

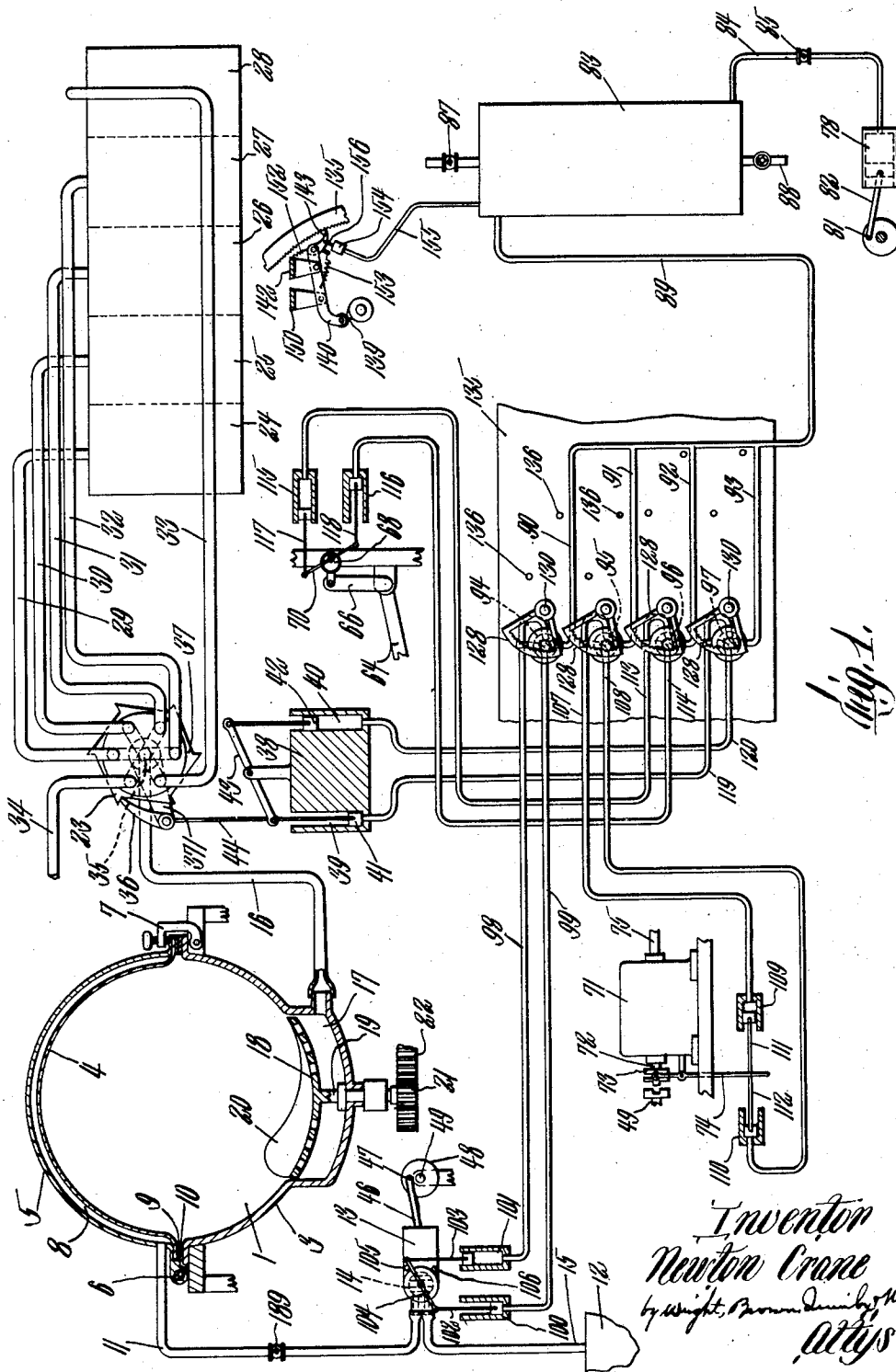
March 15, 1932.

