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[54] **STERILIZED LAUNDRY SYSTEM**
11 Claims, 3 Drawing Figs.

[52] U.S. Cl. 68/210
[51] Int. Cl. D06f 39/14
[50] Field of Search 68/210

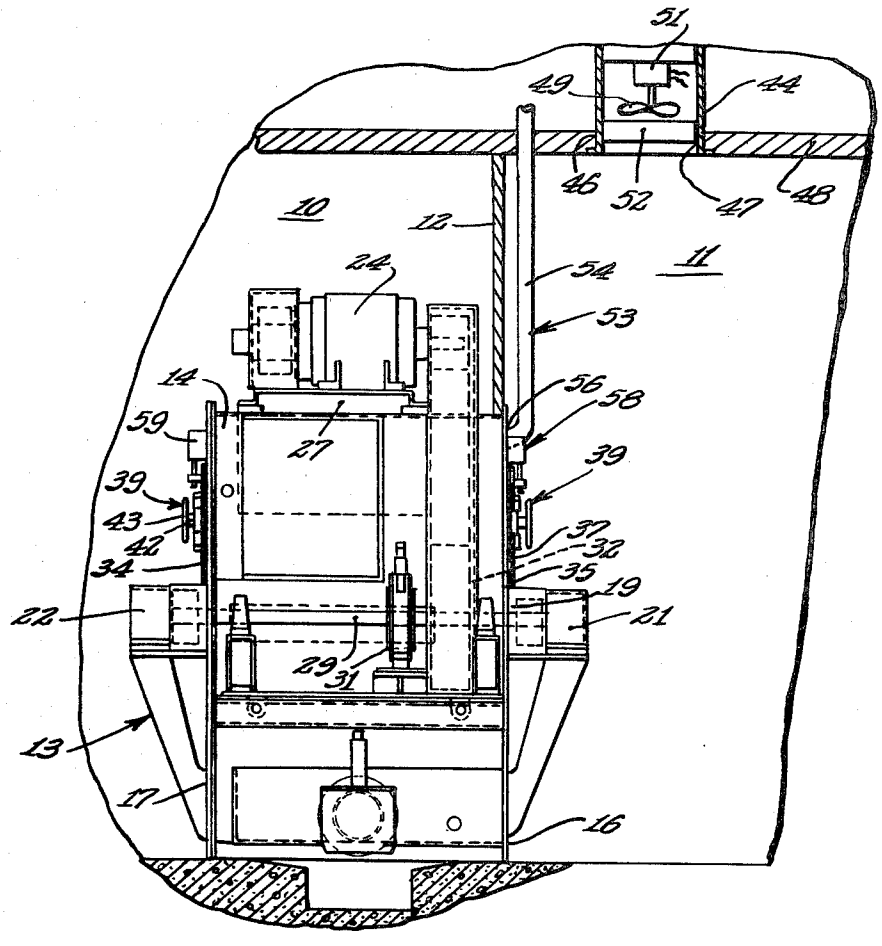
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ABSTRACT: A sterilized laundry system utilizes a washing machine sealingly mounted in a common wall of a soiled area and a sterilized area and includes first and second door means respectively providing access from the soiled and the sterilized areas into an interior of a washing drum horizontally disposed within the washing machine, releasable locking means normally maintaining the pair of doors in a locked position and control means selectively releasing the locking means only to permit opening the doors in a manner to prevent cross infection between the separate rooms. The sterilized area is maintained at a constant positive pressure relative to the soiled laundry area and other areas ambient the sterilized room, thereby preventing flow of contaminated air into the sterilized area.



