April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 1

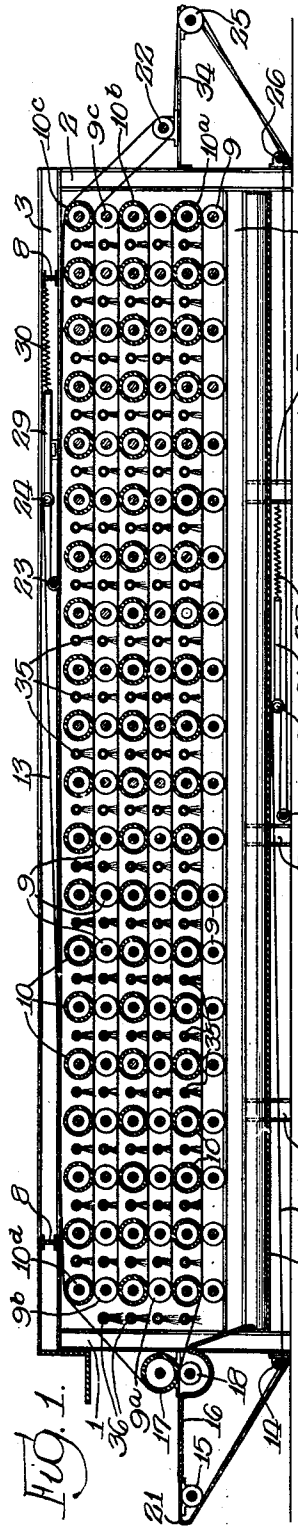


Fig. 1.

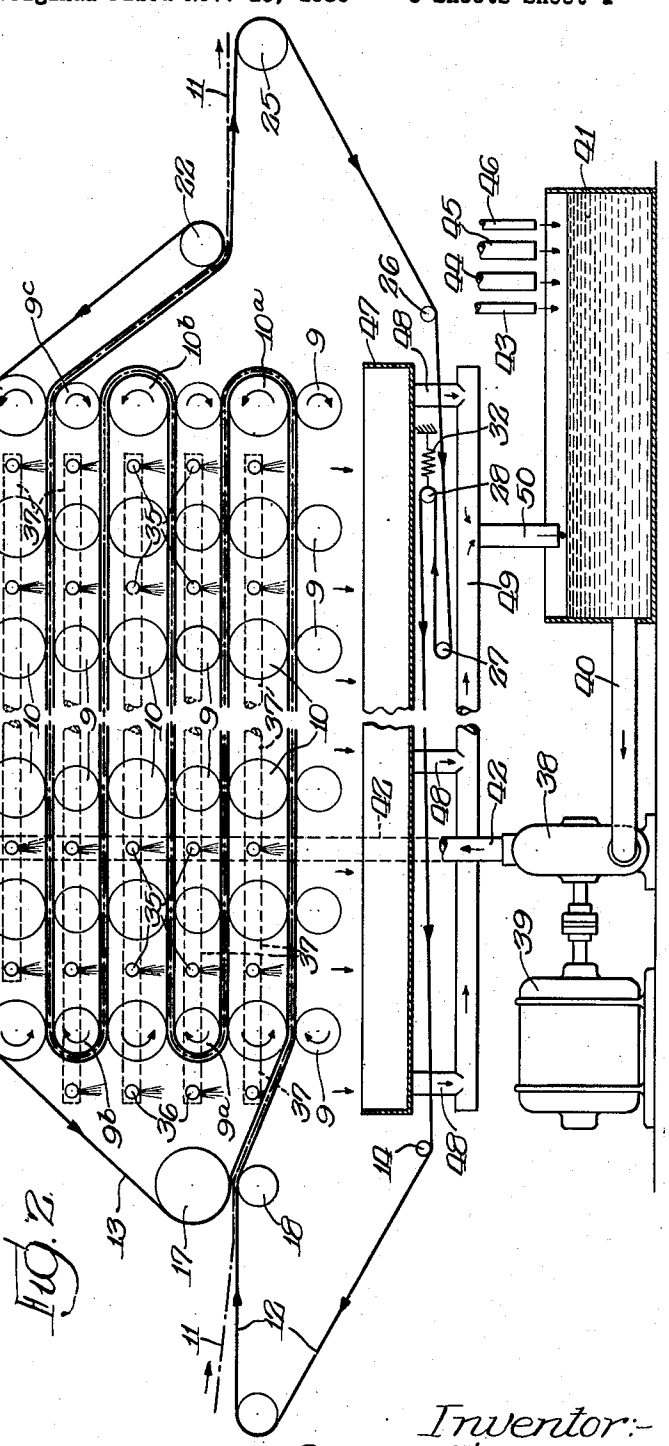


Fig. 2.

Inventor:-
George E. Davies,
By Wilson, Donnell, McCanna & Foley Attys.