N. CRANE

1,849,283

AUTOMATIC WASHING MACHINE

Original Filed Oct. 30, 1925 3 Sheets-Sheet 1



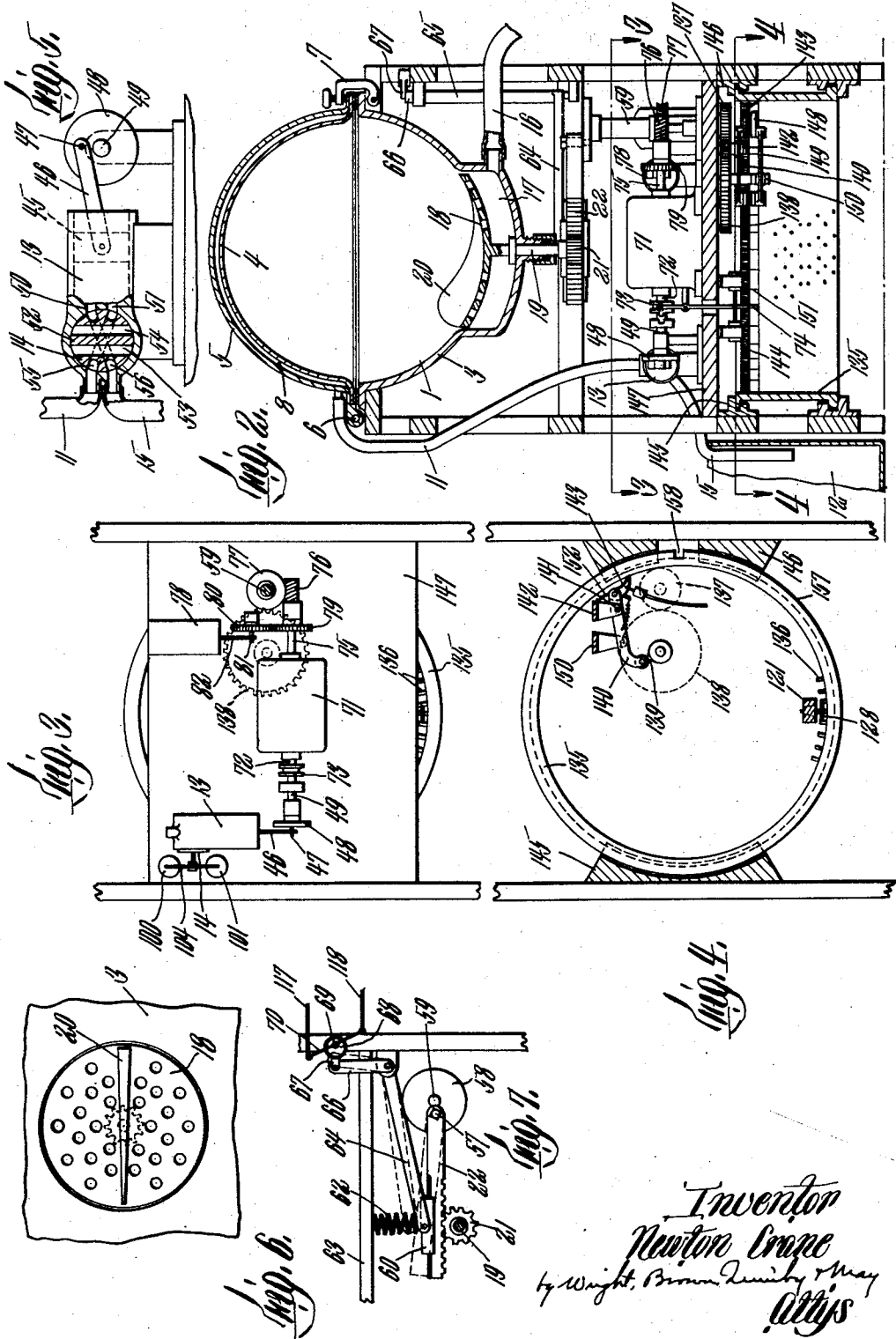
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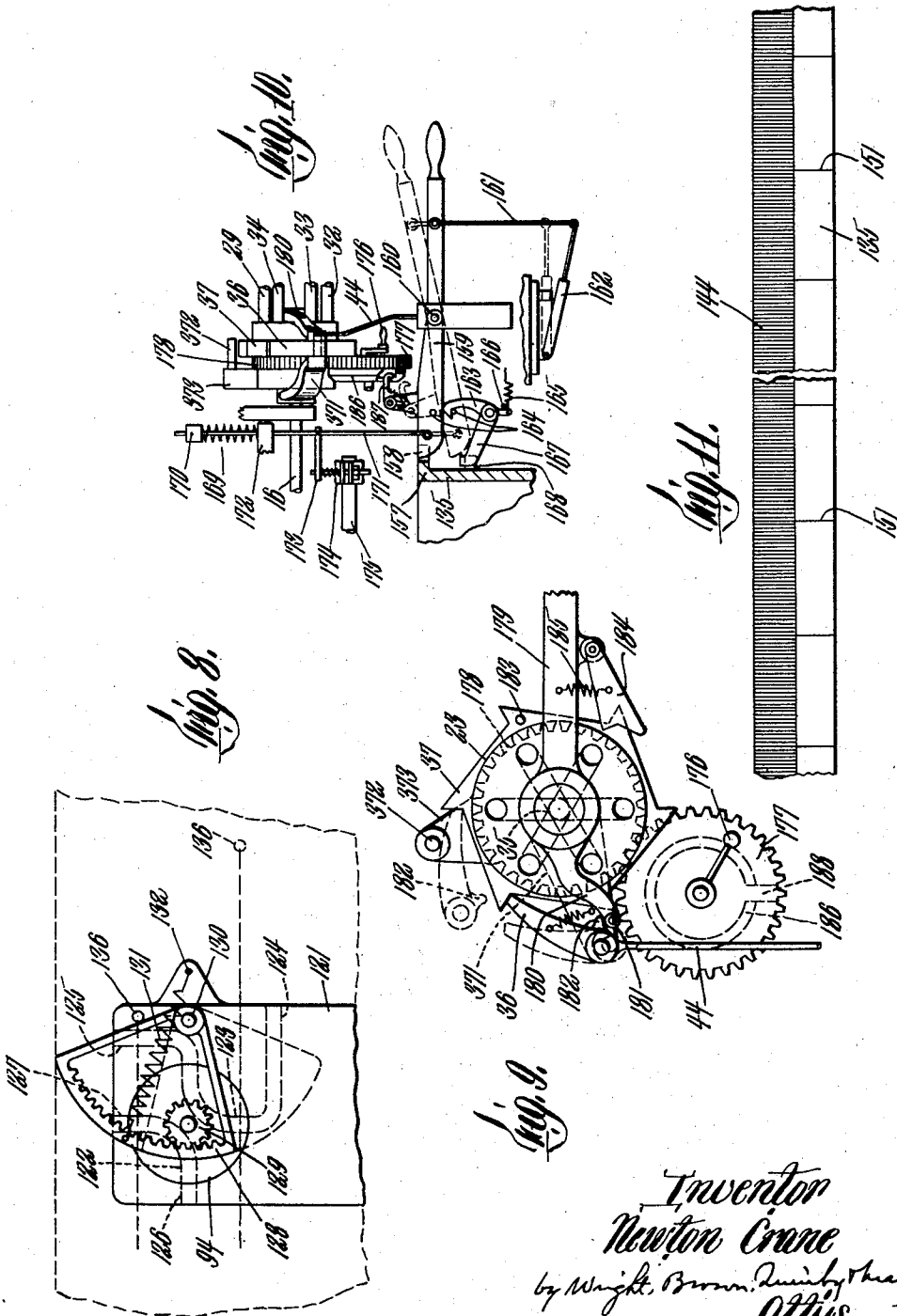
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Original Filed Oct. 30, 1925

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

NEWTON CRANE, OF BOSTON, MASSACHUSETTS

AUTOMATIC WASHING MACHINE

Application filed October 30, 1925, Serial No. 65,779. Renewed June 6, 1931.

The present invention relates to laundry apparatus, and particularly to apparatus for washing clothes and bringing them to a semi-dried condition after washing. In this specification, the term "clothes" or "clothing" is intended to mean and include all goods in the nature of wearing apparel, bed clothing, table linen, or anything else needing to be washed, and which can be washed in laundry apparatus or washing machines. The operation which is also carried out by this machine, of pressing the clothes to expel the washing or rinsing water from them, whereby they are brought to a partially dried condition, will be referred to by the term "drying".

The object of the invention is to provide for laundry use, including use in private homes, a completely automatic machine which, after being set in operation by the attendant, will continue in operation to wash the clothes, also to rinse them one or more times, and to blue them also, if desired, and then dry the clothes, within the meaning of the foregoing definition, all as a continuous automatic operation and without further personal attention until the washed and dried clothes are removed from the machine. The invention therefore comprises a combination of washing apparatus and automatic control means, as hereinafter described fully and in detail in connection with a specific embodiment of such a combination; and further comprises equivalent combinations of specifically different parts or elements, adapted either to perform the operations of washing and drying only, or of washing, rinsing and drying, with as many rinsing operations, including one of rinsing with bluing water, as may be desired. The principles may be extended or contracted from the specific embodiment herein shown, to provide apparatus capable of performing any desired number of separate washing actions, or both washing and rinsing actions, as may be desired, all automatically performed and controlled as to the number of individual actions, their sequence, and their duration in point of time.