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Fig. 1

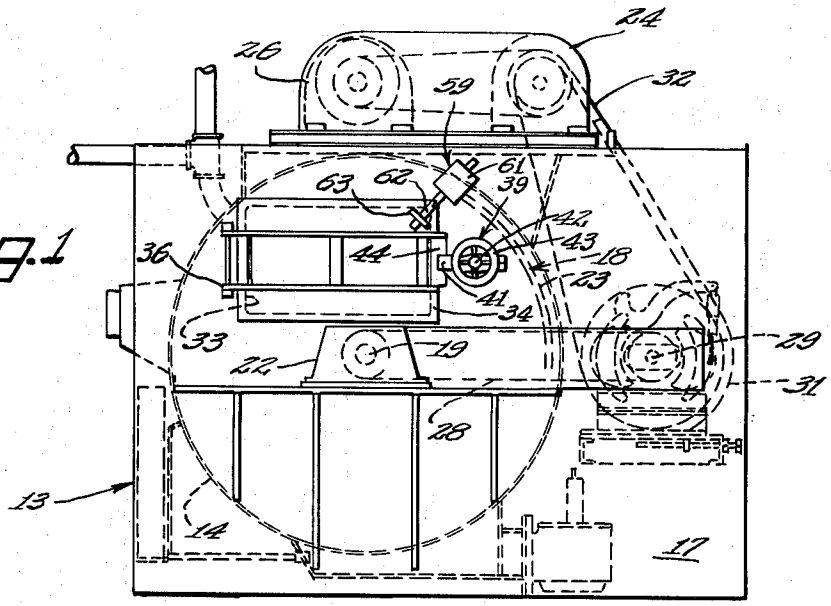
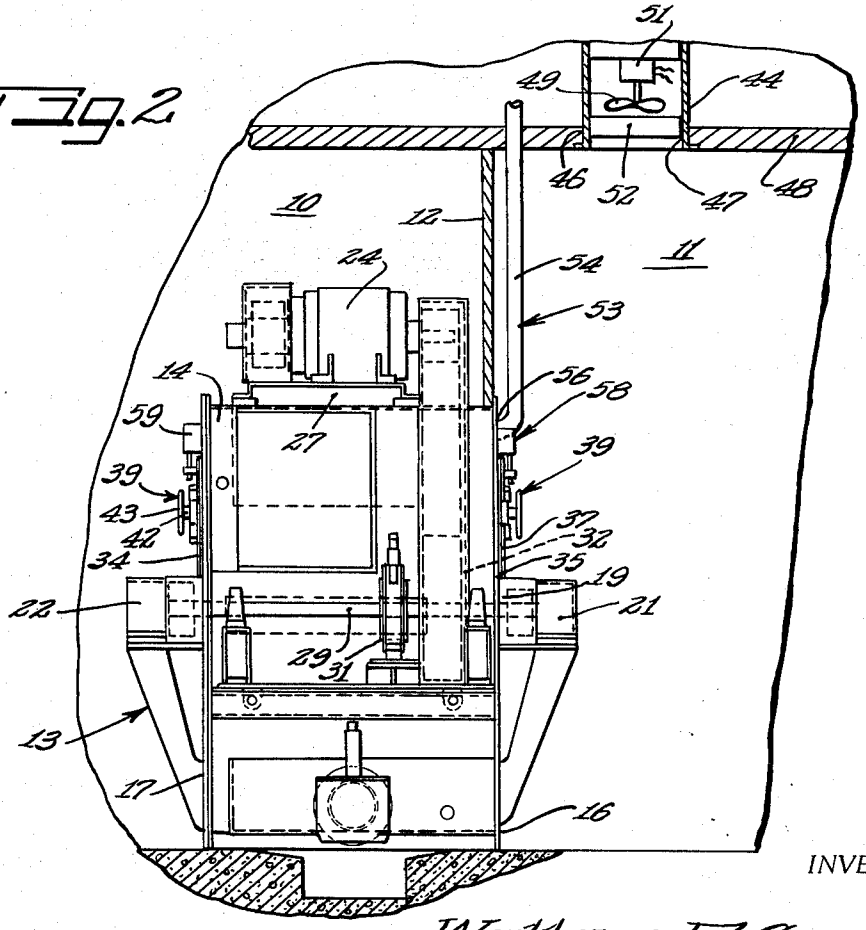