April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 2

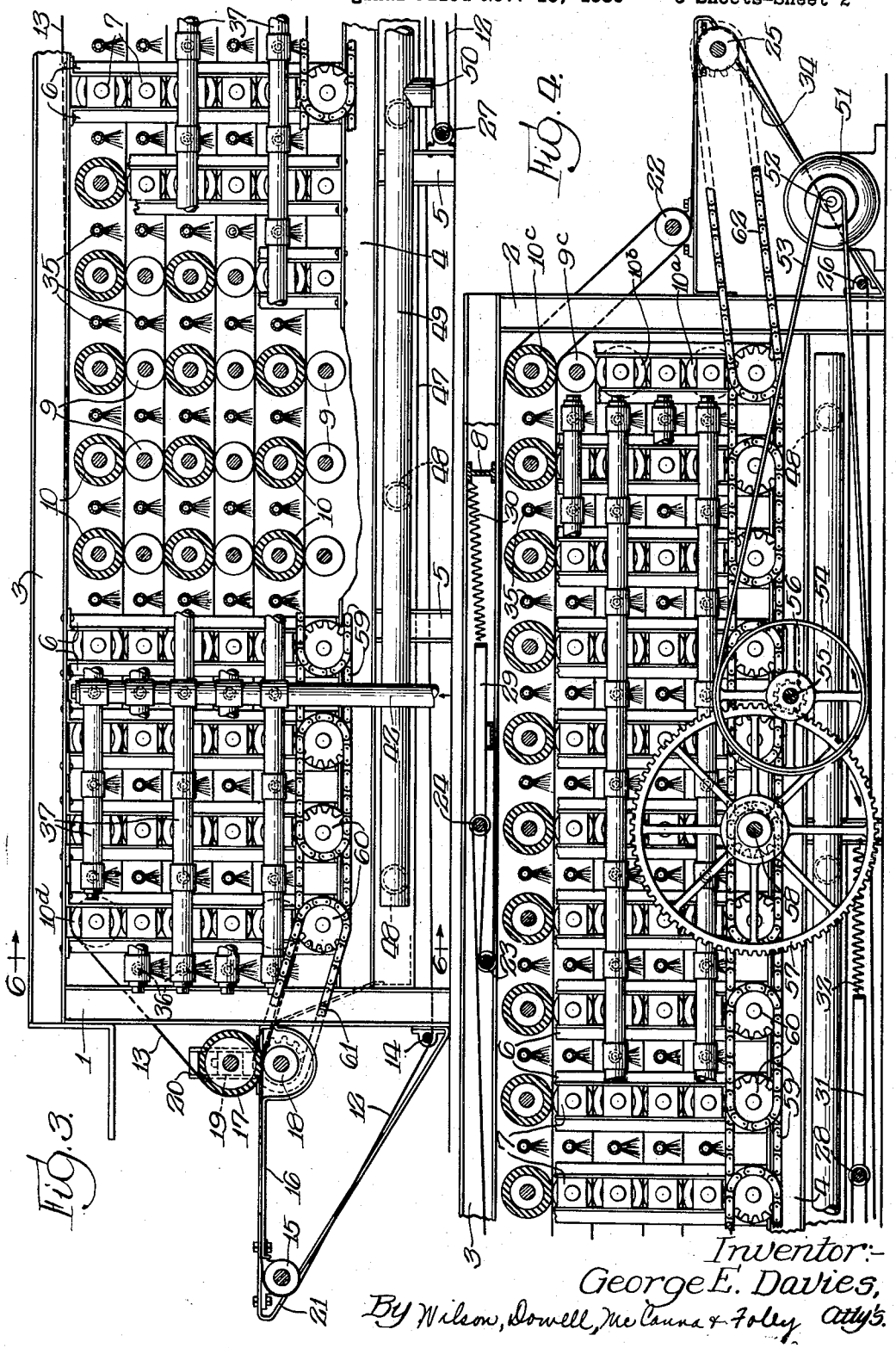


Fig. 3.

Fig. 4.

Inventor:-
George E. Davies,
By Wilson, Dowell, McCanna & Foley Atty's.

April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 3

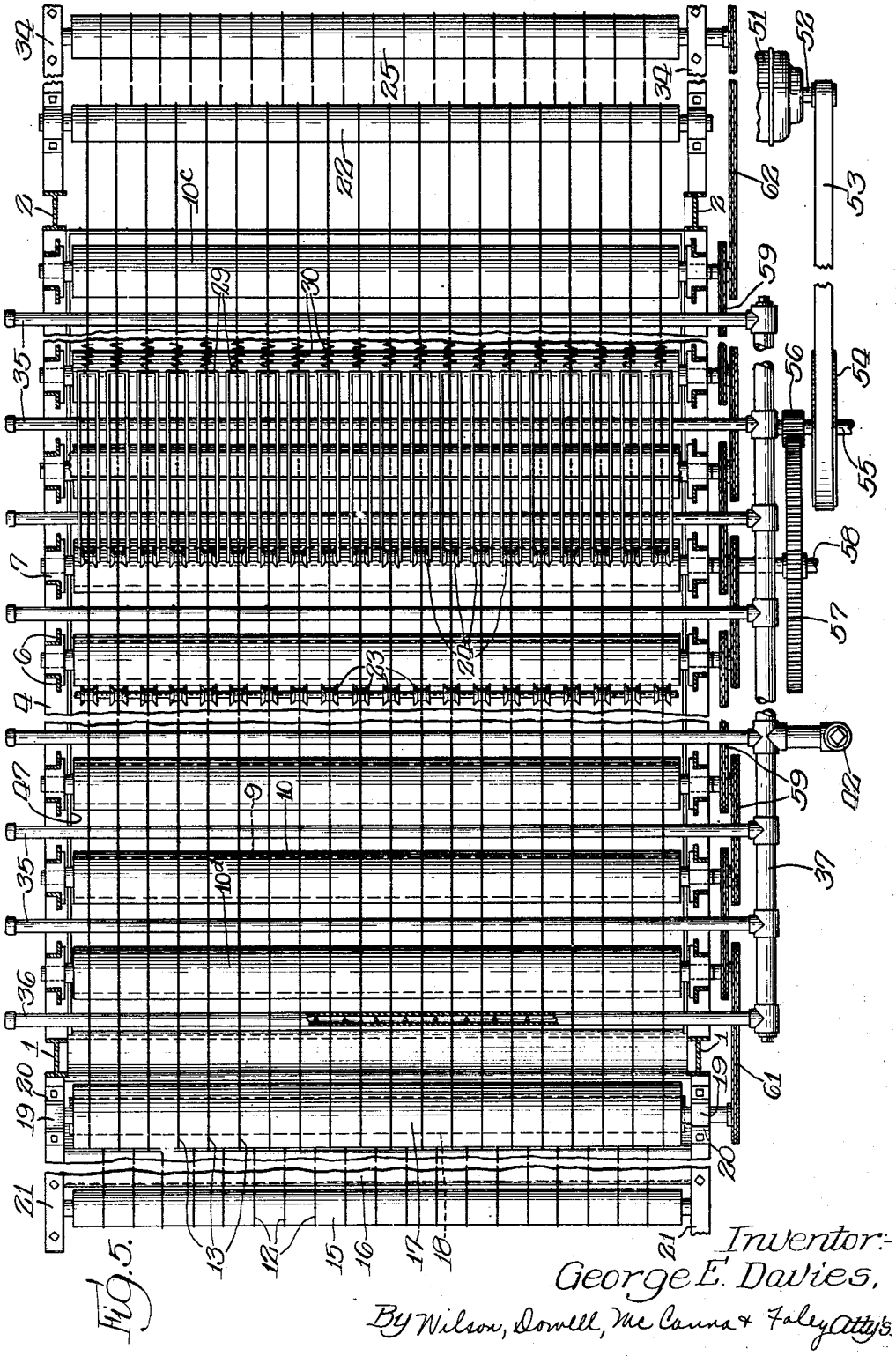


Fig. 5.

Inventor:
George E. Davies,
By Wilson, Dowell, McCanna & Foley Atty's.

