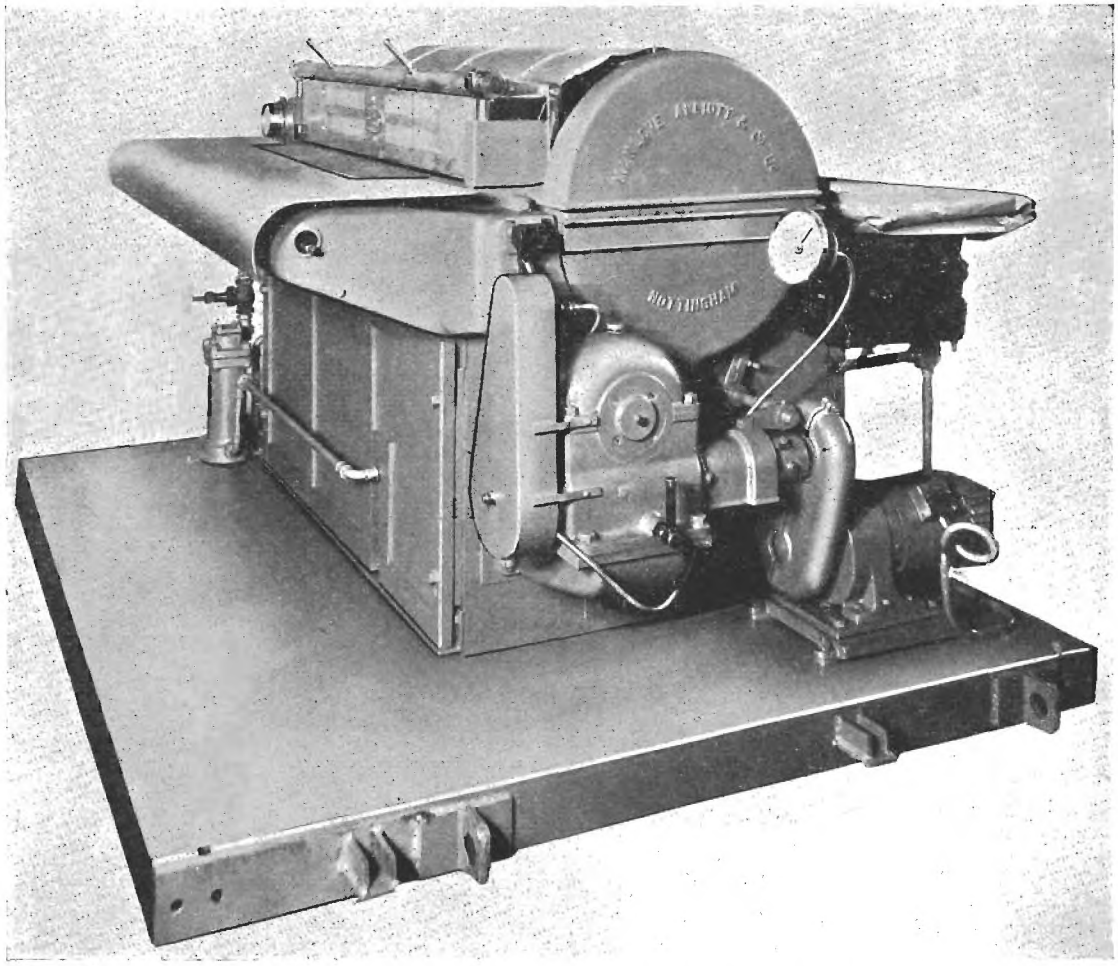


Fig. 47.—Arrangement of 36 × 24-in. Manlove flatwork ironing machine, driving end.

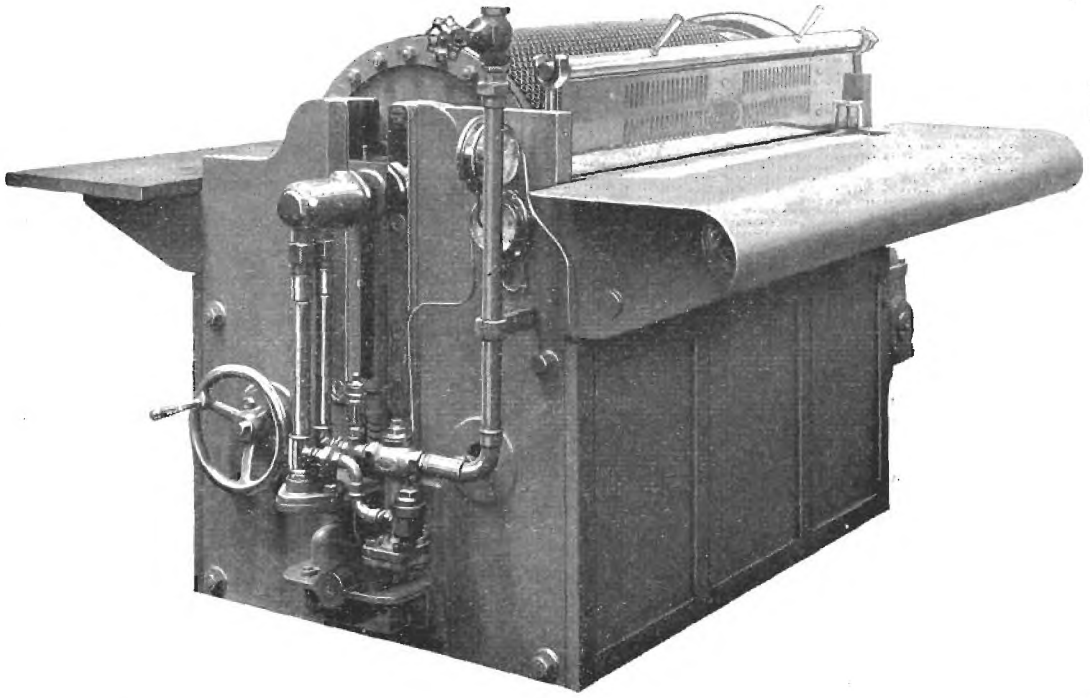


Fig. 48.—Arrangement of 36 × 24-in. flatwork ironing machine, showing spring roller.

these machines are still giving satisfactory service. Because the space occupied and the weight of such machines were out of proportion to their rate of output, more recent practice has been to install machines of 36 in. by 24 in. diameter of the ventilated roller type.

The majority of flatwork ironing machines at present installed are of the straight through type, *i.e.*, work fed in from the feed table passes under the roller to the delivery table on the opposite side of the machine.

With a view to further space conservation relative to increased output, a 56 in. by 25 in. diameter return feed type of machine has been developed for shipboard use. With this type of machine as the name suggests, work fed into the machine is returned back to the operator. The return feed machine has been given separate detailed treatment.

3. Conditions required for processing flatwork

In flatwork ironing, the ideal condition is reached when work can be completely dried and ironed in one transit through the machine. The length of the roller should be such that the largest items, say sheets, can be passed through in one thickness. Output is then dependent upon the speed at which work passes through the machine, bearing in mind that the work must be in contact with the heated surface of the bed for a sufficient time to effect thorough drying. High rate of production can be achieved by:

A single roll machine of large diameter revolving at a comparatively slow speed.

Double or multi-roll machines having smaller diameter rollers revolving at a higher speed.

In Fleet Shore Establishments where the necessity to conserve weight and space does not arise, the ideal condition is achieved by the installation of twin roll type machines having rollers of 120 in. by 24 in. diameter.

STRAIGHT-THROUGH FEED TYPES

4. Description

While, by reason of the variety of types and sizes available, the construction varies in detail, the flatwork ironing machine consists fundamentally of one or more padded—referred to as clothed—steam heated roller(s) suitably supported on end pedestals and capable of revolution in a deep-sectioned polished cast-iron steam-heated bed. The roller(s) are steam heated to a pressure of 10 lb./sq. in. and fitted with reducing and safety valves; the working steam pressure for the bed is 100 lb./sq. in.

5. Roller construction

PLAIN ROLL TYPE.—The moisture in the articles being processed vaporises and escapes freely into the atmosphere; a certain amount of moisture is, however, always present in the clothing of the roller.

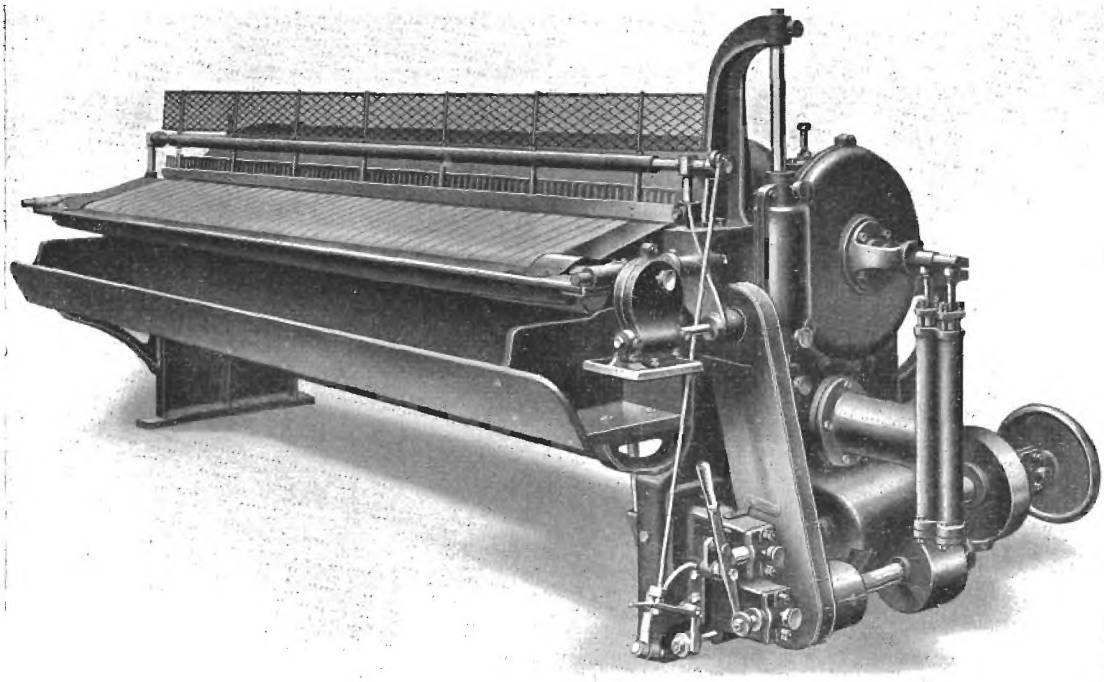


Fig. 49.—Arrangement of T. Bradford 90 × 24-in. single roll flatwork ironing machine.

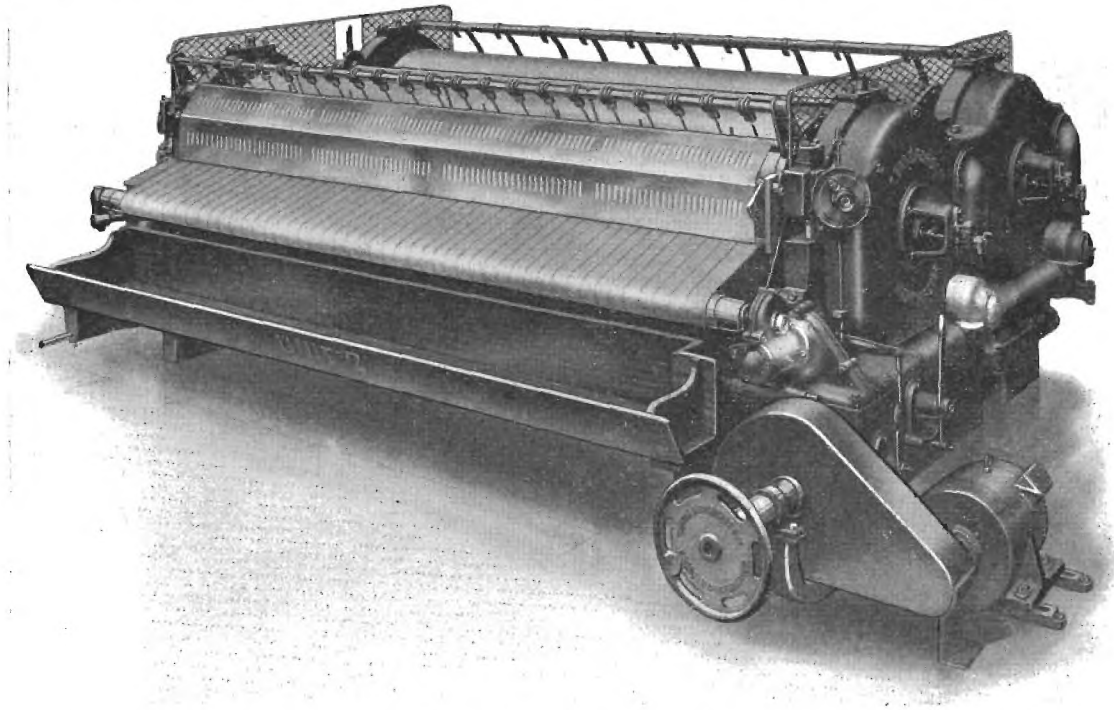


Fig. 50.—Arrangement of T. Bradford 120 × 24-in. double roll flatwork ironing machine.

VENTILATED TYPE.—An air gap is preserved between the actual surface of the roller and the clothing. The vapour generated from the work passes through the clothing, and is rapidly dispersed through vapour outlets at the ends of the roller.

Ventilated type rollers are now always specified for machines for Admiralty service. Typical examples are illustrated in Figs. 51, 52 and 53.

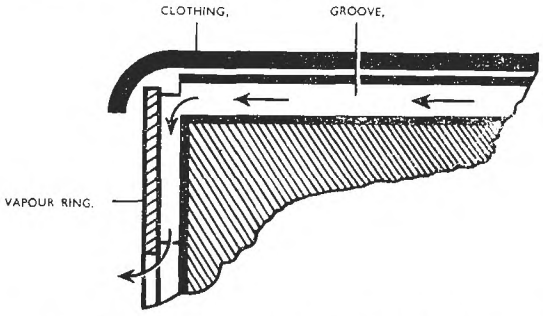


Fig. 51.—Section of ventilated roller for 36 × 24-in flatwork ironer.

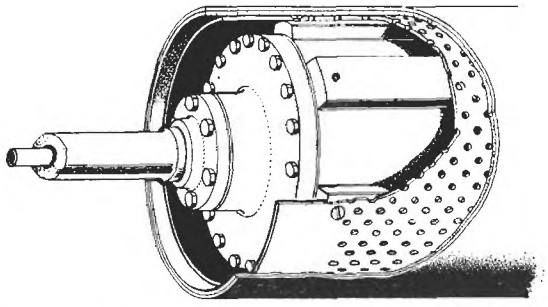


Fig. 52.—Section of ventilated roller for 90 × 24-in. flatwork ironer.

In some very large machines the vapour is drawn from the roller by means of a suction fan, but in all cases machines fitted with ventilated type rollers are, size for size, capable of a much higher ouput than the plain roll type.

FLEXIBLE TYPE.—Unless suitable provision is made, garments having buttons attached, or embossed embroidery, cannot be passed through the flatwork ironing machine without damage to the work. To enable this work to be processed, flexible type rollers are provided in some makes of machines, a typical example being illustrated in Fig. 54.

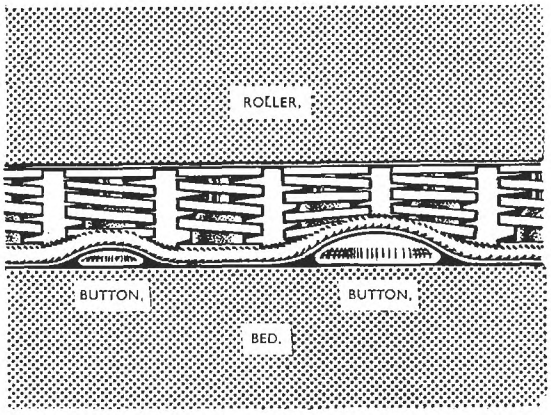


Fig. 54.—Spring padding for 36 × 24-in. flatwork ironer.

6. Pressure adjustment

Lifting gear of either the hand or power-operated type, according to the size of the machine, is provided to raise the roller clear of the bed. Hand-screw-type adjusting gear is provided, to vary within fine limits the pressure of the roller on the work. Some makers of multi-roll machines incorporate a feature whereby the pressure on all the rolls may be automatically increased or decreased simultaneously.

7. Drive

Drive to the machine is arranged by chain or vee belting from the motor through a clutch and thence through reduction gearing to the roller. A two or more speed gear box is fitted on some machines; in certain cases large variations in the speed range of the rollers are obtainable by electrical control.

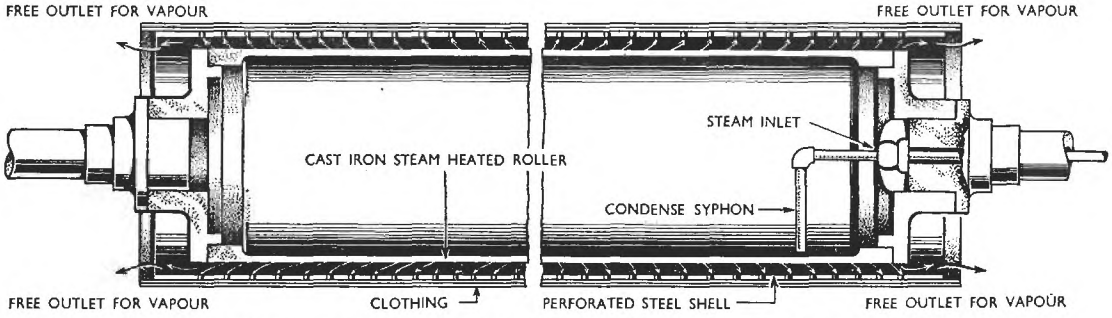


Fig. 53.—Full section of ventilated roller for 90 × 24-in. flatwork ironer.

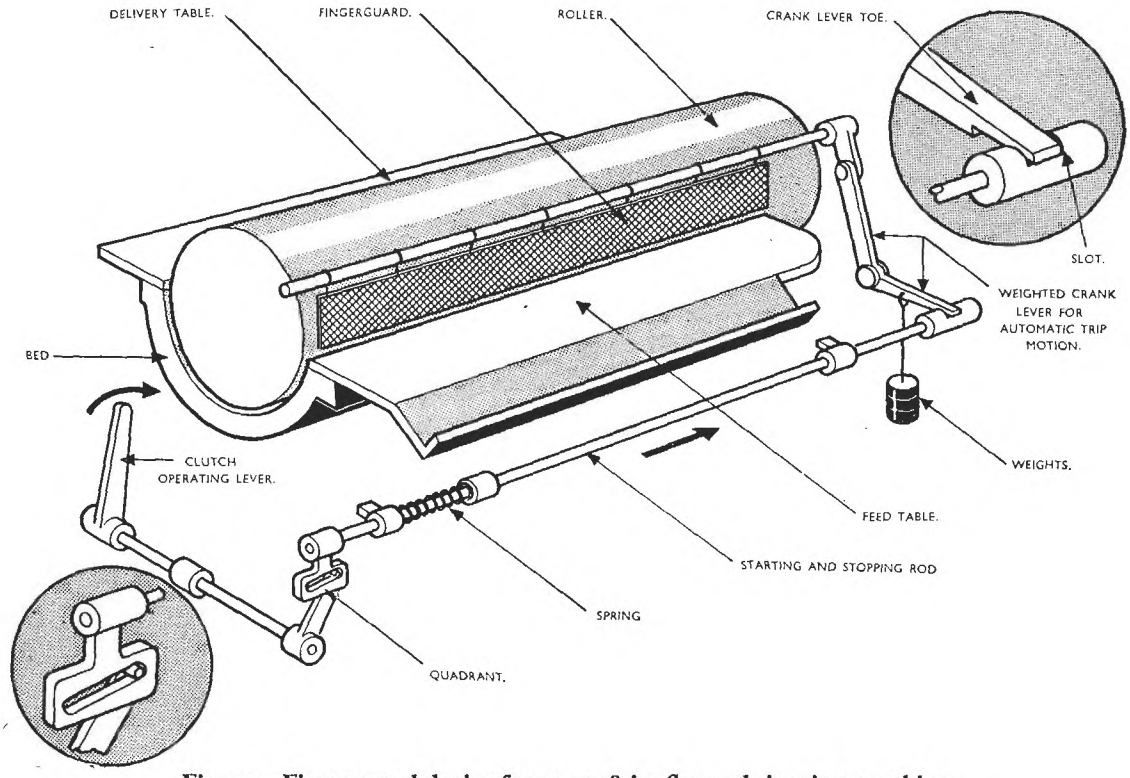


Fig. 55.—Fingerguard device for 90 × 18-in. flatwork ironing machine.

8. Stripping gear

Automatic stripping gear is provided on all large machines whereby the articles are delivered to the delivery table with minimum attention from the operator.

9. Safety devices

To ensure that the operator's fingers cannot be caught between the bed of the machine and the roller, all machines are equipped with a safety device worked in conjunction with the finger guard. Slight pressure on the finger guard results in the immediate stopping of the machine.

(*a*) TYPICAL SAFETY DEVICES.—A typical safety device is illustrated in Fig. 55.

The finger-guard is arranged along the whole length of the feed table, in front of the roller and at a height sufficient to allow passage of material only to the roller. The guard is connected by a system of levers through the stopping-and-starting rod to the clutch-operating lever which engages and disengages the machine-driving clutch. Under normal working conditions the clutch is engaged. The starting-and-stopping rod is spring loaded and retained in position by the engagement of the toe of the crank lever with a slot cut in the extension to the operating rod. Slight pressure on the finger guard, such as may result if the operator's fingers come into contact with the bottom edge of the guard, causes the guard to move. The movement is transferred to the toe piece on the crank lever which lifts thus allowing the spring to move the starting rod in the direction shown. The longitudinal motion of the rod is conveyed through a quadrant to the clutch-operating lever, causing the instant disengagement of the clutch and the immediate stopping of the roller.

(*b*) A diagrammatic arrangement of the finger guard safety device fitted on the 36 in. × 30 in. Manlove flatwork ironing machine is illustrated in Fig. 56.

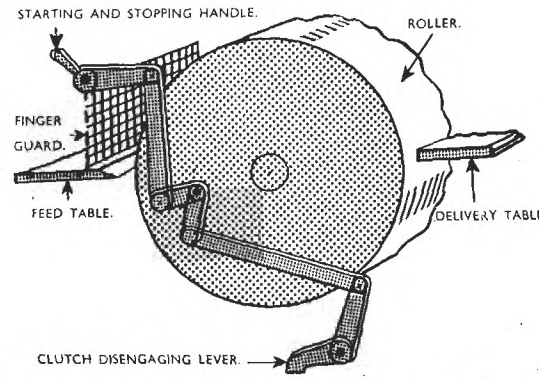


Fig. 56.—Fingerguard device for 36 × 24-in. flatwork ironing machine.

Contact with the finger guard is conveyed by a simple lever system to the clutch disengaging lever and results in the immediate stopping of the machine.

(*e*) SETTING THE FINGER-GUARD

The bottom of the finger-guard on all machines is arranged at a height of $\frac{3}{8}$ in. above the feed table, and should be maintained at this level at all times. Adjustment of the finger-guard safety device should be such that:

(*a*) the guard reacts to the slightest finger pressure

(*b*) resultant upon the movement of the finger guard, the machine will stop within the period taken for the material to travel the horizontal distance between the bottom of the guard and the lip of the bed.

10. Operation

(1) The roller must always be raised clear of the bed when the machine is idle, and must not be lowered prior to working, until the bed and roller are thoroughly warmed through.

(2) The bed and roller must be allowed to warm through for about 30 minutes before the machine is required for use. During the warming through period, the air cocks on the bed, where fitted, should be opened for a few minutes to release all air from the bed.

(3) The steam traps from the bed and roller should be thoroughly blown through.

(4) Lower the roller on to the bed of the machine.

(5) When using the machine for the first time each day, test the finger guard to ensure that the safety arrangements are working efficiently.

(6) Use all the surface of the roller. Constant feeding of small articles or thick materials in one place causes uneven wear on the padding necessitating more frequent renewal of the roller clothing than would normally be necessary.

(7) The variation of the pressure for different quality work can be obtained by means of the hand adjusting gear on the roller.

(8) On closing down for the day, or for any period during which the machine can be expected to remain idle for 15 minutes or more, the roller must be lifted clear of the bed to prevent the padding being scorched. Before raising the rollers, however, the machine should be allowed to run idle for approximately 5 minutes to allow the clothing to dry.

(9) All coverings should be loosened on the roller at week-ends, as the padding tends to recover resiliency if in contact with air.

11. Cleaning the bed

The bed of the machine must be kept free from accumulation of lint and dirt at all times. It is of polished cast iron, and harsh abrasive substances must not be used to clean it or the surface will be quickly destroyed. Powdered lime, or chalk on a damp cloth, is recommended, and cleaning should be done by moving the arm across the radius of the bed and not lengthwise. After cleaning, polish with a dry cloth.

One of the main sources of trouble is the accumulation of starch on the lip and bed of the machine, causing the work to stick and the edges to be turned back. Undue deposits can usually be attributed either to the incorrect preparation of starch or to the bed of the machine being too cold. (These conditions will not arise if the correct operating instructions are adhered to). Small deposits of starch will always tend to be present, but can be removed by cleaning the bed daily with a cloth treated with paraffin wax.

Use a piece of sheeting of the same length as the roller and about 3 ft. wide. Apply the paraffin wax to one half of the width of the sheet only and along its whole length. One side only of the sheet should be waxed (see Fig. 57).

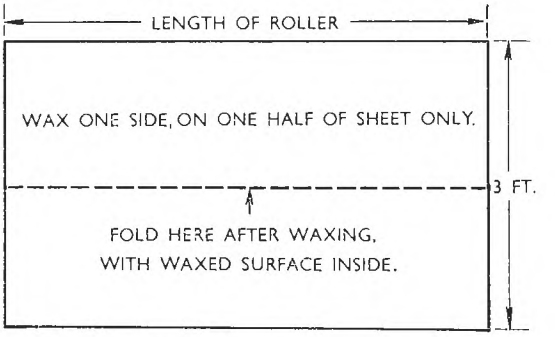


Fig. 57.—Method of waxing a sheet for cleaning the machine bed.

Fold the sheet with the unwaxed side outward and pass twice through the ironing machine with the folded edge first. The sheet should be retained for daily use until the wax content is exhausted.

12. Roller clothing materials

(*a*) The types and grades of clothing recommended by individual makers of flatwork ironing machines are too numerous to justify stocks of each being carried. The undermentioned materials are however generally suitable for reclothing the rollers of all types of ironing machines. *See also* asbestos clothing.

$\frac{1}{16}$ in. asbestos cloth
Knitted cotton padding
Egyptian cotton sheeting (top clothing).

The top sheet requires washing once weekly.

The knitted cotton padding compresses during use, thus gradually reducing the diameter of the roller, and under normal working conditions requires replacement or increasing at three monthly intervals.

The asbestos cloth should last for a considerable period but should be examined on each occasion when replacing the knitted cotton padding.

13. Reclothing the rollers

PRELIMINARIES

(1) Raise the roller as high as possible above the bed of the machine.

(2) Preheat the bed and the roller.

(3) Carefully remove the old clothing from the roller.

(4) Clean the polished bed.