Fig. 2



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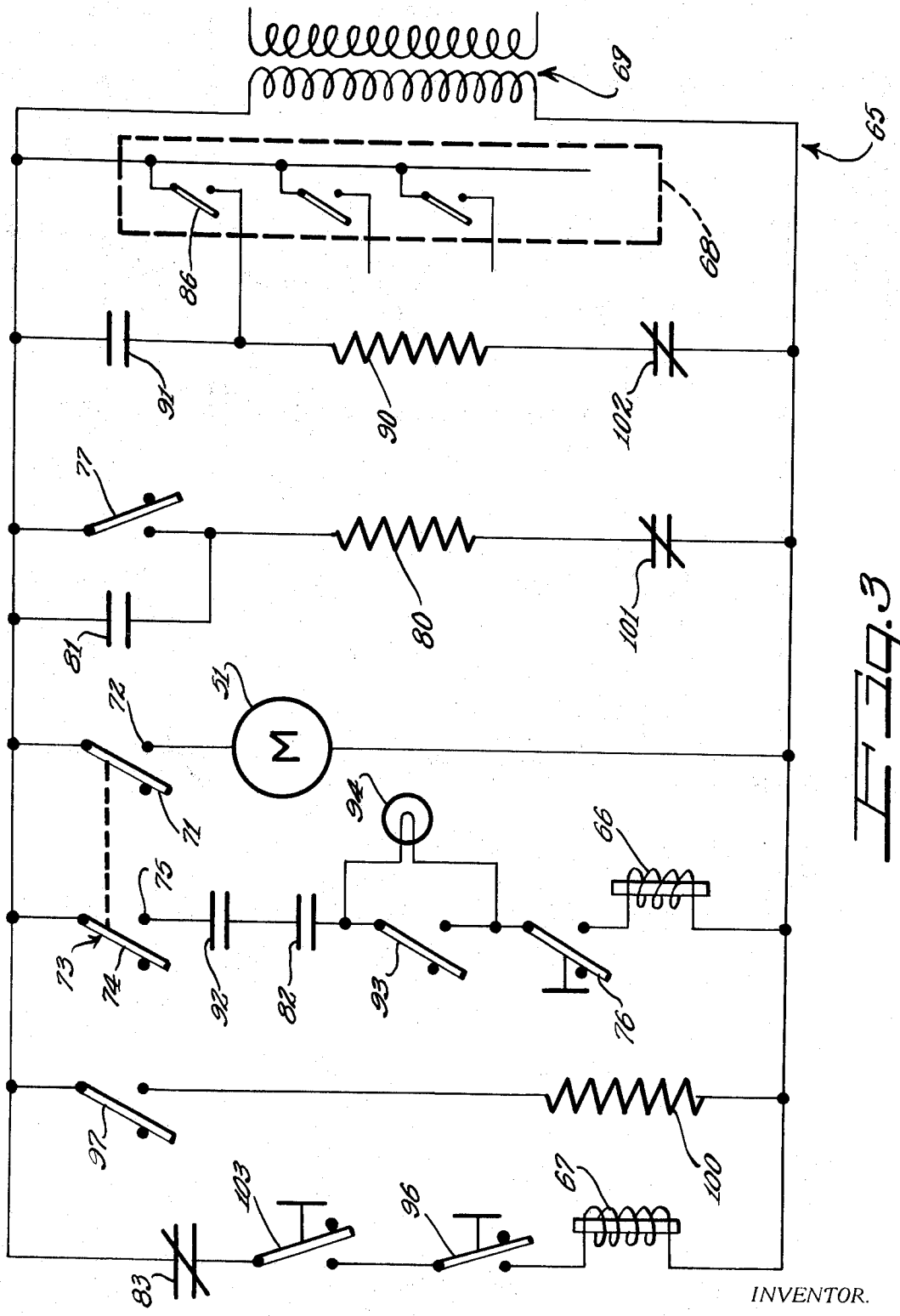


Fig. 3

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STERILIZED LAUNDRY SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to commercial laundry equipment, and more particularly refers to a laundry system including means for delivering sterilized laundry material and for preventing contamination of the sterilized laundry material and for preventing contamination of the sterilized laundry subsequent to removal from a washing machine.