April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 4

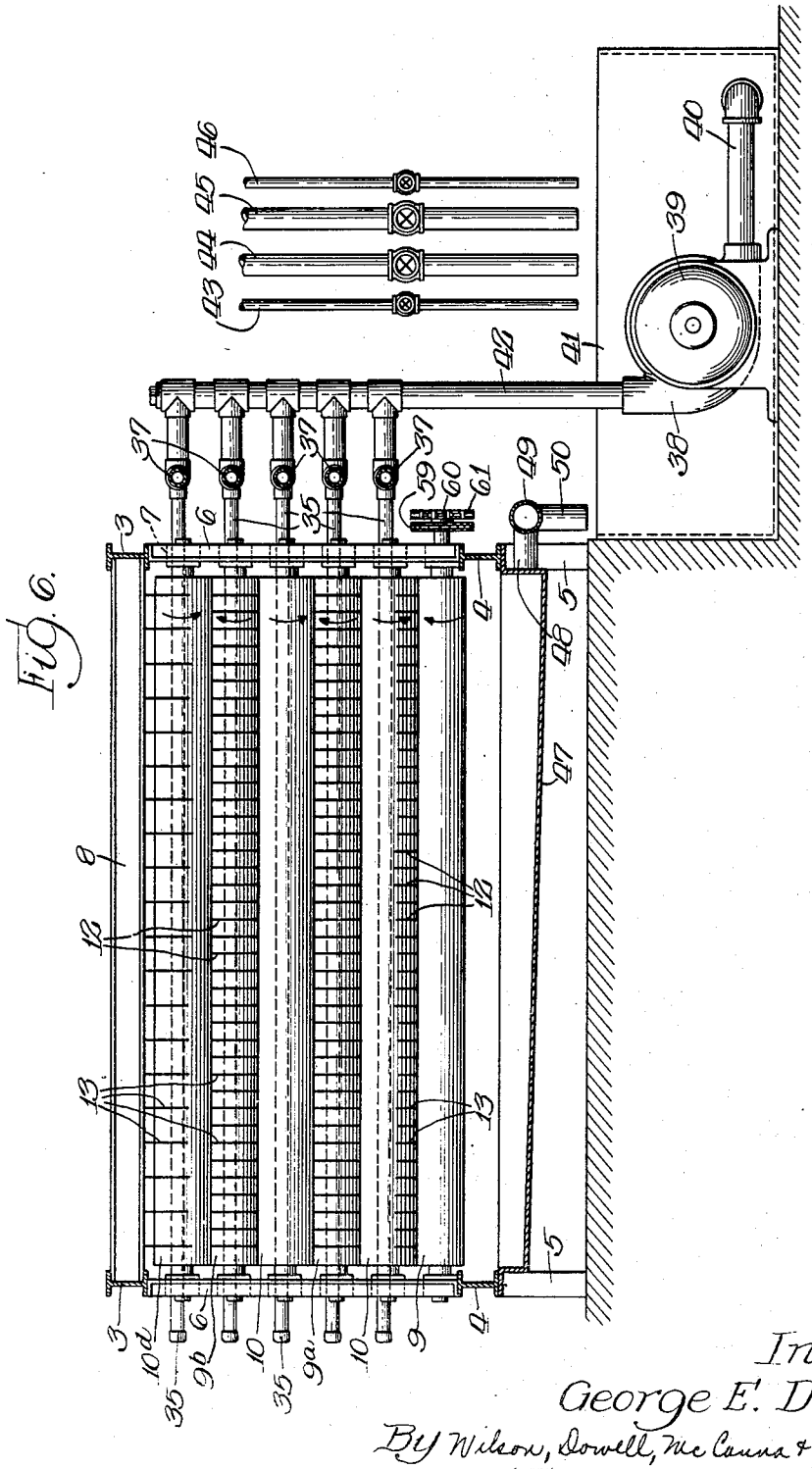


Fig. 6.

Inventor:
George E. Davies,
By Wilson, Dowell, McCanna & Foley Atty's.

April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 5

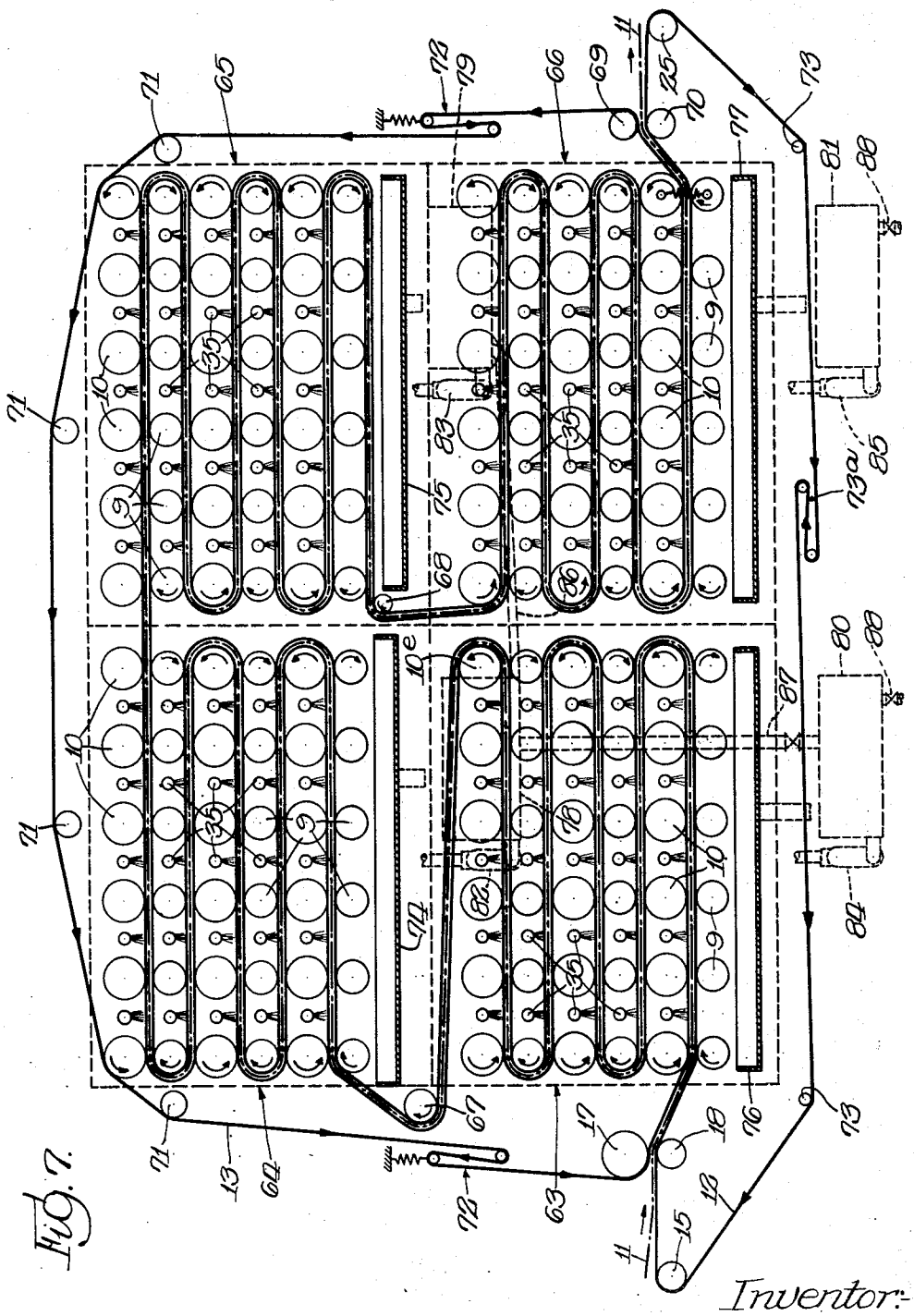


Fig. 7.