Referring now to the drawings, which il-

lustrate one possible embodiment of the invention,—

Fig. 1 is a diagrammatic view showing all of the main parts of the above mentioned embodiment in a single plane;

Fig. 2 is a vertical central section of a specific machine containing the parts above referred to and displayed diagrammatically in Fig. 1;

Fig. 3 is a plan view of the motive mechanism located below the line 3—3 of Fig. 2;

Fig. 4 is a horizontal section of the machine taken on line 4—4 of Fig. 2, and showing the timing means;

Fig. 5 is a side view of a water pump and a sectional view of the control valve for said pump, which form parts of this apparatus;

Fig. 6 is a fragmentary view of the washing chamber showing the agitator in plan;

Fig. 7 is a fragmentary plan view showing the means for operating such agitator and making it inoperative;

Fig. 8 is a fragmentary elevation showing one of a number of duplicate valves by which the actions of the several parts of the mechanism are controlled;

Fig. 9 is a fragmentary elevation showing the valve which controls the admission and discharge of water to and from the washing chamber, together with means for operating said valve;

Fig. 10 is a fragmentary elevation showing the valve last mentioned, together with means for setting the apparatus in action and stopping it;

Fig. 11 is a fragmentary elevation of the timing member.

Like reference characters designate the same parts wherever they occur in all the figures.

Referring first to Fig. 1 for a comprehensive view of the principles of the apparatus, the clothes-receiving member is shown at 1. The clothes to be washed are placed in this member and remain there while being washed, rinsed and dried. The form of such member here illustrated is specifically like that disclosed in my pending application for United States patent, filed February 12, 1924, Serial No. 692,365, entitled "Liquid express-

ing apparatus", but it is to be understood that so far as the present invention is concerned, the structure of such member is not a vital feature and may be widely modified. It comprises a casing having a fixed wall or shell 3, and a movable wall 4, said walls together enclosing a space within which the clothes may be placed, and the movable wall being movable under fluid pressure, or otherwise, so as to contract or enlarge such clothes-receiving space. The movable wall is preferably flexible in order to conform to the jumbled mass of clothes in the chamber when pressing upon them, and in this instance is a bulged or baggy diaphragm. Enclosing the presser or diaphragm is a complementary part 5 of the casing or shell, hinged to the part 3 by a pivot 6 and detachably clamped thereto by suitable means typified by clamp 7. The space 8 between the diaphragm 4 and the member 5 is a receiving chamber for fluid under pressure, by which to displace the movable wall 4.

In the further description herein, the movable wall 4 will be generally referred to as a diaphragm, for convenience simply, and without intent to indicate any limitation as to the essential construction of such movable wall. The diaphragm here shown is clamped at its periphery to the casing member 5 by a ring 9; but it might be otherwise constructed and mounted, for instance, in the manner illustrated in my application aforesaid. A gasket 10 is provided as a packing between the diaphragm and the part 3 of the casing, to prevent leakage of water when the clothes are being dried, but in this feature also variation may be made and other packing means used.

A pipe 11 leads to the pressure chamber 8 for the purpose of delivering thereto and exhausting therefrom the operating fluid, which is preferably water, but may be air or other fluid. In the following description it will be assumed that the fluid is water. It is moved back and forth between the chamber 8 and a supply source, typified by a tank 12, by means of a pump 13 under control of a four-way valve 14, to which the pipe 11 from the pressure chamber 8, and a pipe 15 from the tank 12, both lead. The character of the control valve 14 will be later described in detail.

A pipe 16 leads from the clothes-receiving chamber, preferably opening into an extension 17 in the bottom of the casing. A strainer 18 is placed across the top of the extension 17 to give free course for water while preventing the clothing from obstructing pipe 16. This strainer is rotatably mounted on the shaft 19 and carries an agitator 20 which may be in the form of a blade or paddle rising from the strainer, radially arranged with its main part at one side of the axis of the shaft, as further shown in Fig. 6. Said agitator is os-

cillated at the proper times, and for a suitable length of time, to agitate the clothes and the washing water and cause circulation of the water through the clothes. It is so oscillated by a pinion 21 on the part of shaft 19 which protrudes from the bottom wall of the extension 17, and by a rack 22 in mesh with said pinion, which is reciprocated by means later described.

The pipe 16 leads to a plural-way valve 23 through which connection is made by means of pipes with different ones of a series of tubs or other water containers, indicated at 24, 25, 26, 27 and 28. These may be the set tubs of a domestic laundry, or any other water containers. They are connected with the valve 23 by pipes 29, 30, 31, 32 and 33, respectively. A waste outlet pipe 34 is also connected with the valve 23. There being six connections to the valve, the latter is a six-way valve. It is preferably made as a plug rotatably mounted in the casing and having a central port 35 to which the pipe 16 is connected, and a lateral port coupled to the central port, adapted to be placed in register with any one of the ports in the casing to which the pipes 29—34 inclusive are connected; the latter ports being spaced equally around the axis of the valve.

I have shown five tubs here as being probably the maximum number which would ever be needed for thoroughly washing, rinsing and bluing clothes. The tub 24 may contain soapy water, the tubs 25, 26 and 27 a series of rinsing waters, and the tub 28 bluing water; or more of the tubs may contain soapy water and fewer of them may contain rinsing water. There may, however, be any number of tubs from one to five, or more, according to whether it is desired to provide for washing and drying only, or for washing and rinsing one or more times, and drying. Generally the valve 23 will be a plural-way valve, and will be so called in the specification. It is a confining valve for retaining the water in the clothes chamber when agitation is going on.

The plural-way valve is driven step by step, to connect the washing chamber in desired sequence with the tub or tubs and the waste outlet, by means of a pawl 36 driving a ratchet wheel 37, which has as many teeth or steps as there are connections to the valve. Said pawl is carried by a pawl carrier 371, mounted in any suitable and convenient way, as understood by mechanics, and is driven by a motor 38; such motor in the embodiment shown here comprising two cylinders 39 and 40 containing pistons 41 and 42, respectively, coupled by connecting rods with a rocker 43, which rocker is connected by a link 44 with the pawl carrier. A stop pin 372 is arranged on a rigid arm 373 in position to engage the pawl and limit the extent of its motion so imparted.

I will now refer to Fig. 5 to show the details of the pump 13 and its control valve 14, which, together with the driving means for the pump, constitute a pumping apparatus or means. Said pump contains a piston 45 coupled by a connecting rod 46 with a crank pin 47 on a crank disk 48, the latter being fast on a shaft section 49, which may be coupled to a primary driving motor. The pump chamber has inlet and outlet ports 50 and 51, which may be assumed to be controlled by check valves in accordance with common practice. The control valve 14 is adapted to reverse the action of the pump so that water may be drawn either from the supply tank and forced into the pressure chamber 8, or out of such chamber and returned to the supply tank. Said valve 14 is provided with a rotatable plug 52 having a pair of passages 53 and 54, and another pair of passages 55 and 56. In the position shown, the pump inlet 50 is connected with the pipe 15 by the passage 56, and its outlet 51 is connected to the pipe 11 by passage 55. By turning the plug through a quarter turn the pipe 11 may be connected to the pump inlet through the passage 54, and the pipe 15 to the pump outlet through the passage 53.

In a broad sense, the diaphragm or movable wall 4 is a pump element, cooperating with the pump proper 13 to complete a pumping means or apparatus which causes flow of water into and out of the clothes chamber; and it typifies any means for that purpose, which may be widely different and operated by different means than here shown.