2. Description of the Prior Art

Staphylococcus aureus, a tough strain of bacteria that is resistant to antibiotics, is commonly found in hospitals and may cause serious infection in hospital patients weakened from their illnesses. Elimination or control of the spread of that bacteria and other infectious bacteria is of prime importance for proper hospital administration. Linen which contacts infected persons or infected areas is prime source of the spread of bacteria throughout hospitals resulting in cross infection between patients. Thus, proper sanitary methods in the collection, transportation washing, and distribution of hospital linen will go a long way toward controlling incidence of cross infection. Proper distribution of sterilized laundry material requires that the sterilized laundry be completely isolated from contaminated areas subsequent to sterilization.

One form of commercial laundry equipment utilized for delivering sterilized laundry material and for preventing cross infection between soiled laundry and sterilized laundry includes a washing a washing machine sealingly mounted in a solid common wall separating a soiled laundry area from a sterilized laundry area and having a horizontally disposed, rotatably mounted washing cylinder or drum, Access to an interior of the washing drum is provided by a pair of doors respectively opening from the separate rooms. The washing machine is loaded through one door opening from the soiled area and unloaded from another door opening into the sterilized area.

To prevent cross infection between the soiled area and the sterilized area, the pair of doors providing access to the washing drum must be controllably locked in a manner to prevent simultaneously opening the doors or opening the sterilized room door until the laundry material has been sterilized. Prior art laundry systems have not included adequate, fail-safe means controlling means locking the separate doors in a manner to prevent cross infection.

Since bacteria may be easily transported by air currents, it is also necessary to provide means preventing flow of contaminated air from the soiled area or other areas either into the sterile area, or, subsequent to loading the machine, into the interior of the washing drum. Adequate airflow control means have not been proposed heretofore in the prior art.

SUMMARY OF THE INVENTION

In accordance with the present invention, a washing system for assuring that soiled laundry material is properly sterilized and isolated from contaminated areas comprises a first area for receiving soiled laundry material, a second area completely isolated from the first area by a solid, common wall and a washing machine sealingly mounted in the common wall. To prevent contaminated air currents from flowing into the sterilized room, sterilized air under pressure is forced into the sterilized area to maintain that area at a positive pressure relative to ambient areas including the soiled laundry room. Since air may be sucked into the washing machine during the extraction cycle, a conduit opening directly into an interior of the washing machine supplies sterilized air at a pressure exceeding that of the soiled laundry room, but not exceeding the pressure of the sterilized laundry room. Thus, any leakage of flow of air will always be from the sterilized room to prevent contaminated air currents from entering that area.

The washing machine comprises a horizontally disposed, rotatably mounted washing cylinder or drum receiving the laundry material and means for washing, rinsing, extracting and sterilizing the laundry drawings, Laundry material is loaded into the drum through a first door means opening from the soiled laundry area into an interior of the washing drum, and the sterilized laundry material is unloaded from the washing drum through a second door opening at an opposite end of the washing machine and into the sterilized room. Locking means normally retaining both doors in a locked position are releasable in a controlled manner to assure that the sterilized room will not be exposed to contaminated laundry material or contaminated air currents.

Control means for releasing the door-locking means comprise means preventing simultaneous opening of the soiled room door and the sterilized room door to prevent direct exposure between the separated areas, means preventing release of the sterilized room door locking means until the washing machine has completed its washing cycle and the laundry material has been subjected to sterilizing temperatures for a sufficient period of time to prevent contaminated laundry material from inadvertently entering the sterilized room through the washing machine, and means preventing release of the soiled room door prior to unloading the sterilized material.

Since the total system partially depends upon maintaining the sterilized room at a positive pressure, the control means desirably include interlocking means preventing the sterilized room door from opening unless the forced air supply means is properly functioning.