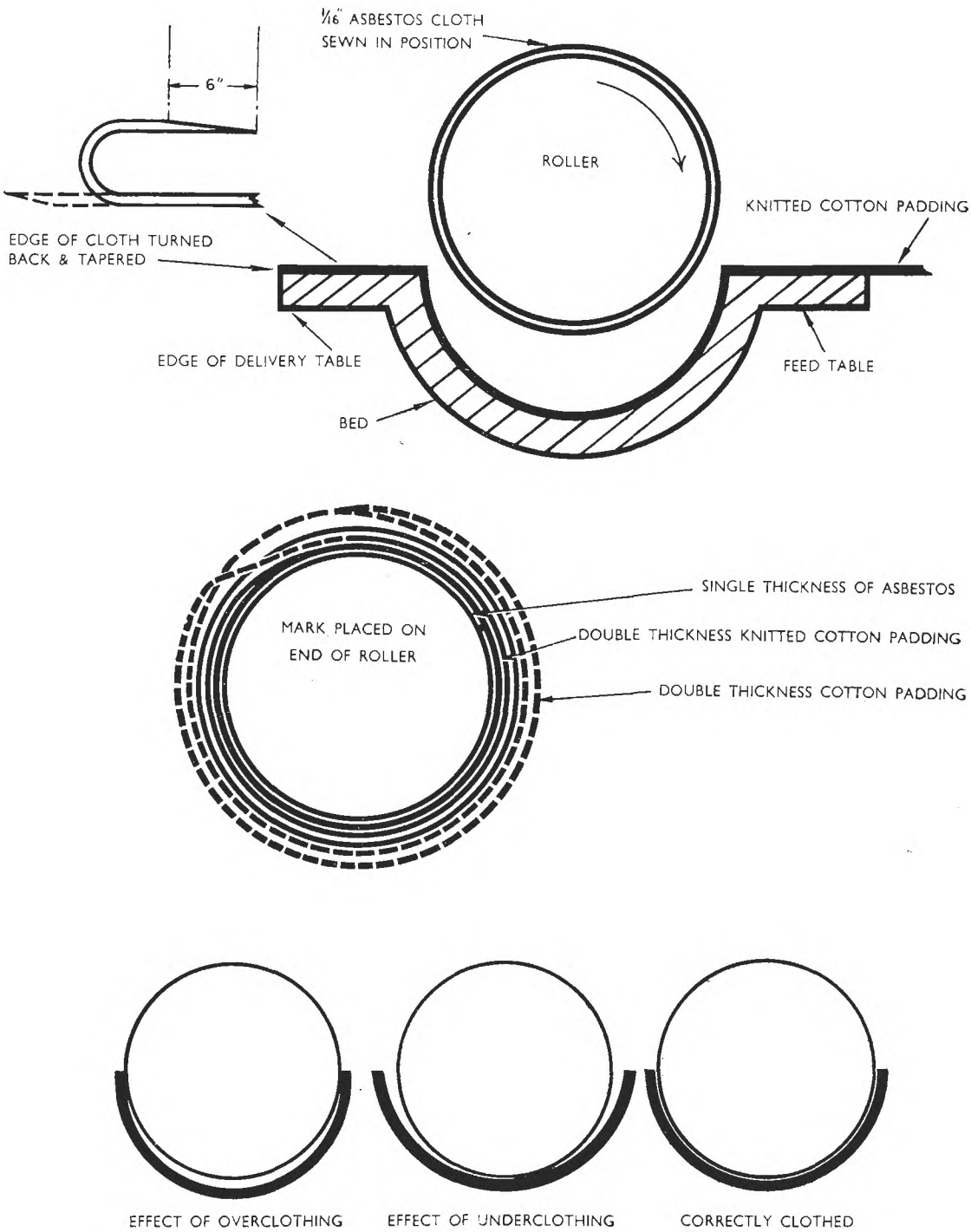


Fig. 58.—Typical method for reclothing the roller.

ASBESTOS CLOTH

(5) Cut to the length of the roller plus 4 in. and width equal to the exact circumference of the roller. All edges should be kept perfectly straight and square.

(6) Stretch the cloth firmly around the roller with a 2 in. overlap each end, and sew the edges together, taking care that no overlap occurs.

KNITTED COTTON PADDING

(7) Cut to the length of the roller plus 4 in. by twice the circumference of the roller plus 9 in.

(8) Allowing 2 in. overlap at each end of the roller, insert the padding squarely through the machine from the feed side. Trim the edge of the cloth using the edge of the delivery table as a guide.

(9) Turn back the leading edge of the padding and, with a steel comb, taper the edge of the cloth for a width of 6 in. along its whole length.

(10) Turn back the combed edge to the original position and lower the roller into the bed, making sure that the padding is not creased or folded under the roller.

(11) Bring the padding over the roller from the delivery side and place a chalk mark at the point of contact at each end of the roller.

(12) Start the machine and feed in the padding; allow the machine to run for 10 minutes, thus permitting the padding to bed down.

(13) Stop the machine when the chalk marks denoting the inner edge of the cloth are 6 ins. above the delivery edge of the bed.

(14) Turn back the padding and taper the edge along its whole length.

(15) Allow the machine to revolve 2 or 3 times to bed-in the tapered edge.

TOP SHEETING

(*Note.*—The sheeting should be thoroughly washed and carefully ironed before use, and a spare top sheet should therefore always be ready for immediate use.)

(16) Cut to length of roller plus 4 in. by twice the circumference of the padded roller.

(17) Stop the machine and throw back the last 18 in. of the padding. Place the sheeting on the roller and return the padding to its previous position. The padding will now lap over the first 18 in. of sheeting. Start the machine and feed the sheeting on to the roller maintaining a slight and even tension on the sheet.

Notes

(i) A steel tape or a caliper type gauge is normally provided with each machine, the length of which is equal to the correct final padded circumference of the roller.

(ii) Complete turns of material should always be used to preserve a true circular shape.

(iii) The clothing for the machine is expensive, and economy in use should be exercised. As the padding compresses it may be possible to make up the diameter of the roller by the addition of one round of calender sheeting or previously used knitted cotton padding.

14. Tests after reclothing

It is important that the roller be neither under nor over-clothed, and after reclothing the following tests should be applied:

(*a*) Start the machine and feed in a piece of tape. If this can be pulled out after going in a few inches the roller is underclothed. In this condition the roller is resting on the bottom of the bed and off the sides. The tape should be fed in at each end and in the centre to test the alignment of the roller.

(*b*) After adding more clothing, re-test in the same manner.

(*c*) Overclothing will be denoted by excessive pressure on the feed and delivery edges of the machine, and clearance between the bottom of the roller and the bed. The latter can be tested with a thin steel rule.

(*d*) The correct amount of clothing can best be determined from experience. New clothing compresses slightly, and a small degree of overclothing may correct itself after a few hours' running.

15. Double roll machines

When clothing double roll machines the back roller should be covered first.

16. General maintenance

(*a*) For maximum efficiency the steam supply to the bed and roller must be maintained constantly at the working pressures for which they are designed. The steam pressures normally adopted by makers are 100 lb. per sq. in., and 10 lb. per sq. in., for the bed and roller respectively.

(*b*) The steam traps, safety valves and safety fingerguard device should be maintained constantly in an efficient condition.

(*c*) All bearings should be kept clean and lubricated regularly, particular attention being directed to the trunnions, lifting screws, link gear of the safety fingerguard device, and to the maintenance of the correct level of oil in the gearbox.

RETURN FEED TYPE

17. General remarks

The return feed type ironing machine has been developed with a view to conservation of space, which is of major importance in shipboard laundries. The fundamental difference between this machine and the types previously described is that work is entirely handled from the front of the machine. Articles are fed into the machine at the top of the roller and delivered from the bottom. Work troughs are provided at the top (feed) and bottom (delivery) positions.

18. Description

The machine, Fig. 59, is largely of fabricated construction, the steel main frame and end pedestals being designed to support the bed, roller and driving mechanism. The steel roller, 25 ins. diameter by 56 ins. long, is of the ventilated type, and is provided with a flexible covering. The bed opening is arranged

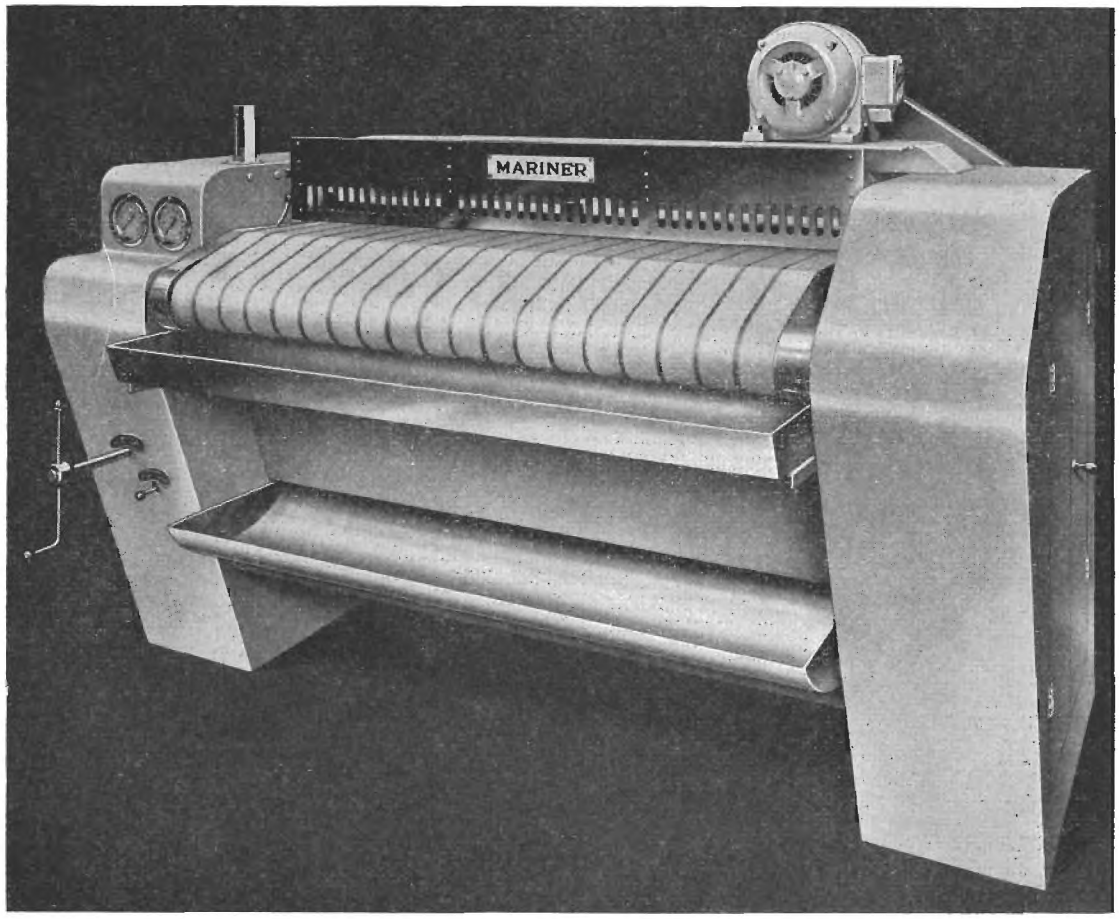


Fig. 59.—Arrangement of T. Bradford 56 × 25-in. return feed flatwork ironing machine.

in the vertical plane, *i.e.*, the ironing bed is vertically mounted in the main frame. The working steam pressure of the roller is 10 lb. per sq. in., and that of the bed 100 lb. per sq. in. Separate steam traps, fitted with strainers and by-pass arrangements, are provided for the condensate from the bed and the roller; the latter is also automatically air vented. Pressure gauges for registering the steam pressures in the bed and the roller are mounted in the front casing of the machine.

The motor is fixed to the top casing of the machine, the drive to the main driving-shaft pulley being through vee belting. Power is transferred through a clutch to a worm, which engages with the main wormwheel mounted on the roller trunnion, Fig. 60. The clutch is disengaged immediately the safety finger-guard is operated.

The roller trunnion-bearing housings, see Fig. 61, are mounted on a slide. Provision is made for moving the roller into or away from the bed, for cleaning and re-clothing and to obtain the required variations of pressure between the bed and the roller for different classes of work. The roller is moved by means of a handwheel, situated at the front left-hand pedestal of the machine, which operates the square-thread pressure and traversing screws through chain reduction-gearing. The chain gearing enables simultaneous movement to be obtained at both ends of the roller. The pressure screws are connected by a wire cable to a pressure indicator, which registers the amount of spring pressure between the roller and the bed. Separate provision for independent hand adjustment to the roller is arranged at the non-gear end of the machine.

19. Ventilated roller with flexible covering

The roller, Fig. 62, is of the built-up drum type. A wire mattress A is fitted over the whole surface of the roller, and is secured at the joint by spiral wire lacing. Driving studs are used to locate the mattress and to prevent it creeping on the roller. The wire mattress serves as a base for the roller coverings D which comprise :

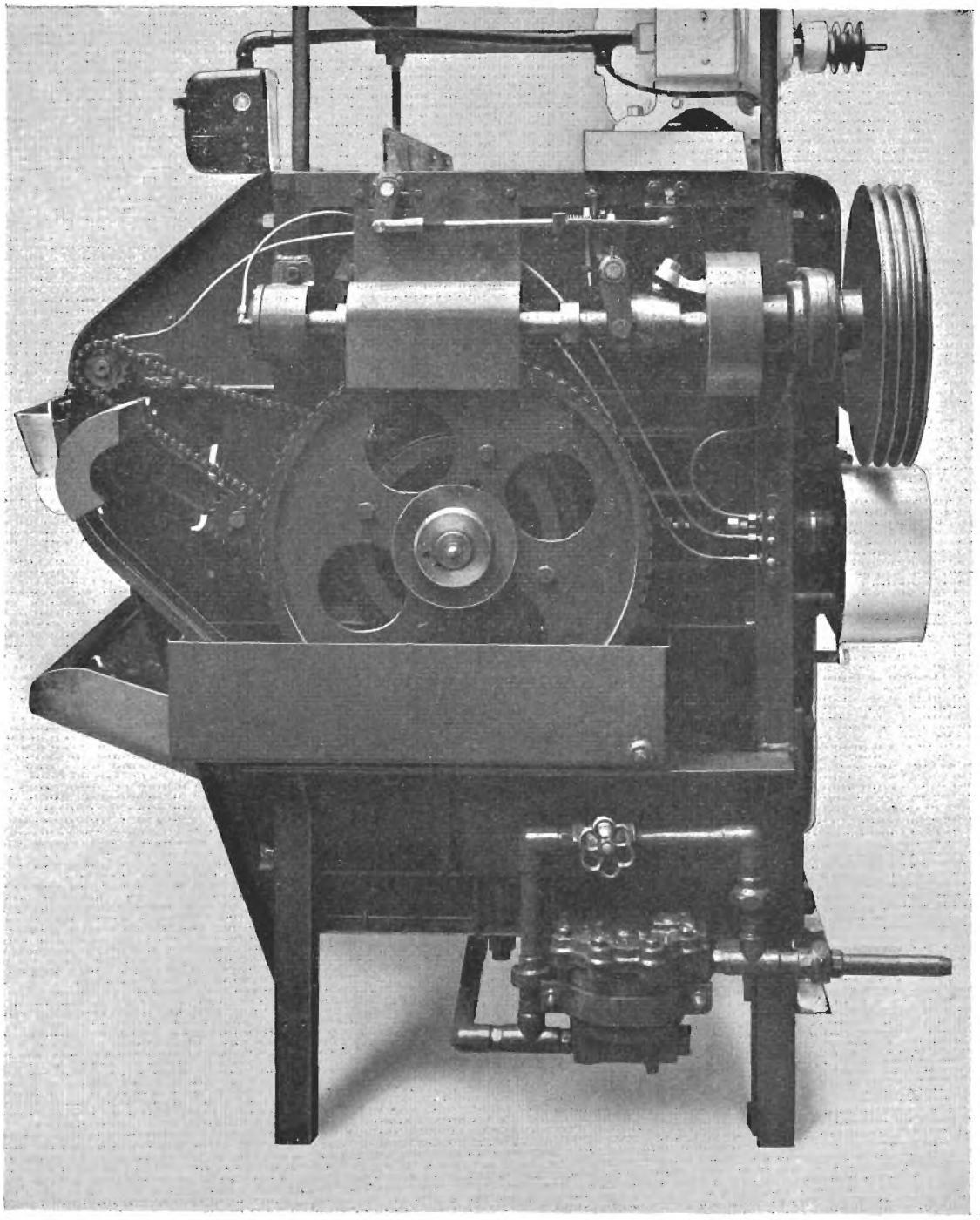


Fig. 60.—Arrangement of gear drive for 56 × 25-in. return feed flatwork ironing machine.

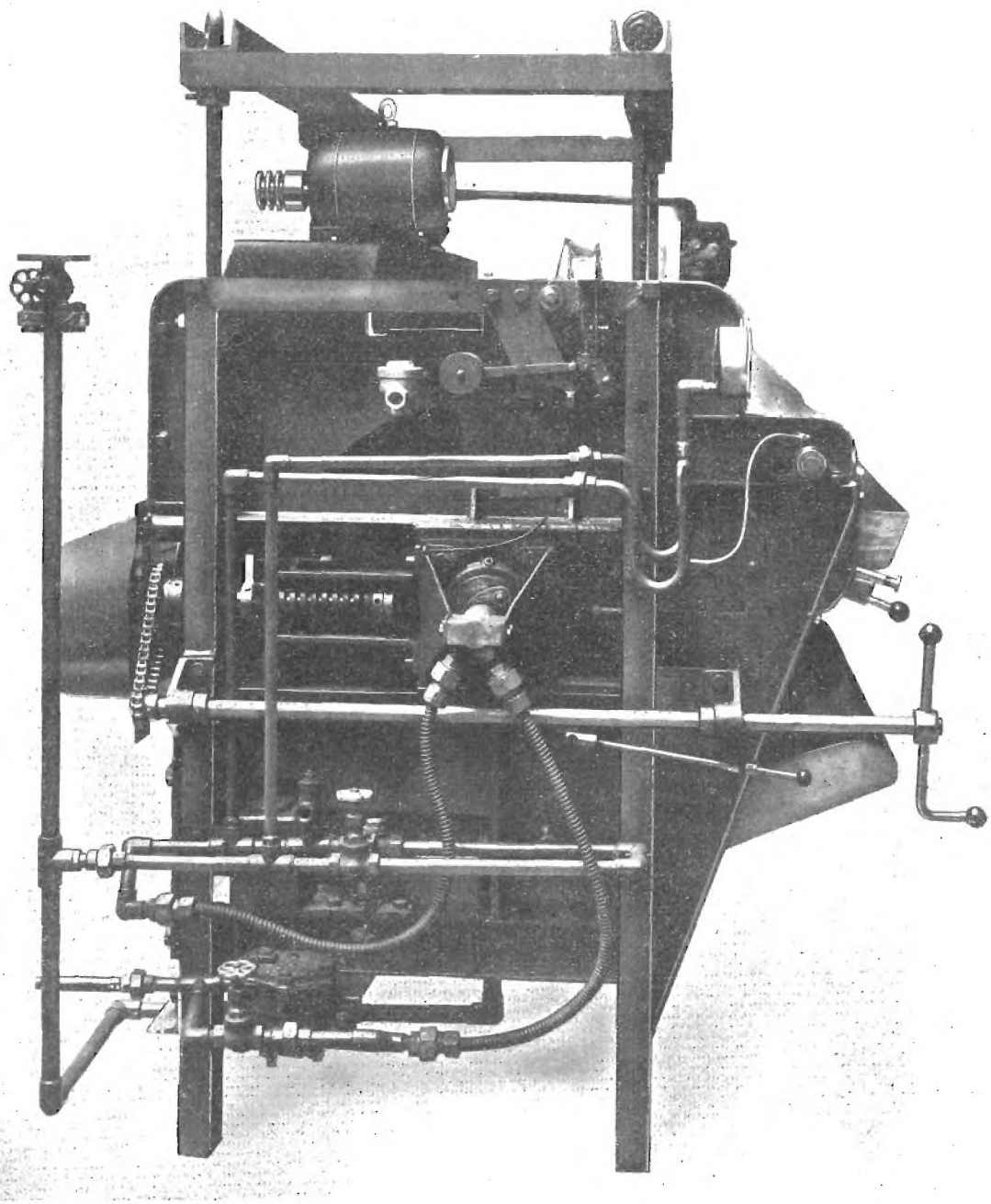


Fig. 61.—Arrangement of non-gear end for 56 × 25-in. return feed flatwork ironing machine.

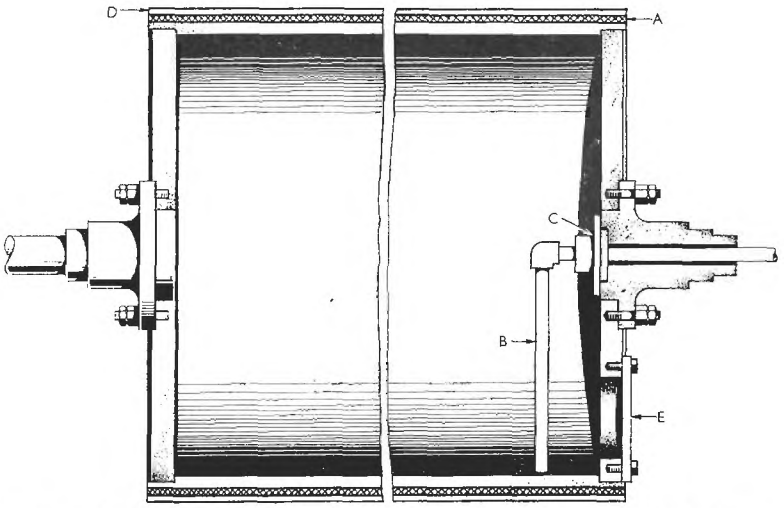


Fig. 62.—Ventilated roller for 56 × 25-in. return feed flatwork ironing machine.

2 wraps of Burlap (*i.e.*, coarse canvas)—56 in. by 158 in.

2 wraps of $\frac{1}{4}$ in. thick knitted padding—56 in. by 158 in.

1 $\frac{1}{2}$ wraps of thin binder sheeting—56 in. by 118 in.

1 $\frac{1}{2}$ wraps of thick sheeting—56 in. by 118 in.

The flexibility of the roller is obtained by the use of the knitted padding, which imparts a cushioning effect to the roller coverings, enabling buttons, etc., to be passed through the machine without damage to them.

Re-covering may be effected by the use of the alternative materials:

2 wraps of $\frac{1}{16}$ in. asbestos—56 in. by 158 in.

2 wraps of $\frac{1}{4}$ in. knitted padding—56 in. by 158 in.

3 wraps of Egyptian cotton sheeting—56 in. by 236 in.

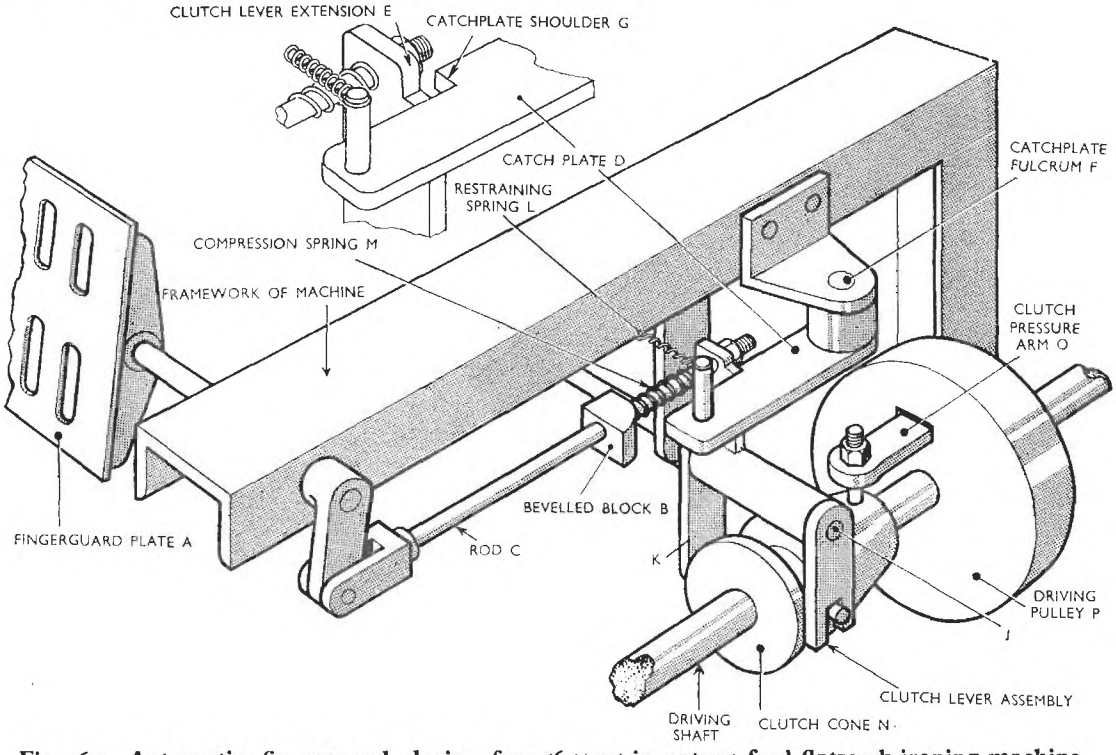


Fig. 63.—Automatic fingerguard device for 56 × 25-in. return feed flatwork ironing machine.

Steam is admitted to the roller at the non-gear end through the trunnion at C, and the condensate is syphoned away through the pipe B. An inspection plate E is provided for maintenance purposes. Ventilation of the roller is arranged as follows: Moisture is freely extracted from the work being ironed, and passes through the clothing to the annular space formed by the wire mattress between the roller coverings and the roller drum.

The free vapour is emitted at both ends of the roller.

20. Automatic finger guard (*Fig.* 63)

Motion of the finger-guard plate A when pushed towards the machine is transmitted to the bevelled block B which is fixed to the rod C. The bevelled face of B causes the catch plate D to swing about its fulcrum F against the tension of the catch plate restraining spring L until the catch plate shoulder G is clear of the extension E on the clutch lever EJK.

When the catch plate is cleared, the compression spring M is released immediately and the clutch lever pivots about its axis JK, so withdrawing the clutch cone N from the clutch pressure-arm O, thus allowing the driving-pulley P to revolve freely without driving the machine.

The guard is re-set by pulling the finger guard plate A forward; movement of the rod C is communicated to the clutch lever EJK, the vertical member (KE) of which travels along the face of the catch plate D, against the pressure of the spring M. The catch plate D is constrained to return to its original position by the tension of the spring L.

The clutch lever slides along the face of the catch plate until the clutch lever extension E drops into position in front of the catch plate shoulder G. The finger-guard is then in the set safety position and clutch cone N engaged for driving.

21. Re-clothing the roller

(1) Withdraw the roller to its maximum position clear of the bed, with the stripping fingers of the " riband feed " in the cleaning position.

(2) Shut off the steam supply to the bed and roller and allow the machine to cool. (If re-clothing is commencing after a period of idleness of the machine, the roller should already have been partially withdrawn from the bed and steam supplies shut off in accordance with standing instructions.)

(3) Remove the feeding trough from the front of the machine.

(4) Remove the worn out clothing.

(5) Before commencing to re-cover the roller it is imperative that the surface of the bed is perfectly clean. With the roller 1 in. clear of the bed and with the stripping fingers of the riband feed still in the cleaning position, feed a clean cloth between the rotating roller and the ironing surface of the bed. *Important.*—See also separate description para. 23 (*b*) " access to the bed for cleaning."

(6) Pre-heat the bed of the machine. This is accomplished more quickly by first by-passing the steam trap. As the bed warms up, the by-pass valve should be closed, thus allowing the condensate to pass through the strainer and trap.

(7) Adjust the roller until the wire mattress is $\frac{1}{2}$ in. clear of the bed surface; covering may now commence.

(8) Place the burlap across the front of the roller, below the riband feed table, and stitch the leading edge to the wire mattress with strong twine. Rotate the roller until the whole length of burlap (158 in.) is wrapped on the roller, excepting a length of 28 in. which is to remain for overlapping the knitted padding.

(9) Place the $\frac{1}{4}$ in. thick knitted padding under the burlap, *i.e.*, having 28 in. of burlap overlapping, care being taken to ensure that the knitted padding is kept square and parallel across the face of the roller. Rotate the roller until the leading edge of the knitted padding is in the centre of the bed. Now traverse the roller until the covering just contacts the surface of the bed, and apply two wraps. Ensure that all creases are removed from the knitted padding during this process.

Allow the roller to rotate in the bed with the knitted padding in light contact with the bed surface until the clothing is thoroughly bedded on the roller.

(10) Check the overlap of the knitted padding in relation to the leading edge and after allowing 2-in. overlap, cut away all surplus material.

(11) Lap the thin binder-sheeting 28 in. under the knitted padding and apply the $1\frac{1}{2}$ turns, taking care that the leading edge is square with the roller and that all creases are removed as the covering is applied.

(12) Allow the covered roller to rotate in the bed for a period, and then apply $\frac{1}{4}$ in. of spring pressure.

(13) Replace the feed trough, and return the stripping finger section of the riband feed to the normal working position.