I will now refer to Fig. 7 to show the driving and control mechanism for the rack 22 which operates the agitator. Said rack is coupled to a crank pin 57 on a crank disk 58, which is secured to a shaft 59 driven from the primary motor above referred to. The rack reciprocates in a guide 60, which is pressed toward the pinion 21 by a spring 62 reacting against a member 63 of a supporting frame. The guide is connected to a rigid arm 64 which is fast to a rock shaft 65, (Fig. 2), mounted in bearings on the frame; and to said rock shaft is secured a second rigid arm 66 coupled by a link 67 with a crank or eccentric 68 mounted on a stud 69 fixed to the frame. A two-armed lever 70 is secured to the eccentric for turning it. By thus turning the eccentric, the arms 66 and 64 may be swung into the dotted line position, withdrawing the rack 22 from the pinion 21, and making the rack inoperative. When the eccentric is placed in the full line position, shown in Fig. 7, the rack is put into mesh with the pinion and the agitator is given the desired oscillative movement.

Both the pump 13 and the rack 22 are driven by a primary motor 71, shown in Figs. 1, 2 and 3. Such motor is preferably an electric motor, since electric power is the most

convenient and inexpensive power available for domestic use. Hence the control means herein shown and later described, have been devised on the premise that an electric motor will be used. However, my invention is not limited to such a motor and the specific control means herein described for controlling it, but, in the broad scope in which I claim protection, includes equivalent motive and control means of other sorts available to those skilled in the art.

In the arrangement here shown, the pump shaft 49 is alined with the shaft 72 of the motor, and is adapted to be coupled thereto by a clutch 73 under control of a clutch shifter lever 74 mouned substantially as shown.

The drive shaft 59 for the rack is coupled to the motor shaft 75, which may be an extension of the shaft 72, or a different shaft, through a worm 76 on shaft 75, and a worm wheel 77 on shaft 59 and in mesh with said worm.

The pump-controlling valve 14, the rack controlling-eccentric 68, the motor 38 for advancing the plural-way valve, and the clutch shifter 74, are all actuated by a fluid medium under pressure, which is preferably compressed air. I do not limit my invention to the use of compressed air alone for the purposes indicated, but prefer it on account of the availability of air, the ease and small expense of compressing it, the rapidity with which the pressure of air may be transmitted through small conduits, the ease with which air conduits may be made substantially leakage tight, and the fact that a certain amount of leakage may occur without making the apparatus inoperative. This apparatus includes a pump for imposing pressure on air and a container for compressed air.

The air pump 78 is shown in Figs. 1, 2 and 3. It is driven by the primary motor 71 through a gear 79 on the shaft 75 thereof, and an intermeshing gear 80 carrying a crank pin 81, to which the pump piston or plunger is coupled by a connecting rod 82. The compressed air is conducted to a tank or reservoir 83 by a pipe 84, in which there is a check valve 85, arranged to prevent back flow. A relief valve 87 on the reservoir limits the pressure which may be created therein. The tank may also have a drain 88, equipped with a valve, for discharging accumulated foreign matter from the tank.

A pipe 89 leads from the reservoir 83 and is provided with branches 90, 91, 92 and 93, which lead to control valves 94, 95, 96 and 97, respectively. From the valve 94 pipes 98 and 99 lead to two air cylinders 100 and 101 respectively, in which are pistons connected by links 102 and 103 with the arms of a lever 104, which is connected with the control valve 14 of the water pump. Such cylinders, with their pistons, constitutes a reversing motor for the valve. It is to be understood that the

stroke of the pistons in these cylinders is long enough to turn the valve through the angle necessary to put either pair of its passages into register with the ports of the pump and with the pipes 11 and 15, as previously explained, and that stops 105 and 106 may be provided for limiting the throw of the valve plug.

The control valve 95 is connected by pipes 107 and 108 with cylinders 109 and 110, in which are pistons coupled by links 111 and 112 with the clutch shifter 74. Admission of pressure to either cylinder 109 or 110, with simultaneous exhaust from the other cylinder, causes the clutch 73 to be coupled or uncoupled with the pump driving shaft 49.

The control valve 96 is connected by pipes 113 and 114 with cylinders 115 and 116, in which are pistons connected by links 117 and 118 with the lever 70, which shifts the eccentric or crank 68, as previously described. It is to be understood that the eccentricity of the crank or eccentric 68 is great enough to cause meshing and unmeshing of the rack 22 by virtue of the movement imparted to the eccentric by these pistons. Stops may be applied here also, as described in connection with the valve 14, for limiting the movement given to the eccentric. Such stops may be provided on the cylinders themselves so as to limit the outward movement of the pistons. This statement applies to all of the air motors.

The control valve 97 is connected by pipes 119 and 120 with the cylinders 39 and 40 of the motor 38, so as to drive the pawl 36 and ratchet 37 forward one step when air is admitted to the cylinder 39, and to retract the pawl when air is admitted to the cylinder 40. It is to be understood that the movement thus given to the pawl is great enough to turn the movable member of this valve through the full angle of one prescribed step on each forward impulse of the pawl.

Reference is directed to Fig. 8 to show the construction in detail of the control valve 94, the other control valves 95, 96 and 97 being similar to this one.

Preferably a valve block 121 is mounted in an upright position on the frame base which supports the machine, and such block has a vertical row of cylindrical recesses, the axes of which are horizontal and parallel to one another (in the present embodiment of the invention), in which are placed all the rotatable valve members, or there may be separate blocks, one for each valve. Each valve member is preferably a plug having passages 122 and 123 terminating at the circumference of the plug in ports located 90° apart. In a part of the block surrounding the plug are a passage 124, to which the branch supply pipe 90 is connected, a passage 125, to which the pipe 98 is connected, a passage 126, to which the pipe 99 is connected, and an exhaust passage

127 opening to the atmosphere. These passages terminate in ports opening through the walls of the recess in the valve block wherein the plug is fitted and spaced correspondingly to the ports in the plug. Thus when the valve is placed in the position shown in Figs. 1 and 8, the supply pipe is connected through the passage 124, the valve passage 123, and the passage 125, to conduct air to the pipe 98 and cylinder 101; while the pipe 99 leading from the cylinder 100 is open to the atmosphere through the passages 126, 122 and 127. By turning the valve plug through an angle of 90° in counter-clockwise rotation, the passage 122 may be coupled with the passages 124 and 126, while the passage 123 may be coupled with the passages 125 and 127, thus admitting air to the cylinder 100 and permitting exhaust to the atmosphere of air from the cylinder 101.

The other control valves are ported and connected in essentially the same way, as will be readily understood by examination of Figs. 1 and 8; whereby air may be admitted to one and exhausted from the other cylinder of each of the other pairs of operating cylinders hereinbefore described.