Inventor:
George E. Davies,
By Wilson, Dowell, Mc Canna & Foley Attys

April 9, 1940. G. E. DAVIES 2,196,695

WASHING MACHINE

Original Filed Nov. 13, 1936 6 Sheets-Sheet 6

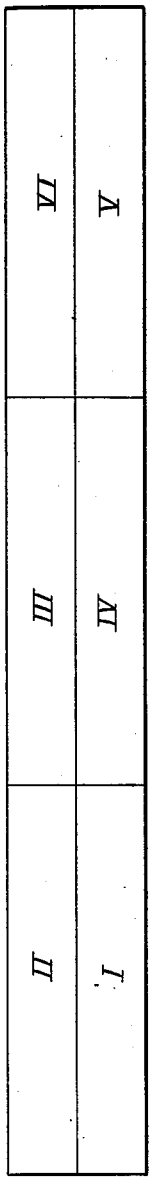


Fig. 8.

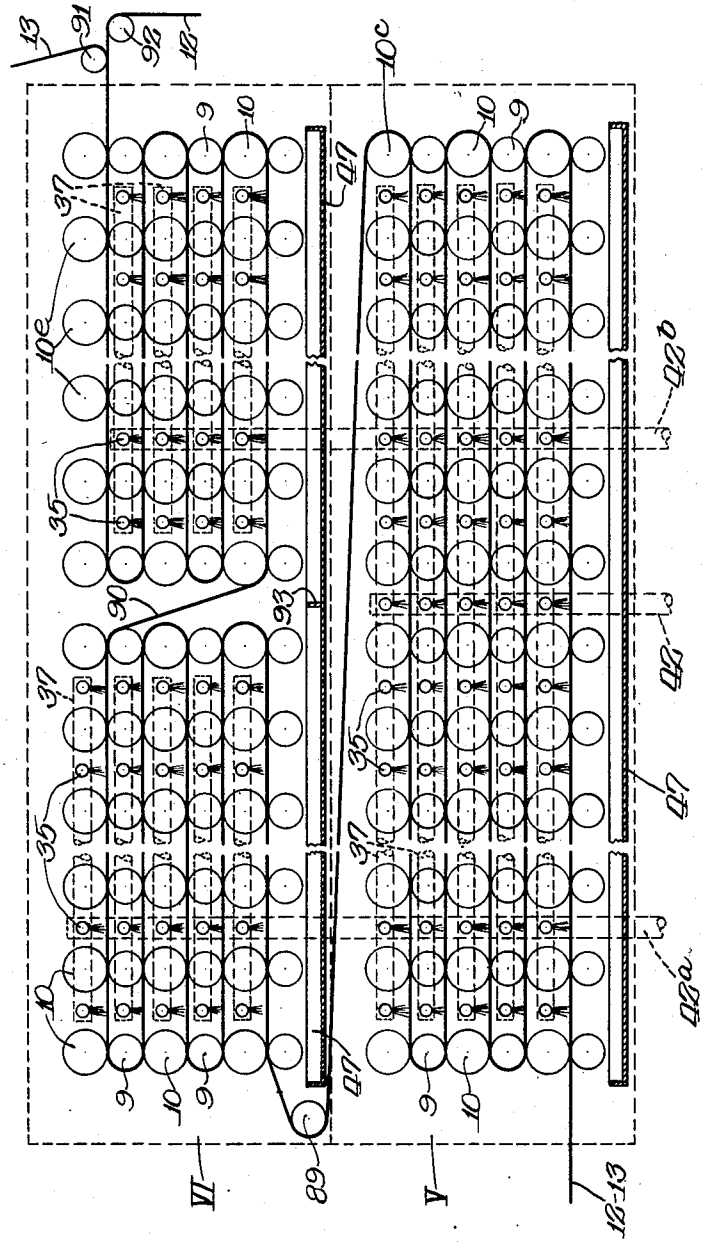


Fig. 9.

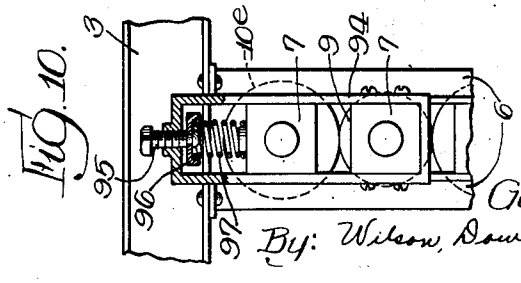


Fig. 10.

Inventor:-
George E. Davies,
By: Wilson, Dowell, McCanna & Foley
Attys.

Patented Apr. 9, 1940 2,196,695

UNITED STATES PATENT OFFICE

2,196,695

WASHING MACHINE

George E. Davies, South Bend, Ind.

Application November 13, 1936, Serial No. 110,633
Renewed November 6, 1939

10 Claims. (Cl. 68—44)

This invention, relating to the laundry industry, embraces a novel washing process and machine for expeditiously washing clothes, household linen, woolen blankets, and the like on an extensive commercial scale. The machine is continuously operating in the sense that the garments, sheets, blankets or other articles to be washed are successively introduced into the machine and conveyed therethrough in practically a continuous stream, while undergoing the washing operation, and are successively delivered in properly cleansed condition; so that the machine may be used for an indefinite time for washing continuously supplied material. The washing process involves frequently passing washing liquid through the material, held and conveyed in spread out or flat state and substantially unobstructed on both sides, and subjecting the material to a multiplicity of wringer roll operations in alternation with the passing of the liquid therethrough, whereby the material is effectively cleansed by the frequently repeated alternating liquid treatment and mechanical action.

Expeditious washing of large quantities of continuously supplied launderable material, efficient and economical operation, practicability of construction and efficiency of the machine, and large capacity installation without occupancy of an undue amount of floor space, are among the objectives of the invention.

For explanation of the invention, reference is made to the accompanying drawings in which:

Fig. 1 is a longitudinal vertical section of one illustrative washing machine embodying the invention.

Fig. 2 is a diagram of said machine, illustrating the course of the conveying means and launderable material through the machine, and showing the liquid supply and recovering means. This diagram represents a longitudinal vertical section of the machine, omitting a large portion of the machinery between its end portions.

Fig. 3 is a view of the first half of said machine, partly in side elevation and partly in section. In this view, the portions appearing in side elevation show only partially the system of piping for supplying washing liquid to the shower pipes.

Fig. 4 is a view of the second half of said machine, partly in side elevation and partly in section, and omitting some of the liquid supply pipes.

Fig. 5 is a top plan view of said machine, omitting various intermediate parts and bringing the illustrated parts into close association for compactness of illustration.

Fig. 6 is a vertical cross section taken on the line 6—6 of Fig. 3, looking in the direction of the arrows.

Fig. 7 is a diagram representing a longitudinal vertical section of another machine embodying the invention and including certain additional subject-matter as a feature of the invention.

Fig. 8 is a diagram representing a washing machine comprising six units of the type shown in Fig. 1.

Fig. 9 is a diagrammatic sectional representation of the last two units of the machine shown in Fig. 8.