(14) Heat the roller, first by-passing the steam trap. When the roller is warm, close the by-pass.

(15) The machine should now be used for a period of ironing thin articles only, and when the covering has bedded down the spring pressure increased to $\frac{1}{2}$ in.

(16) Check the circumference of the roller with the measuring tape provided. The outer thick sheeting must not be added until the covering is reduced to gauge size, *i.e.*, $78\frac{1}{2}$ in.

(17) When the correct gauge is reached, reduce the spring adjustment to $\frac{1}{4}$ in. and apply the final covering as follows: Lap the thick sheeting 28 in. under the thin binder sheet and apply the $1\frac{1}{2}$ turns. After covering, increase the spring adjustment to $\frac{1}{2}$ in.

The machine may now be used for normal work.

22. Operation

To prevent the scorching of the coverings, the roller must always be traversed clear of the bed when the machine is not in use.

The roller diameter should be frequently checked, and should it be found that the clothing is not parallel along its length, the necessary adjustment should be

made by means of the independent hand adjustment roller pressure nut, at the non-gear end of the machine.

The bed and roller must be thoroughly warmed through before the machine is brought into use. When starting up from cold, the steam traps on both the bed and roller should be by-passed to clear the condensate. As the machine warms up, the by-pass valves should be closed.

When the machine is thoroughly warm, the roller should be traversed into the bed by means of the hand wheel provided at the non-gear end of the machine.

When the roller contacts the ironing surface of the bed, further movement of the hand wheel applies spring pressure simultaneously to each end of the roller.

The spring pressure adjustment used for body linen should not be greater than $\frac{1}{2}$ in. and that for flatwork, a maximum of 1 in.

The machine should be operated with the stripping gear in use and articles must not be allowed to accumulate in the delivery tray.

Use all the surface of the roller; constant feeding of small articles or thick materials in one place causes uneven wear on the padding.

Before closing down for the day, run the machine idle for a period of about 5 minutes with light surface contact between the bed and the roller, to allow the clothing to dry.

Before using the machine for the first time each day, test the finger guard to ensure that safety arrangements are working satisfactorily.

23. Adjustments

(*a*) RIBAND FEED.—The tension of the riband feed bands is maintained by a control lever at the non-gear end of the riband feed roller. If the bands stretch beyond the adjustment provided, remove the inserts in each band and re-adjust the tensioning gear accordingly.

(*b*) ACCESS TO THE BED FOR CLEANING.—The finger-guard is arranged to swivel from the vertical to the horizontal position by withdrawing the plunger at the gear end. This gives access to the bed for cleaning. When the guard is so positioned, an automatic stop makes it impossible for the driving clutch to be engaged, and the machine cannot be started until the guard is returned to the safety position.

In addition, the stripping finger section of the riband feed-table can be withdrawn by the lever at the non-gear end of the machine, to give increased clearance between the stripping fingers and the front of the bed.

The roller must be traversed to its maximum position from the bed prior to cleaning.

24. General

MAINTENANCE

For maximum efficiency the steam supply to the bed and roller must be maintained constantly at the working pressures for which they are designed, namely, 100 lb. per sq. in. for the bed and 10 lb. per sq. in. for the roller.

Steam traps, fittings and safety finger-guard devices should be maintained constantly in an efficient condition.

Lubrication of all parts should be applied in small quantities but at frequent intervals as follows:

TRUNNION BEARINGS.—These are arranged for forced feed (grease gun) lubrication and require high melting point grease.

WORM SHAFT BEARINGS AND RIBAND FEED ROLLER BEARINGS.—These are arranged for grease lubrication from battery mounted lubricators at the gear and non-gear side frames.

The following points require oil lubrication:

ROLLER HOUSING SLIDES.—Oil holes are provided in the top of the slides over the bearings, also at the front of each housing.

PRESSURE SCREWS AND ROLLER TRAVERSING GEAR, *including sprocket wheels*.—Bearings and hand wheel shaft bearings are provided with oil holes.

FINGER-GUARD AND CLUTCH.—All pins operating the clutch from the finger-guard, clutch lever, dogs and sliding cone should be lubricated.

STRIPPER GEAR SPINDLE.—Oil holes are provided in each bearing.

FINGER GUARD SPINDLE.—Oil holes are provided in the guards over the spindle bearings.

WORM DRIVE.—The oil well should be sufficiently filled to submerge the teeth of the worm wheel to a depth of $\frac{1}{2}$ in. when the gear is at rest. This makes provision for lubricating the chain drive and tensioning gear to the riband feed roller when the machine is in motion.

STEAMWAY GLAND.—At the non-gear end of the roller should be lubricated daily.

25. Preparation of work

(*a*) All items to be finished in the flatwork ironer require preparation to enable the work to be fed easily into the machine and to help to maintain a continuous output.

(*b*) On removal from the hydro-extractor, all items should be " shaken out."

(*c*) After shaking out, small articles should be made up into conveniently sized bundles and placed on the preparing table in the front on the machine. Articles should be laid with the wrong side up.

(*d*) Large items such as sheets and tablecloths should be folded concertina fashion throughout their whole length into folds of about 12 ins., and built up into piles of 10 articles.

(*e*) The length of the machines installed in H.M. ships will not normally permit large items being passed through the machine lengthwise. Such items should be folded in two prior to folding in concertina fashion.

(*f*) With reference to (*e*), as the article is of double thickness it will not be completely dried after one pass through the machine, and a second pass will be necessary. See also the remarks on part drying, Chapter VI, para. 14.

(*g*) All articles should be fed perfectly straight into the machine.

26. Processing

Methods to be used for folding large items such as tablecloths and sheets, following ironing, are indicated in Fig. 64.

In all cases care should be taken to ensure that the laundry number is visible when the article is folded.

ASBESTOS CLOTHING

(see also Table No. IX)

27. As stated in para. 12 (*a*) asbestos clothing is now in wide use in commercial laundries. The basic details for reclothing such machines with asbestos are as follows:

(*a*) Three, and for certain makes of machines four, complete turns of coarse asbestos (K15 or equivalent) are applied next to the roller.

(*b*) Two complete turns of fine asbestos (K203 or equivalent) are then applied followed by

(*c*) Two complete rounds of cotton sheeting.

(*d*) When the clothing is thoroughly bedded in and wear-down takes place, the two rounds of clothing referred to at (*b*) above are removed and three rounds of fine asbestos substituted. Trials have shown that the machines can be run for in some cases 6 months before reboistering of the diameter of the roller is necessary.

(*e*) The normal expected life of such clothing is:
Top sheeting, 300 working hours
Fine asbestos, 12 months minimum
Coarse asbestos, 3 years minimum.

28. 120 in. × 24 in. Double-roll ironing machine

Initial Clothing with Asbestos

(*a*) GENERAL PROCEDURE

(1) Raise the rollers as high as possible above the bed of the machine.

(2) Carefully remove the old clothing from the roller.

(3) Preheat the rollers and bed.

(4) Clean the rollers before cleaning the bed.

(5) Clean and wax the bed.

(*b*) FRONT ROLLER

(1) Lay the coarse clothing on the roller; ensure that the leading edge is parallel with the lip of the bed.

(2) Secure the clothing around the roller nuts at each end to prevent slipping back. In the case of fluted rollers, the clothing can also be wedged in one or two flutes as an additional measure.

In the case of smooth rolls of the perforated type, the cloth should be anchored to the rolls by means of small wooden pegs spaced at 12 in. intervals, and driven into the perforations about 3 in. from the edge of the cloth.

In the case of smooth rolls without perforations, the cloth should be anchored to the roll by a heat-resisting cement, *e.g.*, " Trojan."

(3) Damp the leading edge of the asbestos cloth to prevent it turning back.

(4) Start the machine and feed on the clothing until the whole length of cloth is wrapped around the roller. To ensure a smooth roller surface, constant smoothing should be done during the " feeding on."

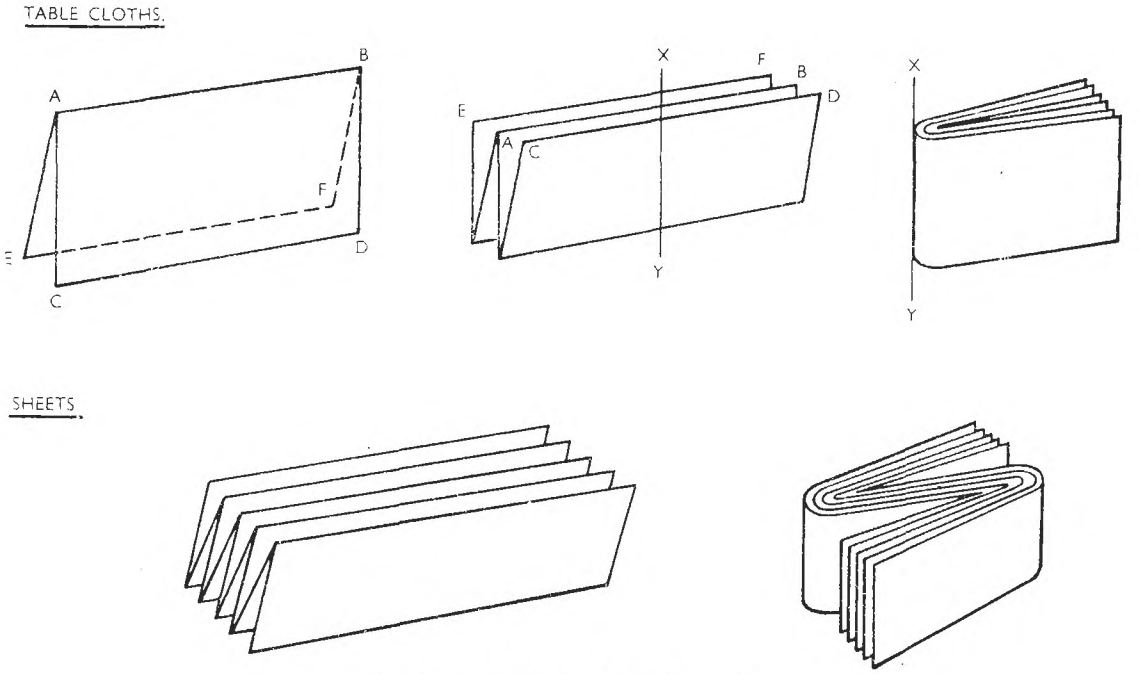


Fig. 64.—Method of folding flatwork.

(5) Cut back the asbestos to exactly three turns on the roller. In cutting back, follow the weft.

(6) Turn the coarse asbestos back, half a turn.

(7) Insert the fine asbestos clothing under the turn-up, and feed on to the roller.

(8) Cut off the fine asbestos to exactly two turns, again following the weft.

(9) Lay the asbestos back, half a turn.

(10) Insert the sheeting under the turn-up and feed on two complete turns.

(*c*) BACK ROLLER

Procedure as for front roller.

29. Single roll machines

Proceed as for (*a*) and (*b*) above, using the number of rounds indicated in Table No. IX.

30. Intermediate clothing

When the roller becomes undersized from the bedding in of the clothing, the two turns of fine asbestos clothing should be removed and replaced by three turns.

The material removed can be used for press coverings etc.

31. Care of clothing

(*a*) It is important that the roller be neither under nor over-clothed; after clothing, tests as detailed in para. 16 should be applied.

(*b*) The rollers should always be raised clear of the bed when not in use; this is particularly important when steam is on, because although it is of asbestos construction the fabric is not impervious to scorching.

(*c*) The clothing should be manipulated at the end of each working week (if practicable) in the case of single roll ironers, and for double roll ironers whenever the tapes or top covers have to be changed. On such occasions it is advisable that the whole of the fine asbestos be removed, and the finishing round of coarse asbestos be allowed to hang loose for as long a period as possible. By such periodic manipulation, it will be found that the rolls keep up to size, with a consequent improvement of finish and a higher rate of production.

CHAPTER VIII

Presses and Pressing

1. The introduction of mechanically-operated presses has reduced the necessity for hand ironing to a minimum. To meet requirements in the vast field of work which is capable of being pressed mechanically, manufacturers have developed numerous types of presses ranging from general purpose machines to those designed for specific duties such as shirt, coat and pillow-slip work.

The size of machines manufactured for a particular duty varies also with individual makers, so that a very wide choice of machinery is available to the laundry trade.

Fig. 65 (on pages 78–79) illustrates a typical selection of lower buck press specifications, and demonstrates the flexibility of manufacture available.

PRESSES, ETC.

2. Types of presses used in Admiralty services

The following types of presses are in general use in H.M. Ships and Shore Establishments and the products of numerous manufacturers are accepted.

General purpose press with rectangular buck—Fig. 66.

General purpose press with tapered buck—Fig. 67.

Shirt bosom press with neckband attachment—Fig. 68.

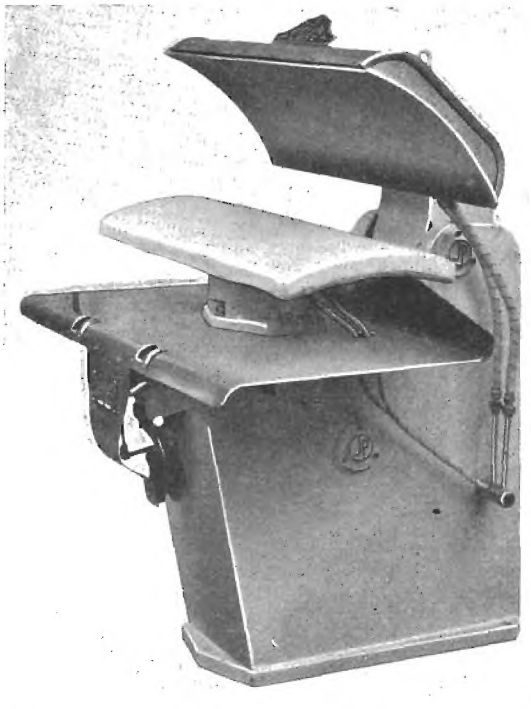


Fig. 66.—General purpose press with rectangular buck.

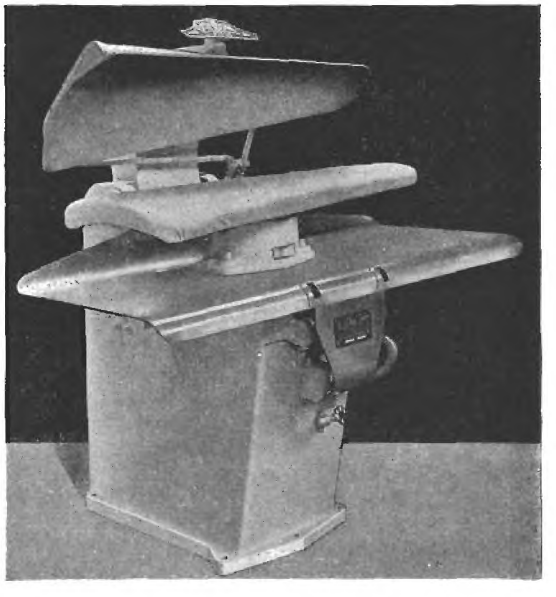


Fig. 67.—General purpose press with tapered buck.

Shirt body press (also G.P. press with rectangular buck)—Fig. 66.

Collar and cuff (triple head) press—Fig. 69.

Single yoke press
Duck coat press
Garment press
} Not illustrated.

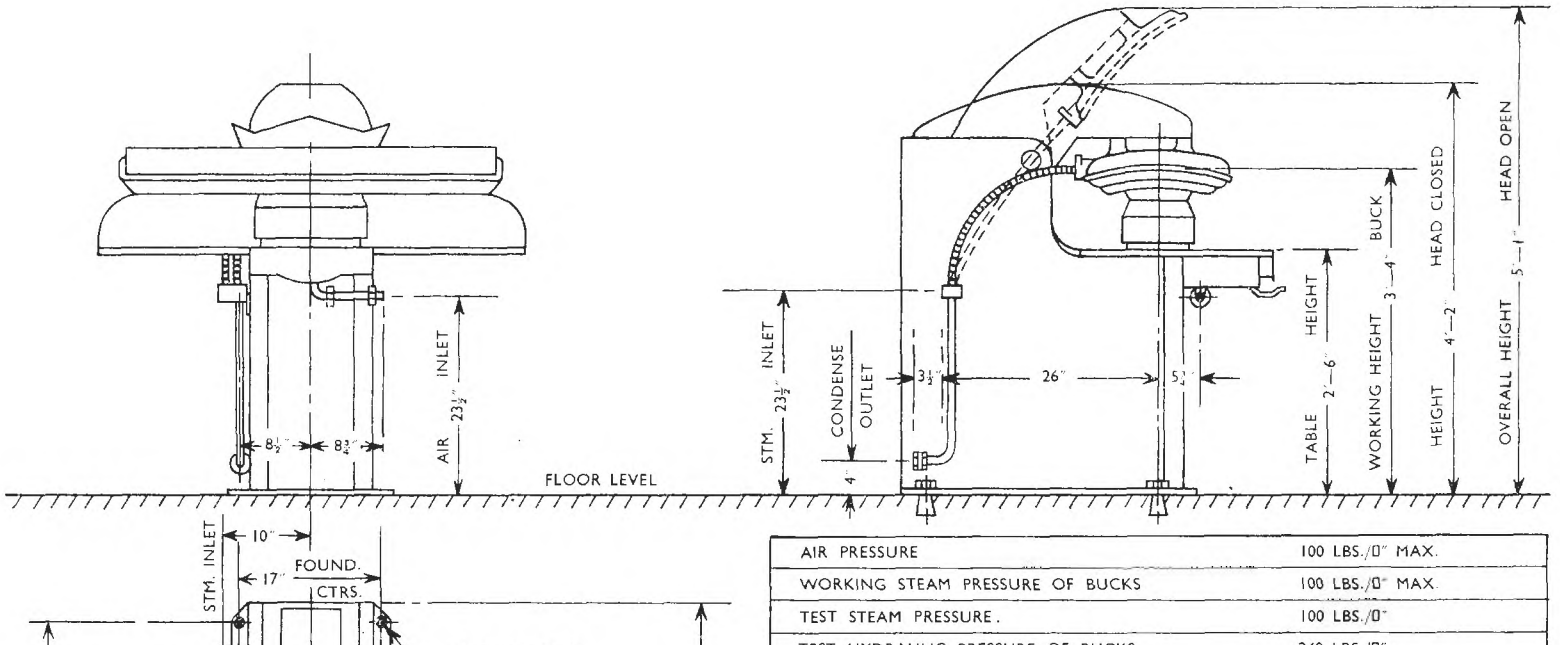
3. Classification

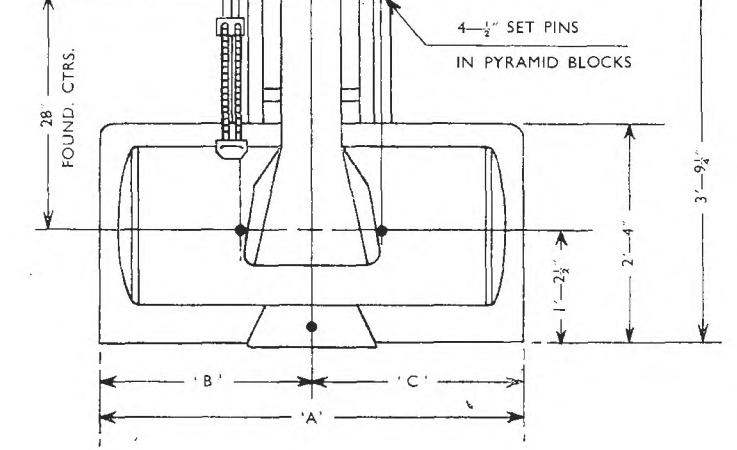
Presses can be classified generally into three groups, namely:

(*a*) Presses having a stationary lower buck with a moving head.

(*b*) Presses having a fixed head with one or two movable lower bucks.

(*c*) Garment presses used mainly in conjunction with a dry cleaning unit for pressing woollen and serge materials.





AIR PRESSURE	100 LBS./□″ MAX.
WORKING STEAM PRESSURE OF BUCKS	100 LBS./□″ MAX.
TEST STEAM PRESSURE.	100 LBS./□″
TEST HYDRAULIC PRESSURE OF BUCKS	240 LBS./□″
AIR INLET	¼″ B.S.P.
MAIN STEAM INLET	⅜″ B.S.P.
CONDENSE OUTLET	⅜″ B.S.P.

VARIABLE DIMENSIONS OF TABLES

TYPE Nos.	'A'	'B'	'C'
1	4′—11″	2′— 2″	2′— 9″
1A, 6A	5′— 9″	2′— 2″	3′— 7″
2, 3, 3A, 3B, 4, 5, 5A, 5TS	4′— 4″	2′— 2″	2′— 2″
7, 7A	5′— 6″	2′— 9″	2′— 9″
8	6′— 0″	3′— 0″	3′— 0″
30	3′— 6″	1′— 9″	1′— 9″

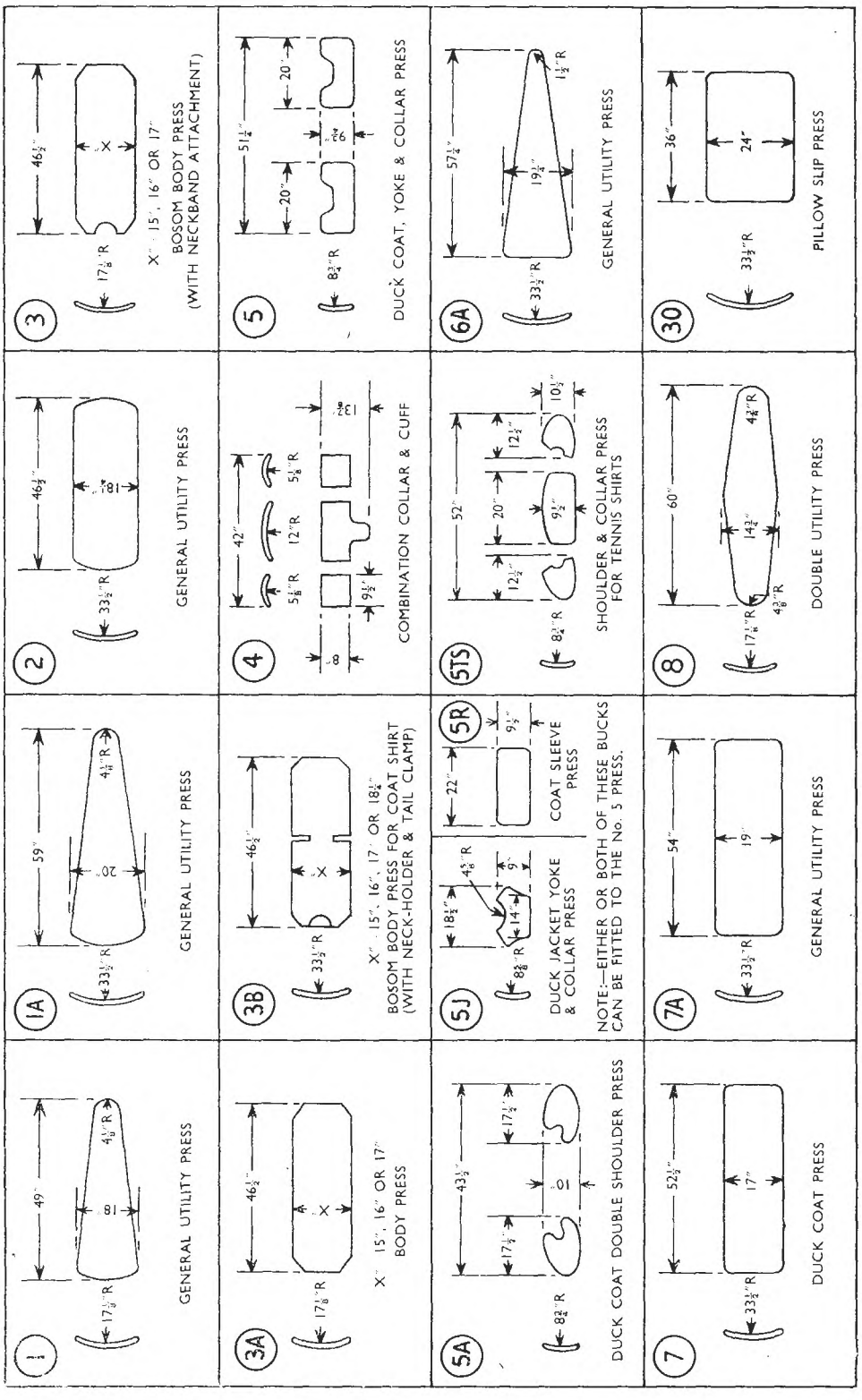


Fig. 65.—Typical shapes of press bucks.



Fig. 68.—Shirt bosom press with neckband attachment.

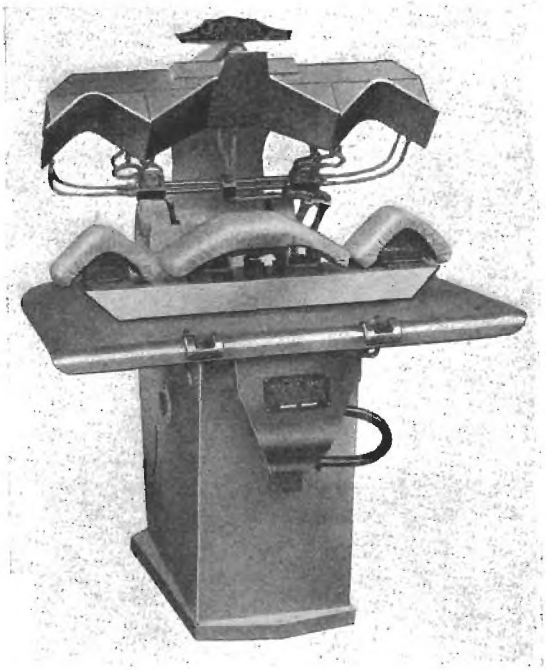


Fig. 69.—Triple head, collar and cuff press.

STATIONARY LOWER BUCK PRESSES

4. Description of typical press

In its essential features and irrespective of the duty for which the press is designed, the machine consists of a pedestal base (preferably of fabricated construction for shipboard use) carrying a steam-heated stationary lower buck on which the work to be pressed is placed.

A steam-heated press-head is brought into contact with the work to be pressed by means of a system of levers. The work is processed in the damp condition as received from the hydro, and the heated head serves the dual purpose of both drying and imparting finish to the garment.

A table, supported on the pedestal below the fixed buck, is provided, on which the work can be conveniently prepared for pressing.

The steam supply adopted practically universally by all press manufacturers to both the head and the lower buck, is 100 lb. per sq. in.

A noteworthy feature of most presses is the flexible steam and drain piping necessitated by the movement of the press head. The air supply pressure necessary for efficient operation is approximately 85 lb. per sq. in., but in all instances the pressure recommended by the individual maker should be worked to. The drains from the head and lower buck are trapped.

THE LOWER BUCK

This is a steam-heated chamber having a convex top, the contour of which varies with the duty for which the press is designed. The pressing surface of the buck is resilient, and in most cases the buck seat is given a further measure of flexibility in its mounting. The latter feature assists in the preservation of complete alignment when contact with the upper head is established, and thus ensures an even distribution of pressure over the whole surface of the lower buck. In most makes of press the resiliency is obtained by means of spring padding, a typical example being that adopted by Messrs. Wm. Jack in the Jaxon type press, Fig. 70.

With this press the buck is built up in the following order:

(*a*) Springs, easily detachable for replacement

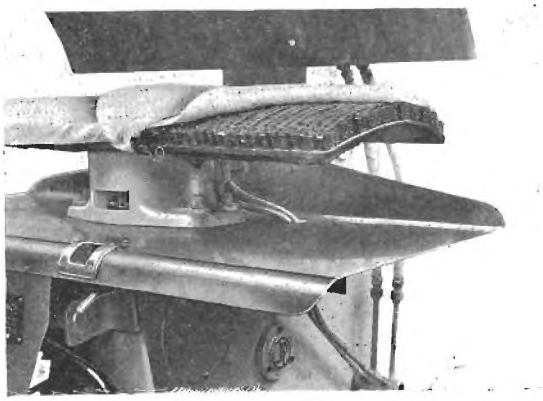


Fig. 70.—Typical build up of lower buck.

purposes, are secured by metal strips to the baseplate of the buck.

(*b*) The springs are covered by a pressed asbestos pad, over which is placed

(*c*) One thickness of canton flannel or knitted cotton padding. A further thickness may be added when the clothing is bedded down.