The valve plug 94 is turned back and forth between the positions above indicated by an internal gear segment 128 which meshes with the pinion 129 fastened to the valve plug, and is pivoted at 130 to the valve block or other supporting structure. A spring 131 is connected to the middle point of the gear segment and is anchored to the supporting structure at 132, the anchorage point being in the line of centers of the gears 128 and 129, but at the opposite side of the center 130 from the gear 129. Thus the spring is at one side or the other of the center of the gear segment when the latter is in either extreme position, and it completes the movement of the segment to that position after the segment has been moved part way by one of the pins, later described. Such movement is limited by the pinion 129, which is embraced by the arms of the segment. The spring also prevents accidental displacement of the valve. Such accidental displacement, however, is not liable to happen, as this machine is subject to practically no vibration when in use. All of the control valves 94 and 97 are operated by like or equivalent means to those just described.

These valves are the primary control valves which cause water to be admitted to the pressure chamber of the washing machine and exhausted therefrom, the agitator to be driven, the washing and rinsing waters admitted to the clothes-receiving chamber and discharged therefrom, and the clothes to be squeezed out and dried, in the proper sequence. They in turn are governed and operated by a timing member 135, which in the present embodiment is a hollow cylinder mounted rotatably and carrying projections which are suitably dis-

posed to engage and shift the various segments 128 at the proper times. The valve block 121 is mounted inside this hollow cylinder and near one wall thereof, as shown in Fig. 4; and the valve controlling segments are pivoted on the side of the block next to the wall of the cylinder. The projections above referred to are preferably pins 136 set into the cylinder and projecting from its inner surface. They are arranged in circumferential rows. Those of the top row are adapted to engage and depress the reversing segment for the valve 94 when such segment is in its elevated position; those of the next to the top row are arranged to engage the same segment when depressed and raise it; those of the third and fourth rows perform similar functions with respect to the reversing segment of valve 95; the pins of the fifth and sixth rows from the top perform like offices for the reversing segment of the valve 96; those of the seventh and eighth rows do the same for the reversing segment of the valve 97. The pins may be placed in any position in their respective rows and may be provided in any numbers with whatever spacing may be desired. A wide latitude is thus permitted in the control of the several elements of the apparatus, which makes it possible to design an apparatus for any desired number and sequence of operations, or readily change and adapt a given apparatus to perform a different number and sequence of operations. The apparatus which I have shown here is adapted to perform 31 operations between the time of starting by the attendant and the time of removing the washed and dried clothes.

The timing cylinder is mounted rotatably and is driven from the primary motor 71 by the shaft 59 just described, a gear 137 on said shaft, a gear 138 in mesh with gear 137, a cam 139 on the shaft of gear 138, (Fig. 4) a lever or pawl carrier 140 pivoted at 141 to a bracket 142, and a pawl 143 carried by the short arm of lever 140. Said pawl engages ratchet teeth 144 on the inside of the cylinder. This is the normal feed pawl. The cylinder is mounted in guides 145 and 146, supported by the frame on which the clothes-receiving chamber is mounted, and located beneath the platform 147 on which the primary motor and the pumps are supported. The gearing and drive pawl for the cylinder are suspended from the platform 147 inside of the cylinder. Thus a cylinder of which the diameter is no greater than the necessary width of the frame, and occupies no additional space, may yet be large enough to have a long enough periphery, to provide a sufficient number of ratchet teeth for exact timing and control of all the operations, without requiring such teeth to be made too small for adequate strength.

The primary motor, running at substan-

tially constant speed, drives the cylinder 135 so uniformly as to make of the latter a very accurate timing means.

In order to save time in the complete cycle of operations, and to cause the several control valves to be thrown over quickly, instead of with the slow motion given by the normal feed pawl 143, I provide in addition a second pawl 148 on a pawl carrying lever 149, which is pivoted to a bracket 150. The lever 149 also has an arm arranged to engage and be moved by the cam 139. The cam operated arm of this lever is short, and its pawl carrying arm is long, which is the reverse condition to that of the pawl-carrying member 140, whereby the pawl 148 travels farther at each stroke than the pawl 143, and constitutes the periodic rapid feed pawl for the timing cylinder. Other ratchet teeth 151 are provided on the inside of the cylinder to cooperate with pawl 148, and these teeth are spaced according to the positions of the control valve operating pins, so that one of the ratchet teeth 151 is in position to be advanced by the pawl 148, whenever one of the pins 136 comes into position to throw over the reversing segment of any one of the control valves. At those times, the drum is given a longer quick advance step, which is sufficient to cause instant reversal of the control valve. The slow feed pawl 143 does not oppose these longer steps of the cylinder, because they are in the same direction as those given by said pawl. The rapid feed pawl normally travels back and forth over a smooth surface of the cylinder, and acts effectively only when one of the ratchet teeth 151 arrives in front of its retracted position. The pawl carriers are returned and are held in contact with the cam 139 by suitably arranged springs, one of which is shown at 152 in Fig. 4.

It is to be understood that by proper design of the gear ratios, the diameter of the timing cylinder, the throw of the driving pawl for said cylinder, and the number of ratchet teeth on the cylinder, the rate of rotation of such cylinder may be controlled as desired; so that it may be given a complete rotation in any desired period of time, and such rotation may be composed of as many steps as desired. It is permissible and readily feasible to interpose reducing gearing between the cylinder and its driving pawl or pawls when needed to make the steps of the cylinder shorter than those of either pawl, the space within the drum giving ample room for there locating such gearing. Such intermediate gearing may be provided readily by the skilled mechanic, within the scope of the present disclosure.

Preferably, all the operations of the complete automatic apparatus are controlled by this timing cylinder; and preferably also the entire cycle of operations is performed during one revolution of the cylinder. Such a

cylinder may be driven by the means here shown with great regularity and accuracy as to the time required for taking each individual step and the total time of a complete revolution. The controlling pins 136 may be placed in any positions wherein they will cause the several controlling valves to function at the times and in the sequence required; and the several rapid motion teeth 151 of the timing cylinder are synchronized with the several pins, so that one of them is brought into coaction with the rapid drive feed pawl 148 whenever one of the pins is brought into position to shift one of the control valve gears 128 in either direction.

It is essential that when the apparatus is set in operation, the timing cylinder should not move if there is insufficient air pressure to operate the various air motors with which the apparatus is equipped. I have provided for this condition and so discounted the possibility of the air pressure developed during one period of operation being dissipated before the next operation of the machine, by providing a means which prevents the timing cylinder from being started, after the primary motor has been started, until a sufficient air pressure has been created by the air pump 78. One form of such means is shown diagrammatically in Fig. 1, and comprises a spring 153 connected to the pawl 143 and to its carrier 140, and normally holding the pawl away from the complementary ratchet teeth on the timing cylinder. Thus even though the pawl should be set in motion, it will not drive the timing cylinder until the retracting power of this spring has been overcome. For doing this and making the pawl operative, I provide an air motor cylinder 154 connected with the reservoir 83 by a pipe 155 and having a piston or diaphragm arranged to actuate a rod 156 which bears on the pawl 143 so as to displace the pawl toward the ratchet teeth in opposition to the force of spring 153; exerting a yielding pressure on the pawl to keep it in engagement with the ratchet teeth so long as sufficient air pressure exists in the reservoir. When the primary motor is started, it immediately drives the air pump and as soon as sufficient air pressure has been created to impel the various air motors, the pawl 143 is put into action. Spring 153 is made strong enough to insure that this action will not occur until the air pressure is sufficient.