Fig. 10 is a detail view of one of the wringer rolls of the last unit of said machine shown in Fig. 8.

It will be understood that the particular machines shown in the drawings are illustrative examples, and that the following specific description thereof is not to be taken as limiting the invention beyond the terms of the appended claims.

Referring to Figs. 1 to 6, the illustrative machine has side frames each comprising end posts 1 and 2, a longitudinal top beam 3 supported by said posts, a longitudinal bottom beam 4 supported by said posts and by additional supports 5, and angle bars 6 connecting the top and bottom beams, said angle bars being arranged in pairs providing vertical guides for the journal boxes 7 of the wringer rolls. The top rails 3 of the two side frames may be connected by cross beams 8.

Mounted between the side frames are a multiplicity of wringer rolls including in this instance bare metal rolls 9, hereinafter referred to as plain rolls, and rubber covered rolls 10 coacting with said plain rolls, so that clothes or garments having buttons, buckles or the like affixed thereto may pass between coacting rolls without breakage of the buttons or buckles, due to the yieldabiilty of the soft rubber jackets or coverings on the rolls 10. These wringer rolls are arranged in stacks, the rolls of each stack bearing one upon another in the same manner as the calendering rolls of a paper making machine. In each stack the rubber covered rolls 10 alternate with the plain rolls 9. The shafts, axles or journals of the rolls are journaled in the boxes 7 which are vertically slidable in the guides provided by the angle bars 6, as best shown in Figs. 3, 4 and 5. The journal boxes of the bottom wringer rolls rest on the longitudinal bottom beams 4, while the journal boxes for the other rolls are floating or unsupported except by the roll journals. The bottom rolls are driven by suitable driving mechanism hereinafter described, while each of the other rolls is driven by frictional engagement with the roll on which it bears or by its coaction with the subjacent roll through the intervening launderable material passing between the rolls. As will be obvious, each pair of coacting rolls rotate in opposite directions, so that their peripheral surfaces are traveling in the same direction at the bite. Thus

in the illustrative machine the plain rolls 9 rotate clockwise while the coacting rubber covered rolls rotate counterclockwise.

In the specific construction shown there are twenty stacks of coacting wringer rolls, each stack comprising six rolls and thus functioning to provide five pairs of coacting rolls per stack. It will be understood that the number of the stacks and number of rolls in each stack may be varied.

Passing back and forth through the stacks of wringer rolls are coacting conveyers holding between them the material undergoing the washing operation. Such material is diagrammatically indicated in Fig. 2 by the dash and dot line 11. This material in some instances might be a continuous sheet, as in the case of washing long bolts of cloth, but ordinarily in commercial laundry operations the material will consist of various articles such as linen sheets, woolen blankets, undergarments and other textile fabric articles successively spread out flatwise and fed one after another into the machine. The coacting conveyers which carry the material through the machine are of the open-work type, leaving the entire area of the material on both sides exposed and substantially unobstructed by holding or conveying means. As the conveyers and intervening material pass through the machine in a sinuating course and around various rolls, it is desirable to employ conveyers which can travel in the same plane and which can pass in reverse directions around different rolls without alternately stretching and slacking of the conveyers; and therefore, as a feature of the present invention, the illustrative machine is equipped with so-called string conveyers. The lower one of these conveyers comprises parallel endless strings 12, and the coacting upper conveyer comprises parallel strings 13 arranged in spaces between the strings 7. The strings may consist of cords, wires or tapes.

In the specific arrangement shown, the lower conveyer strings 12 pass under the machine and are led upwardly from the guide roll 14 around the guide roll 15 and over a supporting table 16 and between coacting feed rolls 17 and 18; while the coacting upper conveyer strings 13 are led from above around the guide roll 17 and pass with the strings 13 and intervening launderable material 11 (Fig. 2) between said guide rolls 17 and 18. As best shown in Fig. 3, the feed roll 17 bears of its own weight on the subjacent feed roll 18, the journal boxes 19 of the feed roll 17 being vertically movable in guides 20 supported by the frames 21 which support the table 16 and the bearings for the guide roll 15 and for the feed roll 18. It will be understood that articles to be washed, such as sheets, towels, woolen blankets, undergarments and the like, are successively placed in spread-out or flat condition on the conveyer strings 12 as they pass over the supporting table 16 and are fed one after another into the machine between feed rolls 17 and 18.

The course of the coacting string conveyers and intervening launderable material through the machine, according to the specific arrangement utilized in the illustrative machine now being described, is most clearly shown in the diagram in Fig. 2. The multiplicity of wringer rolls may be considered as arranged in vertical stacks and in horizontal tiers or rows. It will be seen that the conveyers and intervening launderable material pass from the feed rolls 17, 18 rearwardly through the machine between the bottommost and adjacent tiers of wringer rolls, then around the roll 10^a and forwardly between the second and third tiers of wringer rolls, then around the roll 9^a and rearwardly between the third and fourth tiers of wringer rolls, then around the roll 10^b and forwardly between the fourth and fifth tiers of wringer rolls, then around the roll 9^b and rearwardly between the fifth and sixth tiers of wringer rolls, and then from the wringer roll 9^c downwardly and under the guide roll 22 where the two conveyers diverge. The upper conveyer strings 13 pass around the guide roll 22 and upwardly over the wringer roll 10^c to and around the small guide pulleys or spools 23 and thence reversely to and around the tensioning spools 24 and then forwardly to and over the wringer roll 10^d and then to and around the feed roll 17. The lower conveyer strings 12 pass under the guide roll 22 and thence rearwardly to and around the guide roll 25 and then forwardly under the machine in engagement with the guide roll 26 to and around the guide spools 27 and then reversely to and around the tensioning spools 28 and then forwardly under the machine in engagement with the aforesaid guide roll 14 to and around the guide roll 15 and over the receiving table 16 to and between the feed rolls 17 and 18.

In Fig. 2, which is diagrammatic, the coacting string conveyers and the various coacting feed rolls and wringer rolls are shown separated. This is merely to illustrate clearly the course of travel of the coacting string conveyers and intervening line of material undergoing the washing operation. Actually the strings of the two conveyers travel in practically the same planes and pass around the rolls in arcs of substantially the same radii, and there will ordinarily be no such exaggerated separation of the coacting feed rolls 17 and 18 and the various coacting wringer rolls as appears in Fig. 2, since the various coacting rolls will be separated only by the thin layer of fabric passing between them.

As shown most clearly in Figs. 2, 4 and 5, the upper conveyer strings 13 are tensioned by passing around the guide spools 23 mounted on a fixed shaft and then passing reversely around the tensioning spools 24 which, as shown in Figs. 4 and 5, are attached to the forward ends of relatively long stirrups 29, these stirrups being connected at their rear ends to coiled retracting springs 30 which are attached to one of the cross beams 8, these springs forcibly but yieldably drawing the spools 24 toward the rear end of the machine, so that the conveyer strings are maintained at a proper tension. The lower conveyer strings 12 are similarly tensioned, as shown in Figs. 1 to 4, by passing around the guide spools 27 and thence reversely around the tensioning spools 28 attached to the forward end of stirrups 31 which are connected by the retractile springs 32 to one of the supports 4.