(*d*) The whole is covered by a single thickness of calico sheeting of sufficient size to provide an overlap reaching to the underside of the buck, thus allowing for a hem to be threaded with cord for tying.

Means are provided to permit of the adjustment of pressure on the buck. This adjustment is usually effected by the provision of lifting screws situated on the underside of the lower buck. Pressure is increased or decreased by raising or lowering the buck within predetermined limits. A tell-tale indicator which registers the pressure on the spring padding is fitted on some machines.

THE PRESS HEAD

This consists of a steel, cast iron, or aluminium alloy steam-heated chamber having a very highly polished concave face, the plated surface of which mates with the padded profile of the lower buck. The polished head is capable of movement in the vertical plane on a fulcrum arm, the fulcrum pin being housed in the press pedestal. The weight of the press head is balanced by means of either counterbalance weights, or restraining springs, which also assist in returning the head from the " closed " to the " open " position.

5. Action of hand-operated presses

A few hand-operated presses are installed in H.M. ships but the majority of the presses installed are of the air-operated type. Manually operated presses have a wide handle fixed to, and projecting from, the head by which the operator pulls the head

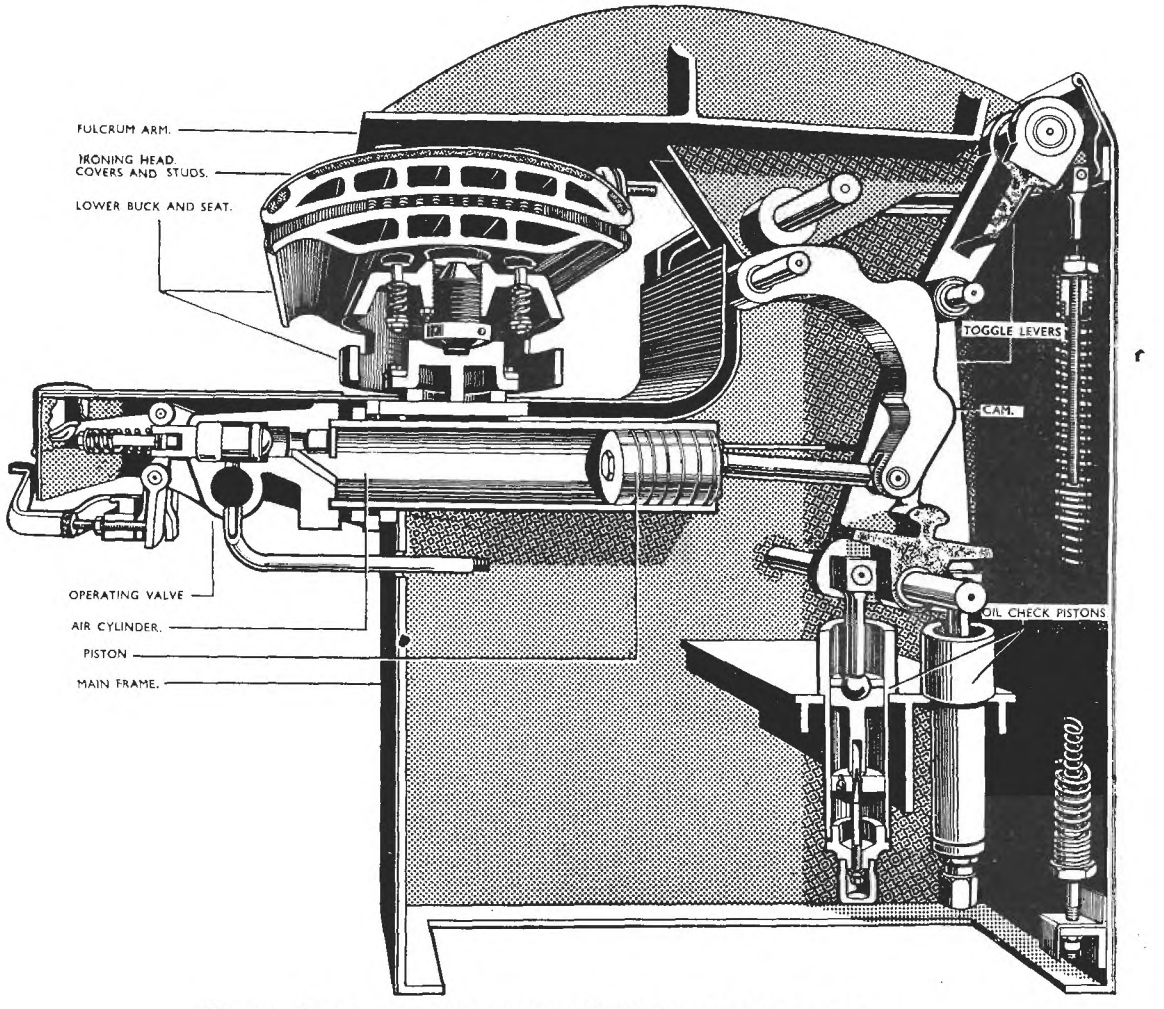


Fig. 71.—Sectional arrangement of Tullis Imperial type press.

down to the lower buck. With this type of press, both hands should always be used to depress the head. This prevents the possibility of burning the free hand, which might occur were one hand only used. When in the closed position, pressure is conveyed from the head to the lower buck by means of a foot-operated lever system, and the pressure maintained by a toggle. Damper gear is fitted to bring the head smoothly to rest on its return to the open position.

6. Action of air-operated presses

The method of operation of pneumatic presses varies with different makers, but in general conforms to the broad principles described below and illustrated in Figs. 71 and 72. Movement of the head is obtained by means of an air-operated piston which conveys pressure to the head by means of a system of levers. The head is retained in the closed position by means of a toggle or cam mechanism, which automatically locks it when closed. The admission of air supply to the operating piston is controlled by two push-buttons situated on the front of the machine. The air circuit is so arranged that both push-buttons must be depressed simultaneously before air is admitted to the cylinder. This is a positive safety device, designed to ensure that the operator's two hands are clear of the buck before the head can be lowered.

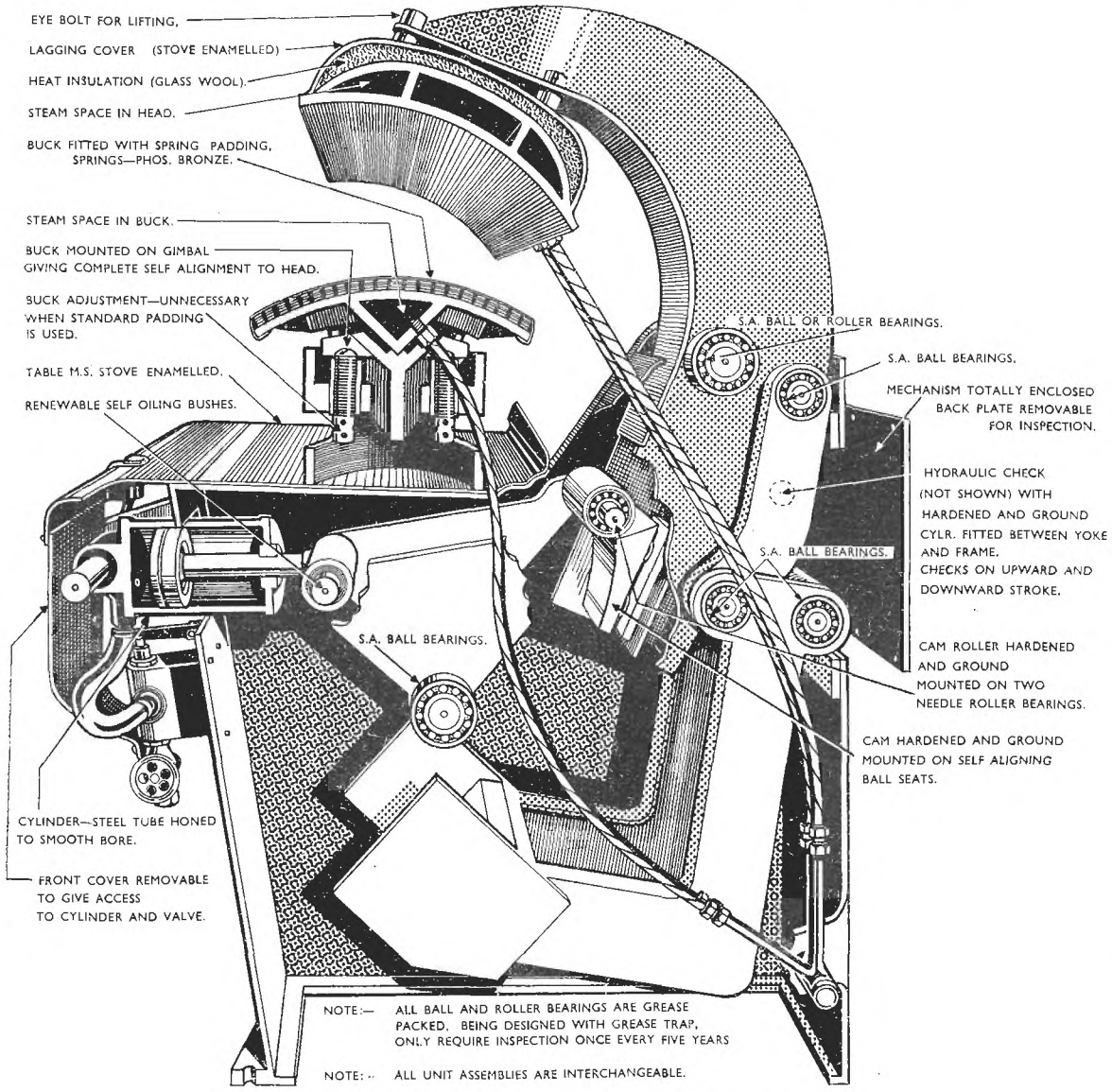


Fig. 72.—Sectional arrangement of Jaxon type press.

A separate lever is provided to exhaust the air from the cylinders; the head then returns to the open position.

Movement of the head is worked in association with a shock-absorbing device. This usually takes the form of an oil-check piston directly coupled to the lever mechanism of the press head, thus ensuring a smooth movement of the head on to the work and the elimination of " slamming " when the head reaches the extreme up or down positions of travel.

7. General maintenance

(*a*) All bolts, nuts, etc., should be kept properly secure, as the securing arrangements have a tendency to work loose.

(*b*) The machine should be regularly lubricated, particular attention being directed to the maintenance of the correct quantity of oil in the " oil check " mechanism.

(*c*) Air and steam connections must be kept tight, particular attention being paid to the steam glands and connections at the ends of the flexible steam and drain pipes.

(*d*) The steam-trap and air-strainer should be constantly maintained in an efficient condition.

(*e*) The press should not be allowed to continue working if a slamming action develops on the down or return stroke. If slamming occurs, immediate adjustment should be made.

(*f*) The press head should be kept in the open position when not in use, to prevent the padding from being scorched.

(*g*) The press should be constantly maintained in a clean condition externally, and the mechanism kept free from accumulations of dust, lint, and excessive oil and grease.

(*h*) The air supply to the press should be " shut off " when making internal adjustments.

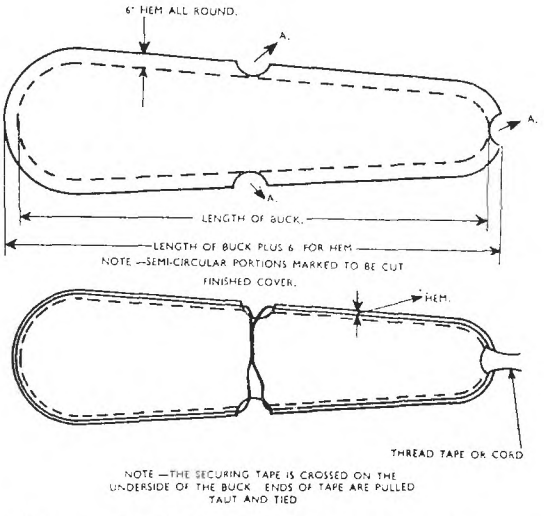


Fig. 73.—Method of cutting out a press cover.

CLEANING THE POLISHED HEAD

Particular care is necessary to preserve the highly polished surface of the press head. On no account must harsh abrasive or liquid metal polish be used. The press head should be cleaned daily with powdered chalk or lime on a damp cloth. Alternatively, the press head can be cleaned when hot by briskly rubbing the surface with a paraffin-waxed rag.

At the end of each day's work, the polished surface should be thinly smeared with a film of paraffin wax. This prevents condensation overnight, with the associated formation of rust. The film of wax should be rubbed off before commencing the day's work.

RE-COVERING THE LOWER BUCK

Ready-made replacement top clothing (press covers) are not supplied, but can easily be manufactured. Fig. 73 illustrates a method of making the replace cover for a general purpose press of the tapered buck type. The same principles can be applied for any shape of buck.

New covers should be washed before use. When the cover is removed for washing, the padding under should be shaken out and allowed to " open up " and soften. At this stage opportunity should also be taken to brush accumulations of burnt fibres and dust from the spring pad. The top cover should be washed weekly, or more frequently if the occasion demands.

TWIN PRESSES

8. Description

These presses are of the fixed head type with movable lower bucks. Various types are manufactured and are designed for specific duties dependent upon the shape of the lower bucks, such as shirt-pressing, duck-coat-pressing or general purpose work.

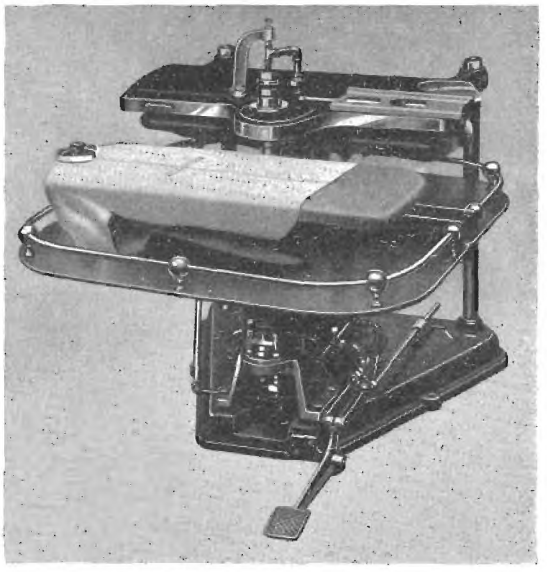


Fig. 74.—Twin rapid type shirt press.

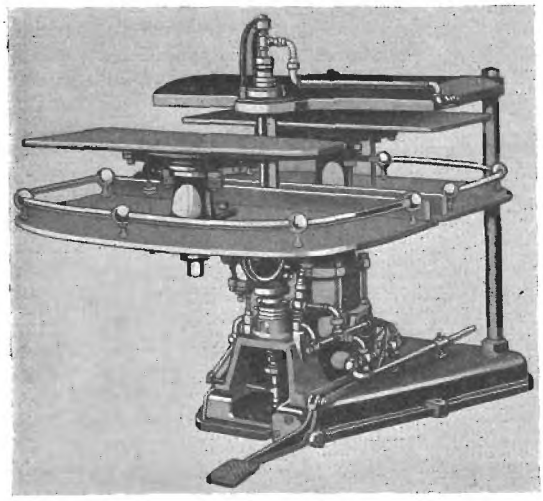


Fig. 75.—Twin rapid type general purpose press.

A number of " twin rapid " shirt presses are installed in Naval laundries.

The press, Figs. 74 and 75, is constructed with a turn table carrying two lower bucks which swing under a header situated at the back of the machine. The head and lower bucks are steam heated to a pressure of 100 lb. per square in. The table is rotated manually, but vertical movement of the lower buck towards and away from the press-head is arranged by air pressure acting on a ram. The bucks are released by pressing the foot treadle in the front of the machine. A centring device is provided to ensure the correct disposition of the lower buck beneath the press head, before vertical movement takes place.

With this type of machine, while the work on one buck is being pressed under the head, the other buck is in front of the operator, allowing removal and relaying of the work to be effected.

Twin rapid presses of a type in which the table is rotated by compressed air are also manufactured.

9. Operation

(1) Before working the press each morning, open the by-pass valve on the $\frac{1}{2}$ in. trap, allowing steam to blow straight through, clearing the circuit of all condensate. This promotes rapid heating of the head and tables.

(2) When the head and tables are thoroughly heated, close the by-pass.

(3) The main air and steam stop valves should be fully open when working.

(4) When the table is central under the head, the pressure is automatically applied by the tappets opening the centre valve and admitting air to the cylinder.

(5) To release the pressure depress the foot lever, and when the table has dropped swing away from the head.

(6) The pressure between the head and the table is automatically maintained. As the padding is pressed down, the ram of the cylinder rises slightly to compensate for the reduced thickness of padding. No adjustments are required.

(7) At least 1$\frac{1}{4}$ in. thickness of padding should be provided on the tables. With thin padding the table has to travel farther to reach the head, which causes unnecessary strain on the banjos and a larger air consumption.

(8) The press can be rotated in either direction.

(9) When the press is not in use the steam supply should be turned off and the bucks lowered away from the press head.

10. Maintenance

(*a*) The machine should be thoroughly examined once a week to ensure that all bolts and nuts are tight, and that all moving parts are properly lubricated.

(*b*) Grease nipples should be given a charge of grease each week.

(*c*) All valves should be properly adjusted to ensure that no leakage of steam and air takes place.

(*d*) The main and centring cylinders should be oiled weekly to keep the cylinder cups in good condition and to prevent corrosion of the cylinder walls.

(*e*) If leakage occurs at the stuffing-boxes, the gland nut should not be tightened excessively. Subject to the spindles being in correct alignment with the

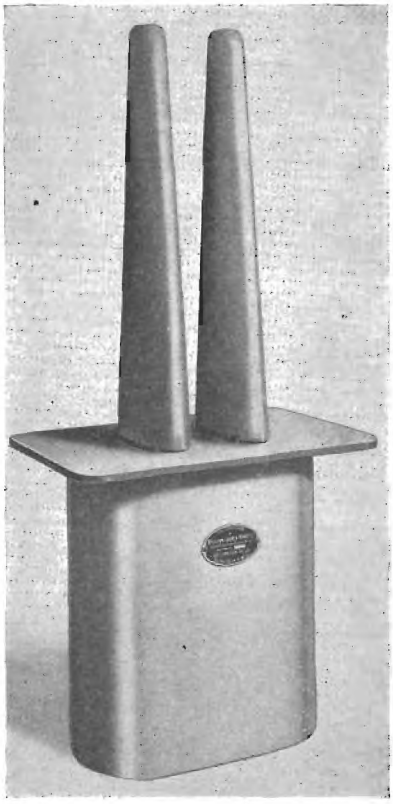


Fig. 76.—Double sleeve form.

stuffing-box, hand tightening of the gland nut should be quite sufficient to maintain a tight steam-joint.

(*f*) Always make sure that the air supply is shut off before making internal adjustments.

OTHER APPARATUS

11. The sleeve form

This item is an important component of the shirt unit and is ued to dry and smooth out the shirt sleeves and gussets.

Sleeve forms are of either the single or double type, and vary in shape according to the duty for which they are required, *e.g.*, shirt work or coat processing. A typical double sleeve form, shirt type, is illustrated in Fig. 76. It consists of two steam heated " formers" mounted on a pedestal type base. Steam at a pressure of 100 lb. per square in. is admitted to the inside of each " former " casting. The drain from the " formers " is led to a steam trap.

12. The shirt-folding table

A shirt-folding table is supplied in large vessels. A typical table is shown in Fig. 77 and consists of a fabricated framework carrying a padded top on which the shirts are folded and " finish " ironed.

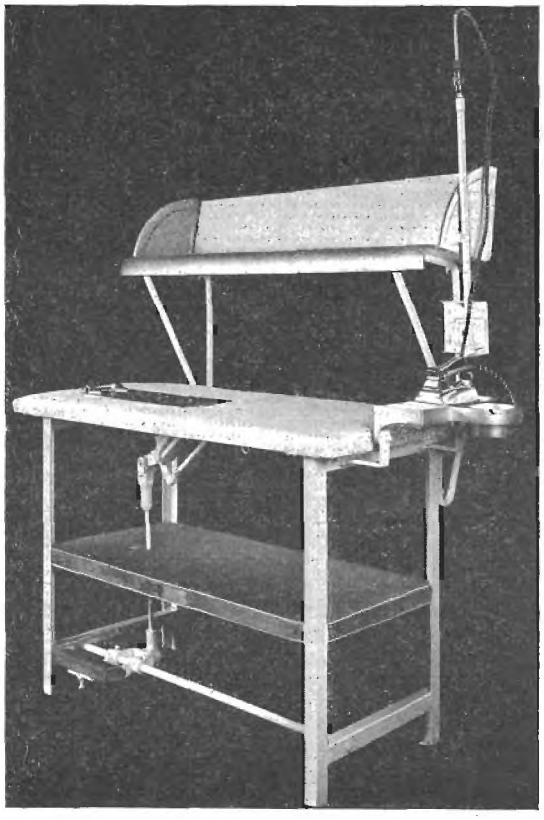


Fig. 77.—Shirt folding table.

On completion the finished articles are placed in the rack above the table. The table is fitted with a hand iron and damping bowl. The shirt is held in position by means of a foot-operated neckband attachment, and is folded around a ~~hinged~~ plate former or folding blade.

PROCEDURE:

(1) Insert a small metal stud in the stud holes.

(2) Lay the shirt face downwards on the folding table.

(3) Depress the foot pedal and place the neckband of the shirt around the neckband attachment.

(4) Release the foot pedal, thus allowing the neckband attachment to grip the shirt firmly, and smooth out the shirt.

(5) Bring the folding blade on to the back of the shirt.

(6) Proceed as ~~(5)~~ to (*k*) of the shirt folding operation described, in para. 16 *i.e.*, when using the shirtboard.

(7) Depress the treadle and slide the shirt off the blade.

(8) Touch up the shirt as necessary with the hand iron provided.

LAYOUT

13. Arrangement of presses on installation

The layout adopted at the installation stage has a large effect on the subsequent production rate which can be obtained from a press unit. In this connection, the presses should be arranged where possible in a sequence of operation from left to right and be so disposed as to necessitate a minimum amount of movement by the operators when changing from one operation to another.

14. The shirt unit

An ideal arrangement of a shirt unit comprising the following items is illustrated in Fig. 78.

Work bin.

Double sleeve form.

Collar and Cuff Press (triple head).

Shirt body press.

Shirt bosom press with neckband attachment.

Shirt folding table.

Shirt hanger.

Although a layout closely approximating this ideal has been possible of achievement in certain isolated cases, it can seldom be realised in H.M. ships, as the siting of presses is governed by space limitations and normal shipboard obstructions such as pillars, ventilation trunking etc.

Typical arrangements of presses as installed in H.M. ships are indicated in Fig. 79.

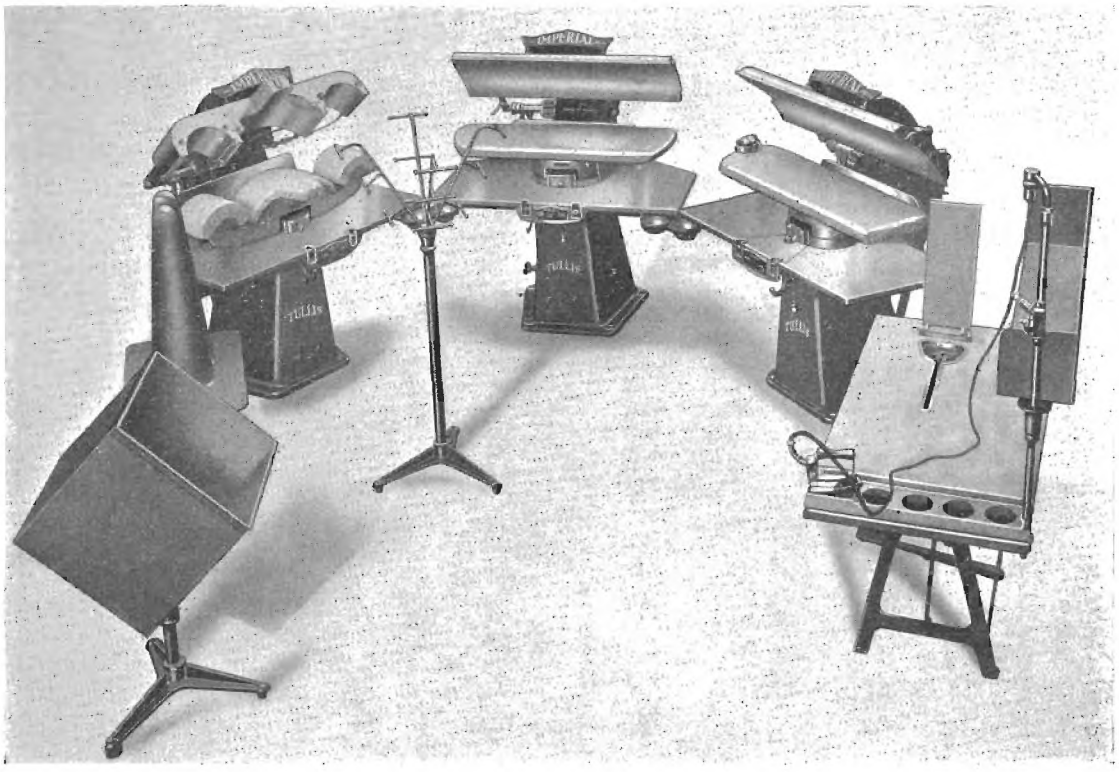


Fig. 78.—Arrangement of shirt unit.

PRESSING AND FOLDING

15. Sequence of pressing operations

In the finished pressing processes described in the next section the operations have largely been related to a general purpose press, to emphasise the general utility value and range of work which can be performed with this single machine. Where machines designed for specific duties, namely, collar and cuff pressing, shirt neckband pressing, etc., are installed, the particular operation should naturally be done on the special machine provided.

16. Shirts (*Fig.* 80)

(*a*) SLEEVES

Place the shirt sleeves over the sleeve former. While the sleeves are drying, the operator should take a careful hold on the cuff of each sleeve alternately, and dry the gusset by moving it around the top of the sleeve former.

(*b*) COLLAR AND CUFFS

Press the cuffs and neck band by laying these front downwards on the collar and cuff press, or G.P. press if the former type machine is not installed.

(*c*) SHIRT BODY, SIDES

Fold the shirt in halves and press the sides.

(*d*) SHIRT BODY, BACK

Open the shirt and place it on the press with the back in position. Most shirts have a pleat at the back; the tail piece should be pulled out allowing this pleat to fall in position before pressing.

(*e*) SHIRT BODY, BOSOM

Pass the shirt over the buck with the front uppermost. When available, the shirt bosom press with neckband attachment should be used and the neck band held in position accordingly. The shirt buttons should be fastened before the final pressing.

(*f*) NO. 8'S (COLLAR ATTACHED)

The sequence of pressing operations is as previously described, excepting that when the cuffs are being pressed on the collar and cuff press, the collar also should be laid out and pressed.

FOLDING—(*See also Para.* 12)

Shirts can be effectively folded by using a shirt-folding board which consists of a rectangular piece of thin wood of size 14 × 8 ins.

Insert a small metal stud in the front stud holes.

(*g*) Lay the shirt face downward on the table, and place the folding board centrally on it, at a position in line with the top edge of the shoulders.