Thus, the primary object of the present invention is to provide a laundry system for delivering sterilized laundry material and preventing contamination thereof by soiled laundry material.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings., although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

FIG. 1 is an end elevational view of a washing machine embodying the features of the present invention:

FIG. 2 is a side elevational view of the washing machine of FIG. 1 and illustrating the machine mounted in a common wall separating a soiled laundry are a from a sterilized laundry area; and

FIG. 3 is a schematic drawing illustrating a control circuit embodying the features of the present invention and for controlling release of locking means normally retaining access doors of the washing machine in a lacked condition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a laundry system constructed in accordance with the principles of the present invention comprises a soiled laundry area or room **10**, a sterilized laundry area or room **11** sealingly separated from the soiled laundry room by a solid common wall **12**, and a washing machine **13** sealingly mounted in the common wall so that the mechanical equipment thereof projects into the soiled laundry room. The machine **13** may be of the washer-extractor type and includes a sterilizing cycle wherein the laundry material is subjected to steam or water exceeding 180° F. for a sufficient time interval to assure destruction of most bacteria and thus sterilization of the laundry material.

The washer **12** has an imperforate outer cylindrical housing or shell **14** extending on a horizontal axis between rectangularly shaped front and backplate members **16** and **17**, respectively,. An airtight seal is formed between the front and backplates **16** and **17** and outer peripheral edges of end portions of the outer shell **14**.

Situated within and disposed coaxially of the shell !11 is a washing cylinder or drum **18** in which soiled material to be laundered is deposited. A shaft **19** having opposite end portions thereof journaled in a pair of bearing blocks **21** and **22**, respectively secured to the front plate **16** and the backplate **17** mounts the drum **18** for corotation therewith. The washing drum **18** comprises a foraminated cylindrical sidewall **23** and a pair of circular enclosures closing opposite ends of the cylindrical sidewall to form a closed drum. An interior of the washing drum **18** may be longitudinally divided into several separate compartments by substantially radially extending partitions.

During a washing operation, the drum **18** is rotated with the shaft **19** at tumbling speeds by means of an electric motor **24**, and during an extracting operation the drum is rotated at a higher extracting speed by a relatively high-speed motor **26**. Both motors **24** and **26** are supported or a shelf **27** which in turn is secured to the outer shell **14**. THe cylinder shaft **19** is drivingly connected by a V-belt **28** to an auxiliary shaft **29** disposed parallel to, and laterally outwardly from, the cylinder shaft. The auxiliary shaft **29** is connected through a clutch and brake mechanism as at **31** and a multibelt drive as at **32** to the motors **24** and **26**.

In order to provide access to the washing drum **18** for loading the machine **13** with soiled laundry material, the backplate **17** has an access opening **33** formed therein and a door **34** hinged at **36** and sealingly closable over the opening **33**. Soiled laundry material is only loaded from the back or soiled room side and only unloaded from the front or sterile room side. Access to the washing drum **18** for unloading purposes is provided through an access opening **35** formed in the front plate **16** and selectively closable by a hinged door **37**. Each circular end closure of the washing drum **18** has openings in registry with each one of the individual separate compartments formed by the radially extending partitions, thereby providing ingress and egress means through which the laundry material is loaded into, and removed from, and interior of the washing drum **18**. By jogging the washing drum **18**, the openings for the individual compartments may be sequentially moved into registry with the corresponding opening **33** or **35** formed respectively in the backplate **16** and the front plate **17**.

In order to seal an interior of the washing machine defined by interior surfaces of the outer shell **14**, the front plate **16** and the backplate **17**, seal means are provided between the hinged doors **34** and **37** and their associated openings **33** and **35**, and door-securing means as at **39** securely clamp the doors **33** and **37** into sealing engagement with their respective end plates **16** and **17**. Each door-securing means comprises a latch bar **41** and a screw means characterized by a threaded post **42** projecting outwardly from an associated one of the end plates **16** and **17** and loosely received in an aperture formed in the latch bar and a handwheel **43** threaded onto the post and abutting the latch bar. In a clamping position the latch bars **41** overlap offset portions as at **44** formed on the hinged doors **34** and **37** and the handwheels **43** are screwed onto the post a sufficient distance to tightly seal the access openings **33** and **35**. The latch bars **41** may be released by backing the associated handwheel **43** off the threaded post **42** and rotating the latch bar to a noninterfering position.

