

Oct. 17, 1967

A. S. KLAUSNER  
WASHING MACHINE OR THE LIKE WITH ADJUSTABLE  
PROGRAMMING CONTROLS

3,347,066

Filed Sept. 15, 1966

4 Sheets-Sheet 1

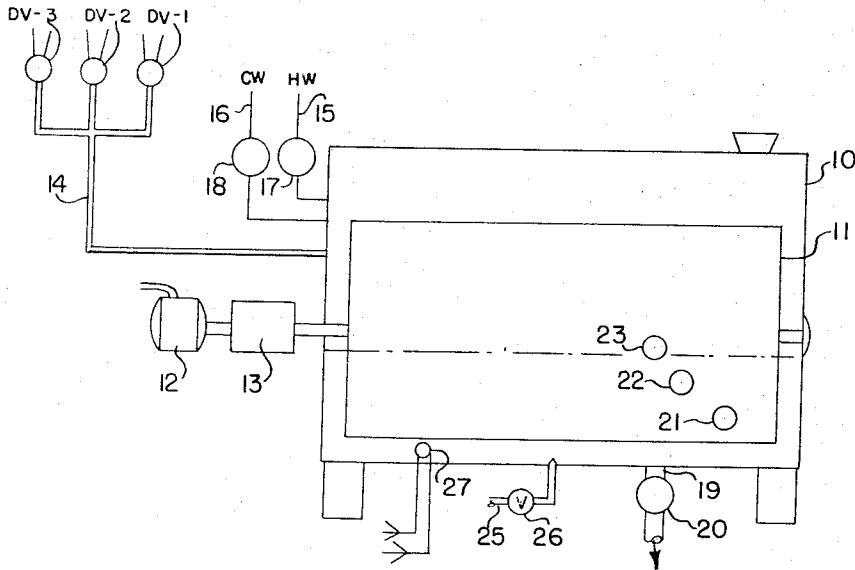


FIG. 1

INVENTOR  
ALVIN S. KLAUSNER

BY

*Ely and Gohick*

ATTORNEYS

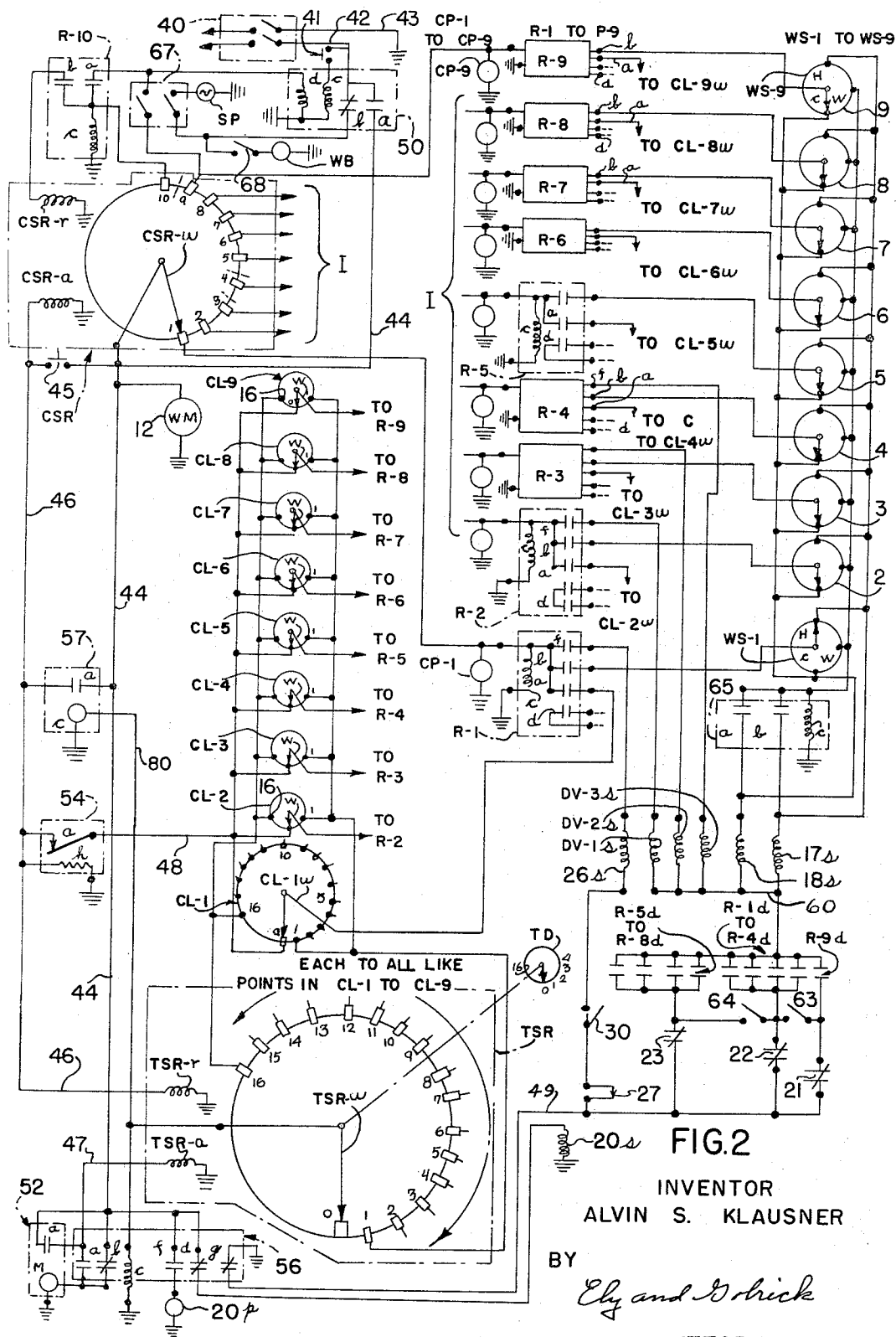
Oct. 17, 1967

A. S. KLAUSNER  
WASHING MACHINE OR THE LIKE WITH ADJUSTABLE  
PROGRAMMING CONTROLS

3,347,066

Filed Sept. 15, 1966

4 Sheets-Sheet 2



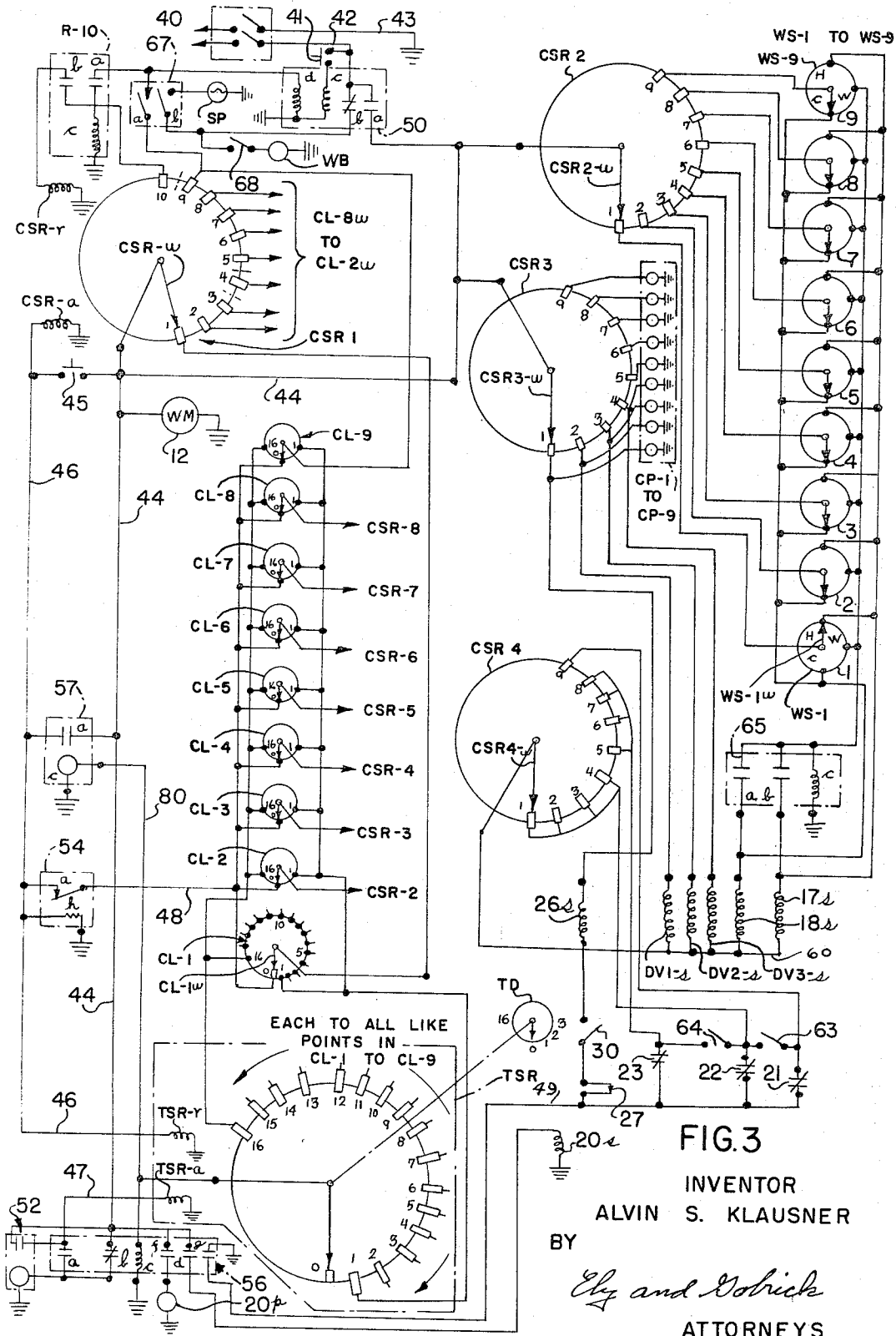
Oct. 17, 1967

A. S. KLAUSNER  
WASHING MACHINE OR THE LIKE WITH ADJUSTABLE  
PROGRAMMING CONTROLS

3,347,066

Filed Sept. 15, 1966

4 Sheets-Sheet 3



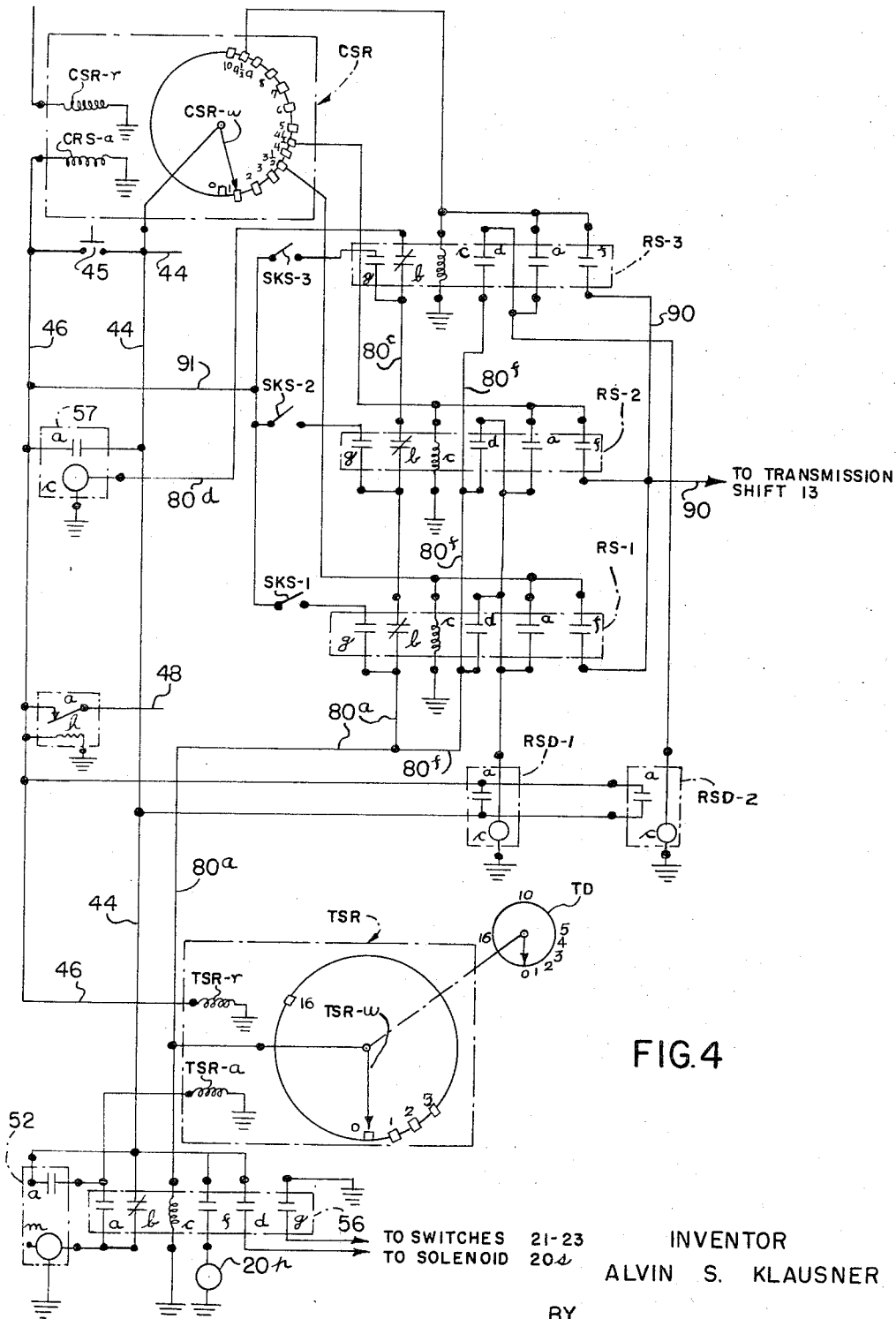
Oct. 17, 1967

A. S. KLAUSNER  
WASHING MACHINE OR THE LIKE WITH ADJUSTABLE  
PROGRAMMING CONTROLS

3,347,066

Filed Sept. 15, 1966

4 Sheets-Sheet 4



INVENTOR  
ALVIN S. KLAUSNER  
BY  
*Ely and Dobrick*  
ATTORNEYS

1

3,347,066

WASHING MACHINE OR THE LIKE WITH  
ADJUSTABLE PROGRAMMING CONTROLSAlvin S. Klausner, 14465 Summerfield Drive,  
Cleveland, Ohio 44118

Filed Sept. 15, 1966, Ser. No. 579,719

12 Claims. (Cl. 68—12)

The present invention relates generally to a washing machine or like apparatus, and more particularly to such machine in which is automatically carried out a succession of distinct operations, and specifically to improved controls for the automatic operation of such machine.

Hitherto, in the art relating to apparatus for automatically carrying out a sequence of operations, as in the washing or cleaning of clothes, fabrics or other articles, a great diversity of machines has been commercially developed or proposed in the patented art, including as well controls whereby the duration of one or more of the operational cycles in an automatic sequence or overall cycle of operation may be selectively varied or skipped by a pre-setting of controls at the time the general operation or overall cycle is initiated.