No such retracting and control means are necessary for the rapid feed pawl 148, because the teeth or shoulders against which the latter pawl works are spaced farther apart than the throw of this pawl, and none of them is in position to be acted upon when the timing cylinder is in its prescribed stopping position.

The same effect may be secured, within the scope of this invention, by providing a disconnectible clutch between the primary motor

and the pawl-driving mechanism; for instance, such a clutch as is provided at 73, and providing in connection therewith a disconnecting spring and a pneumatic motor for coupling it, such motor being connected with the air reservoir in the way described as to the motor 154.

I have also provided means for locking the timing cylinder in a given stopping and starting position, automatically stopping it in that position and at the same time stopping the primary motor and preventing starting of the machine until the valve 23 is in what I may call the zero position. In the present design, the zero position is that in which the clothes-receiving chamber is connected to the waste outlet. The means last mentioned are shown in Figs. 9 and 10.

A flange 157 on the timing cylinder is provided with a notch 158 into which projects one arm of a hand control lever 159 when the cylinder is in its stopping position, said arm providing a lock. This lever is mounted on a fixed pivot 160. It is connected by a link 161 with the control switch 162 of the primary motor. This being an electric motor, the switch is an electric switch in the main circuit of the motor and is open when the control lever occupies the notch 158, the position shown by full lines in Fig. 10. Such switch typifies also other equivalent control means, such as a valve, which may be used for starting and stopping other types of primary motor than electric motors. When the control lever is moved to the dotted line position, it releases the timing cam and closes the motor switch. It is held in that position during the time which may intervene after starting the motor before the timing cylinder begins to move, by a latch 163 hooking over a pin 164 on the lever. Such latch saves the attendant from the necessity of holding the lever during the period of time which may intervene until enough air pressure has been pumped up to cause the cylinder driving means to become operative. A spring 165 normally holds the latch against a stop 166 and permits it to engage the pin 164 in a manner readily understood from the drawings. An arm 167 is connected to the latch and this arm is arranged to be displaced by a cam device 168 on the cylinder, which cam is arranged and operates to release the latch soon after the cylinder starts in motion, or at any rate, at some time before it reaches the stopping position. The control lever then being released, bears on the under side of flange 157 ready to enter the notch 158 under impulse of the spring 169 pressing on an abutment 170 on a link 171 connected to the lever, such spring reacting on fixed part 172 of the frame. Said spring 169 at the same time applies a brake to the primary motor, acting to that end through an arm 173 carried by the link 171 and connected to apply

or set brake 174 which engages a shaft or drum 175 coupled to the primary motor.

The valve 23 is adapted to be set in the zero position above identified by a hand crank

5 176 connected to a gear 177, which latter meshes with a gear 178 fastened to the valve-driving ratchet 37. I have provided on the frame member 179, which supports the valve 23, a rigid arm 180 having a stop 181 arranged
10 to engage a lug 182 on the driving pawl 36 when the latter is retracted after propelling the valve ratchet 37. This disengages the pawl from the ratchet and leaves the latter free to be turned reversely by the crank 176.

15 The ratchet may be so turned until the pin 183 thereon strikes a dog 184, which is pivoted to the frame member 179 and actuated by a spring 185 so that it yields when the pin 183 passes it in normal rotation, but rigidly
20 arrests the pin on the reverse rotation.

On the back of the gear 177 is a flange 186 so formed that a latch 187 carried by the lever 159 will hook over it when the locking arm of said lever is raised, and will then en-
25 gage the latch to prevent lowering of this arm. The flange has a lip directed inward toward the center of the gear to permit of such interlocking, and the latch is so formed with an inclined end, and is controlled by
30 a spring with complemental limit stops, as shown, so that it passes readily over the lip of the flange and becomes thus interlocked with the latter. There is a notch or gateway 188 in the flange, as shown dotted in Fig. 9, and this gateway comes opposite to the latch 187 when the valve 23 is in zero position, thus leaving the control lever free to be moved.

The mechanism last described is mounted on the framework in a convenient position and at a height relative to the time cylinder substantially as shown in Fig. 10. If the frame is rectangular in plan, this mechanism may be so placed in one of the corners without substantial projection from the frame except
35 as to the handle of the control lever, which need only be in a readily accessible position. Such details, however, may be variously embodied in commercial structures according to the will of the mechanical designer.
40

The operation of the apparatus will be readily understandable from the foregoing description, but may be briefly reviewed as follows:

45 The attendant, having provided washing and rinsing water in readiness in the several tubs, places the clothes to be washed in the chamber 1 and closes the cover thereof. Before the machine can be started the valve 23 must be put in zero position by the hand
50 crank 176. Then the control handle of lever 159 may be moved, and when moved in the only direction possible, it releases the timing cylinder 135 and starts the primary motor 71. The attendant therefore places the

valve 23 in zero position, if it is not already there. This having been done, the control lever handle is pulled, and this is the last thing that the attendant need do before removing the washed and dried clothes. The
70 motor then drives the air compressor 78 and also drives the agitator operating rack 22 idly. If there is already a sufficient pressure in the air reservoir 83, the timing cylinder starts also; but, if not, the cylinder waits un-
75 til pressure has been pumped up. The attendant need not stand by, but may leave the machine to carry on its cycle in a completely automatic manner.

The first action of the timing cylinder after
80 starting is to couple the pump 13 to the primary motor. The diaphragm or wall 4 is now moved to expel air from the clothes chamber and from the mass of clothes placed therein. Then the pump is stopped and the
85 valve 23 moved to connect the clothes chamber with the tub of washing water. The reversing valve 14 of the water pump is shifted at the same time, or at a previous or subsequent step, if desired. The water pump
90 is then started again and its next action is to pump out water from the pressure space 8, causing wash water to be taken from the tub 24 into the clothes chamber. The pump is now stopped and the agitator set in oper-
95 ation. The following step of agitating the clothes is the longest single operation, and may be continued as long as desired, having regard to the diameter and speed of the timing cylinder, and the necessity of reserving a
100 part of the circumference of this cylinder for causing other operations.

Next the agitator is stopped, the water pump control valve 14 turned into position for delivering water into the pressure cham-
105 ber 8, and the pump 13 is set in action to force water into such chamber. Thereby the wash water is expelled from the washing chamber and returns to the tub 24. If desired, however, the plural-way valve 23 may
110 be so arranged and operated as to deliver the expelled wash water to a waste outlet; but whether this is done or not is a matter of design and of secondary importance.

The plural-way valve is now turned to connect the closed chamber with the second tub,
115 the water pump valve reversed and the pump operated to draw water from this tank for either a second washing or a rinsing, as the case may be. The agitator is again set in
120 motion and run for a brief time, as before described, for the same purpose, or for washing out the soap and dirt still remaining in the clothes, and then stopped; and the pump 13 is reversed and again operated to expel the
125 rinsing water.