At the rear end of the machine, suitable frames 34 support the bearings for the guide rolls 22 and 25. The articles which have undergone the washing operation emerge at 22 and are carried by the lower conveyer strings 12 to the roll 25. The laundered articles may be successively removed at the roll 25 or from the conveyer strings in advance of said roll, or may be delivered from the roll 25 into receiving baskets or receptacles or to other conveying means for automatically transferring the articles and carrying them through wringing equipment or through another similar unit for further washing

or further work, and finally through drying and ironing machines.

A multiplicity of shower pipes **35** are interspersed among the wringer rolls for showering washing liquid or liquids upon the material which is being carried back and forth through the series of roll stacks. In the machine shown in Figs. 1 to 6, a number of shower pipes **36** are arranged to shower washing liquid upon the material before it passes between the first pair of coacting wringer rolls, and a multiplicity of shower pipes **35** are arranged between the various stacks of wringer rolls and above the respective horizontal runs of the material through the machine, so that in any run except the topmost run the material is directly showered by the liquid discharged from the pipes immediately above it, and also receives the water falling upon it from the superposed run of the material. It will be seen that the washing liquid is very frequently passed through the material, not only by reason of the multiplicity of shower pipes which discharge water or washing solution under pressure against the material, but also by reason of the fact that the material is carried a number of times back and forth under various groups of shower pipes.

Washing liquid under pressure is supplied to the shower pipes by any suitable system, as for example by pumping the liquid from a suitable source of supply to a series of pipes **37** connected with the shower pipes, said pipes **37** being partially shown in Figs. 3, 4 and 5, and being indicated by dotted lines in Fig. 2. In the specific arrangement shown, a centrifugal pump **38** driven by the motor **39** draws liquid through the pipe **40** from the tank **41**, and delivers the liquid through the manifold pipe **42** to the various pipes **37** connected with the shower pipes. The tank **40** may receive various liquids from suitable pipes, for instance the tank **41** may be supplied by suitable valve controlled pipes **43**, **44**, **45** and **46** with liquid soap, hot water, cold water and bleaching solution, respectively.

The liquid discharged from the shower pipes through the launderable material is caught in the pan **47** extending under the series of shower pipes and stacks of wringer rolls. This pan may have an inclined bottom as shown in Fig. 6, and from its deeper side may discharge through outlet connections **48** to a pipe **49** which discharges through the branch pipe **50** into the tank **41**. Thus the liquid not absorbed in the fabric articles undergoing the washing operation is recovered and may be utilized over and over again, diluted as required with fresh water supplied by the pipes **44** or **45** or either of them and replenished as required with soap and bleaching solution by the pipes **43** and **46**. The liquid supply system may be variously modified to suit different requirements and conditions, for example to supply different washing liquids or solutions to the shower pipes in different portions of the apparatus. In other words different sections or parts of the apparatus may be supplied with washing liquids from different sources. For example in the illustrated machine the liquid recovered from the washing operation might be supplied to the lowermost shower pipes, or to the shower pipes associated with the first several horizontal tiers of wringer rolls, while cleaner solution could be supplied to shower pipes associated with upper intermediate wringer rolls, and clean rinsing water or bluing water could be supplied to the shower pipes of the uppermost roll or to a series of shower pipes which are the last to operate on the material. In a machine comprising a series of units of the type described, through which the launderable articles are successively passed, each unit will usually be supplied with a separate washing solution, and in the last or final unit liquid for the usual souring operation may be supplied in the first half of the unit, and a bluing liquid may be supplied in the last half of the unit. In the last unit, the last ten or twelve rolls through which the material passes could be used simply as wringer rolls, the pressure between them being increased by springs, and the shower pipes in connection with such last ten or twelve coacting pairs of wringer rolls being omitted.

Suitable mechanism for driving the machine is illustrated in Figs. 3, 4 and 5 wherein **51** denotes an electric motor, the shaft **52** of which is connected by the driving belt **53** with the pulley **54** on a suitably mounted shaft **55** having a pinion **56** meshing with a relatively large spur gear wheel **57** on the extended shaft **58** of one of the bottom wringer rolls. All of the bottom wringer rolls are driven from said shaft **58** by sprocket chain drives from shaft to shaft as will be readily apparent from Figs. 3, 4 and 5 in which **59** denotes the several sprocket driving chains and **60** denotes the sprocket wheels on the shafts of the bottom wringer rolls engaged by said chains. As shown in the drawings, the shafts of the bottom wringer rolls of adjacent stacks are connected by a multiplicity of short sprocket chain driving connections, each shaft being connected to the next shaft by a separate sprocket driving chain connection, and the connections between adjacent such shafts overlapping the connections between other adjacent such shafts. Thus the shaft **58** is connected by one sprocket chain with the shaft immediately in front, which by another sprocket chain is connected to the shaft in front of it, and said shaft **58** is connected by another sprocket chain to the shaft immediately in rear of it which by another sprocket chain is connected to the next rearward shaft, and so on. The feed roll **18** in front of the machine is driven by the sprocket chain driving connection **61** from the shaft of bottom wringer roll of the foremost stack, and the guide roll **25** at the delivery end of the machine is driven by the sprocket chain drive **62** from the shaft of the lowermost wringer roll of the rearmost stack. It will be apparent that the driving mechanism is such that all the bottom wringer rolls and the feed roll **18** and delivery roll **25** are driven with similar directions of rotation, in this instance clockwise as viewed in Fig. 2, as required in view of the course of the conveyers and the intervening material according to the arrangement embodied in the illustrated machine.

It will be observed that the material undergoing the washing operation, comprising household linen, woolen blankets, garments and various other articles such as are commonly treated in commercial laundries, is held and conveyed through the machine in spread out or flat condition, and in passing through the machine is subjected in rapid succession to a multiplicity of showering operations in alternation with wringing operations, thus effectively cleansing the material. Although the conveyers and intervening materials move relatively slowly, the stacks of rolls and interspersed shower pipes are so closely spaced that the alternating showering operations and wringer roll operations appear in rapid sequence. As the lower wringer rolls and inter-

mediate wringer rolls in intermediate stacks are driven by the rolls on which they bear, the material passing between the various coacting rolls is subjected to wringing operation which involves both a mechanical rubbing and a pressing, which in connection with frequent passing of the washing solution through the material is highly efficacious. The arrangement of the wringer rolls in closely disposed stacks with interspersed multiplicity of shower pipes is of great advantage for efficient washing operation and gives other advantages in compactness and the provision of a large capacity machine without occupancy of an undue amount of floor space. The machine is of a highly practicable type for expeditious washing of large quantities of goods continuously supplied to the machine.