However, as far as known to the present inventor such prior proposals have entailed disadvantages in the complexity and cost of the controls for a given degree of flexibility of overall operation; or in affording only a relatively limited flexibility or selectivity in varying the overall operation or the individual cycle durations of the apparatus; or in unreliability of operation; or in inconvenience of procedures or means required to set up a desired program of operation.

Accordingly it is the general object of the present invention to provide, in a washing or cleaning machine or like apparatus especially for commercial operations, adjustable programming controls which will afford in convenient fashion a high degree of flexibility of overall operation especially in pre-selection of durations for individual operational cycles thereof.

A further and more particular object is to provide in controls for apparatus for the type described means for obtaining a widely variable duration of individual operating cycles. A still further object is the provision of means for obtaining such wide variability of individual cycles which are readily pre-set, quickly changed, and involve relatively inexpensive components.

Other objects and advantages and a specific embodiment of the invention will appear in the following description and the drawings wherein:

FIG. 1 is a generalized representation of a commercial washing or laundry machine with which the present invention is associated;

FIG. 2 is a schematic diagram of the controls for one embodiment of the invention not affording extraction or spin cycles;

FIG. 3 is a schematic diagram of the controls for a second embodiment;

FIG. 4 is a schematic diagram of additions to the controls of FIGS. 2 or 3 to provide spin cycles.

In the drawings the invention is shown and in the following specification is described as applied to an apparatus such as a commercial washing machine, presented by a generalized outline in FIG. 1 as comprised of a closed vessel 10 and rotatably mounted therein with access through a suitable vessel door, a laundry batch receiving drum 11 driven by an electric motor 12 including motor starting circuitry through suitable belting or gearing type transmission means 13. To this vessel may be supplied selectively at cycles 2, 3, 4 detergent, bleach or sour by line 14, and water by hot and cold supply lines 15, 16 having respective solenoidally-operated water valves 17,