So the cycle continues; the pump 13 being alternately driven, reversed as to its connections, and again driven, to draw water from successive tubs and to expel the water, the
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agitator briefly operated between intake and exhaust of the water, and the plural-way valve 23 being intermediately advanced after each exhaust and before the next intake, to connect the washing chamber with the several tubs one after another. Agitation during the subsequent rinsings, while desirable, may be omitted. After the last rinsing step, which may be carried out with bluing water, and after expulsion of the water, the pressure fluid is pumped out from the chamber 8 with the clothes chamber 1 connected with the atmosphere through the plural-way valve. Finally, the timing cylinder reaches the end of its rotation and the control lever springs into the notch 158, opening the control switch of the primary motor, and stopping the timing cylinder and the motor. The attendant may now open the clothes chamber, finding the clothes therein in a compressed and semi-dried condition. Sufficient pressure may easily be imposed by the pump 13 to leave the clothes dry enough to be ironed immediately and without further drying in the air. An adjustable relief valve may be placed in the pipe 11 as shown at 189 to avoid excessive pressure on the apparatus from continued driving of the pump.

Preferably the timing cylinder is so constructed and equipped as, when it reaches the stopping position, to leave the pressure chamber 8 exhausted of water, the pump 13 disconnected from the primary motor, its control valve 14 in position to cause the pump 35 when next driven to pump water into the pressure chamber, the agitator driving rack out of mesh with the pinion, the plural-way valve 23 open to the waste outlet (though it may be connected to the first tub), and the driving pawl 36 in retracted position. With the parts thus set, all is in readiness to commence and carry on the cycle as described, upon pulling the control handle by the attendant.

All the many operations of the complete cycle are performed automatically, without care on the part of the attendant and without possibility of mistake. The attendant's duties are reduced to the elementary ones of putting in and taking out the clothes, and moving the control handle. The further action, before described, of setting the plural-way valve in zero position is generally unnecessary; but whenever it does become necessary, it is performed without fail, for the machine cannot be started until it has been done.

It will be apparent that many modifications and variations in the construction and arrangement of the whole combined apparatus, and of its various parts, may be made within the scope of the present invention. Therefore, I do not limit my protection to the details herein shown, but intend to protect the principles embodied in operative form,

whatever the specific form of such embodiment may be, within the meaning and scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A laundry apparatus comprising a clothes-receiving chamber having a movable wall and a pressure chamber at the opposite side of said wall from the clothes-receiving chamber, a water connection with the clothes-receiving chamber, fluid-forcing means connected with said pressure chamber for forcing fluid therein and exhausting such fluid therefrom, a reversing motor for causing reversal of the flow caused by said fluid-forcing means, and a power driven controller for governing the action of said reversing motor.

2. A laundry apparatus comprising a clothes-receiving chamber having a movable wall and a pressure chamber at the opposite side of said wall from the clothes-receiving chamber, a connection for admission and discharge of fluid from said clothes-receiving chamber, fluid-forcing means coupled with said pressure chamber for forcing fluid therein to move said wall and contract the clothes-receiving chamber, and withdrawing fluid to move said wall in the direction to enlarge the clothes-receiving chamber, a valve coupled with said fluid connection and having a plurality of ports, a plurality of fluid containers separately connected with different ports of said valve, a flow reversing valve for said fluid forcing means, control motors for the respective valves, and power driven timing means for causing operation of said motors at predetermined times.

3. In a laundry apparatus as set forth in claim 2, including also a motor for actuating said fluid forcing means, a releasable clutch between said motor and fluid forcing means, said clutch being connectible and disconnectible by said timing means.

4. A laundry apparatus comprising a clothes-receiving chamber, an agitator in said chamber, water displacing means for putting water in said chamber and discharging water therefrom, driving means for the agitator, control means for putting said water-displacing means and said agitator-driving means into and out of action, means for reversing the direction of water flow caused by said water-displacing means, a power driven timing member, and means by which said timing member actuates said control means and said reversing means.

5. A laundry apparatus comprising a clothes-receiving chamber, a flow connection leading from said chamber, a plural-way valve connected to said flow connection and having separate ports adapted to be connected with different water containers and a movable member adapted to put different ones of said ports in communication in said flow connection, reversing means for causing water to

flow into and out of said chamber through said connection, and automatic means for actuating said reversing means, and for shifting the movable member of said valve from one communication to another between actuations of said reversing means.

6. An automatic washing machine comprising a clothes-receiving chamber, a plurality of containers for washing fluid, a plural-way valve having connection with the several containers and also having a connection with said chamber, said valve including a movable member operable to establish communication between said chamber connection and said container connections successively, means for transferring fluid into the chamber from said connections and expelling the fluid from the chamber, and power driven control means arranged and operable to operate, and reverse the direction of flow caused by said fluid-transferring means, and to shift the movable member of said valve, in a predetermined sequence.

7. An automatic washing machine comprising a clothes-receiving chamber, a plurality of containers for washing fluid, a plural-way valve having connection with the several containers and also having a connection with said chamber, said valve including a movable member operable to establish communication between said chamber connection and said container connections successively, means for transferring fluid into the chamber from said connections and expelling the fluid from the chamber, an agitator in said chamber, actuating means to drive said agitator, means to render said actuating means operative or inoperative, and power driven control means for causing actuation of said fluid transferring means and reversing the direction of water flow caused thereby, for making said agitator-operating means operative and inoperative, and for shifting the movable member of said plural-way valve, in a predetermined sequence.

8. In a laundry apparatus a clothes-receiving chamber having a movable wall, means for moving said wall back and forth to contract or enlarge the volume of said chamber, a flow connection leading from said chamber, a plural-way valve to which said flow connection leads, a number of separate conduits leading from said plural-way valve adapted to be placed in separate water containers, said valve including a movable member having provisions for placing the chamber connection in communication with different ones of said conduits in turn, power driven means respectively actuating said valve member and said displaceable wall, and a power driven timing member for controlling the times and sequence of operation of said power-driven means.

9. A laundry apparatus comprising a casing having an interior movable partition di-

viding it into a clothes-receiving chamber and a pressure chamber, a pump, connections leading from said pressure chamber and a water supply to said pump, a shiftable valve interposed between said pump and connections for reversing direction of flow through the connections, a fluid motor connected to said valve for shifting it, a control valve for governing the admission and exhaust of working fluid to said motor for causing it to actuate said valve, and a power driven timing element arranged to shift said control valve at predetermined times.

10. A laundry apparatus comprising a casing having an interior movable partition dividing it into a clothes-receiving chamber and a pressure chamber, a pump, connections leading from said pressure chamber and a water supply to said pump, a shiftable valve interposed between said pump and connections for reversing direction of flow through the connections, a fluid motor connected to said valve for shifting it, a plurality of water containers, conduits leading from said water containers and from the clothes-receiving chamber of said casing, a valve shiftable to put said chamber in connection with different water containers exclusively, means for moving said valve, a fluid motor for actuating said valve moving means, separate control valves for the two before named fluid motors shiftable to cause successive operations of the respective motors, and a single power driven timing member having provisions for shifting said control valves in a predetermined sequence.