The machine diagrammatically illustrated in Fig. 7 is of the same general construction and mode of operation as the first described machine, though involving a different specific arrangement and additional subject-matter. Like the first described machine, the machine of Fig. 7 comprises a multiplicity of wringer rolls, including plain rolls 9 and rubber covered rolls 10 coacting with plain rolls; a multiplicity of shower pipes 35 interspersed among the wringer rolls; and coacting string conveyers 12 and 13 which carry the material undergoing the washing operation. As in the first machine, the wringer rolls in Fig. 7 are arranged in stacks, the rolls of each stack bearing one upon another, and the rubber covered rolls 10 alternating with the plain rolls 9 in each stack. The bottom rolls of the respective stacks are driven by suitable driving mechanism (not shown) in the manner required for the course of the material through the machine. It will be understood that the showing in Fig. 7 of the coacting wringer rolls and coacting conveyers separated from one another is for the purpose of clearly illustrating the course of travel of the string conveyers and intervening material through the machine, this showing being exaggerated.

The wringer rolls and shower pipes are arranged in Fig. 7 in four groups or sections 63, 64, 65 and 66. The lower conveyer strings pass under the machine and are led upwardly around the guide roll 15 at the front end of the receiving table and pass over the table and between the coacting feed rolls 17 and 18, while the upper conveyer strings passing over the top of the machine are led downwardly under the guide roll 17. The coacting conveyer strings with the intervening launderable material pass in the manner shown through the first section 63 of the machine and then from the wringer roll 10e to and around the guide roll 67, and then through the second section 64 of the machine in the manner shown, and then through the third section 65 in the manner shown, and then around the guide roll 68 and through the last section 66 of the machine in the manner shown. The conveyers and intervening material then pass out between the rolls 69 and 70, where the conveyers diverge, the upper conveyer strings passing upwardly and over the machine and the lower conveyer strings passing rearwardly over to and around the guide roll 25 and then under the machine. The upper conveyer strings run over the machine in engagement with the several guide rollers 71 and are tensioned at the front and rear ends of the machine by the tensioning mechanisms 72, these tensioning mechanisms being of the same character as those described with reference to the machine of Figs. 1 to 6. The lower conveyer strings pass under the machine in engagement with the guide rollers 72 and are tensioned by the tensioning mechanism 73 of the same character as the tensioning mechanism for the lower strings in the first described machine. The wringer rolls may be driven by driving mechanism of substantially the same character as that previously described except that the bottom wringer rolls in the two upper sections 64 and 65 will need to be driven by sprocket chains from the shaft or shafts of one or more of the bottom wringer rolls in the lower sections 63 and 66. Under the several sections of the machine are pans 74, 75, 76 and 77 for catching the water showered through the material in the respective sections. Associated with the respective sections are tanks 78, 79, 80 and 81 for different washing liquids, and pumps 82, 83, 84 and 85 which pump the respective liquids through suitable pipe systems to the shower pipes in the respective sections of the machine. The liquid caught in the several pans 74, 75, 76 and 77 discharge into the respective tanks 78, 79, 80 and 81. The tank 79 from which liquid is supplied to the third section 65 of the machine is arranged at a higher elevation than the tank 78 which supplies liquid to the second section 64 of the machine, and liquid may flow from the tank 79 to the tank 78 through the pipe 86, while liquid may flow from the tank 78 through the pipe 87 to the tank 80 which supplies liquid to the first section 63 of the machine. The pipes 86 and 87 are preferably equipped with suitable shut off valves, and the tanks 80 and 81 are preferably equipped with normally closed drain valves 88. Various liquids such as hot water, cold water, liquid soap, bleaching solution, bluing solution and the like may be supplied to the various tanks 78, 79, 80 and 81 by valved supply piping not shown. With this arrangement the clothes passing through the first section may be treated principally with the water recovered from the second and third sections 64 and 65, the shower pipes in the first section 63 being supplied with liquid from the tank 80 which liquid is principally supplied from the superposed tank 78 through the pipe 87. The material passing through the second section 64 of the machine may be treated largely or principally with liquid recovered from the third section 65, the shower pipes in the second section 64 being supplied with liquid from the tank 68 which derives liquid from the tank 79 through the pipe 76. In the last section 66 of the machine the material may be treated with cleaner liquid or solution supplied from the tank 81.

While in Fig. 1 the conveying means are arranged to pass back and forth through the entire length of the machine in the specific manner shown and hereinbefore described, it will be understood that the course of the conveying means through the machine may be variously arranged to suit requirements. For example, the conveying means may be arranged to pass back and forth through the stacks of wringer rolls in only a portion of the machine, in which a washing operation is performed with one solution, and then back and forth through the stacks of wringer rolls of a succeeding portion of the machine in which a succeeding operation is performed with another solution, as will be apparent in connection with the description hereinbefore given with reference to Fig. 9.

It is contemplated that a plurality of machines such as shown in Fig. 1, or of the type shown in

Fig. 1, may be used for performing a succession of washing or treating operations with different fluids; the conveying means of each machine or unit being arranged to deliver the material to the conveying means of the next machine or unit, or a single conveying means comprising coacting string conveyers 12 and 13 being threaded in succession through the different machines or units.

For example, Fig. 8 is a diagram representing an elaborated washing machine comprising in this instance six units I, II, III, IV, V, VI in which different washing and treating operations are performed; successive washings of the material with different solutions being performed as the material passes successively through the first four units, and the usual souring operation being performed in the fifth unit, and bluing and wringing operations being performed in the last unit. Each of these units may be assumed to be, for example, substantially the same as shown in Fig. 1 with respect to the series of stacks of wringer rolls and interspersed shower pipes, and each unit may be supplied with liquid for showering from a separate source of supply.

Assuming that the material is carried through the several units of Fig. 8 by a single conveying means, comprising coacting string conveyers 12 and 13 as already described, the course of the conveying means may be various; for example the conveying means may carry the material successively through the units I, II, III, IV, V, VI in the order named, or it may carry the material successively through the units I, IV, II, III, VI, V in the order last named, and in each unit the conveying means may carry the material back and forth through the stacks of wringer rolls of only a portion of the unit and then back and forth through the stacks of wringer rolls of a succeeding portion of the unit, according to the washing and treating operations desired.

In Fig. 8 it is assumed, for example, that the conveying means carries the material successively through the first four units I, II, III, IV in the manner indicated in Fig. 7, and thence through the last two units V and VI in the manner indicated in Fig. 9. As shown in Fig. 9, the conveying means comprising coacting string conveyers 12 and 13 pass from the unit 4 into the unit 5 and back and forth through the stacks of wringer rolls of the unit V in the same manner as in Fig. 1, and thence from the last roll 10^c of the unit V to and around a guide roll 89 and then back and forth through the stacks of wringer rolls of the first half of the unit VI and then downwardly as indicated at 90 and back and forth through the stacks of wringer rolls of the second half of the unit VI and then out from the machine, the conveyer strings 13 passing around the guide roll 91 and upwardly, and the conveyer strings 12 passing around the guide roll 92 and downwardly, the respective sets of conveyer strings being returned in engagement with suitable guide rolls and tensioning rolls not shown for reentry into the first unit I of the machine.