2

18; and the vessel having a dumping or drainage bottom outlet 19 opened by a solenoidally-operated dump valve 20 herein assumed to be a normally-open type valve.

Solenoidally-operated feed and control means for releasing detergent, bleach or sour compositions to the vessel 10 are represented here by solenoidally opened dispensing valves DV-1, DV-2, DV-3; though the dispensing means could be manually charged containers solenoidally tipped or water valved flushed, or automatic dispensers.

Appropriately mounted on the vessel 10 are three normally-closed water level switches 21, 22, 23 respectively low, medium and high water level switches. Further there is provided steam supply line 25 with normally-closed, solenoidally-opened or actuated steam control valve 26, whereby steam may be injected directly through a nozzle into water contained in the vessel for obtaining higher temperatures than would normally be desired to be maintained for the hot water supplied to line 15; the steam supply also under control of a thermostat switch 27 appropriately located in the vessel 10, preferably adjustable for desired extra-hot water temperature.

For consideration of the controls of FIGS. 2 and 3, the washer drum driving motor, therefore the drum, is assumed to be a type continuously rotating once the overall cycle of operations on a batch is begun, rather than including appropriate electric means for turning off the motor, or with the motor left running, for interrupting the transmission of motion from the motor to the drum, for example, during the time of dumping of liquids between cycles. However, for consideration of FIG. 4, providing extraction or spin cycles, the washer mechanism is deemed to provide not only a normal drum speed, but also a high spin speed; achievable by use of a two speed motor or, as here taken to be the case, transmission means 13 responding to a signal from spin controls to shift to a high speed setting upon energization of a shift solenoid with return to normal speed setting upon termination of such signal.