11. In a laundry apparatus a clothes-receiving chamber, a plurality of connections between said chamber and different water depositories, a plural-way valve in said connections operable to put the chamber into communication with different depositories in turn, a pumping apparatus for causing flow of water into and out of such chamber through said connections, a compressed air motor for controlling the operation and direction of flow caused by said pumping apparatus, a separate compressed air motor for actuating said plural-way valve, and a timer for putting said motors into and out of operation in a predetermined sequence.

12. In a laundry apparatus a clothes-receiving chamber, pumping means for causing water to flow into said chamber and for expelling water therefrom, means including a fluid motor for putting said pumping means into and out of operation, a valve for controlling the admission and exhaust of working fluid to and from said motor, and a timer for operating said valve.

13. In a laundry apparatus a clothes-receiving chamber, pumping means for causing inflow and outflow of water into and out of said chamber, means including a compressed air motor for starting and stopping

said pumping means, a compressed air motor for effecting reversal of the direction of water flow caused by said pumping means, valves controlling the admission and exhaust of air to and from said motors, and a timer for actuating said valves in a predetermined sequence.

14. In a laundry apparatus a clothes-receiving chamber, pumping means for transferring water to and from said chamber, an agitator in the chamber, means for driving said agitator, means including a compressed air motor for rendering such agitator driving means operative and inoperative, other means including a second compressed air motor for putting said pumping means into and out of action, control valves respectively controlling the admission and exhaust of air to and from said motors, and a timer for actuating said control valves in a predetermined sequence.

15. In a laundry apparatus the combination of a clothes-receiving chamber, pumping means and cooperating valve means for causing flow of fluid into said chamber and forcing the water out of the chamber, other valve means for putting different sources of fluid into flow transmitting connection with the chamber, a timer and means controlled by said timer for operating said valve means in a predetermined sequence.

16. In a laundry apparatus a washing chamber, pumping means and cooperating valve means for causing flow of fluid into and out of said chamber, an agitator in the chamber, a primary motor, disconnectible driving connections from said motor to said pump and said agitator, and common, power driven means for coupling and uncoupling said connections in a predetermined manner.

17. In a laundry apparatus a washing chamber, pumping means and cooperating valve means for causing flow of fluid into said chamber and then forcing the fluid out of the chamber, a primary motor, a selective timer driven by said motor, and means controlled by said timer for operating said valve means.

18. In a laundry apparatus a clothes-receiving chamber, a pump for putting water in and discharging it from said chamber, an agitator for agitating clothes and water in said chamber, a primary motor, disconnectible transmission connections for driving said pump and said agitator from said motor, pneumatic motors arranged respectively for coupling and uncoupling said connections, and common, power driven means for actuating said pneumatic motors independently and in a predetermined sequence.

19. In a laundry apparatus a clothes-receiving chamber, a pressure chamber, a pressure operated movable wall between said chambers, a pump, a water supply, connections between the pump and said pressure

chamber and water supply respectively, a reversible valve for connecting either of said connections with the pump intake and the other with the pump outlet, disconnectible driving means for said pump, a pneumatic motor for coupling and uncoupling said driving connections, a pneumatic motor for reversing said valve, and power driven timing means controlling the admission and exhaust of air to and from the respective motors in a given sequence.

20. In a laundry apparatus including washing and drying means, fluid-pressure motors for actuating said means, flow connections for delivering and exhausting working fluid to and from the respective motors, reversing valves in said flow connections, and a timer having means for shifting of the several reversing valves back and forth in a predetermined sequence.

21. In an apparatus of the character described, a fluid motor for operating a part of said apparatus, a reversing valve in controlling relation with said motor for reversing its action, comprising a casing having a plurality of ports, a rotatable plug having passages movable into register with different ones of said ports, a gear on said valve plug, a gear segment in mesh with said gear and having impact receiving abutments, and a timer having projections arranged to engage said abutments and move the gear segment alternately in opposite directions.

22. In an apparatus of the character described, a fluid motor for operating a part of said apparatus, a reversing valve in controlling relation with said motor for reversing its action, comprising a casing having a plurality of ports, a rotatable plug having passages movable into register with different ones of said ports, a gear on said valve plug, a spring connected to said gear segment and anchored at the opposite side of the pivot of the segment from its point of connection with the segment, whereby it tends to move the segment to extreme position from a point near mid position, and a rotatable timing means having abutments arranged to engage said segment alternately at opposite sides.

23. In a laundry apparatus the combination with a plurality of fluid motors for operating various parts of said apparatus, of a timing member comprising a cylinder, reversible valves mounted adjacent to the surface of said cylinder in flow directing relationship with the several motors, the several valves being displaced from one another in the axial direction of the cylinder, oscillatable reversing means associated with the respective valves, and abutments carried by said cylinder arranged to pass said reversible means and engage each at opposite sides of its pivot alternately.

24. In an apparatus of the character described, a rotatable timing cylinder having a

- series of ratchet teeth, a primary motor, a pawl driven by said motor and arranged to engage and advance said ratchet teeth, an air pump driven by said motor, a spring normally withholding the pawl from said ratchet teeth, and an impeller operated by air pressure developed by said pump for putting said pawl into action in opposition to said spring.
25. In a laundry apparatus having a washing chamber, a primary driving motor, means for causing flow of liquid into and out of the chamber, means for agitating the clothes and liquid in said chamber, a plurality of valves for severally controlling the said means, a timer for actuating said valves in a given sequence, and driving means between said primary motor and said timer.
26. In a laundry apparatus having a washing chamber and operating devices in connection therewith, a primary motor, a fluid pressure pump driven by said motor, a timer for governing the actions of said operating devices, a driver for the timer actuated by said motor normally tending to occupy an inoperative relationship to the timer, and means governed by fluid pressure developed by said air pump for making said driver operative to propel the timer.
27. In an apparatus of the character described, a primary motor, a timer, a control member for starting and stopping said motor, and a lock for said timer connected with said control member for actuation simultaneously therewith.
28. In a laundry apparatus a washing machine, means for putting water into and out of said machine, a valve for connecting the washing machine with different depositories of water in turn, a primary driving motor, a timer, a control means for said motor, a lock for said timer coupled to said control means for simultaneous operation and a lock associated with said valve for preventing release of said timer lock except when the valve is in a predetermined position.
29. In an apparatus of the character described, a timer, a normal feed pawl for driving said timer, and a secondary pawl having a longer throw than said normal feed pawl for giving periodic rapid feed movements to the timer; the timer having shoulders cooperating with said second pawl and spaced at distances apart greater than the length of stroke thereof.
30. In an apparatus of the character described, a control valve, reversing means for said control valve, a timer having abutments arranged to engage said reversing means alternately at opposite sides and move it alternately in opposite directions, a normal feed pawl for said timer and a periodic rapid feed pawl also operable to drive the timer in the same direction; the timer having abutments cooperative with the second named pawl located at distances farther apart than the length of travel of the pawl and synchronized with said valve reversing abutments.
- In testimony whereof I have affixed my signature.
- NEWTON CRANE.

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