To assure that the sterilized laundry material unloaded from the machine **13** remains uncontaminated after removal from the washing drum **18**, it is necessary that the sterile room or area **11** be maintained in a sterile or uncontaminated condition. Thus, it is contemplated by the present invention, that the laundry system include means supplying the sterile room **11** with sterilized air under pressure to maintain that area at a positive pressure relative to ambient areas including the soiled laundry room **10**, thereby causing any leakage of air between the sterile room **11** and the soiled laundry room **10** to flow from the sterile area to the contaminated area for preventing contamination of the sterile area by airborne bacteria.

In accordance with the principles of the present invention, the means supplying bacteriafree air to the sterile room **11** comprise a conduit or air duct **44** having a lower end portion as at **46** sealingly mounted in a complementarily shaped aperture **47** formed in a ceiling **48** of the room **11** and a fan **49** driven by an electric motor **51** and mounted within the air duct **44**. An air purification device **52** is disposed within the duct **44** downstream of the forced air fan **49**, thereby to sterilize air forced into the sterile room or area **11** by the fan.

During an extracting operation or cycle, air may be drawn into the machine, and if that air contains bacteria, the contents of the machine may be contaminated. Therefore, it is contemplated by the present invention to provide means for delivering sterilized air to the interior of the washing machine **13** during the operation thereof and for preventing flow of air from the soiled laundry room **10** to an interior of the washing machine **13** subsequent to starting the machine cycle. That means include a conduit or air duct **53** having a vertical portion **54** passing through a sealed aperture **56** in the ceiling **48** and a short horizontal section passing through a sealed aperture in the front plate **16** and terminating in the interior of the washing machine defined by the outer shell **14**, the front plate **16** and the rear plate **17**. Pressurized sterile air is forced through the duct **53** and into the interior of the washing machine, thereby supplying sterile air to replace air exhausted during the extracting operation and maintaining a positive air pressure relative to the pressure of the soiled laundry room **10** within the machine **13**. Desirably, the pressure within the machine **13** is maintained in a range of pressures exceeding the pressure of the soiled laundry room **10** but less than the positive pressure within the sterile room **11**. Thus, any flow of air currents due to leakage or otherwise will always be from the sterile room, to the interior of the washing machine and then to the soiled laundry room **10** or directly to the soiled laundry room **10**. In that manner only bacteriafree air is delivered to the sterile room **11** and the interior of the washing machine **13**, thereby preventing cross infection between the soiled laundry and the sterilized laundry by airborne bacteria.

Locking means **58** and **59** are provided respectively for the access doors **37** and **34** to normally lock the doors in a closed position. Each locking means may include a pneumatic cylinder as at **61**, a piston or plunger **62** extending from, and axially slidable within, the cylinder, and a striker plate **63** characterized by an aperture for receiving an outermost end portion of the plunger. When the associated door **37** or **34** is sealed in a closed position by the securing means **39**, the plunger **62** is aligned with the aperture of the striker plate **63** and will enter thereinto upon an increase in pressure at a rearward end of the cylinder **61**, thereby locking the associated door in a closed position. On the other hand, increases in pressure on a forward end of the piston **61** causes the plunger **62** to retract into the cylinder **61** and withdraw from the striker plate **63** to unlock the associated door **37** or **34**. Air supply to each of the pneumatic cylinders **61** of the locking means **59** and **58** are separately controlled by a pair of solenoid-operated air control valves forming a portion of a pneumatic control circuit of the machine **13**.

If desired the pneumatic cylinder **61** may be replaced by an electrically operated solenoid having a plunger similar to the plunger **62** and functioning in a manner similar thereof in response to properly applied electric current.