In the embodiments of the invention as represented in FIGS. 2 and 3 provision is made for nine distinct cycles of operation, each of adjustable selectable length, such operations as washing, bleaching, souring, rinsing, with a terminal cycle option available for an operation such as starching; while the modification of either of these represented by FIG. 4 spin cycles are provided. The invention provides for selection and programming of operational cycles and conditions by settings of certain components mounted on a suitably located control panel.

**Control panel.**—On or at a suitably located and accessible control panel, in addition to a normally-open push-button start switch 41, controlling initial application of electrical power to the apparatus and its control system from the power main lines 42 and 43, the latter being grounded in the system, there are provided in addition to the hereinafter variously named pilot lights and "batch finish" or "Add Starch" warning bell, a 2-pole, double-throw panel toggle switch 67 to render operative "Add Starch" warning pilot SP and cycle 9 interruption; a warning bell cut-off panel toggle switch 68; a normally-open push-button cycle advance switch 45 for manual rather than automatic advance of the hereinafter described cycle stepping relay CSR; a bank of nine manually-set, three-position (H—hot, C—cold, W—warm) water temperature selector switches WS-1 to WS-9 inclusive for selecting the water valve or valves to be turned on for each cycle's fill; a high-heat panel switch 30 for using added steam heating on cycle 1 is desired; and a bank of nine, manually-set multi position cycle length selector switches CL-1 to CL-9, inclusive, each including a skip contact 0 for skipping of a particular operation, followed by successive time duration contacts shown as 1 to 16 for increasing cycle duration in unit increments,

conveniently of 1 minute, with respective dials marked to show selected or desired length of a respective cycle duration of operation.

Conveniently the cycle pilot lamps CP-1 to CP-9 inclusive are adjacent respective switches CL-1 to CL-9, to indicate the cycle in progress at any time. Also to allow use in cycle 9 of a medium rather than lower water level usual for starching, the panel push-button switch 63 is provided; and a similar switch 64 to allow use of a high level for cycles 1-4 inclusive, usually wash cycles, rather than the normal medium level. Further on the panel there is preferably provided an indicator dial TD connected with the wiper arm shaft of time stepping relay TSR to show the current time interval of a cycle in progress.

*General organization of controls.*—In the drawings, the contacts or coils of a given non-stepping relay are generally designated by bare lower case letters, but in this description each will be referred to by the legend of the relay as a whole with the respective letter suffixed; thus as to relay R-1 with coil designated c and the contacts a, b, d, f, the references herein will be to relay coil or solenoid R-1c and contacts R-1a, R-1b, etc.; and similarly the merely numbered contacts or wiper arms in stepping relays TSR and CSR as contacts TSR-1, TSR-2, etc., CSR-1, etc., and for cycle selector switch numbers contacts or arms, e.g., CL-1-0, CL-1-1, etc. At times an unspecified one of a group of similar or identical components, or the group itself will be referred to by the reference letters common to that group without numerical suffix.

Basically the control circuit includes:

- (I) The interlocking relay 50 with normally-open and normally-closed contacts 50a, 50b moved to non-normal condition upon energization of its "on" solenoid coil 50c by closure of the start push-button switch 41 in series therewith between ground and the main line 42 thereby to put power on in the controlled power line 44 and maintain it on for the major period of operations, until 50a is re-opened (and 50b re-closed) by interlock "off" solenoid 50d energized upon CSR reaching position 9 before cycle 9 starts when 67 is on, and in any event upon CSR reaching position 10;
- (II) Cycle length selector multi-position rotary switches CL-1 to CL-9;
- (III) Water temperature selector three-position switches WS-1 to WS-9 selecting the hot, or cold water valve opening solenoids to be energized on each cycle;
- (IV) Water level control switches 21, 22, 23;
- (V) A dump control relay 56;
- (VI) Means including a ten-position cycle stepping relay CSR, effective at each of its positions 1-9 to apply power to the selector arm of a respective one of the multi-position cycle duration selector-switches CL-1 to CL-9 inclusive, and simultaneously apply potential or power to the selector arm of one of the water temperature selector switches WS-1 to WS-9 inclusive for operation of the water control solenoidal valves 17, 18 under control of a selected one of the water level switches 21, 22, 23, and in the case of position 1 also to the steam valve 26, and for positions 2-4 to dispensing valve solenoids DV-1s, DV-2s, DV-3s, and at position 10 to terminate operations;
- (VII) A time stepping relay TSR with each of its fixed contacts commonly connected to corresponding numbered contacts in each of the cycle length selector switches CL-1 to CL-9, whereby for each successive cycle as the wiper arm TSR-w arrives at the contact of the same interval number as the setting of the CL switch for that cycle, marking the cycle end, the power available at the corresponding cycle length selector switch arm is effective on arm TSR-w, therefore line 80, to initiate dumping of the vessel 10 by

- causing valve 20 to open (no dump on skip) and after a time delay sufficient for dumping to cause resetting of the time stepping relay with advance of the cycle stepping relay CSR to begin a new cycle;
- (VIII) A timer unit 52 producing timing pulses used to advance the time stepping relay TSR to its successive positions at constant increments of time in an operational cycle until a signal at 80 produced upon TSR-w reaching a contact marking the cycle end interrupts timer 52 during dumping;
- (IX) An adjustable interval delay timer 57 taking over to time application of power from line 44 to line 46 for resetting TSR and advancing CSR.

Provision is also made for a skip of any cycle by a setting on the contact 0 of the corresponding CL switch, causing skip flasher relay 54 to apply power to the TSR reset and CSR advance line 46.

Since the normally-open push-button advance switch 45 is connected between the controlled internal power line 44 and the line 46, its closure not only energizes the reset coil TSR-r of the time stepping relay but also the cycle stepping relay advance coil CSR-a.

For clarity in the drawings the following simplifications are used:

- (a) In the single-throw relays R-1 to R-9 inclusive, since the 4-pole relays R-3 and R-4 (all normally-open contacts) are identical with R-2 and R-1, and the 3-pole relays R-6 to R-9 (all normally-open contacts) are identical with R-5, and these groups are similarly connected to corresponding respective components only the internal coil and contact elements of R-1, R-2 and R-5 are shown, but the internal element reference letters are applied to terminals.
- (b) In the identical cycle duration selector switches CL-1 to CL-9 inclusive, only the connections of the contacts for the skip position, 1 position (one minute cycle) and 16 position (16 minute cycle) respectively to flasher relay heater and normally-open contacts 54a, to TSR contact 1, and to TSR contact 16 are shown in full.
- (c) One set of normally-open contacts in each R-1 to R-9 inclusive is represented at the general relay showing, with no indicated connections, but also with proper connections in proximity to the water level switches 21, 22, 23.