Different solutions are supplied to the shower pipes 35 in the unit V and in the two halves of the unit VI. The liquid supply pipes 37 of the unit V are supplied with liquid from a manifold pipe 42. The liquid supply pipes for the first half of the unit VI are supplied with liquid from the manifold pipe 42^a, and the liquid supply system for the second half of the unit VI are supplied with liquid from the manifold pipe 42^b. As the material undergoing the washing operation passes through the unit V, it may be subjected to a rinsing operation by showering the material with clean water supplied under pressure from the manifold pipe 42. As the material passes through the first half of the unit VI, it may be subjected to the ordinary souring operation by showering it in alternation with the pressing operations with suitable souring fluid supplied by the manifold pipe 42^b; and as the material passes through the second half of the unit VI it may be subjected to a bluing operation by showering it in alternation with the pressing operations with clean liquid containing bluing solution.

Under each of the units V and VI and also under each unit of the machine of Fig. 8, there is provided a drip pan 47, as already explained with reference to Fig. 1. The drip pan of the unit VI may be medially divided by baffle plate 93 so as to keep separate the two kinds of liquid recovered from the operations performed in the two halves of said unit VI.

It will be observed that the arrangement of the shower pipes in the second half of the unit VI is the same as in the first half, except that the topmost horizontal row of shower pipes is omitted in the second half, there being no shower pipes between the topmost tier of wringer rolls 10^e; thus enabling the said topmost wringer rolls 10^e and the immediately subjacent rolls 9 with which they coact to be utilized merely as wringer rolls. The rolls 10^e may be spring pressed against the rolls 9 on which they bear by means, such for example as shown in Fig. 10. As already explained, the journals of the rolls are mounted in axle boxes 7 which slide in the guides provided by the angle bars 6. The axle boxes 7 for the rolls 10^e and the immediately subjacent rolls 9 may be slightly extended, and the axle boxes for said rolls 9 may have stirrups 97 attached thereto slidably embracing the axle boxes for the rolls 10^e, and compression springs 97 may be interposed between the axle boxes for the rolls 10^e and followers 96 engaged by adjusting screws 95 attached through the upper ends of the stirrups; whereby the said rolls 10^e may bear with adjusted spring pressure upon the immediately subjacent rolls 9.

The details of construction and arrangement of the illustrative machines may be variously modified to suit different conditions and requirements, and various features of the invention may be advantageously used in various different combinations and subcombinations.

What I claim as my invention, and desire to secure by Letters Patent, is:

1. A washing machine comprising a multiplicity of wringer rolls arranged in a series of stacks, each roll engaging the adjacent roll in surface contact, a pair of coacting string conveyers which with intervening launderable material in flat state pass back and forth through said series of stacks in a series of superposed runs, the several runs being through different bites of coacting rolls of said stacks, and a multiplicity of means for showering washing solution against the material in alternation with the passing of the material between wringer rolls.

2. In a washing machine, a series of roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being power driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of coacting string conveyers which with

intervening launderable material in flat state pass back and forth through the series stacks in a series of superposed runs, the different runs being between different pairs of coacting rolls of said stacks, and a multiplicity of shower pipes distributed between said stacks and between different runs of the material.

3. A machine having side frames comprising longitudinal top and bottom rails, a series of wringer roll stacks supported between said frames, each stack comprising a power-driven bottom roll and a superposed series of rolls supported thereon and each bearing on the roll beneath it, the bottom rolls of said stacks having bearing boxes supported on said bottom rails, spaced, vertical angle bars connecting said top and bottom rails, said angle bars arranged to provide vertical guides, and boxes vertically slidable in said guides in which are journaled the roll shafts of the rolls above the bottom rolls.

4. A washing machine comprising a plurality of series of wringer roll stacks, each stack comprising a series of wringer rolls bearing one on another, the bottom rolls of each series of stacks being driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of endless open work conveyers which with intervening launderable material in flat state travel successively through the several series of stacks and back and forth through each series in a series of superposed runs, groups of shower pipes associated with the respective series of stacks, each group comprising a multiplicity of shower pipes distributed between the stacks and runs of material therethrough of the series with which such group is associated, and liquid supplying systems for supplying different washing liquids to the different groups of shower pipes.

5. A washing machine comprising a series of wringer roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of endless open work conveyers which with intervening launderable material in flat state pass back and forth through a group of said stacks in a series of superposed runs and then pass back and forth through another group of said stacks in another series of superposed runs, a multiplicity of shower pipes distributed between said stacks and between the runs of the material, and liquid supplying systems for supplying different liquids to the groups of shower pipes associated with the respective series of superposed runs of said material.

6. A washing machine comprising a series of wringer roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being power driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of endless open work conveyers which with intervening, launderable material in flat state travel back and forth through a group of said stacks in a series of superposed runs and in a course of travel upwardly from the lowermost run and then, from the topmost run of said group, downwardly and then back and forth through another group of said stacks in another series of superposed runs and in a course of travel upwardly from the lowermost run in said second group, a multiplicity of shower pipes distributed between said stacks and between the runs of said material, and liquid supply systems for supplying different liquids to the shower pipes associated with the respective series of superposed runs of said material.

7. A washing machine comprising a multiplicity of wringer rolls arranged in a series of stacks, each stack comprising a series of such rolls bearing one on another, the bottom rolls of said stacks being power driven and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of coacting endless open work conveyers which with intervening launderable material in flat state travel repeatedly through said stacks between different rolls thereof and alternately back and forth through different stacks, whereby the material is supported in a series of superposed runs in spaces between adjacent stacks, and a multiplicity of shower pipes distributed between said stacks and between said runs for showering washing liquid against said material.

8. A washing machine comprising a series of closely spaced wringer roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being power driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, means for conveying launderable material in flat state and substantially unobstructed on both sides back and forth through said series of stacks in a series of superposed runs, the several runs being between different pairs of coacting rolls of the several stacks, and a multiplicity of shower pipes distributed between said stacks and between said runs for showering washing liquid against said material.

9. A washing machine comprising a series of wringer roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being power driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of endless open work conveyers which with intervening launderable material in flat state pass back and forth through said series of stacks in a series of superposed runs, the several runs being between different pairs of coacting rolls of the several stacks, and a multiplicity of shower pipes distributed between said stacks and between said runs for showering washing liquid against said material.

10. A washing machine comprising a series of wringer roll stacks, each stack comprising a series of rolls bearing one on another, the bottom rolls of said stacks being driven in the same direction and the other rolls being frictionally driven each by coaction with the roll on which it bears, a pair of endless open work conveyers which with intervening launderable material in flat state pass back and forth through a group of said stacks in a series of superposed runs and then pass back and forth through another group of said stacks in another series of superposed runs, and a multiplicity of shower pipes distributed between said stacks and between the runs of the material for showering washing liquid against the material.

GEORGE E. DAVIES.