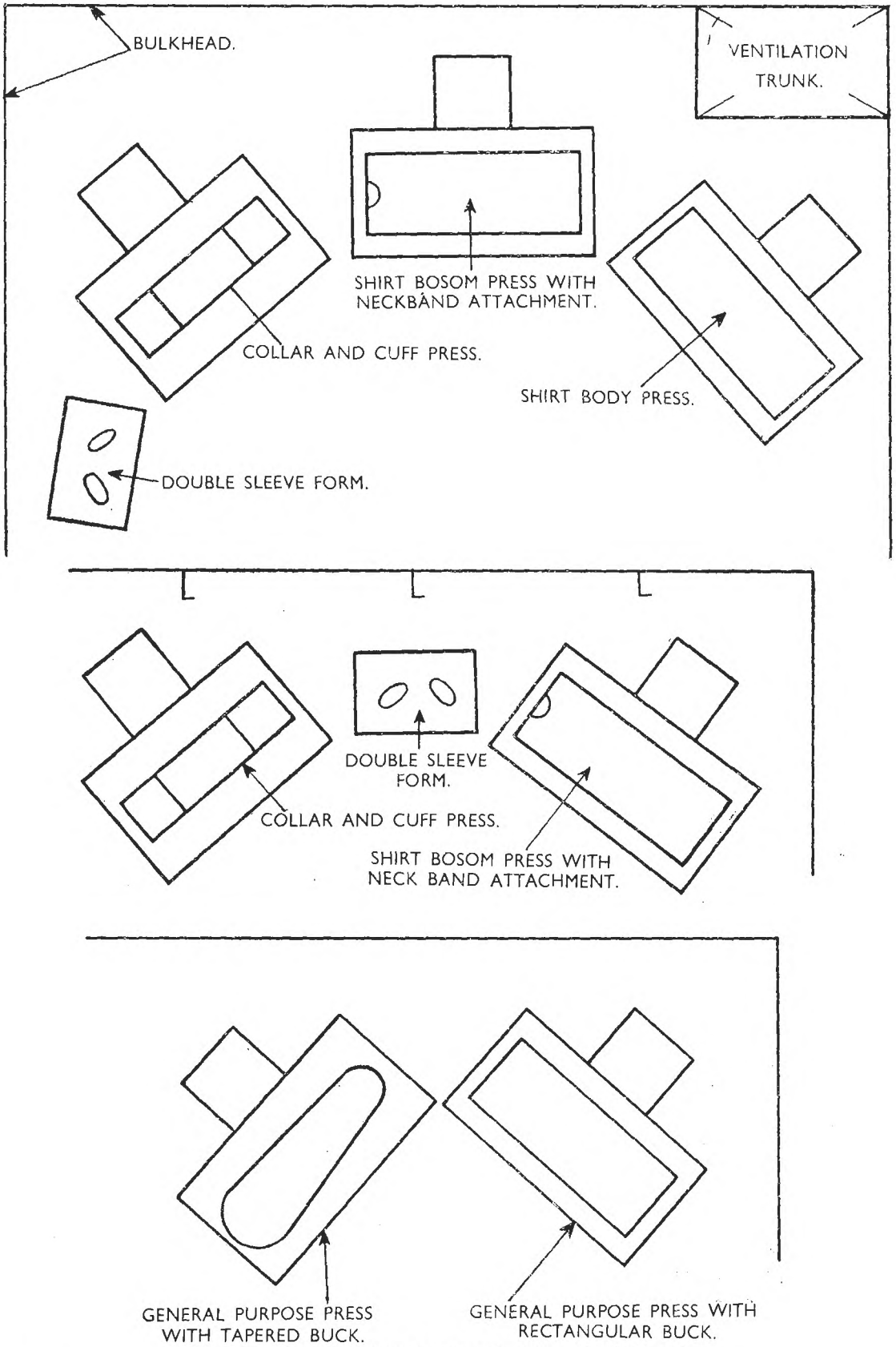


Fig. 79.—Typical arrangements of presses in H.M. ships.

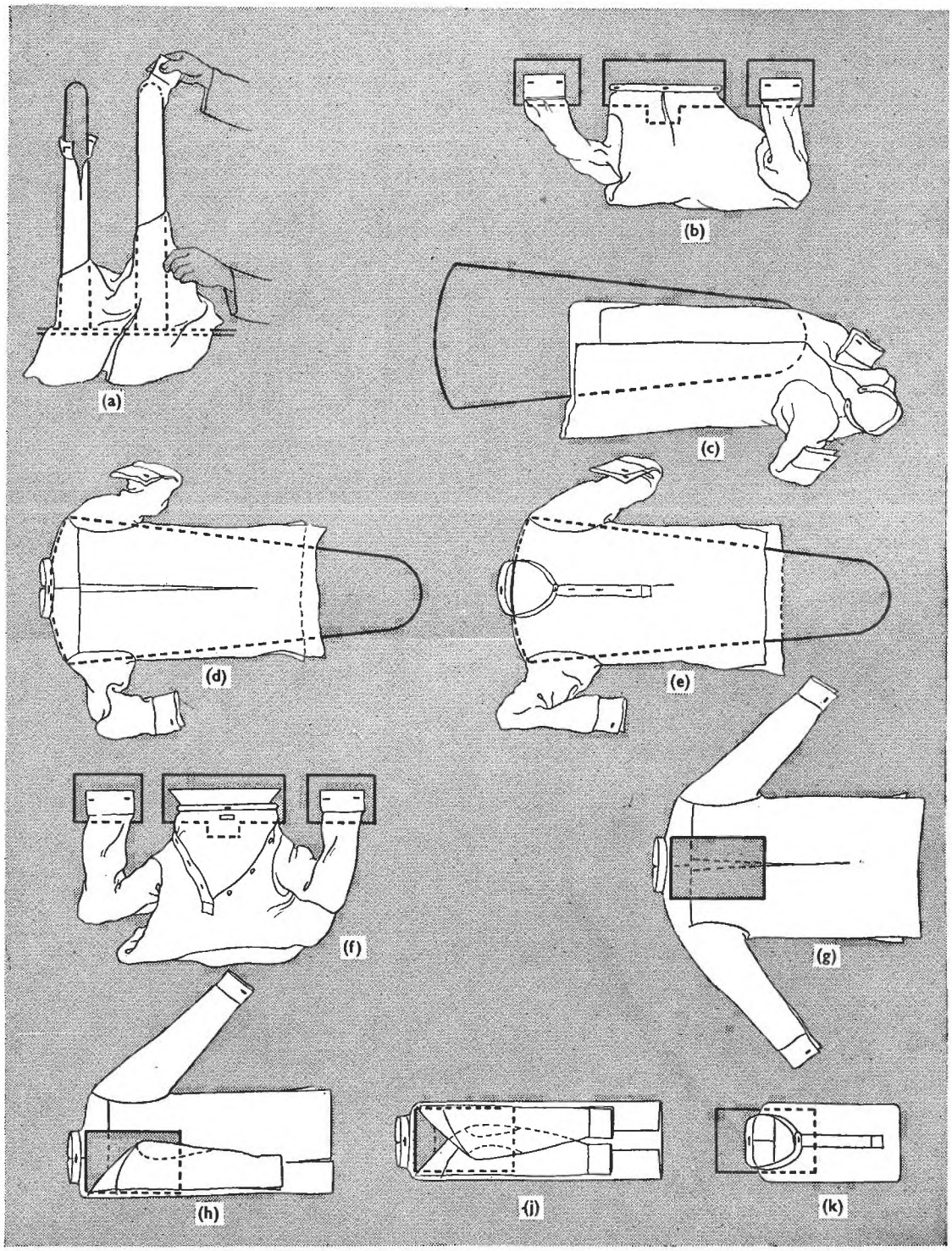


Fig. 80.—Shirt pressing and folding operations using limited facilities.

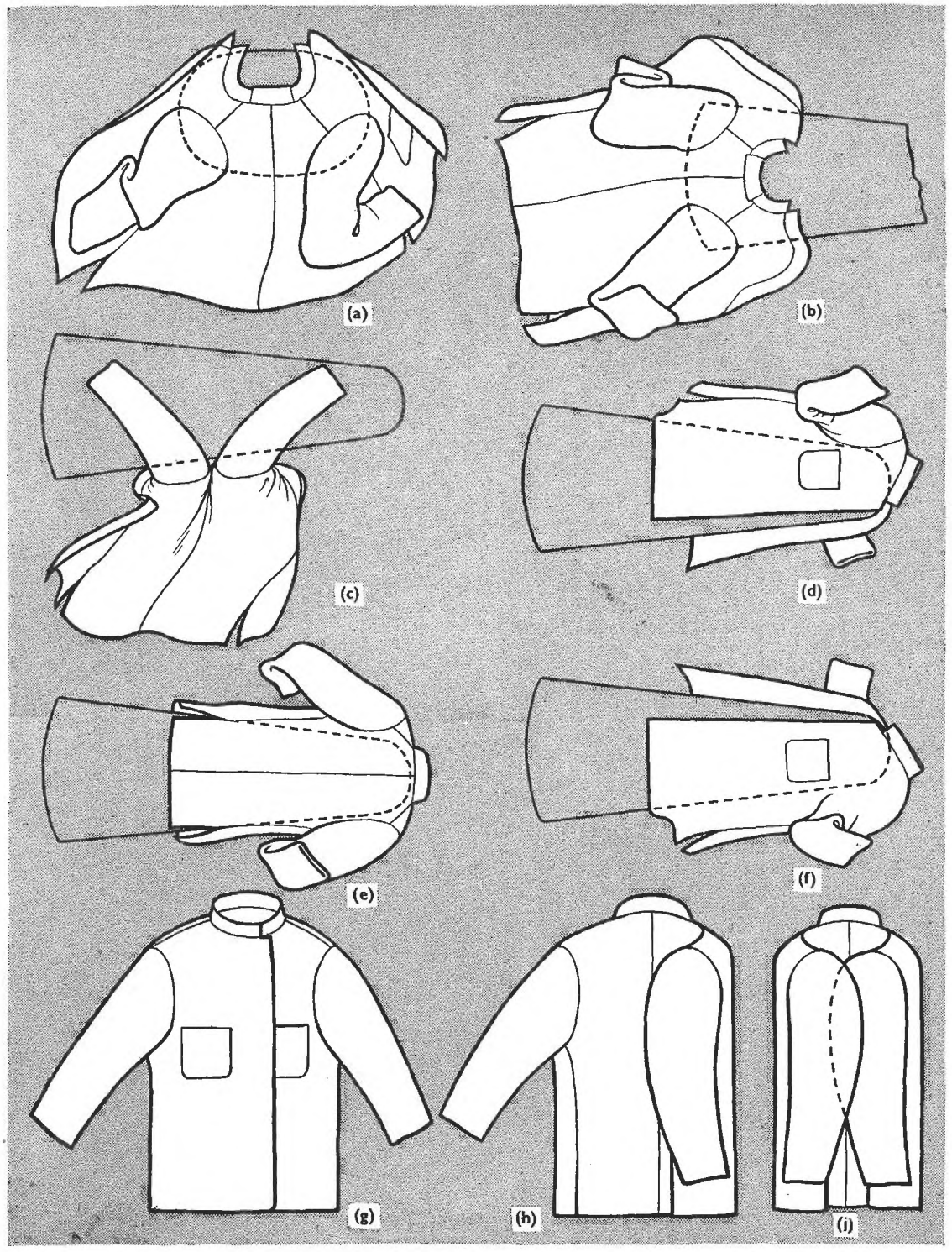


Fig. 81.—Method of pressing and folding white tunic coats.

Smooth out the shirt.

(*h*) Fold the left hand side of the shirt over the folding board, and lay the sleeve along the body parallel with the fold.

(*j*) Repeat the process with the right hand side and right sleeve.

Fold the tail back as far as the cuffs.

(*k*) Fold again until the bottom portion is in line with the neck band.

Slide the board away from the shirt.

Touch up where necessary with a hand iron after folding.

17. Coats (White tunics) (*Fig.* 81)

(*a*) Press the shoulders on the yoke press, or on the end of the G.P. press, as shown in the diagrams.

(*b*) The collar may be pressed on the collar-and-cuff press, or at the opposite end of the G.P. press.

(*c*) Press both sleeves by laying them across the buck. After pressing the sleeves the operator should pass his hand through them to prevent the material sticking together.

(*d*) Press the right hand side of the coat.

(*e*) Press the back of the coat.

(*f*) Press the left hand side of the coat.

(*g*) Take the coat by the shoulders and lay it flat on the table back downward and with the right hand side overlapping the left hand side of the coat. Turn the coat completely over, keeping the front folded.

(*h*) Fold in both sides about 4 ins.

(*j*) Lay the sleeves down the edge of the fold.

(*k*) Fold the coat from bottom to top and turn it over front top uppermost. *See Fig.* 82 (*a*).

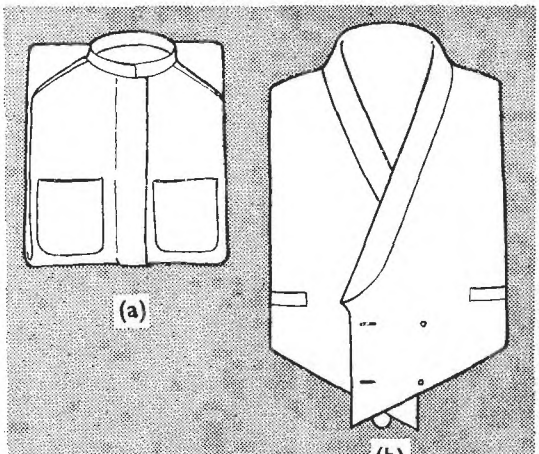


Fig. 82.—Method of folding officers mess jackets.

18. Officers mess jackets

(*a*) These should be pressed in a similar manner to coats, except that the collars and lapels should not be pressed into position, but folded by hand to produce a rolled effect.

(*b*) Fold as for white tunics, but instead of the last fold being from top to bottom as for tunics, fold the jacket into halves right side over left.

19. Trousers (*Fig.* 83).

(*a*) Press the pockets, with the trousers inside out.

(*b*) Press the fly fronts, with the trousers inside out.

(*c*) Press the front left hand side, trousers right side out.

(*d*) Press the back.

(*e*) Press the front right hand side.

(*f*) Lay out the legs separately so that the inner and outer seams of each singie leg are together. This will ensure that the front crease is in the right position. position. Press each leg separately from the crutch down.

(*g*) Lay both legs together for final pressing and folding.

(*h*) Fold the trouser legs about a line A-B just below the knee.

Fold again about C–D.

SHORTS

(*j*) These should be pressed as for trousers, and folded in halves from hem to waistband about A–B.

20. Pyjamas (*Fig.* 84)

COATS

(*a*) Press the collar flat on the buck.

(*b*) Lay both sleeves across the buck and press.

Press right side, back and left side, as for white tunics.

Fold into four and give a final pressing.

(*c*) Fold both sleeves over together and fold end to end.

TROUSERS

(*d*) Unlike ordinary ones, pyjama trousers do not require creases in the front of the legs. They can be pressed flat, then folded leg to leg and finally pressed lengthwise along the buck.

(*e*) Fold as for trousers first, about A–B, and then C–D.

21. Underclothes (*Fig.* 84 (*f*))

Simple pressing only is necessary. Shake out vests and pants and lay them flat across the buck of the press. Several articles may be pressed in one operation. Undervests should be folded, first left over right to bring the outer edges together and then from bottom to top.

Note.—If the machines are installed, underclothes should be part dried in the tumbler and finished on the flatwork ironer. This reduces press work, leaving the presses free to cope with the articles requiring a higher degree of finish.

PRESSING LAYS

For twin rapid type presses

22. Figs. 85 and 86 illustrate the methods of pressing when using the " Twin rapid " type of press, and are self-explanatory.

The garment-lays indicated are those recommended by the makers to obtain maximum output.

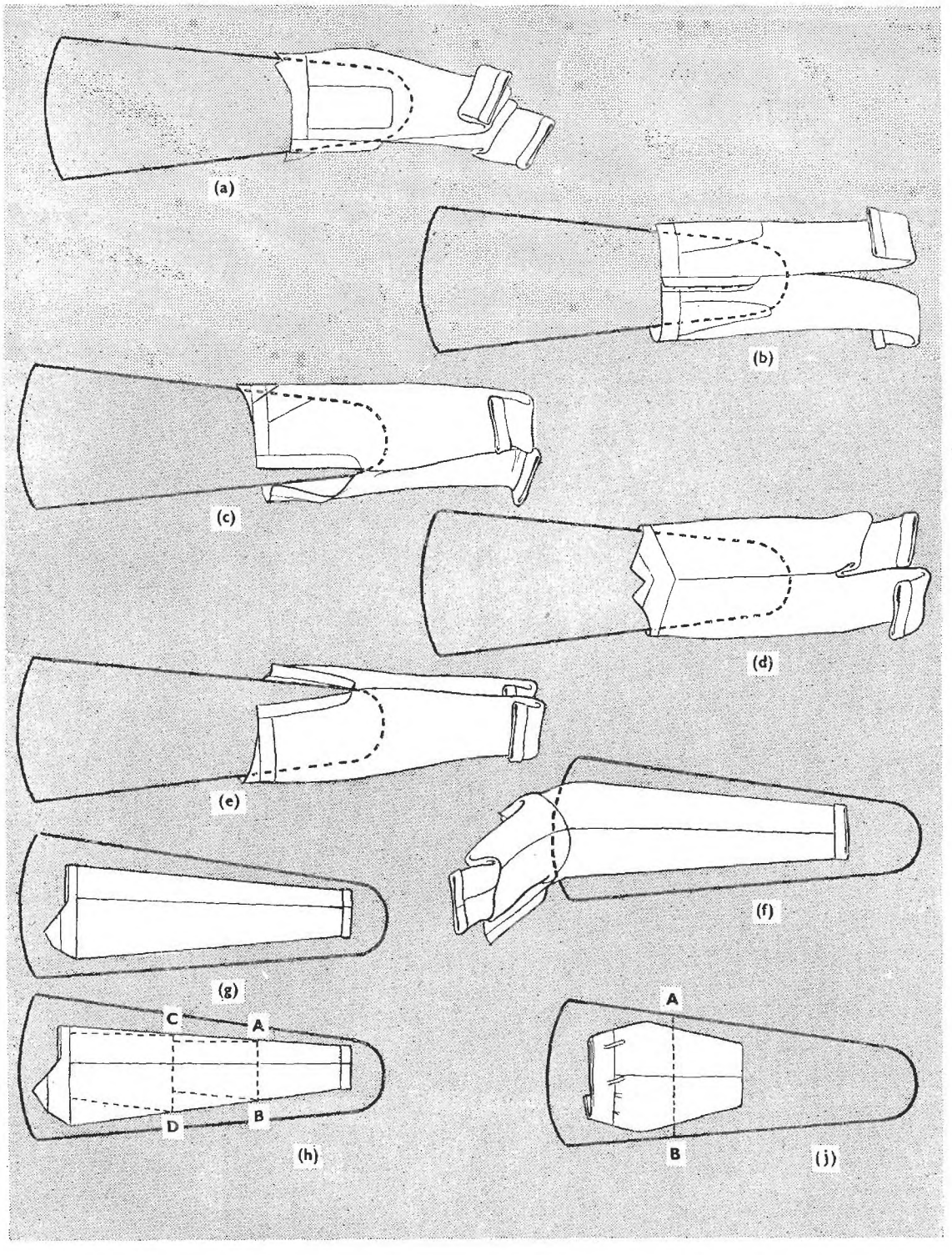


Fig. 83.—Method of pressing and folding trousers and shorts

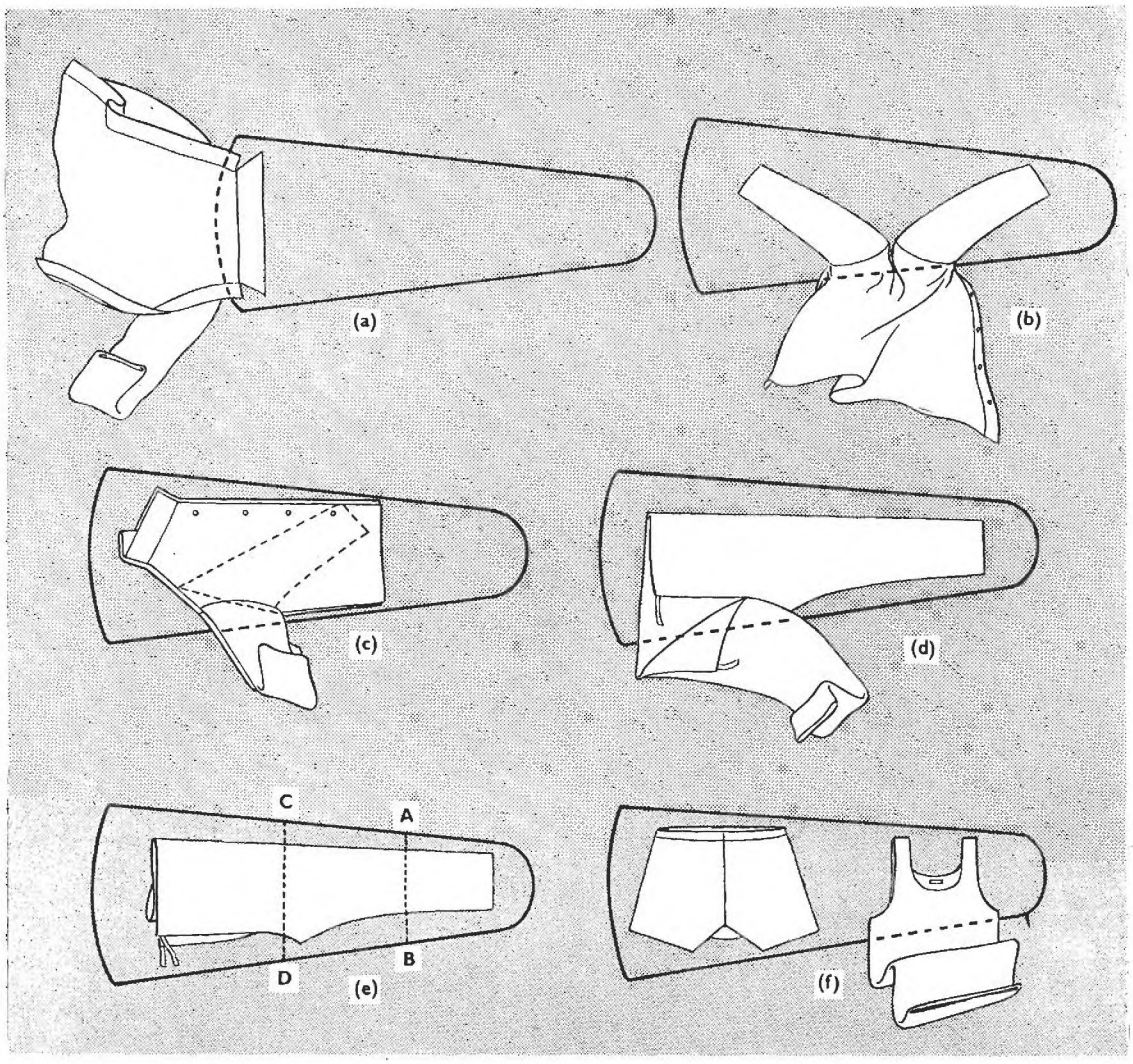


Fig. 84.—Method of pressing and folding pyjamas and underclothing.

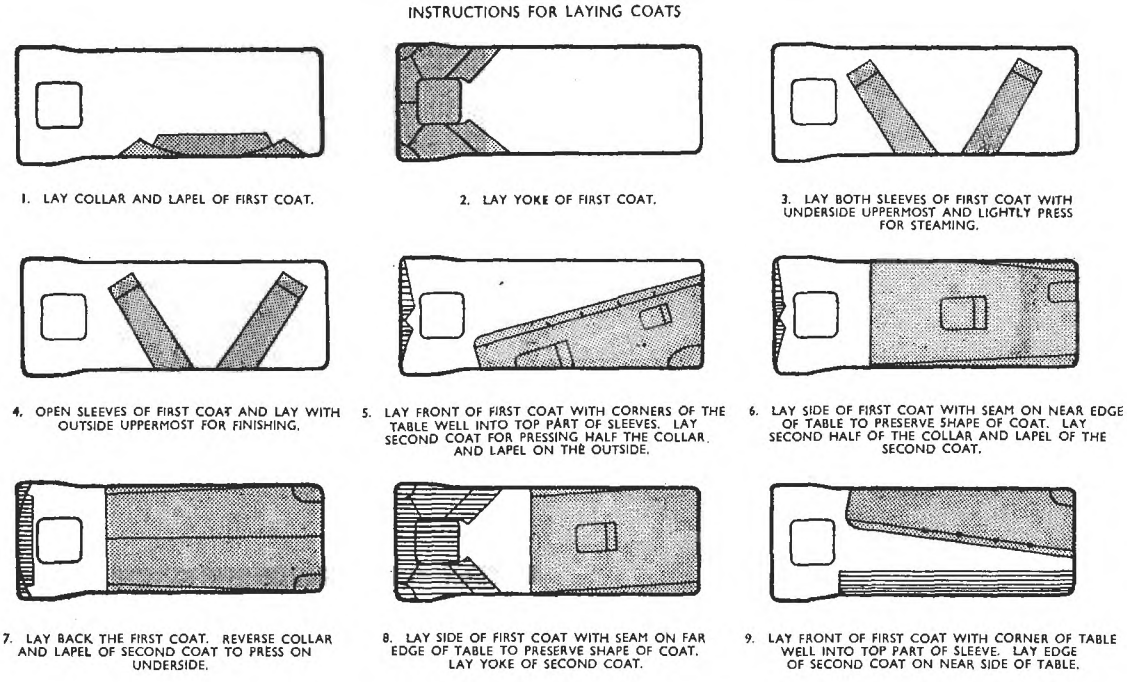


Fig. 85.—Coat pressing sequence using a twin type press.

The nine lays completely finish the first coat. To finish the second coat continue as from Diagram 3, laying sleeves.

The sleeve lay, as in Diagram 3, is the only time when one coat is on the table. When sleeves are pressed, commence laying the body of one coat and half the collar and lapel of another, as shown in Diagram 5.

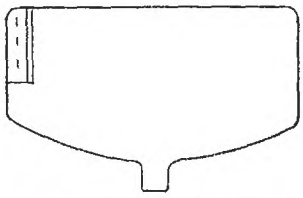
The operations are performed on both press tables, thus it will be seen that four coats are being pressed simultaneously.

KEY
1st SHIRT
2nd
3thd

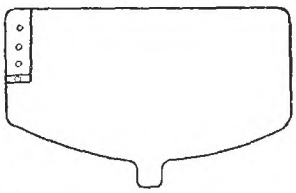
TWIN-RAPID COMBINATION SHIRT PRESS
RECOMMENDED LAYS FOR BEST QUALITY FINISH

— PRELIMINARY LAYS —

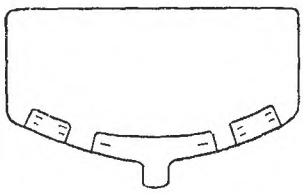
(UNTIL THE PRELIMINARY LAYS ARE COMPLETED THE RECTANGULAR BUCK IS NOT USED)



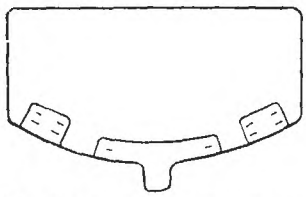
A. LAY BUTTON HOLE STRIP OF FIRST SHIRT.



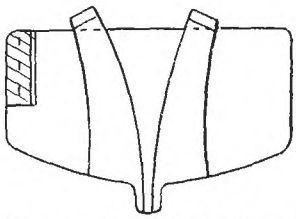
B. LAY BUTTON STRIP OF FIRST SHIRT.



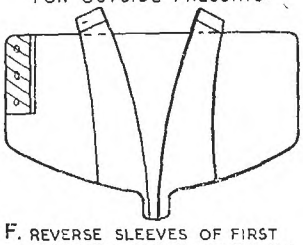
C. LAY NECKBAND OF FIRST SHIRT FOR INSIDE PRESSING, AND DOUBLE CUFFS FOR INSIDE PRESSING OR SINGLE CUFFS FOR OUTSIDE PRESSING.



D. REVERSE NECKBAND AND CUFFS OF FIRST SHIRT FOR SECOND PRESSING.

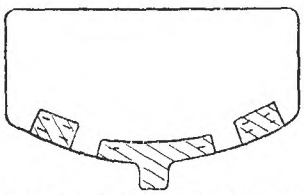


E. LAY SLEEVES OF FIRST SHIRT. LAY BUTTON HOLE STRIP OF SECOND SHIRT.



F. REVERSE SLEEVES OF FIRST SHIRT FOR SECOND PRESSING, ENSURING SLEEVES ARE PRESSED RIGHT UP TO CUFFS. LAY BUTTON STRIP OF SECOND SHIRT.

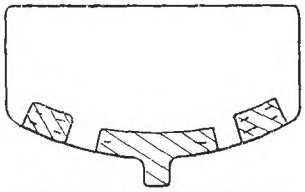
— SEQUENCE LAYS —



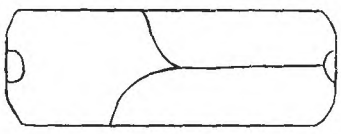
1. LAY NECKBAND OF SECOND SHIRT FOR INSIDE PRESSING AND DOUBLE CUFFS FOR INSIDE PRESSING OR SINGLE CUFFS FOR OUTSIDE PRESSING.