*Cycle stepping relay.*—CSR in FIG. 2 is a rotary type single bank switch with wiper arm CSR-w advanced stepwise from an initial contact 1 position to successive contacts, immediately upon each respective successive energization of its advance coil CSR-a, and immediately reset from any position back to initial position by an energization of its reset coil CSR-r. Ten contacts are used in FIG. 2, but thirteen in FIG. 4.

At each position it applies power to the several means establishing selected functions or operations for a corresponding cycle, indirectly in FIG. 2 through R-1 to R-9. In FIG. 3, hereinafter described, the operation of the four bank type CSR is similar.

*Time stepping relay.*—TSR is again a rotary type single bank switch with wiper arm TSR-w advanced stepwise from a zero position (at a non-used or no-contact position) to successive, contacts of which sixteen are here used, immediately upon each respective successive energization of its advance coil TSR-a, with immediate reset to zero position from any position by energization of reset coil TSR-r.

*Dump valve relay.*—It may be here noted that the solenoid 20s of the normally-open dump valve 20 is energized through the normally-closed contacts 56d of the dump relay as long as the dump relay coil 56c thereof is not energized, and further that upon energization of the dump relay coil 56c at the end of a cycle, not only are the normally-closed contacts 56d opened to de-energize

and open the dump valve, but also that normally-open pilot lamp contacts 56f close lighting the dump pilot 20p.

**Timer circuits.**—The internal power line 44, to which the power is applied from 42 with interlocking relay contacts 50a closed upon closure of start switch 41 to energize its coil 50c, thereafter puts power not only on the selector arm CSR-*w* of the cycle stepping relay CSR, on the normally open push-button manual cycle advance switch 45, and on the washer motor 12 or a starter device therefor, but also the normally-closed contacts 56b of the 4-pole, double-throw dump relay 56 and to the motor 52m of the timer device 52 including normally-open microswitch timing contacts 52a cam-closed by the time motor at one minute intervals thereby to apply power through line 47 to pulse or energize the advance coil TSR-*a* of the timer stepper relay for a one-step or one-position advance upon each closure or pulse from 52a, also making such power available at the normally-open contacts 56a of the dump relay 56. The latter contacts serve briefly to maintain power on motor 52m, at such time as TSR marks the end of a cycle energizing R-56 despite attendant opening of 56b, until the timer motor 52m moves the cam crest to a point where 52a contacts open de-energizing TSR-*a*, ensuring that no spurious pulse will be applied to TSR at the start of any subsequent cycle.

The movable time stepping relay contact or wiper arm TSR-*w* is connected both to the dump relay solenoids 56c and also to the actuating component or timing cam driving motor 57c of a timer delay relay 57 having normally-open contacts interposed between the line 44 and to a controlled line 46 connected to both the cycle stepping relay advance coil CSR-*a* and the time stepping relay reset coil TSR-*r* so that when the latter reaches a contact marking the end of the cycle the auxiliary timer 57 begins to time a period allotted for dumping (e.g., 1 minute, usually sufficient, but 57 adjustable) upon the end of which closing 57a powers line 46 to energize TSR-*r* and CSR-*a* to start the next cycle or the shut off operations.

**Skip circuit.**—Line 46 is connected to line 48 commonly connected to all cycle length selector switch initial or skip position contacts 0, so that with power put on line 48 by CSR arriving at a contact for a switch CL set at skip, a skip advance of CSR ensues. To ensure proper skip action, especially where CSR is immediately advanced upon power application to CSR-*a* but requiring a certain brief time of deenergization of CSR-*a* before a next power or pulse application can be effective, here 48 is connected to 46 by normally-closed contacts 54a of a flasher relay 54 with grounded timing-heater 54h also connected to 46. If CSR-*w* arrives at a contact at which skip should occur, with consequent re-energization of CSR-*a* without a sufficient deenergization interval, heater 54h opens contacts 54a, the reclosing delay providing the necessary interval before application of power to CSR-*a* from 48, upon which then skip occurs.

**Cycle relays.**—In FIG. 2 the aforesaid means, for making power available at each of the selector switches for a respective cycle of operation and also providing power for other elements controlled during that cycle, includes the above described cycle stepping relay having in addition to its advance coil CSR-*a* also a reset coil CSR-*r*, whereby after attaining its last position in a completely automatic sequence, (either position 10 where cycle 9 is not used for starching or other unusual operation in the terminal cycle, or position 9 where the automatic sequence is to be interrupted before the cycle 9 operation is carried out), CSR is reset to its starting position, position 1, for the first cycle of operation in the next automatic sequence cycle.

For each such cycle there is provided a respective one of the relays R-1 to R-9, having both its relay solenoid coil and also the commonly connected sides of all but contacts *d* connected to a corresponding fixed contact of

CSR; with a corresponding one of the pilot lights CP-1 to CP-9 on the control panel, preferably immediately associated with a corresponding one of the cycle length selector switches. Each of the cycle relays has a first pair of its normally-open contacts connected to the selector switch arm of the corresponding cycle length switch, as contacts R-1a connected to the wiper arm CL-1w; a second normally-open contact pair connected to the selector arm of a respective one of the water temperature selecting switches WS-1 to WS-9 inclusive, such as contacts R-1b connected to the arm of WS-1; and a third normally-open contact pair, the *d* contacts as a water level selecting switch connected to one of the water level control switches as hereinafter described.

**Water level control.**—These *d* contacts of cycle relays R-1 to R-9 are in fact also separately shown in the lower right portion of the diagram in FIG. 2, comprising the parallel group R-1d to R-4d, the parallel group R-5d to R-8d, and the single R-9d connected in series respectively with the normally-closed single throw water level switches 22, 23 and 21, between lines 60 and 49.

The R-9d contacts pair is also connectable selectively by an off-on control panel switch 63 to the low level switch 21; and in similar manner the second group of contacts R-1d to R-4d inclusive through a like on-off panel switch 64 to the medium water level switch 22, whereby for the cycles 1 to 4 inclusive there is selectively available either a medium or a high water level for operation, and for the last cycle or number 9 cycle selectively either a low level or a medium water level by use of switch 63, or conceivably a high level with 63 and 64 on; but for cycles 5-8 only a high water level.