In accordance with the principles of the present invention, control means are provided for controlling the locking means **58** and **59** respectively associated with the sterile room door **37** and the soiled laundry room door **34** so that the doors may not be inadvertently opened in a manner to contaminate the sterile room **11**. As schematically illustrated in FIG. **3**, a locking means control circuit **65** forming a portion of the overall circuit controlling various functions of the machine **13** comprises a solenoid **66** for unlocking the sterile room door locking means **58** whenever the solenoid **66** is energized and another solenoid **67** for unlocking the soiled laundry room door locking means **59** whenever the solenoid **67** is energized. A timing drum **68** driven by an appropriate timing motor controls an operating cycle of the machine and is connected to one side of a secondary coil of a transformer **69** supplying the control circuit **65** with 24-volt current.

The fan motor **51** driving the fan **49** to supply the sterile room **11** with forced air for maintaining that room at a positive pressure is connected in series with a manually operated fan switch **71**. The fan switch **71** is mechanically interlocked with a switch **73** having a switch blade **74** and contact **75** and which in turn is connected in series with the unlocking solenoid **66**. Thus, whenever the fan motor **51** is operating to supply sterile air to the sterile room **11**, the switch **73** is closed.

After soiled laundry material is loaded into the washing drum **18**, the soiled laundry room door **34** is closed and secured causing a portion of that door to engage and close a door interlock switch **76** electrically connected in series with the unlocking solenoid **66**.

Situated within the machine **13** in a position to sense temperature of water drained from the washing drum **18** is a temperature sensitive switch **77** closing in response to sensing sterilizing temperatures, for example temperatures in excess of 180° F., present during a sterilizing cycle. When closed, the temperature-sensitive switch **77** energizes the relay coil **80** having normally open sets of contacts **81** and **82** and a normally closed set of contacts **83**. The set of holding contacts **81**, disposed in parallel with the temperature-sensitive switch **77**, close in response to energization of the relay coil **80** to hold that coil in an energized state until the circuit is broken by other means. With the relay coil **80** energized, the set of contacts **82**, disposed in series with the unlocking solenoid **66**, move to a closed position, whereas the normally closed set of contacts **83**, connected in series with the unlocking solenoid **67** open to prevent actuation of the solenoid **67**.

The timing drum **68** includes a switch means **1** momentarily closing upon completion of the machine cycle and connected in series with a relay coil **90** having normally open sets of contacts **91** and **92**. Closing of the timing drum switch **86** energizes the relay coil **90** causing the normally open contacts **91** and **92** to close. The normally open contacts **91** connected in parallel with the switch **86** hold the relay coil **90** in an energized condition until that circuit is broken by other means. The normally open contacts **92** actuated by the relay coil **90** are connected in series with the unlocking solenoid **66** and close in response to completion of the machine cycle.

Thus, before the sterile room door unlocking solenoid **66** may be actuated, the fan **51** must be operating to close the mechanically interlocked switch **73**, the laundry material must be subjected to sterilizing temperatures to close the normally open contacts **82**, the machine cycle must be completed to close the normally open contacts **92** and the soiled laundry room door must be secured in a sealed position to close the door interlocked switch **76**. When all of those conditions have been met, a sterile room door unlocking switch **93** may be moved to a closed position to complete the series circuit and thereby actuate the solenoid **66** to move the plunger **62** of the locking means **58** to an unlocked position. With the unlocking switch **93** in a closed position, an indicating light **94** located in the soiled laundry room lights to indicate to personnel in the soiled laundry room that the sterile room door **37** is unlocked.

Subsequent to unloading the sterilized laundry material from the machine **13**, the sterile room door **37** is closed and secured. Once the door **37** is secured in a sealed position, the unlocking switch **93** is opened to deactuate the unlocking solenoid **66**, thereby moving the plunger **62** of the locking means **58** into locking engagement with the aperture of the striker plate **63** mounted on the door **37**. Closing and securing the door **37** causes a portion of that door to engage and close a door interlock switch **96** electrically connected in parallel with the unlocking solenoid **67**.

Before the soiled laundry room door may be unlocked, the control circuit must be reset by momentarily closing a reset switch **97** to energize a relay coil **100** having normally closed contacts **101** and **102** connected respectively in series with the relay coils **80** and **90**. Momentarily opening the normally closed contacts **101** and **102** deenergizes the relay coils **80** and **90** to move the sets of contact thereof to there normal position, nd in particular, to close the set of contacts **83** connected in series with the unlocking solenoid **67**. Once the control circuit is reset, the unlocking solenoid **66** may not be opened until the machine has completed another cycle including a sterilizing operation.