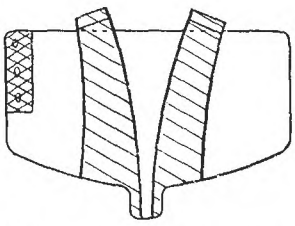
2. LAY FRONT OF FIRST SHIRT.



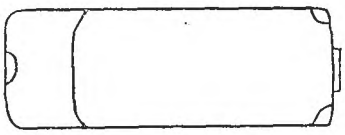
3. REVERSE NECKBAND AND CUFFS OF SECOND SHIRT FOR SECOND PRESSING.



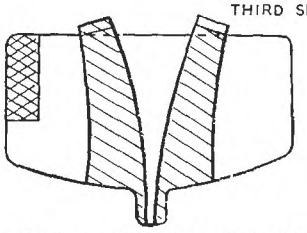
4. LAY LEFT SIDE OF FIRST SHIRT SINGLY.



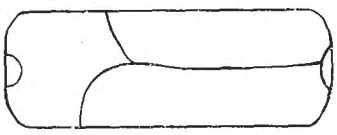
5. LAY SLEEVES OF SECOND SHIRT AND BUTTON HOLE STRIP OF THIRD SHIRT.



6. SLIDE SIDE OF FIRST SHIRT OVER BUCK TO LAY BACK.



7. REVERSE SLEEVES OF SECOND SHIRT FOR SECOND PRESSING, ENSURING SLEEVES ARE PRESSED RIGHT UP. LAY BUTTON STRIP OF THIRD SHIRT



8. SLIDE BACK OF FIRST SHIRT OVER BUCK TO LAY RIGHT SIDE.

RECOMMENCE SEQUENCE, LAYING NECKBAND AND CUFFS OF THIRD SHIRT.

THE SEQUENCE OF LAYS SHOWN IN THIS DIAGRAM GIVES ONE SHIRT EVERY EIGHT PRESSING OPERATION

Fig. 86.—Shirt pressing sequence using a twin type press.

CHAPTER IX

Collar and Dress-Shirt Processing

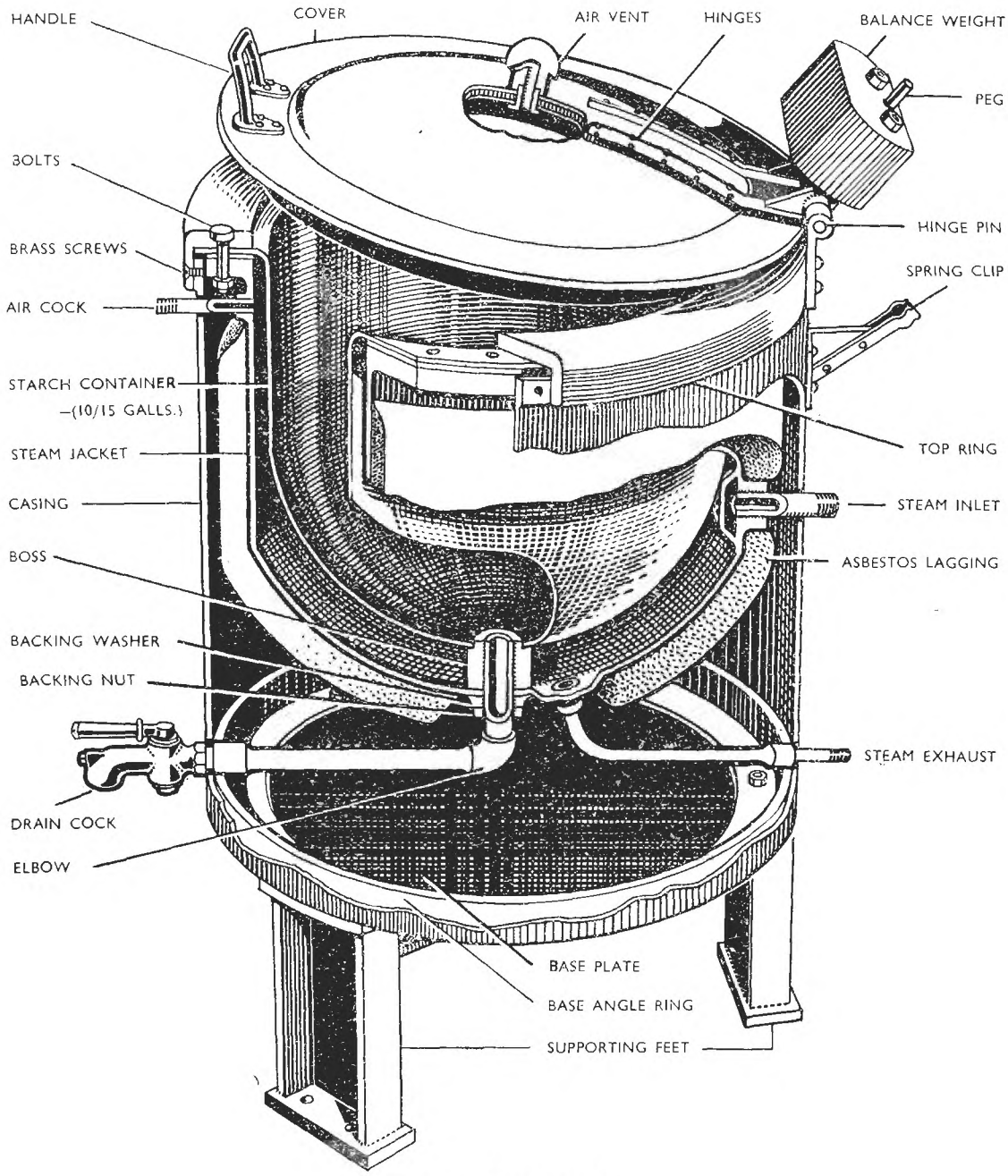


Fig. 87.—Starch cooker.

THE COLLAR UNIT

1. Collar processing is a highly specialized branch of laundry work, and particular care must be exercised throughout each individual operation if good results are to be obtained.

The complete collar unit is built up from the following items of equipment:

Starch cooker.
Starching machine.
Hydro extractor.
Collar ironing and polishing machine.
Collar seam damper.
Collar edge ironing machine.
Collar hot tube.

2. Starch cooker

This item, Fig. 87, is supplied to enable the starch stock solution to be conveniently prepared. Cookers recently installed are of 15 gal. capacity, and consist of an inner monel-metal starch-container, fitted with a steam heating jacket, suitable for a working steam pressure of 100 lb. per sq. in. The hinged cover is suitably counterbalanced and the cooker is provided with a large draw-off cock fitted with a cleaning plug.

Maintenance.—The starch cooker should be cleaned immediately after use, care being taken to ensure that the internal pipe leading to the draw-off cock and the orifice of the cock itself is clear.

3. Starching machine

A typical machine is illustrated in Fig. 88. The collars to be processed are placed in the tub of the machine, which also contains the starch solution.

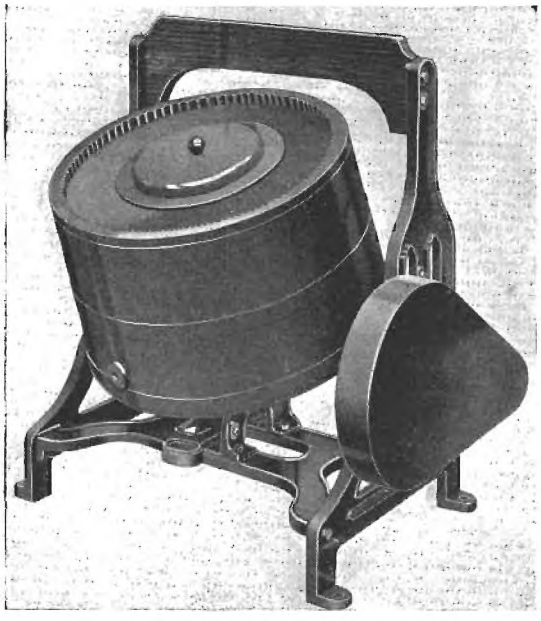


Fig. 88.—Starching machine.

The tub is provided with three internal beaters, and when the tub revolves, mechanical agitation causes the collars to become impregnated with starch.

The tub is mounted on a central spindle which carries a large crown wheel rigidly secured to its underside; the crownwheel meshes with a pinion wheel fixed to the driving spindle. Drive from the motor to the driving spindle is arranged through vee belting.

A foot treadle is provided by means of which the tub can be tilted to run in any of three position, *i.e.*, with the spindle in the vertical plane or approximately 20° and 40° respectively from the vertical. The forward tilt causes a tumbling effect, thus ensuring the thorough penetration of the starch liquor into the collars, and assists in the easy removal of the collars by the operator when the machine is running, (*see para.* 9 (5).

The tub in machines installed at present is manufactured from pitch pine, but in future models it will be of metal.

Maintenance:

(*a*) The inside of the tub should be kept free from starch deposits.

(*b*) All bearings should be regularly lubricated and the teeth of the driving wheels should be smeared occasionally with grease.

4. Hydro-extractor

In the case of large collar units installed in shore establishment laundries, an 18 or 21 in. hydro-extractor is supplied as a component part of the collar unit. Provision of a separate machine for collar work is not justified in H.M. Ships; the collars are therefore dealt with in the general purpose machines installed. In these, care must be taken before dealing with collars to ensure that the extractor basket is thoroughly cleaned.

5. Collar ironing and polishing machines

In its essential features, the collar ironing and polishing machine consists of a padded table on which the work to be processed is placed; the table is given a forward and backward motion beneath a heated rotating roller. Machines are manufactured with either gas or electrically-heated rollers, but electric heating of the roller is most commonly used for machines in Admiralty service. The size of the machine is determined by the length of the roller, 18 and 24 in. machines being in general use in H.M. Ships. Machines having a roller length up to 40 ins. are installed in Fleet Shore Establishments.

In large commercial laundries which deal with many thousands of collars per week, separate machines are provided

(*a*) for the initial steaming or blocking of the collars—this process can be satisfactorily effected by a machine arranged for automatic movement of the tables;

(*b*) for final polishing—it is an accepted fact that best results can be obtained by manual control of the table movement.

Space restrictions in H.M. ships preclude the possibility of fitting separate machines for these operations, and both processes are done on the one combined ironing and polishing machine installed. While blocking can be satisfactorily effected by the automatic motion of the table, the final polish, necessitating heavier roller pressure, is best accomplished by manual control.

In manually-operated machines, while the movement of the table is power-assisted, the stroke of the table is controlled by the operator, action being necessary to limit by hand control the extent of travel of the table in a forward and backward direction. Operators usually experience difficulty in synchronising the foot treadle movement, which determines the direction of movement of the table, with the hand control

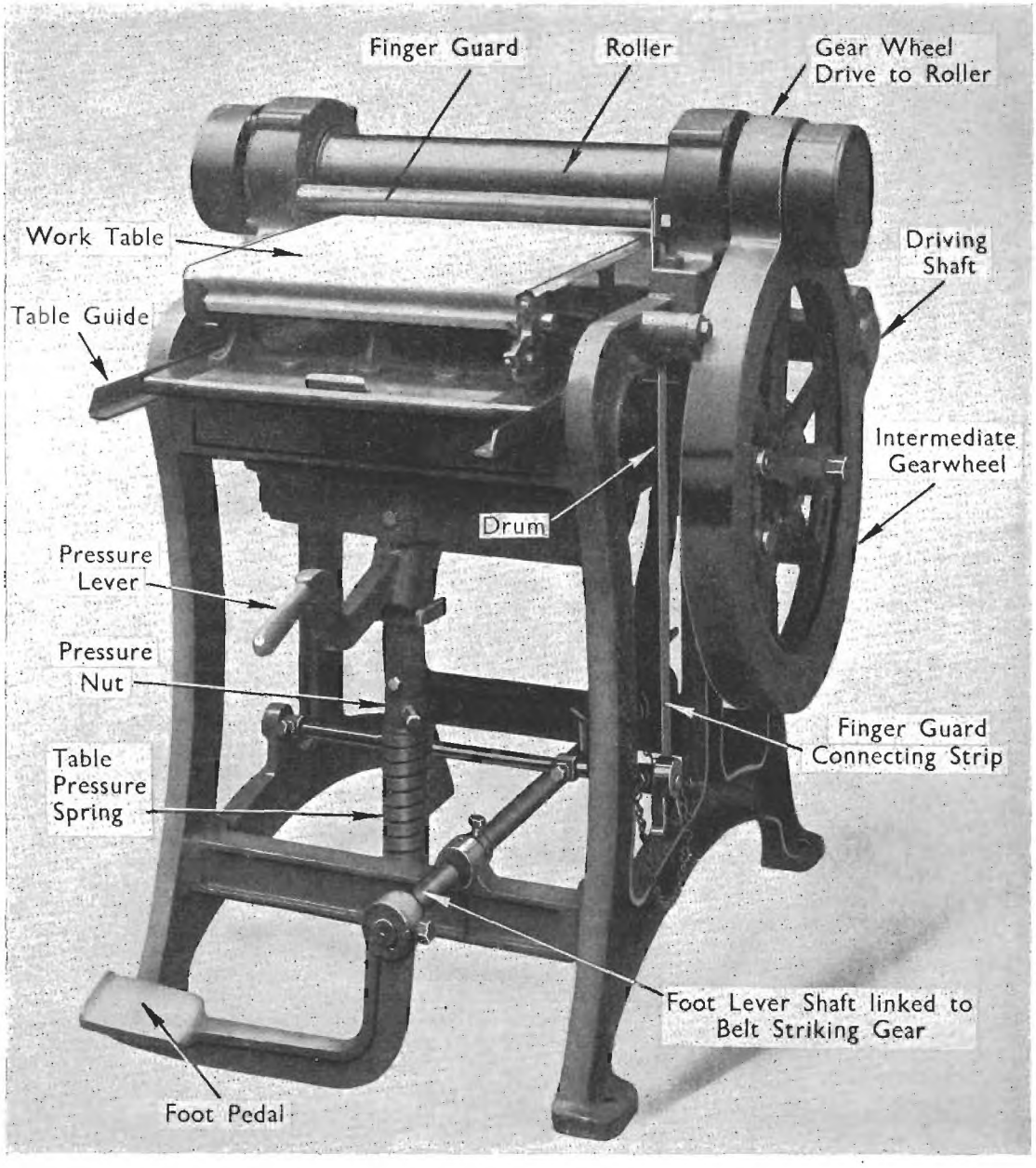


Fig. 89.—Collar and dress-shirt ironing and polishing machine.

necessary to limit the travel of the table in a given direction. A modified design of machine capable of both automatic and manual control is therefore being installed in future in H.M. ships. These machines are provided with a clutch which, when engaged, enables the initial collar blocking to be done automatically, thus relieving the operator of the tedious arm movement necessary to control the table stroke. When the clutch is disengaged the final polishing can be undertaken by manual operation.

Two tables are provided with all machines installed in naval laundries, one for collar work and one for processing dress shirt cuffs and fronts.

Description

A typical machine as installed in H.M. ships is illustrated in Fig. 89. The machine is driven through countershafting, reversal being arranged by the alternate engagement of the open and crossed belting with the fixed driving pulley which is mounted on the machine driving shaft. Rotary motion to the heated roller is arranged through a train of spur gearing.

The shaft carrying the intermediate gear-wheel also carries a drum of large diameter, the periphery of which is in surface contact with the underside of the work-table. Thus rotary motion of the drum causes the table to travel horizontally and, according to the direction of rotation of the drum, the table moves towards or away from the operator. The limit of travel of the table is controlled by the operator.

The cradle carrying the work-table is independently supported from the main framework of the machine, and is so arranged that pressure between the table and the roller is not transmitted to the gearing. The gearing is carried on fixed centres, and therefore always remains in correct mesh. The independent suspension of the table permits varying thicknesses of padding to be used on the table without adversely affecting the working of the machine.

Reciprocating action of table—*Fig.* 90

The forward and return motion of the table is operated through the medium of a treadle placed at the front of the machine, and the initial arrangement of the belt drive is such that when the treadle is depressed, the table moves inward towards the roller (*i.e.*, away from the operator). The belt-striking gear-rod or horizontal sliding strap-bar is linked to a vertical strap-bar which is freely mounted on the treadle-shaft. A bracket carrying a kicking lever is keyed to the treadle shaft. The lever is free to turn or lift, and is held in its normal working position by a spring-loaded pin and location stop on the bracket.

When the treadle is depressed, corresponding movement is also imparted to the kicking lever, and the motion is transmitted through the vertical strap-bar to the belt-striking gear-rod. When the treadle is released, the spring on the striking gear-rod returns the lever mechanism to its original position.

Safety finger-guard device (*Fig.* 90)

A safety finger-guard extending the full length of the roller is provided to prevent the operator's fingers being caught between the heated roller and the work table. Vertical connecting links are fitted at each end of the guard-plate, the lower ends of the links being coupled to the cross-shaft levers. The tripscrew lever fitted to the centre of the cross-shaft carries a safety tripscrew which disconnects the drive when the guard is lifted. The kicking-lever is extended to pass over the tripscrew. When the machine is in its normal working position, the clearance between the bottom of the guard and the table is $\frac{1}{4}$ in. and the tripscrew is set to just clear the bottom of the kicking-lever.

When the finger-guard is operated, the action of lifting the guard-plate rotates the cross-shaft and presses the trip against the underside of the tripping lever. This action raises the lever clear of its location, and completely releases the pressure previously exerted by the kicking-lever against the vertical strap-bar. When the pressure is released, the spring on the belt-striking gear-arm returns the vertical strap-bar to the vertical position, with the associated immediate reversal of drive.

It should be noted that possible danger to the fingers can only occur when the table is moving away from the operator, and therefore reversal of the drive automatically prevents the accident materialising.

Trouble experienced by the constant tripping of the treadle gear may be due to one or more of the following causes:

(*a*) Insufficient pressure on the compression-spring fixing of kicking-lever.

(*b*) Wear, or rounded edges, of the location stop, and the corresponding edge of the kicking-lever.

(*c*) The finger-guard trip screw being set too high, thus fouling the kicking-lever when the treadle is operated.

Operation

A starting lever is situated on the left-hand side of the machine, and when in the off position locates the driving belts on their associated loose pulleys. In this position no motion of the table is possible.

To start the machine, pull the starting lever forward; this allows the spring-loaded belt-striking gear-rod to move the belt on to the driving pulley, thus traversing the table towards the operator.

To reverse the motion of the table, depress the treadle.

To increase the pressure between table and roller, turn the pressure nut to the left. To reduce the pressure, insert the brass fork provided for this purpose above the top of the boss of the lever and lift the lever to grip the fork. This lighter pressure is required for blocking and/or steaming collars; the fork must be removed and the lever pressed downwards to the full extent for polishing.

For polishing, remove the steaming pad and push the pressure-lever downward to the full extent. This gives the correct pressure for polishing on the harder surface.

Roller

The roller should be cleaned each morning with paraffin wax after heating, due care being taken to ensure that no fouling of the table occurs.

Alternatively paraffin wax should be applied to the roller at the end of each day's work while the roller is still hot. This will keep the roller clean and polished The wax should be wiped off during the preliminary heating of the roller and before commencing the collar work of the day.

Accumulations of starch on the roller may be removed by scouring with a hot soda solution. The roller should always be finally polished with a soft cloth.

TABLES

(*a*) *Collar table.*—For the steaming or blocking of the collars and cuffs, a movable steaming pad (composed of 2 thicknesses of flannel and a piece of calico on the top, basted together) should be provided. This covering should be long enough to overhang 3 in. or 4 in. at each end of the table. When a number of articles have been blocked, remove the steaming pad, press down the lever, and proceed to polish on the hard-faced coverings on the table. Dry the coverings before polishing.

(*b*) *Shirt table.*—The coverings on the shirt table should be kept soft and pliable, and frequently washed or replaced by new paddings. This padding must be of the fixed type, *i.e.*, not a movable steaming pad as for collars.

MAINTENANCE

(*a*) The machine should be frequently lubricated, particular attention being directed to the moving parts of the table-reversing mechanism and the finger-guard actuating gear.

(*b*) The finger-guard safety gear is to be maintained constantly in an efficient working condition.

(*c*) The bearings of the heated roller should be fed with a mixture of tallow and yellow sulphur.

(*d*) Belts should be maintained constantly at the correct tension.

(*e*) The faces of the driving gears should be thinly smeared with grease once weekly.

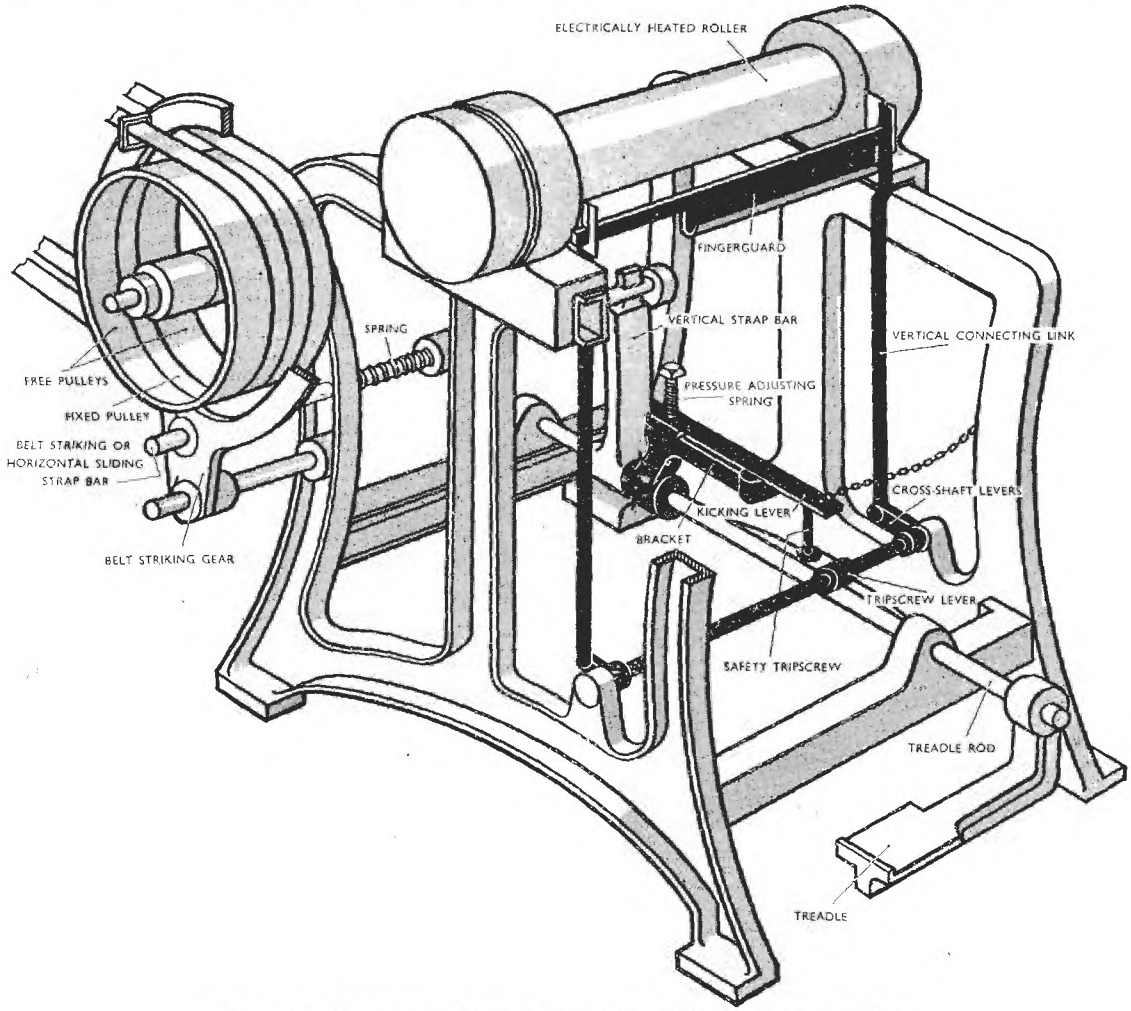


Fig. 90.—Fingerguard safety device for collar ironing machine.

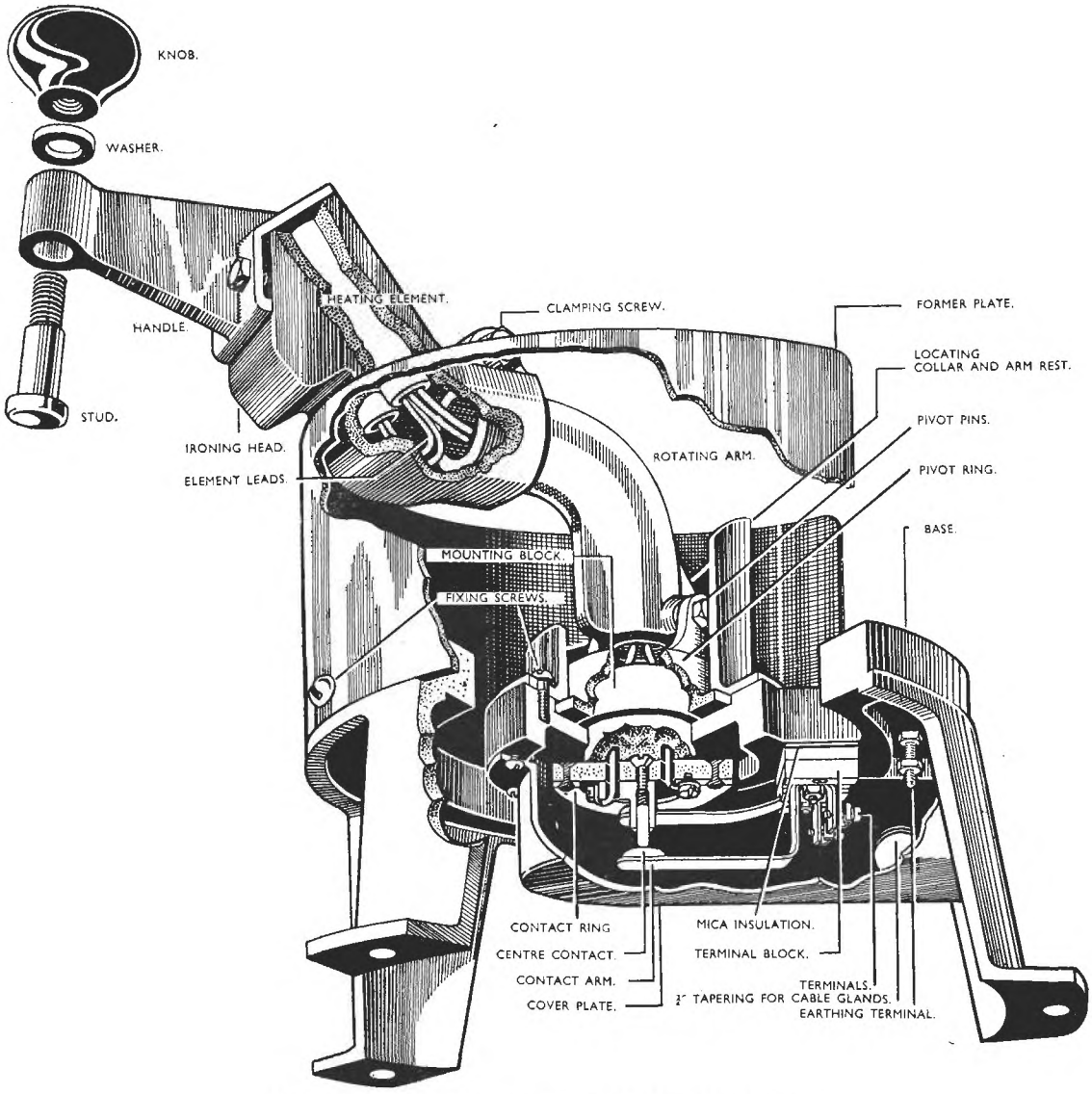


Fig. 91.—Sectional arrangement of collar edge ironer.

6. Collar-edge ironing machine

This fulfils the following duties:

(*a*) It irons and dries the folded edge.

(*b*) It provides a tie space inside the collar.

(*c*) It produces an initial shaping or curved set to the collar.