**High heat-steam valve control.**—The relays R-1 to R-4 inclusive have a fourth set of normally-open contacts *f*, of which R-1f are connected in series with the washer thermostat switch 27, the steam valve solenoid 26c, and preferably an on-off control panel switch 30, for example, connected to the common control line 49 connected to ground through the normally-closed dump relay contacts 56g, primarily the latter contacts for removing control of any water flow from the respective level switches during a dumping period. Thus position contact 1 of CSR is a source of power for the steam valve solenoid.

**Dispensing device control.**—In relays R-2, R-3, R-4, the fourth contact pairs R-2f, R-3f, R-4f are connected to the dispensing valve or dispersive device solenoids DV-1s, DV-2s, DV-3s, and the other sides of the dispensing solenoids being connected, commonly with one side each of the hot water valve and cold water valve solenoids 17s, 18s, by the line 60 to one side each of the normally-open switches or normally-open contact pairs R-1d to R-9d inclusive so that dispensing solenoid operation is also potentially subject to water level switch control.

**Cycle water temperature selection.**—In the three-position water temperature selector switches WS-1 to WS-9 inclusive all contacts C, representing the cold water selection position of each, are commonly connected to one side of the cold water valve solenoid 18s; similarly all contacts H, corresponding to the hot water selection, are commonly connected to one side of the hot water valve solenoid 17s; while the intermediate contacts W, for warm water, are commonly connected both to the warm water relay coil 65c and to the normally-open contact pairs 65a and 65b respectively connected also to the hot water and cold water valve solenoid coils 17s and 18s. Hence, when any of cycle relays R-1 to R-9 is energized, line 44 power applied to the arm of a corresponding WS switch will, according to the setting of the latter, either directly energize one of the hot or cold water valve solenoids 17s or 18s to fill the washer with hot or cold water, or indirectly by energizing warm water relay coil 65c, closing normally-open contacts 65a and 65b, to open both hot and

cold valves; the filling terminated by opening of the effective level switch.

*Interlock relay, warning, and terminal cycle functions.*—Returning to the interlocking relay, the "off" coil 50d thereof, whereby the same has its contacts returned to "normal" conditions, is connectable through the contacts 67a of the 2-pole, single-throw panel switch 67 to the contact CSR-9 and also to contact CSR-10 by normally-open contacts R-10a of a further relay R-10 with coil R-10c also connected to contact CSR-10, and also having normally-open contacts R-10b connecting contact CSR-10 to the cycle stepping relay reset coil CSR-r.

For a separately handled or special terminal cycle operation such as starching, there is a still further, selectably usable, warning circuit for lighting an "Add Starch" pilot lamp SP or sounding an audible signal by bell WB, which either or both are connectable respectively by contacts 67b of panel switch 67 and bell panel switch 68 in series with the normally-closed interlocking relay contacts 50b and thereby to the line 42 when the interlocking relay is set to "off" position.

*Operation.*—With the form of control circuit shown in FIG. 2, by way of example of operation, assume a desired overall program for which the following tabulation sets forth the operation cycle number, the duration of the operation or a desired skip, and the third column the settings required.

It is assumed here that the normal hot water supply temperature is 140° F. and that the thermostat switch 27 is set to open at 160° F., and master switch 40 is on.

| Number | Operation and Conditions                                                          | Settings Required                                                                    |
|--------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1----- | 160° F. hot soak; 10 minutes; Medium level.                                       | Switch 30 on; thermostat 27 set 160° F.; WS-1 on H; CL-1 on 10; 64 off.              |
| 2----- | 140° F. detergent wash; 15 minutes; Medium level.                                 | CL-2 on 15; WS-2 on H.                                                               |
| 3----- | Hot water wash, detergent; 5 minutes; Medium level.                               | CL-3 on 5; WS-3 on H.                                                                |
| 4----- | Warm bleach; 10 minutes; Medium level.                                            | CL-4 on 10; WS-4 on W, warm.                                                         |
| 5----- | Warm water rinse; 2 minutes; High level.                                          | CL-5 on 2; WS-5 on W.                                                                |
| 6----- | Warm water rinse; 5 minutes; High level.                                          | CL-6 on 5; WS-6 on W.                                                                |
| 7----- | Hot water rinse; 5 minutes; High level.                                           | CL-7 on 5; WS-7 on H.                                                                |
| 8----- | Skip.                                                                             | CL-8 on 0.                                                                           |
| 9----- | Starch; with bell and "Add Starch" pilot light warning; 10 minutes; Medium level. | CL-9 on 10; switch 63 "on"; (Switches 67 and 68 set "on" immediately after "start"). |

With all the settings indicated in the third column initially set up at the control panel, and the necessary detergent available at the charging points controlled by DV-1 and DV-2, and necessary bleach at that controlled by DV-3, after the washer is loaded, pushing the panel start push-button 41 (whereafter the switches 67 and 68 are turned on) energizes the interlocking relay coil 50c, opening contacts 50b and closing contacts 50a to apply power to line 44; which immediately through the arm CSR on its initial or reset position 1 provides function power, starts washer motor 12 for drum rotation; energizes 20s through normally-closed dump relay contacts 56d to close the dump valve 20, and also operates the timer device 52 through normally-closed contacts 56b.

The power applied at contact CSR-1 turns on pilot light CP-1 and energizes relay coil R-1c closing the several contacts of R-1, applying power through WS-1 on H energizing 17s to open the hot water valve and fill vessel 10 as permitted by now closed contacts R-1d until normally-closed medium level switch 22 opens to de-energize the hot water valve solenoid 17s and thereby cut off water.

The high heat panel switch 30 being set at "on," contacts R-1f energize the steam-valve-opening solenoid 26s supplying line steam until the water reaches 160° F. to open thermo-switch 27 and cut off steam.

As the timer 52 operates at the assumed 1 r.p.m., cam-

closing microswitch 52a at one minute intervals to energize coil TSR-a from line 44 power through line 47, arm TSR-w steps correspondingly from its zero or reset position through position 9 without any control action change, since power is available in cycle 1 only at CL-1, and that at contact 10. The tenth closing of 52a, advancing TSR-w to position 10 and marking the end of the selected time for cycle 1 wash, results in power application by TSR-w to line 80; whereby the dumping relay coil 56c is energized and so also the time delay relay motor or operating device 57c.