With the control circuit reset and the door interlock switch **96** closed, a soiled laundry room door unlocking switch **103** may be closed, thereby, actuating the solenoid **67** to unlock the door **34** and enable the machine to be loaded with soiled laundry material.

From the foregoing description, it should be noted that once the laundry material has been subjected to sterilizing temperatures, the unlocking solenoid **67** controlling the soiled laundry room locking means **59** may not be actuated until the control circuit is reset. Thus once the laundry material has been sterilized it is impossible to expose the laundry material to the soiled laundry room **10** and then unload the laundry material into the sterile room **11** without first resterilizing the laundry material. That arrangement prevents contaminated laundry from entering the sterile laundry room and only permits sterilized laundry material to be unloaded from the machine **12** into the room **11**. Also, whenever the fan motor **51** is not running to maintain the sterile room **11** at a positive pressure relative to ambient pressures, the sterile room door **37** may not be opened.

Although those versed in the art may suggest various minor modifications, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications which naturally and properly come within the scope of my contribution to the art.

I claim:

1. A laundry system for preventing cross infection between soiled laundry material and sterilized laundry material comprising:

a washing machine having an interior chamber for receiving laundry material, first selectively lockable door means providing access in to the interior chamber from a soiled laundry area and a second selectively lockable door means providing access into the interior chamber for a second room area for receiving sterilized laundry material;

first and second selectively releasable means respectively locking said first and said second door means in closed positions;

means preventing release of said first locking means whenever said second door means is open; and

means preventing release of said second locking means whenever said first door means is open and until said laundry material contained within the interior chamber has been subjected to sterilizing temperatures for a sufficient time period to assure proper sterilization.

2. The laundry system of claim **1** and further characterized by means preventing release of said second locking means until said machine completes a full washing cycle between releases thereof.

3. A laundry system as defined in claim **1** and further characterized by air distribution means forcing sterilized air into said second room area for maintaining said second room area at a positive pressure relative to said first room area.

4. A laundry system as defined in claim **1** and further characterized by duct means directing sterilized air under pressure into the interior chamber for maintaining the same at a positive pressure relative to said first room area.

5. A laundry system as defined in claim **3** and further characterized by means preventing release of said second locking means unless said air distribution means is properly functioning.

6. In a laundry system including a washing machine having first and second normally locked door means, a control circuit comprising:

first electrically actuated means for unlocking a first normally locked door means;

a second electrically actuated means for unlocking a second normally locked door means;

normally open, temperature-sensitive switch means disposed within an interior of a washing machine and closing in response to sensing sterilizing temperatures; and

first normally open contact means connected in series with said first unlocking means and closing whenever said temperature-sensitive switch means closes.

7. In a laundry system as defined in claim 6 and further characterized by second normally open contact means connected in series with said first unlocking means and closing in response to completion of a washing machine cycle.

8. In a laundry system as defined in claim 7 and further characterized by normally closed contact means connected in series with said second unlocking means and opening whenever said temperature sensitive switch means closes.

9. In a laundry system as defined in claim 8 and further characterized by reset switch means for opening said first and said second normally open contact means and closing said normally closed contact means.

10. In a laundry system including a washing machine having first and second normally locked door means, a control circuit comprising:

first electrically actuated means for unlocking a first normally locked door means;

a second electrically actuated means for unlocking a second normally locked door means;

temperature sensitive switch means disposed within an interior of a washing machine and being actuated in response to sensing sterilizing temperatures; and

first circuit means electrically connected with said first unlocking means and permitting actuation thereof whenever said temperature-sensitive switch means has been actuated.

11. A laundry system as defined in claim 1, wherein said means preventing release of said second locking means comprise temperature-sensitive means disposed in an interior chamber of a washing machine and permitting release of said second locking means only upon said temperature sensitive means sensing sterilizing temperatures within the interior chamber.