A typical collar-edge ironer is illustrated in Figs. 91 and 92. The machine consists of an electrically-heated ironing head attached to an arm which is capable of being rotated on a collar " former "plate.

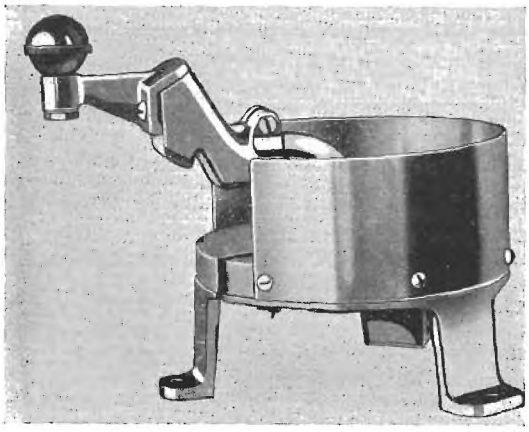


Fig. 92.—External view of collar edge ironer.

7. Collar-seam damper

A typical damper is shown in Fig. 93, and consists of a perforated fish-tail steam nozzle which emits a small jet of low-pressure steam.

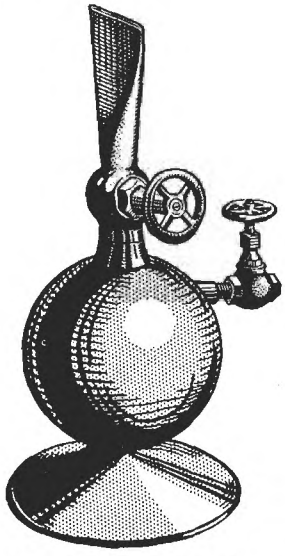


Fig. 93.—Collar seam damper.

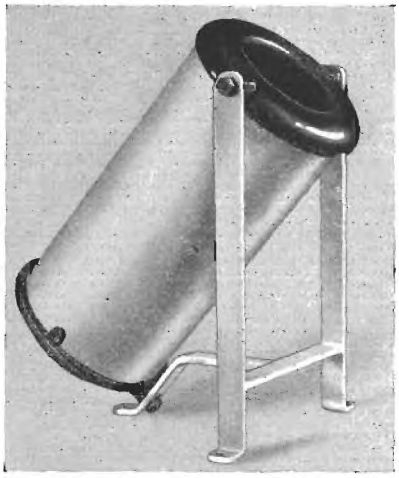


Fig. 94.—External view of collar hot tube.

8. Collar hot tube

A typical collar hot tube is illustrated in Figs. 94 and 95. It comprises a porcelain cylinder, around the outside of which is fitted a steam-heated coil.

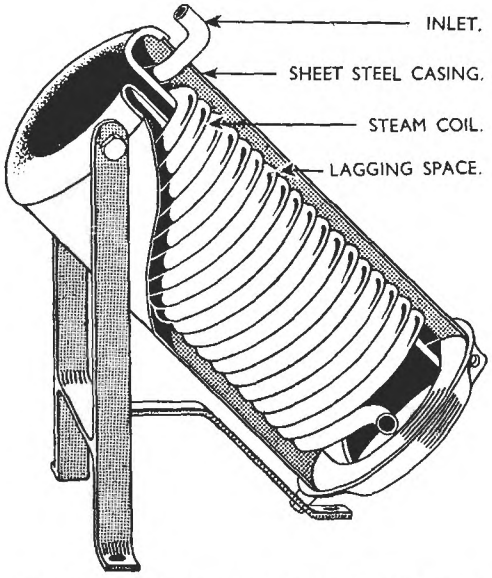


Fig. 95.—Sectional ar rangement of collar hot tube

THE COLLAR PROCESS

9. Washing and Starching

(1) Wash the collars in accordance with washing formula I (Ch. V, para. 7).

(2) After washing, thoroughly hydro the collars.

(3) Load the starching machine with collars and add starch stock solution in sufficient quantity just to cover the collars. For effective starching the machine

must be run with the tub in the inclined position. The stock solution must be added carefully, therefore, to ensure that no overflow of starch occurs when the tub is tilted.

The final production of a good finish is largely dependent on the efficacy of the starching process. The senior rating should make certain, therefore, that all operators are familiar with the approved method of preparation of the stock solution. (*See* Ch. IV, Paras. 25, 28 and 29).

Note.—The same charge of starch can be used repeatedly in the starching machine. It is *not necessary* to change the solution until it becomes clouded or loses its correct density, *viz.*, Twaddell 5° to 7°.

(4) After loading the machine, replace the cover, adjust the tub to the inclined position and process the collars for 30 minutes.

(5) The collars should be removed, if possible while the tub is revolving, about 6 at a time and the surplus starch squeezed back into the machine by hand. Such action reduces the risk of deposition of starch on the surfaces of the collars, which may occur if they are allowed to settle in the starch solution, *i.e.*, with the machine stopped.

(6) Rinse the collars by dipping them into a clear starch rinsing solution, prepared in the proportion of 1 part starch stock solution to 2 parts water.

Note.—The clearing rinse is necessary to effect the complete removal of surface deposition from the collars, and must on no account be omitted.

(7) Remove the collars, squeeze out the surplus rinse solution by hand, and hydro for 10 to 15 minutes.

(8) After hydro extraction, each collar should be brushed lightly on each side with a soft scrubbing brush to remove loose surface starch.

This action is necessary to minimise the possibility of loose starch sticking to the roller of the collar ironing machine. If loose starch does contact the hot roller it scorches and becomes brown and is liable to mark collars being subsequently processed. Loose starch also causes the collars to stick to the roller, thus upsetting the arrangement of collars on the machine table.

10. Faults in starching and remedies

(*a*) LIMP COLLARS.—Limpness may be due to the insufficient penetration of the starch into the collars. This condition may also arise if the starch solution is too weak or if it contains too large a quantity of wax or glycerine.

(*b*) TOP-STARCH MARKS OR "SNAILS TRAILS."—These are caused mainly by the use of a starch stock solution of too high a density (Twaddell reading). A further cause is the overloading of the starching machine. These marks are usually remedied during the clearing rinse.

(*c*) CRINKLES IN THE COLLAR FOLDS.—These do not normally become apparent until after the edge ironing process. The principle cause is the presence of old starch in the collar seam. Crinkles may also be caused if too much borax is used in the starch stock solution. When excessive crinkling occurs, the collars should be rewashed in water at a temperature of 200°F. for at least 20 minutes.

11. Finishing

(*a*) BLOCKING OR STEAMING

Before commencing the blocking process it is essential to ensure that the roller, padding and top sheeting is clean and taut. During the blocking process the moisture content in the collar is largely removed, and provided that the temperature of the rollers is high enough (about 350° to 400°F.) the starch granules become baked into a stiff cement.

NOTE.—Stiff collars are made with two fine pieces of linen in the centre. These centre layers retain the starch granules which stiffen when heat is applied.

The steaming pad should be placed on the surface of the table and the table pressure adjusted to about half maximum pressure. The collars should be arranged horizontally on it, *i.e.*, with the length of the collar parallel to the roller and with the outside of the collar downwards.

The collars should be passed under the roller 3 or 4 times and then reversed on the steaming pad so that the outside is uppermost. They should then be given a further 3 or 4 passes under the roller, after which they should be removed and allowed to stand until the vapour generated in them by the hot roller has evaporated, leaving them almost dry.

To speed production, it is advisable to block a reasonable number of collars, say 50, before proceeding with the next operation.

(*b*) POLISHING

The steaming pad should be removed and the collars polished on the hard covering face of the table. The table face must be thoroughly dried and the table adjusted to maximum pressure. When polishing, a smaller number of collars should be dealt with at each time, and the speed of oscillation of the table under the roller should be higher than that used for blocking. The collars should be placed in position in a single row at right angles to the roller. This enables a shorter stroke of table, with consequent greater speed of surface contact to be employed.

Note on semi-stiff collars.—In dealing with semi-stiff collars the blocking process is unnecessary; they can be processed in one stage on the collar machine. Alternatively, they can be dealt with on the flatwork ironing machine; if this method is used the collar should be given 3 or 4 passes through the machine, making sure that the collar is arranged with its outside surface in contact with the machine bed on the last "pass."

(*c*) FOLDING

After polishing, both stiff and semi-stiff type collars require to be folded on the seam. At the stage now reached in the collar process, the article is dry and the linen fibres are firmly held by the starch.

If collars are folded dry, the fibres, being brittle, have a tendency to break at the seam, thus reducing the life of the collar. Breaking of the fibres is also accompanied by the destruction of the starch film, leaving a rough edge which causes discomfort to the wearer.

The seam of the collar should, therefore, be softened before folding. This is done by passing the seam over a collar-seam damper. (*See* para. 7.) Once the seam is damped, the collar can be folded easily by hand and without damage. When folding care should be taken to follow the seam; the seam of a well-cut collar is not straight but slightly curved.

(*d*) COLLAR-EDGE IRONING

Having folded the collar it is now necessary to dry and shape it, which is done on the collar-edge ironing machine (*see* para. 6). The seam is placed over the " former " plate and the heated head is passed over it, thus ironing and drying the edge. The tie space, also set, is equal in width to the thickness of the " former " plate.

(*e*) CURLING AND SETTING

This is the final process, and all stiff collars need to be curled and set. This is done by first curling the collar round the hand and then placing it in the collar " hot " or " airing " tube. The collars are placed in the tube one at a time and, as additional ones are inserted, they are gardually pushed down until each passes completely through the tube. A basket should be placed at the outlet to collect the collars.

Note.—Semi-stiff collars do not need curling, but after folding at the seam should again be folded point to point.

PROCESSING DRESS SHIRTS

12. Starching

When possible, dependent upon the capacity of the laundry to undertake such work, dress shirts should be washed as a separate load and thoroughly boiled to ensure that all traces of old starch are removed. Washing Formula I may be used.

Slight starching, as for normal white shirts, should be applied during the washing process to starch the body of the shirt, but the cuffs, neckband and front need separate intensified starching treatment as detailed below. After hydro-extraction the cuffs, neck-band and front should be steeped in the starch stock solution.

The solution should be prepared in the same manner as the collar starch solution, with the exception that borax should be omitted and the glycerine content slightly increased to give added flexibility.

Gather up the dress shirt by the sleeve edges of the cuffs and bosom and thoroughly impregnate the starch into these parts by dipping them into the starch bowl some twelve times. The starch should be ingrained into the fabric by squeezing during each dip and the surplus starch liquor removed by squeezing and wringing after each dip. The starched surfaces should then be lightly brushed off with a slightly damp brush.

The shirt is now ready for ironing on the collar and dress shirt ironing machine.

13. Ironing

The shirt body should be gathered at the front of the table, below the level of the ironing surface, and the cuffs laid out for ironing one on each side of the table. The cuffs should be ironed on the wrong side (inside) first by passing them three or four times under the roller, then turned right side up and given a further seven or eight passes under the roller. This process is repeated on the wrong and right side of the cuff.

The shirt should then be draped carefully over the table. The neckband should be placed in the recess provided, the back of the shirt carefully drawn under the table body and the shirt bosom smoothed flat on the table surface. The shirt front should then be blocked and polished in one continuous operation. Commence ironing at the top of the shirt front and gradually work downward. The front should be lifted occasionally during the operation to ventilate and cool the fabric. Continue polishing until dry.

Note.—Dress shirts with piqué or pleated fronts should not be machine processed, but should be hand ironed, due care being taken in the touching up of the pleated front.

14. Ironing when no shirt and collar ironing machine is installed

If no polishing machine is installed, dress shirt fronts and cuffs may be finished on the shirt bosom press.

Special care is necessary when setting the shirt on the buck to avoid creasing. It is recommended that the press head be lowered for a very short period only, say two seconds, in the first instanee, then raised to ensure the absence of creases. If the front is free of creases pressing can be continued for a sufficient period to set the starch.

If creases do appear at the preliminary pressing stage they can be removed by damping the front of the shirt with a clean cloth and warm water. After pressing, the shirt should be removed and finally polished by hand ironing.

IMPORTANT.—It is essential at all times to ensure that no loose surface starch is present on the shirt front, etc. Loose starch tends to stick to the polishing surface and when scorched imparts brown marks to the work being subsequently ironed or pressed.

It cannot be too strongly emphasised that the basic requirement for the production of high quality stiff collar and dress shirt work is the use of good quality starch. The cold starch method using a high grade starch, as detailed in Chapter IV, paragraph 29, is recommended, rather than a preparation necessitating the separate addition of various ingredients to obtain a starch solution of the correct texture.

CHAPTER X

Racking and Packing Processed Articles

1. Packing or Issue Room

The collection and reassembly of the clean clothing into separate bundles in readiness for issue to each individual owner is the final process in the sequence of laundry operations.

Space permitting, a separate packing or issue room is provided adjacent to the laundry. When space cannot be made available for separate rooms, the receiving and issuing facilities are combined.

The ideal condition is achieved when a number of racks sufficient to handle all the bundles for one complete laundry journey can be installed. A minimum of 120 separate compartments is *aimed at* in large vessels, but space limitations seldom permit the installation of so many.

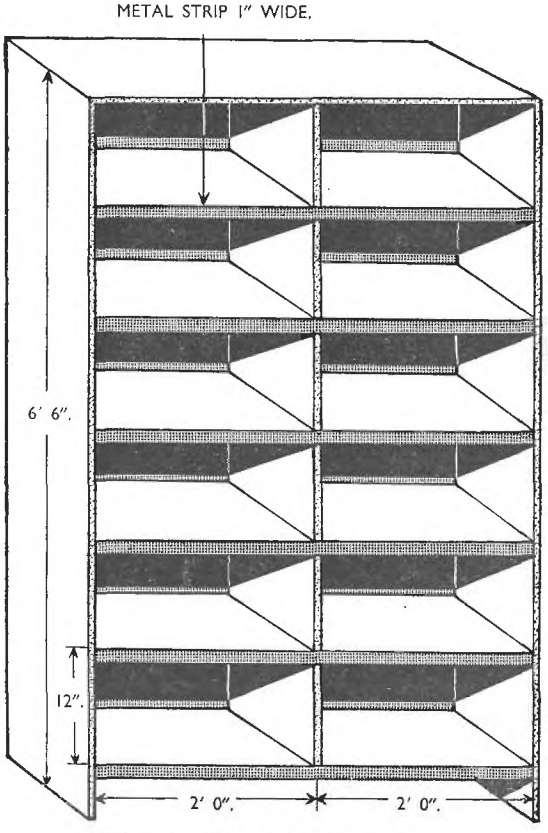


Fig. 96.—Nest of issue racks.

Other desirable fittings in the issue room include a table for folding and checking the work, and a desk with a ledger rack over.

A nest of packing racks is illustrated in Fig. 96. The strip on the bottom of each shelf is painted black. The laundry numbers of the owners of the bundles being processed during any particular journey are chalked on the strip and are readily visible on the black surface.

2. Procedure

The laundry work is processed in a series of complete " journeys," each journey being based on the capacity of the laundry. As stated in chapter 2 paragraph 10, when the contents of the bundles comprising the complete journey have been checked in the laundry receiving room, the companion chits are passed to the issue room.

On arrival in the issue room the laundry chits should be arranged in numerical order. The receiving-room operator should acquaint the issuing operator of any discrepancies which have been noted on the chits during the initial sorting and checking stage.

The issue racks should then be numbered with the numbers corresponding to those on the laundry chits being handled. It is suggested that the racks be numbered in sequence from left to right, commencing with the top left hand rack in the compartment; the system of numbering can be adapted to suit the arrangement of racks installed.

The " finished " articles are brought into the packing room as the journey progresses. Certain garments require more processing operations than others, so that the completion of a journey will be spread over a period, *i.e.*, all the different types of garments will not arrive into the issue room together. The finished work should be sorted on arrival and the garments belonging to each owner placed in the separate rack containing the owner's laundry chit.

This sorting and assembling process is known as " racking " and should be progressed as speedily as possible, to prevent completed work from accumulating with the associated danger of such work becoming creased and soiled.

Final checking

When the whole journey is racked, each separate bundle must be finally checked and wrapped. The bundle, complete with the laundry chit, should be taken from the shelf and placed on the sorting table on the left of the operator. The operator engaged in

checking duties should remove the laundry chit and place it in front of him on the table. The largest or most suitable garment should be used as a wrapping for the remainder of the bundle. This item should be withdrawn by the operator and placed on his right side, and its completion duly noted by the insertion of a tick mark in the " checked out " column on the laundry chit. A towel folded in halves forms a useful article for wrapping purposes, and one is usually contained in each bundle.

Each item in the bundle should then be checked, ticked off on the laundry chit if correct, and placed neatly on the towel or garment being used as a wrapping. When checking has been completed the covering should be carefully wrapped around the bundle and the chit replaced inside the last fold.

The bundle should then be returned to its rack and a line drawn through the number on the rack, to indicate that checking has been completed. The number should not be erased from the rack at this stage unless the shelf is required for racking additional bundles, which will be necessary if insufficient racks are available to hold a complete laundry journey. The retention of the number on the rack enables the position of the bundle to be easily determined when the owner arrives to collect it. If, however, the rack is required to progress a further bundle, the number should be completely erased and the new number allocated. The completed bundle should be placed aside.

4. Missing articles

If any of the articles previously certified by the receiving staff as being received into the laundry are found to be missing at the checking out and assembly stage, the bundle should be replaced in its rack. In this circumstance the number of the rack must not be crossed out and the rack must not be used to progress further bundles for the time being. It will usually be found that the missing item has been delayed for rewashing or complete re-processing, and on its arrival in the issue room it should be connected up with the parent bundle.

5. Final delivery

When the bundle is issued, it should be checked again in the presence of the owner and the laundry chit retained in the laundry as a receipt for the bundle.

Any queries regarding loss or damage of articles should be referred to the senior rating in the first instance, who if unable to settle the problem, will refer it to the Laundry Officer.

6. A specimen of a completed laundry chit is shown below:

P/MX.129622

Established September, 1946

S.1279b LAUNDRY CHIT

Class I and III

Uniform

NAME J. F. SMITH Date 1-1-50

MESS E.R.As. Laundry No. J.S.9622

ARTICLES	REC'D.	CHECKED OUT
Shirts (white)	2 ✓	✓
Shirts (working)		✓
Collars (soft and semi-stiff)	2 ✓	✓
Collars (stiff)	1 ✓	✓
Vests	2 1 only E.J.V.	1 only ✓
Pants	2 ✓	✓
Pyjamas (suit)	1 ✓	✓
Cap covers		
Handkerchiefs	4 ✓	✓
Towels (hand)	1 ✓	✓
Towels (bath)	1 ✓	✓
Sheets		
Pillowcases		
Overalls		
Hammock		
Bedcover		
Work'g dress shirt	1 ✓	✓
Working dress trousers		
TROPICAL		
Shirt		
Shorts		
Trousers		
Tunics		
White stockings		
White scarf		
Socks		
Pullover		
BY WHOM	E.J.V.	C.S.K.

It will be observed that the operator responsible for checking has duly ticked each item as being correctly received from the receiving room and has placed his initials at the bottom of the " checked out " column.

CHAPTER XI

Decontamination of Clothing and Equipment

1. Definitions

GAS.—Includes any chemical substance, solid, liquid or gaseous, used in war for its poisonous, blistering or irritant effect on the human body.

NON-PERSISTENT GAS.—A gas which forms a cloud (not necessarily visible) immediately it is released, and leaves no liquid contamination on the ground.

PERSISTENT GAS.—A gas in liquid form which evaporates slowly and so continues to give off dangerous vapour for a long period. Both vapour and liquid may have harmful effects. Typical examples are tear gases, blister gases and nerve gases.

CONTAMINATION.—The liquid or vapour remaining on an object or person as a result of exposure to gas (usually persistent gas).

DECONTAMINATION.—A process intended to remove or destroy the contaminating gas.

METHODS

2. Essentials of decontamination

Should the necessity arise, decontamination would be undertaken in laundries or other similar places by the trained laundry crews. The process consists of the conversion of the contaminant into harmless compounds, the change being brought about by keeping the goods submerged in boiling water for about 30 minutes. This treatment can be applied to all white cotton or linen goods without deleterious effect, but with woollens, some rayons, and most dyed work, damage may occur, and any such damage must be accepted. It has been established that the shrinking and harshening (felting) of woollens does not render them unserviceable, and the effects on most rayons are slight. Unless coloured work can be roughly classified, the running of dyes must also be accepted. Whilst the actual process of decontamination is comparatively simple, certain fundamental precautions must be observed before, during and after the process (*see* para. 5).

3. Effecting decontamination

All affected clothing must be freed from contamination before it can be worn again. The method used is dependent on the nature of the contamination, whether liquid or vapour; on the material from which the article is made: cotton, wool, leather, rubber, etc., and on the equipment available. The decontamination of clothing may be carried out by one of the following methods:

(*a*) WEATHERING

Suitable for certain items of clothing and equipment which have been subjected to vapour contamination only. Consists of exposure to the open air until the gas has evaporated.

(*b*) BOILING

All types of Service clothing and equipment except those containing leather and oilskin.

(*c*) STEAM TREATMENT

In this process, which takes place in a high-pressure disinfector, the gas is partially evaporated by heat and vacuum treatment, followed by the destruction of the remainder by means of pressure steam.

(*d*) IMMERSION IN HOT WATER

A temperature of 203°–210° F. should not be exceeded for articles made wholly or partly of oiled fabric.

A temperature of 120°–130° F. should not be exceeded for articles made wholly or partly of leather.

Satisfactory decontamination of all items which can safely be subjected to boiling can also be achieved by immersion in water at temperatures below boiling-point. The process period, however, becomes longer as the temperature of the water used is reduced.

TEMPERATURE	PERIOD OF IMMERSION
° *F.*	*Hours*
212	½
194	1 ½
176	2
159	3
140	7
122	24
104	48
86	96

From the above table it can be readily seen that if suitable provision is available for decontamination by boiling, the whole process is speeded up and a much larger volume of work can be dealt with in a given time. The time factor is a major consideration and under the conditions prevailing speed of action is essential.

4. Processes used

The foregoing remarks are of general application. In Table 10 particulars have been tabulated to illustrate a decontamination procedure which may reasonably be adopted in H.M. ships in which laundry machinery is available.

5. Precautions

(*a*) TRAINED STAFF.—All personnel must be fully trained so that they may have a proper appreciation of the dangers involved and so accept, with full confidence, the measures provided to counteract them. In this connection all persons engaged in handling contaminated articles and in carrying out the decontamination process must be dressed in suitable protective clothing, including a respirator. Staffs should also be exercised in decontamination work when wearing protective clothing, so that they may become familiar with the actual conditions under which they would be expected to perform these duties.

(*b*) CHANGING AND WASHING FACILITIES.—It is essential to provide suitable accommodation—known as cleansing stations—in which the staff may change into and out of protective clothing. Such facilities form a normal part of a ship's internal organisation.

(*c*) PROTECTIVE MEASURES are provided, and it is the responsibility of individual operators to safeguard themselves from injurious effects by the proper use of the protective devices supplied. These include:

The respirator.

Protective clothing, either heavy or light type.

Ointments.

Dressing and undressing routines.

Detailed instructions regarding (*a*) and (*b*) are given during the comprehensive training course.

(*d*) VENTILATION.—The ventilation of the space in which the work is carried out must be adequate to prevent the accumulation of gas, and as a minimum it must be sufficient to remove the steam generated. Steps must also be taken to ensure that contamination is not spread through the ventilation system to otherwise clean areas. The importance of ensuring efficient ventilation cannot be overstressed. Some blister gases, mustard for example, produce no immediately recognizable sensation or effect (some persons cannot even detect the smell except in high concentrations) and the effects may not become apparent until it is too late to prevent serious injury.

(*e*) DOUBT REGARDING POSSIBLE CONTAMINATION.—Should any doubt arise as to whether or not an article of clothing or equipment is contaminated it should always be treated as contaminated.

(*f*) CLEANING UP.—When the work of decontaminating the clothing is completed, the deck, machinery, tables, bins, trolleys, drains (scuppers), sumps, etc., must be thoroughly decontaminated by an approved procedure. The polished surfaces of machinery can be decontaminated by swabbing with rags or cotton waste damped with paraffin or mineral oil. It is essential also for the protective clothing itself to be decontaminated before it is used again. Internal fittings of washing machines should not normally require special treatment as these are constantly subjected to the decontaminating effect of the boiling water. In fact, if care is exercised when loading the washing machine, there is no reason why contaminated articles of clothing should contact any item of laundry equipment other than the washing machines. Contamination will occur only from contact with the protective clothing worn by the operator or carrier during his movements around the laundry.

(*g*) MARKING.—All bins or receptacles used for holding or transporting contaminated material, must be given distinguishing marks to ensure that they are not used for any other purpose before they have been decontaminated.

6. Notes on the process

(*a*) Decontamination is a process which aims at the removal of the gas contaminant only and does not include washing in the true laundry sense. If articles have to be washed as well as decontaminated, the two processes must be kept entirely separate and the decontamination completed first.

(*b*) Open pocket machines should not have more than one vertical division and should be of metal; wooden machines are unsuitable. Similarly machines with " Y " or " D " pockets (*i.e.*, in lateral divisions) are useless for decontamination, as the articles must be completely immersed in water during the whole of the process—such machines are, however, not normally provided for Admiralty services.

(*c*) Washing machines must be maintained in an efficient state, as leakage from a machine may seriously effect the efficiency of the process and increase the risk to the operators.

(*d*) The gas-proof bags or metal bins containing the contaminated clothing must be left in the open and should be isolated from all other work until required. The clothing should be loaded straight from the containers into the machine with the absolute minimum of handling.

(*e*) The load must be " poled " if possible at intervals during the decontamination process to ensure that all parts of the goods are submerged in the water. Any parts which are not submerged may become damaged by the acidity which develops during the breaking down of the blister gas. Under the slightly alkaline conditions of water pertaining when washing cottons and linens, this acidity can do no harm. The acidity has little or no effect on woollens and plain water only is used, *i.e.*, no alkali is added. The woollens must, however, be kept submerged.

(*f*) The temperature of the load must be maintained at over 200° F. for half an hour (except for leather or oiled fabrics). Thermometers should be fitted to all machines to indicate that this requirement is met.

(*g*) The intermittent rotation of the cage is necessary to effect the occasional redistribution of the load and thus add to the efficiency of the process.

(*h*) A portion of the last rinse may be retained when using machines of the side-opening type, and made up with additional warm water for use in washing the next load.

PROCEDURE

7. Sorting and classifying

The sorting of contaminated clothing must be done *outside the laundry*, preferably in the open air thus reducing the vapour concentration to a minimum. Clothing should be placed directly in the bins or gas-proof paper sacks in the following classifications:

(*a*) White cotton clothing such as towels, shirts, underwear, sheets, pillow-cases, handkerchiefs, etc.
(*b*) Coloured cotton clothing such as shirts, collars, action working dress, overalls, etc. } Cottons

(*c*) Blue service uniforms
(*d*) Greatcoats and caps
(*e*) Miscellaneous woollen articles, jerseys, socks, flannels, etc.
(*f*) Blankets } Woollens

(*g*) Boots and other leather articles.
(*h*) Rubber articles.
(*j*) Webbing.
(*k*) Protective clothing.
(*l*) Respirators.

Articles of clothing may be further sub-classified if capacity exists but in general the main objects to be achieved are:

To obtain the initial separation of " cottons and linens " from " woollens," and

To obtain the further separation in the two main categories of " coloured work " from " whitework."

The clothing should be taken to the laundry in the sealed bags or other containers only as capacity exists in the laundry to deal with it.

8. Apportionment of duties

In the difficult conditions envisaged, the work of ensuring a smooth routine in the laundry will call for careful organization on the part of the laundry officer, who must therefore be fully acquainted with all aspects of the procedure. It is suggested:

(*a*) That in view of the comparatively small numbers of trained laundry crew available in H.M. ships and of the strenuous nature of the duties involved *i.e.*, working in a humid atmosphere in protective clothing, the trained staff be allocated duties in the laundry only and that such duties be on a short shift basis. Assuming a crew of 9

Decontamination in washing machine	1	Crew of 9 in rotation
Hydro extraction and drying	1	1 hour duty
Folding and re-issue ..	1	2 hours off.

Longer continuous periods of duty may be possible in the case of operator(s) engaged in preparing goods for re-issue. The crew engaged in these duties could be dressed in light protective clothing, thus reducing fatigue. These personnel would be known as " operators."