This results in an immediate opening of normally-closed contacts 56d de-energizing the dump valve solenoid 20s to open the dump valve 20, also closing normally-open dump valve pilot contacts 56f to turn on the dumping indication pilot panel lamp 20p, and opening 56g to disable all of the water level switches and prevent any water fill valve from opening. Also though the dump relay energization causes the normally-closed contacts 56b to open, which would tend to de-energize timer motor 52m with contacts 52a remaining closed, by the simultaneous closing of contacts 56a in series with 52a between line 44 and motor 52m, timer energization is maintained, until the time cam permits the microswitch contacts 52a open to stop the timer motor 52m. The now active delay timer 57 (set say for a closure one minute after initial energization which has taken over timing), allows adequate time for dumping, before closure of the contacts 57a therein to start the next cycle 2. This arrangement ensures allotment of the proper time to each of the operational cycles, with no time being subtracted during a dumping period.

By the thus timed closure of contacts 57a, line 44 power applied to the line 46 immediately energizes the reset coil TSR-r and the advance coil CSR-a to reset the time stepping relay to its zero position and to advance the cycle stepping relay to its cycle position 2, the latter advance de-energizing relay R-1 and extinguishing the pilot light therefore with the normally-open R-1 contacts all opening; R-2 then becoming energized.

The resetting of the time stepping relay back to its zero position immediately de-energizes the timer 57 and also the dump relay coil 56c closing 56g restoring water level control to the water level switches; causes contacts 56d to resume normally-closed position, energizing the dump valve solenoid to close the dump valve ready for cycle 2 filling; opens 56f to turn off the dump pilot; opens the normally-open contacts 56a; and closes 56b to again start the timer 52.

The cycle stepping relay CSR now on position or contact 2 in similar manner turns on the cycle 2 pilot CP-2; energizes and closes the contacts in relay R-2, thus applying power through cycle length control switch CL-2 (set on 15) to contact TSR-15, through WS-2 on position H to the hot water valve opening solenoid 17s to fill the vessel with hot water until the medium water level switch 22 opens, and through contacts R-2f to the detergent dispensing valve solenoid DV-1s to discharge the required detergent through the line 14 into the washer.

The cycle 2 washing operation then proceeds with timing by timer 52 and stepping relay TSR in the manner previously indicated until the arm TSR-w reaches the contact 15, whereupon washer dumping, CSR advance to cycle 3 position and TSR reset are repeated as previously described for the end of cycle 1. Cycles 3 and 4 are then carried out in the manner of cycle 2 but with 5 and 10 minute durations established by CL-3 set on 5 and CL-4 on 10, discharge of detergent and bleach by DV-2 and DV-3 with hot and warm water fills as established by H and W settings of WS-3 and WS-5 and operation of R-3 and R-4 respectively. The setting of WS-4 on W, of course, causes energization of both hot and cold water valve opening solenoids 17s, 18s by energizing warm water solenoid 65.

The successive individual cycles will thus proceed in similar manner except that as no dispensing is provided for in cycles 5-9, cycles basically intended for rinsing (with, however, an option at cycle 9) only cycle time, water temperature and level control functions come into play.

Thus on cycle 5, CL-5 establishes a 2 minute cycle, and WS-5 a warm rinse water temperature on high level (the only level here available on cycles 5-8). On cycle 6, CL-6 sets a 5 minute cycle and WS-6 warm water rinse; on cycle 7, CL-7 sets a 5 minute cycle and WS-7 a hot water rinse.

After the cycle 7 dumping interval has been completed with resetting of TSR and simultaneous advance of CSR to position 8, immediately upon the energization of relay R-8 and closure of its contacts, since CL-8 is set on its skip position, power is applied through CL-8 to common skip line 48 to energize flasher relay heater 54c opening its contacts 54a, upon the reclosing of which to apply power also from line 48 to the line 46 thereby immediately advancing the cycle stepping relay to contact 9, with the time stepping relay remaining at its zero position with the inconsequential energization of its reset coil. It will be observed that the dumping relay is not actuated and there is no interruption of timer 52 operation in this practically instantaneous skip phase of operation.

Upon advance of CSR to its position 9, the time stepping relay remaining yet on zero, since switch 67 is closed, power on contact CSR-9 immediately energizes the interlocking relay turn-off coil 50d, thereby opening the main control power contacts 50a removing power from line 44 to shut off the timer 52 and the washer motor, and in fact from all controlled functions. This, however, closing the contacts 50b applies line power to sound the bell or other audible signal WB and turns on the control panel "Add Starch" pilot SP since 67 and 68 are both on; these signals persisting until the operator turns off switches 67 and 68. At this point the operator adds starch, pushes the start push-button 41, to pulse interlock relay coil 50c closing "on" contacts 50a restoring power on line 44, starting the washer motor 12, the timer 52, and closing dump valve 20, as at the start.

Thereupon, the relay R-9 is energized to function in normal manner to apply power through WS-9 on W for filling with warm water to the medium water level here selected for starching since the switch 63 (also used at other cycles especially for a "sour" operation) has been set "on," so that opening of 21 at the low level generally used for starching is ineffective to turn off water.

At the end of the 10 minute starch cycle established by CL-9 set on 10, when the time stepping relay arm TSR-w arrives at contact 10, the dumping and CSR advance and TSR reset by timer 57 ensues as usual; but with advance of CSR-w to position 10, energization of turn off relay coil R-10c closes both normally-open R-10 contacts; R-10b energizing the cycle stepping relay reset coil CSR-r to reset the same, and the simultaneous momentary closure of the R-10a energizing 50d to turn off the interlocking relay, again opening the contacts 50a to cut-off all control power, stopping the washer motor, and if 68 is on, by closing contacts 50b to sound WB as a signal for the end of the overall cycle of the wash.

It may be noted that with the connection of 45 as above indicated, at any point in the operation there is a manual override available inasmuch as pressing 45 causes a resetting of the time stepping relay and simultaneous advance of the cycle stepping relay.