(*b*) That the initial sorting operation, and the subsequent transfer of the decontaminated clothing from the sorting area to the laundry, should be done by additional personnel selected from the ship's company. These men would be known as " carriers " and would be dressed in heavy protective clothing. They would transport the classified clothing to the laundry and load the washing machine under the guidance of the trained operator. The carrier must on no account attempt other operations on the washing machine, and once the machine is loaded he should return to the sorting area. Great care should be taken by the " carrier " when loading the machine to reduce his contact with it to a minimum, and thus keep it as free from contamination as possible. A further member of the trained crew could be present at the sorting area to advise on classification.

Notes

(*a*) The operator should prepare the machine to receive the load from the carrier.

(*b*) The carrier should only load, care being not to touch the machine or surrounds more than is absolutely necessary.

(*c*) All subsequent work, *i.e.*, poling, turning on steam, water, etc., should be done by the operator.

(*d*) The operator should take the earliest opportunity to decontaminate portions of the machine which the carrier may have touched. This work must be done before removing the load, and can probably best be done during the heating up stage.

(*e*) The machine should be unloaded by the operator and the contents passed to the hydro-extractor operator. It will probably be most convenient to unload into a clean trolley.

9. Preparation of laundry

It should be possible by careful preparation, to restrict the area in the laundry subjected to positive danger of contamination to a minimum.

A typical arrangement of laundry is illustrated in Fig. 97.

The number of washing machines, etc. required for use would be dependent upon the bulk of work to be decontaminated, but if possible one or more machines should be retained " clean."

In this arrangement, the following measures are suggested:

(*a*) One washing machine only should be used for decontamination purposes.

(*b*) The machine, and access to it, should be separated from the rest of the laundry by the erection of a temporary gas-proof screen.

(*c*) The absorbent surfaces of all laundry equipment, *i.e.*, the lower bucks of presses, the rollers of flatwork ironing machines, etc., should be covered with protective material.

The above arrangement confines the area liable to positive contamination by liquid to that in the immediate vicinity of the washing machine. If a truly gas-proof screen can be contrived, conditions of operation for hydroing, drying and sorting would be considerably eased. In general, however, it must be assumed that such an arrangement does not provide positive freedom from vapour, and all operators engaged on any form of decontamination within the main laundry bulkhead must wear protective clothing.

Where the drying and issue rooms are remote from the laundry washing compartment, operators

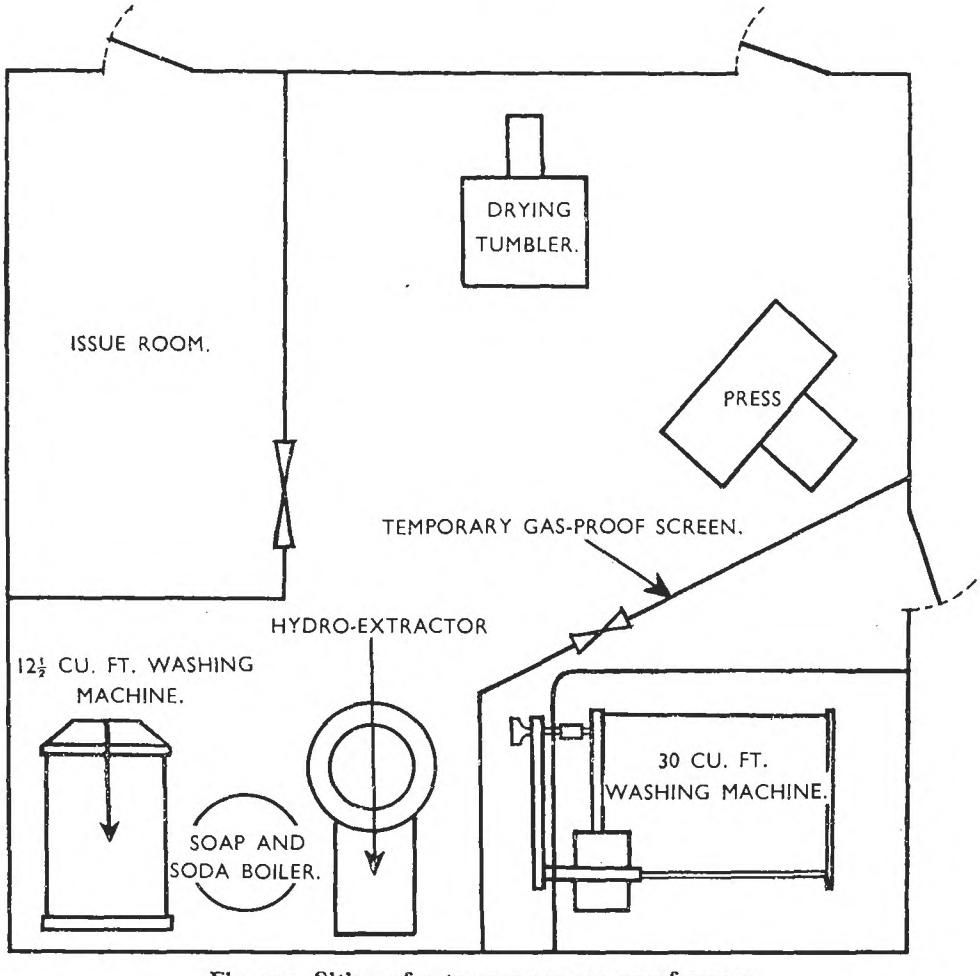


Fig. 97.—Siting of a temporary gas proof screen.

engaged on these duties need not wear protective clothing when handling decontaminated clothing. There are so many factors involved, however, that the declaration of safe working conditions must be left to the discretion of the responsible officers concerned.

DECONTAMINATION USING WASHING MACHINES

10. General Notes

(*a*) All cottons, linens and woollens can be decontaminated in the washing machine by using the same general procedure, but work should be undertaken in the separate classifications listed.

Cottons and linens: Alkali is used.
Woollens: No alkali.
Impregnated A.V. Clothing: Powdered chalk.
} See Table 10

(*b*) The correct loading rate is $2\frac{3}{4}$ lb. dryweight of clothing for each cubic foot of cage capacity, and this loading rate should not be exceeded.

30 cu. ft. machine. Normal load, 105 lb. Decontamination load, 80 lb.

12½ cu. ft. machine. Normal load, 43 lb. Decontamination load, 35 lb.

28·5 cu. ft. (end open). Normal load, 100 lb. Decontamination load, 78 lb.

(*c*) The machine must be kept stationary during the whole of the process, except for the periodical rotations referred to.

11. Side opening machine

OPERATOR

(1) Admit warm water to a depth of 8 in.

(2) Add alkali, dependent upon the nature of the load (see (*a*) above), at the rate of 1 oz. for every cu. ft. of cage capacity, *i.e.*, 12½ oz. in a 12½ cu. ft. machine or 30 oz. in a 30 cu. ft. machine.

CARRIER

(3) Load the machine under the guidance of the operator to the correct degree of loading, taking care

not to spread contamination to the machine or surrounds.

OPERATOR

(4) Fill the machine with warm water to the maximum dip and ensure that the clothes are well submerged by pushing them under the water with a metal rod. This operation is termed " poling."

(5) Close the machine, admit steam, and bring the water to the boil.

(6) Decontaminate such portions of the machine as may have been touched by the " carrier."

(7) As the temperature of the water approaches 200° F., rotate the cage 2 or 3 times using the hand turning gear. This redistributes the load and ensures free circulation of the water through the clothing.

(8) When boiling point is reached, open the machine and give a further poling to ensure that the load is submerged.

(9) Close the machine and allow the water to boil vigorously for 30 minutes, taking the time from the moment boiling begins.

(10) Rotate the inner cage one complete revolution, using the hand turning gear, at intervals of 10 minutes throughout the boiling period.

(11) After the load has been boiling for 30 minutes, open the outer door and give the load a further " poling " before turning off the steam.

(12) Release the water from the machine.

(13) Rinse once with hot water, filling the machine to its maximum dip. The clothes should be agitated either by " poling " or by one rotation of the cage. Discharge the water after rinsing for 2 to 3 minutes.

(14) Rinse again using warm water to maximum dip. A portion of this water, *i.e.*, to a dip of 8 in. may be used for washing the next load.

(15) After the final rinsing as at (14) the decontamination process is complete, and the goods may be removed from the machine for hydroing and drying prior to issue to individuals or return into store.

Note : Great care must be exercised during the removal of the load from the washing machine to prevent possible re-contamination due to contact with contaminated surfaces.

Woollens should be gently turned over and prodded down and not vigorously " poled " as for cottons.

12. End opening machine

(*a*) The construction of this machine is fundamentally different from that of the side opening type, and in connection with its possible requirement for decontamination purposes, the following points assume importance:

(*b*) The machine can be completely filled with water, so that the clothes in the cage are totally submerged during the whole of the process, rendering " poling " unnecessary.

(*c*) The door cannot be opened when the machine is loaded, making " poling " impracticable in any event.

(*d*) Hand turning gear is not provided and revolution of the cage to obtain the periodical redistribution of the load must be carefully effected by means of the power drive.

CARRIER

(1) Loading should begin when the cage is empty. The machine should be loaded to the accepted degree under the supervision of the operator.

OPERATOR

(2) Close the machine and fill with warm water to the highest level possible, *i.e.*, to a level just above that of the top of the cage.

(3) Add alkali, according to the type of material being dealt with, at the rate of 1 oz. for every cubic foot of cage capacity.

(4) Admit steam and bring to the boil.

(5) Decontaminate such portions of the machine as may have been touched by the " carrier."

(6) As the temperature approaches 200° F., revolve the machine 2 or 3 revolutions using the power drive.

(7) Allow the clothing to boil briskly for 30 minutes, taking the time from the moment the water begins to boil.

(8) Rotate the cage one complete revolution, using the power drive, at intervals of 10 minutes, throughout the boiling process.

(9) After the load has been boiling for 30 minutes turn off steam and release all the water from the machine.

(10) Rinse with hot water, filling the machine to maximum dip as at (2). Revolve the cage once and release the water after 2 to 3 minutes rinsing.

(11) Rinse again in warm water.

(12) Release the water and unload the machine, taking care to avoid contact with contaminated surfaces.

FINISHING

13. Hydro-extraction

After washing, all decontaminated cotton and woollen articles should be hydroed. The goods should be loaded into the machine in accordance with the normal scale of loading, *i.e.*, 12 lb. dryweight per cubic foot of cage capacity.

27-in. machine, approx. 3 ½ cu. ft.—42 lb. load.

30-in. machine, approx. 6 cu. ft.—72 lb. load.

Woollens should be hydroed for about 5 minutes, other goods until the steady flow of water from the waste pipe has ceased.

14. Drying

After hydroing the goods should be completely dried in the drying-tumbler, or in the drying-room if no tumbler is available. In the conditions prevailing it is unlikely that the laundry staff could undertake the complete finishing of laundry goods and these will be issued therefore in the rough-dried condition only, after re-sorting.

15. Deodorization

Clothing contaminated with lewisite retains a strong smell of geraniums even after decontamination. The smell can be removed by airing in the open, although as long as 14 days may be required to effect its complete removal. This deodorization can be done in 2 hours, however, by the immersion of the clothing in a cold solution of 2 lb. of Chloramine T to 10 gallons of water. One gallon of the solution is required for each pound of clothing. After treatment the clothes should be rinsed and hydroed again. Deodorization in the Chloramine T solution can be done in the washing machine, but the machine should not be used for this purpose to the exclusion of the main requirements, *i.e.*, initial decontamination.

LEATHER AND OILSKIN

16. Decontamination of leather articles

Leather articles are irreparably damaged if subjected to direct contact with steam or boiling water. Decontamination by weathering or by the evaporation of the gas in hot dry air conditions is possible, but the process is slow and the results uncertain. Baking is also liable to cause damage, especially if the articles are not thoroughly dried beforehand.

It is necessary therefore to treat leather articles by immersion in water of a comparatively low temperature, namely, 120 to 130° F.

(*a*) Articles worn over clothing, footwear, gaiters, etc.—immerse for 2 hours.

(*b*) Braces, webbing, worn next to or adjacent to the skin—immerse for 6 hours.

Notes

(i) If decontamination is done in the washing machine, the cage may be rotated and the load prodded as for cottons.

(ii) One gallon of water should be used for each pound of leather, and the temperature must be kept within the limits specified.

(iii) As much of the free liquid contamination as possible should be wiped off before the immersion treatment.

17. Drying

After immersion the goods should be drained and allowed to dry evenly in a warm atmosphere (approx. 100° F.). Boots and shoes should be dried on trees or formers. If these are not available, the footwear should be packed to shape with paper.

Certain made-up leather articles containing glue are liable to be damaged even by this immersion process, and nearly all leather goods will require polish or dubbin to restore the flexibility of the leather.

18. Decontamination of oilskin

The decontamination of oilskin clothing requires particular care to prevent damage to the oil proofing. Boiling water must not be used because of the deleterious effect of steam on the proofing and the similar liability to damage occasioned by agitation. It is important, therefore, to keep the oilskin garments flat and to prevent them sticking together or rubbing. A laundry machine is not suitable for this operation

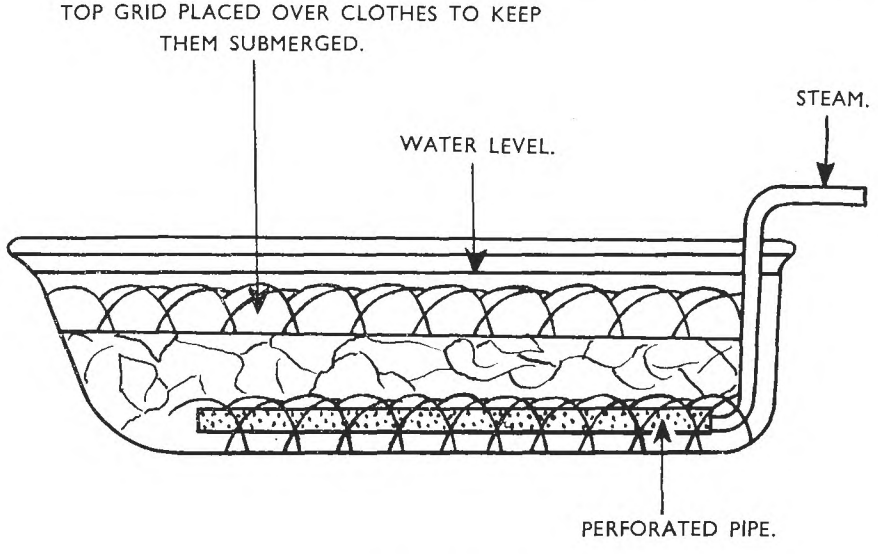


Fig. 98.—Use of long bath for decontamination purposes.

and the process of decontamination must be carried out in a long bath or suitably fitted tank.

The process of decontamination consists of folding the oilskin articles, using the minimum number of folds, and placing them on a grid in a bath or tank full of water. A heavy grating is placed on top to keep the oilskins immersed. The water should be maintained at a temperature of between 203° F. and 210° F. (just below boiling point) for the period shown in Table 10.

About 6–8 heavy oilskin suits can be dealt with in one full bath. The water should be changed between each batch. On completion of the immersion, the oilskin clothing must be removed very carefully to prevent the oil film surfaces sticking together and so stripping off the protective layer. The garments should then be placed on hangers and allowed to dry. Drying should be effected preferably in a well ventilated space in a temperature not exceeding 120° F.

IMPROVISATION

19. In small ships in which no laundry machinery, or unsuitable machinery (domestic washing machines), is installed, the equipment for effecting decontamination must be improvised. A satisfactory arrangement can be made by using the long bath normally installed in officers' bathrooms.

A typical arrangement is shown in Fig. 98.

The processes and temperatures for different types of materials are generally the same as those adopted for decontamination when using the washing machine.

If the bathroom is provided with one side-scuttle only, ventilation should be augmented by the use of portable suction fans of the type used in cleaning closed tank compartments.

Appendix

TABLE 1. SCALE OF OPERATORS

MACHINE OR OPERATION	NO. OF OPERATORS	REMARKS
1 Washing machine 1 Hydro extractor	1	Responsible for maintaining his own soap and stock tanks.
2 Drying tumblers	1	Where only one tumbler is fitted, this can be operated by the men engaged on washing and flatwork ironing duties.
1 Flatwork ironing machine	2	
1 Sleeve form 1 Collar and cuff press 1 Shirt bosom press 1 Shirt body press 1 Shirt folding table } Shirt unit	2	
1 General purpose press	1	
1 Flannel press	1	
1 Starching machine 1 Collar polishing machine 1 Collar edge iron 1 Collar hot tube 1 Starch boiler } Collar unit	1	
1 Marking machine 2 Sets of classification bins	2	
2 Sets of sorting racks	2	In addition to sorting, these operators may also be required to issue the work if an additional hand cannot be made available.

TABLE 2. TIMETABLE

DUTY WATCH	TIME	NON-DUTY WATCH
	0700	
Turn To - - - - - - - - - - - -	0730	
	0800	- - - - - - - - Turn To
	0830	
	0900	
Work Period	0930	Work Period
	1000	
	1030	
	1100	Break for Dinner and become Duty Watch
	1130	
Break for dinner and become Non-Duty Watch	1200	- - - - - - - Turn To
	1230	
Turn To - - - - - - - - - - - -	1300	
	1330	Work Period
	1400	
Work Period	1430	
	1500	
	1530	- - - - - - - - Commence Tea
Secure (Leave) - - - - - - - - - -	1600	- - - - - - - - Turn To
	1630	
	1700	Work Period
	1730	
	1800	- - - - - - - - Secure

TABLE 3. LAUNDRY ROUTINE: FLEET CARRIER

Dirty laundry for the forenoon wash is to be handed in during the dog watches of the previous day and is to be ready for distribution during the following dog watches. Dirty laundry for the afternoon wash is to be handed in during the breakfast hour of that day and be ready for distribution during the breakfast hour of the next day.

DAY	FORENOON	AFTERNOON
Monday	Officers	Air Repair Division Electrical Division
Tuesday	Seamen Chief and Petty Officers Master at Arms Regulating Petty Officers	Air Repair Division Electrical Division
Wednesday	E.R.A.'s Mechanicians C.P.O. Stoker Mechanics P.O. Stoker Mechanics	Flight Deck Division Forecastle Division Communications
Thursday	Shipwright Artificers Canteen Staff Sick Berth Attendants Writers Supply Assistants	Foretop Division Main Top Division Royal Marines and Band
Friday	Stewards Cooks	Quarterdeck Division Cooks working dress Boiler suits as necessary
Saturday	Stoker Mechanics (Starboard) Mess Table Linen Sick Bay Linen	Stoker Mechanics (Port) Boys' Division
Sunday	Bedding	Care and maintenance routine

TABLE 4. LAUNDRY ROUTINE: *TOWN* Class CRUISERS

Dirty laundry is to be handed in during the Dog Watches of the previous day and collected at 0700 on the day following processing.

DAY	FORENOON AND AFTERNOON
Monday	Officers Master at Arms Regulating Petty Officers Sick Berth Attendants Boys' Division Communications
Tuesday	Forecastle Division E.R.As. C.P.O. Stoker Mechanics P.O. Stoker Mechanics Shipwright Artificers
Wednesday	Quarterdeck Division Chief and Petty Officers Writers Supply Assistants
Thursday	Top Division Cooks Stewards Electrical Division
Friday	Stoker Mechanics Royal Marines
Saturday	Boiler suits Mess Table Linen
Sunday	Bedding. Care and Maintenance Routine

TABLE 5. LAUNDRY ROUTINE: REPAIR AND DEPOT SHIPS

Dirty laundry for the forenoon wash is to be handed in during the dog watches of the previous day and be ready for distribution during the following dog watches.

Dirty laundry for the afternoon is to be handed in during the breakfast hours of that day and be ready for distribution during the breakfast hours of the following day.

DAY	FORENOON	AFTERNOON
Monday	Officers (including those attached)	Ship's Seamen Divisions Boys' Division Communications (50 per cent.)
Tuesday	Shipwright Artificers Chief and Petty Officers Master at Arms Regulating Petty Officers Canteen Staff Writers Sick Berth Attendants Supply Assistants	Communications (50 per cent.) Ship's Stoker Mechanics Division Electrical Division
Wednesday	Attached Chief and Petty Officers E.R.As. and Mechanicians Cooks Stewards	Attached Seamen
Thursday	Ships E.R.As., E.As. O.As. and Artisans	Attached Seamen
Friday	Attached Seamen	Attached Stoker Mechanics
Saturday	Mess Table Linen Sick Bay Linen	Sports Gear Bedding
Sunday	Complete Bedding	Care and Maintenance Routine

TABLE 6. POSITIONS FOR MARKING

GARMENT	WHERE MARKED	REMARKS
Vests	Maker's tab or inside on the back centrally	Wherever possible use maker's tab.
Pants (short or long)	Maker's tab or inside on the back centrally	
Shirt (all types)	Inside centre of neck band	On shirt with collar attached, make sure it is on double material.
Collars (all types)	Inside centre, close to stud hole	Wing collars, special care required to ensure marking inside.
Handkerchiefs	Diagonally opposed corners one either side	
Sheets	Ditto	
Towels	Either end on hem or smooth part, each side	
Pyjama coat	Inside collar on double material	
Pyjama trousers	Inside at both ends of waist band	
Pillow cases	Inside hem either side	
Cap covers	Inside the band	
White tunics	Inside neckband centrally	
Shorts and trousers (tropical)	Inside waist band centre or right and left side	
Tropical white cotton socks or stockings	On instep of foot	Woollens by numbered pins.
Overalls, white	Inside neckband	
White flannel	Inside tail	
White flannel front	On bottom hems either side	
Blue jean collar	At bottom of front	If seam is unsuitable, mark on underside of collar at one corner.
White drill jumper	On seam joining collar to back centrally inside	
White drill	Inside centre of waist band	

TABLE 7. VOLUMETRIC CAPACITY OF WASHING MACHINES

DIP IN INCHES, MACHINE STATIONARY	CORRESPONDING VOLUME IN GALLONS					
	SMITH & PAGET 36 in. × 51 in.	BRADFORD 36 in. × 50 in.	CHERRY TREE 43 in. × 38 in.	RITCHIE 34 in. × 54 in.	SMITH & PAGET 27 in. × 36 in.	BRADFORD $25\frac{3}{4}$ in. × 36 in.
3 in.	58	57	57	57	26	8
4 in.	61	60	60	60	28	11
6 in.	68	67	66	66	33	18
8 in.	75	74	74	74	39	25
9 in.	79	78	78	78	42	29
10 in.	83	82	83	83	45	33
12 in.	91	89	91	89	51	42
14 in.	101	99	102	99	—	—
15 in.	108	106	107	106	—	—
Maximum allowable—*i.e.*, to centre line of cage	131	128	123	128	57	50

Notes.—(i) The quantity of water absorbed by the load is a constant figure at 25 gal. per 100 lb. of work, *i.e.*, this volume of water is retained by the load after draining the machine at the end of each stage of washing or rinsing.

(ii) The dip normally increases by approximately 1 in. to 2 in. when a running machine is stopped.

TABLE 8. READY GUIDE TO MACHINE LOADS

In numbers of Articles. All Weights refer to Dry Weight

ARTICLE	WASHING MACHINE		TUMBLER		HYDRO'S	
	100 *lb.*	50 *lb.*	30 *lb.*	90 *lb.*	28 *lb.* (21 *in.*)	48 *lb.* (27 *in.*)
1. Blankets 4 lb. 13 oz.	21	10	6	18	5	9
2. Hammocks 3 lb. 15 oz.	25	12	6	18	7	13
3. Bedcovers 2 lb. 9 oz.	40	20	11	35	10	20
4. Overalls 2 lb.	50	25	15	45	14	24
5. Working shirt† 12 oz.	75	37	22	66	21	36
6. Working trousers† 1 lb. 4 oz.	80	40	24	72	22	40
7. Sheets† 2 lb.	50	25	15	45	10	20
8. Bath towels 1 lb. 4 oz.	80	40	24	72	22	40
9. Towels 5 oz.	320	160	96	288	89	153
10. Pillow cases† 6 oz.	266	133	80	240	74	128
11. White flannels† 15 oz.	106	53	32	96	27	51
12. No. 6 suits (Seaman) 3 lb. 10 oz.†	32	16	8	24	7	13
13. No. 6 (C.P.Os. & P.Os.) No. 10 (Officers)† 2 lb. 7 oz.	40	20	12	36	11	19
14. Suits, tropical† 1 lb. 12 oz.	57	28	17	51	16	27
15. Shirts† 10 oz.	160	80	48	144	140	76
16. Set of underwear† 8 oz.	200	100	60	180	56	96
17. Pyjamas† 1 lb. 8 oz.†	66	33	20	60	18	32

Note.—Items marked † are part dried only in the tumbler, *see* Chapter 6, para. 14.

TABLE 9. ASBESTOS CLOTHING FOR FLATWORK IRONING MACHINES

MAKER'S NAME AND TYPE	WIDTH OF CLOTHING REQUIRED	COARSE, K15 OR EQUIVALENT		FINE, K203 OR EQUIVALENT		MAKE-UP K203 OR EQUIVALENT	
		rounds	*yards*	*rounds*	*yards*	*rounds*	*yards*
Bradford 120 in. × 24 in. Double roller	124 in.						
Front roller		3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Back roller		3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Manlove, 120 in. × 24 in. Double roller	124 in.						
Front roller		3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Back roller		3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Bradford, 120 in. × 24 in. Single roller	124 in.	3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Bradford, 90 in. × 24 in. Single roller	94 in.	3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$
Smith & Paget, 90 in. × 24 in. Single roller	94 in.	4	$6\frac{1}{4}$	2	$3\frac{1}{6}$	3	$4\frac{3}{4}$
Smith & Paget, 72 in. × 18 in. Single roller	76 in.	4	$6\frac{1}{4}$	2	$3\frac{1}{6}$	3	$4\frac{3}{4}$
Bradford, 56 in. × 25 in. " Mariner " return feed	62 in.	4	$8\frac{2}{3}$	2	$4\frac{1}{3}$	3	$6\frac{1}{2}$
Manlove, 36 in. × 24 in. General utility	40 in.	3	$6\frac{1}{4}$	2	$4\frac{1}{4}$	3	$6\frac{1}{4}$

TABLE 10. DECONTAMINATION PROCESSES

TYPE OF CLOTHING	DECONTAMINATING PROCESS	
	Liquid Contamination	*Vapour Contamination*
Woollens		
Serge suits, greatcoats, jerseys, flannels, wolllen underclothing and pyjamas, socks, blankets, caps, etc.	(*B*) Using plain water boil for half-hour (*C*) May be used if garments are dry	(*A*) 6 to 12 hours airing. Treat as liquid contamination if exposed for a long time to a high concentration of vapour.
Cottons and linens		
Drill and duck suits, overall suits, calico and cellular underwear, shirts, ties, handkerchiefs, towels, pillow-cases, etc.	(*B*) Using soda ash, 1 oz. per cu. ft. of cage capacity. Boil for half-hour	
Miscellaneous textiles		
Haversacks, webbing equipment, etc.	(*B*) Using soda ash, 1 oz. per cu. ft. of cage capacity. Boil for half-hour	
A.V. clothing	(*B*) Using 6 oz. of powdered chalk per 8 cu. ft. of cage capacity	
Oilskins	(*D*) Using plain water, immerse for 30 minutes at 203 to 210° F.	(*A*) At least 24 hours' airing. Treat as liquid contamination if exposed for a long time to a high concentration of vapour.
Rubber articles		
(i) Ground sheets and waterproofs, etc. (ii) Rubber seaboots Rubber A/G gloves (iii) Respirator facepieces and corrugated tubes	(*B*) Using plain water: (i) boil for one hour (ii) boil for two hours (iii) boil for three hours	
Leather		
(i) Footwear, gaiters, belts and straps worn over clothing, etc. (ii) Braces, webbing anklets, fabric lined garments, articles worn close to the skin, etc.	(*E*) (i) Using plain water, immerse for two hours at 120 to 130° F. (ii) Using plain water immerse for six hours at 120 to 130° F.	
Miscellaneous		
Sun helmets, peaked caps, etc.	(*A*)	

Key to lettering

A—Weathering
B—Boiling
C—Steam treatment in high pressure disinfector
D—Immersion in water at 203° F. to 210° F.
E—Immersion in water at 120° F. to 130° F.