Switch 67 is set to "off," if there is to be no starching or other special operation requiring interruption of operations at end of cycle 8 or start of 9, for example, after a wash at cycle 4 followed merely by a single rinse and that handled by cycle 9 settings, therefore with CL-5 to CL-8 set on skip 0, and after completion of cycle 4, CSR will advance through positions 5, 6, 7, and

8 to position 9 by flasher relay 54 operation; but at position 9, switch 67 being "off," the interlocking relay is not affected, relay R-9 energizes, and the washer fills with rinse temperature set by WS-9 for a rinse cycle length established at CL-9. The timing by 52 and TSR and dumping proceed as usual, with dump delay timer 57 resetting TSR and advancing CSR to contact 10, whereupon the turn-off operations by R-10 and interlocking relay 50 follow as previously described with bell warning if 68 is on. With the switch 67, open CL-9 can also effect a skip of cycle 9, with advance from position 8, through 9 to position 10 for the turn-off operation which will then proceed as previously described.

FIG. 3 form.—For convenience and with the type of components readily and currently available the afore-described means of applying power from the cycle stepping relay both to the functions served for each cycle and also to the multi-position selector switches presently appears preferably to a certain degree for some convenience in wiring and the character of power to be handled.

However, a further extension of the invention is contemplated insofar as use of the relays R-1 to R-9 inclusive can be obviated by using (instead of the single bank type relay CSR of FIG. 2) a four-bank type cycle stepping relay CSR as appears in FIG. 4, wherein the respective banks appear as CSR1, CSR2, CSR3, CSR4. The wiper arms are on a common shaft, those of the first three banks being commonly connected to the line 44, but with the arm of CSR4 insulated from the others. The contacts 1-9 of the first bank CSR1 are respectively connected to the arms of the selector switches CL-1 to CL-9 inclusive, and conveniently the contacts 9 and 10 of this first bank also being respectively connected, as in FIG. 2, to the switch contacts 67a and to the coil and contacts in R-10; the respective contacts 1 to 9 of the second bank CSR2 connected to respective selector arms of the water temperature selector switches WS-1 to WS-9 inclusive; the third bank CSR3 contacts 1 to 9 connected to the panel cycle indicating pilots CP-1 to CP-9 inclusive, with further contacts 1, 2, 3, 4 respectively connected to the panel switch 30 in the steam valve solenoid line, and to the dispense solenoids DV-1s, DV-2s, DV-3s respectively. In bank CSR4, the wiper arm is connected to line 60, and its contacts 1, 2, 3 and 4 are joined to one side of switch 22, contacts 5, 6, 7 and 8 to switch 23, and contact 9 to switch 21.

Though relays R-1 to R-9 of FIG. 2 are eliminated in FIG. 3, it is immediately apparent that the operations will proceed precisely in the manner described for FIG. 2; and also that with the first bank CSR1 including contacts 3½, 4½, 9½ as described for FIG. 4, the spin circuitry of FIG. 4 may be added to FIG. 3, any corresponding contacts 3½, 4½, 9½ on banks CSR2, CSR3 and CSR4 being then not used.

Modification with spin cycles.—FIG. 4 is a fragmentary schematic diagram showing a modification of the control circuitry where the invention is desired to be incorporated in a commercial washer-extractor type apparatus and provide for automatic spin or extraction cycles. The overall circuit for such purpose is essentially that as shown in FIG. 2 with addition or insertion of certain components as shown by FIG. 4; but is applicable also with the hereinbefore described circuit of FIG. 3.

Where, in addition to the nine controllable length operational cycles for which the 10-contact cycle stepping relay CSR sufficed in FIG. 2, the apparatus is to have also available three spin or extraction cycles, a thirteen contact cycle stepping relay CSR is to be here used, in which for convenience in referring to the previously described circuit, three contacts for spin operations and positions are designated 3½, 4½, and 9½ as spin contacts or positions on the cycle stepping relay CSR occurring respectively after the contacts for the above-designated cycles 3, 4, and 9, as part of means for applying power through line 90 to the washer motor transmission

shift means 13 for high speed or spin drive setting. The only added essential components are two like spin delay (i.e., timing) relays RSD-1, RSD-2, each a timing device which, only upon elapse of a selected set (spin) period after energization (e.g., 1 minute and 3 minutes respectively) closes its contacts to terminate a spin cycle; and three like 4-pole, double-throw spin relays RS-1, RS-2, RS-3, of which normally-open spin relay contacts RS-1f, RS-2f, RS-3f upon respective closures connect line 90 from washer shift control 13 to CSR contacts 3½, 4½ and 9½ respectively to initiate spinning. Preferably, respective spin cycle skip panel switches in appropriate circuit branches, are included.

However, in addition to the connection from line 44 to the line 56 through the normally-open contact 57a as in FIG. 2, there is a still further connection to line 46 afforded from 44 through either of the normally-open parallel-connected spin timing relay contacts RSD-1a, RSD-2a; so that closure of either of the latter effects advance of CSR from a spin contact, removing power from and allowing shift mechanism 13 to return to normal washer speed setting; and initiating the next cycle.

The line 80 of FIG. 2, from the time stepping relay arm to the dump time delay relay 57, here includes in series the normally-closed *b* contacts of the spin relays; in non-spin cycles, when none of the spin relays RS is energized, the path therefore from the time stepping relay arm TSR-*w* to the dump delay timer relay device 57c comprising line 80, closed contacts RS-1b, line portion 80b, contacts RS-2b, 80c, RS-3b, and 80d, so that the power when available on the arm RSR-*w* is applied to the delay timer 57 directly in the manner previously described for FIG. 2.

The cycle stepping relay CSR contacts 3½ and 4½ are similarly connected both to the respective spin relay coils RS-1c and RS-2c and also, through the respective normally-open contacts RS-1a, RS-2a, are commonly connected to spin timer relay coil RSD-1c; while the CSR contact 9½ is connected to the spin relay coil RS-3c and through the normally-open contacts RS-3a to the spin timer relay coil RSD-2c. Also the dump relay coil 56c, on the line 80a as well as the output wiper or selector arm TSR, is further connected by line 80a and a line 80f, through the normally-open contacts RS-1d or RS-2d to the same sides of contacts RS-1a and RS-2a as the spin timing relay coil RSD-1c, and through normally-open contacts RS-3d to the same side of contacts RS-3a as spin timer relay coil RSD-2c, resulting in power to energize the dump relay 56 and thereby dump valve opening solenoid 20a when any of spin relays RS is energized; at which time corresponding RS contacts *b* open to prevent power application on 80a, 80f from energizing timer device 57.

To provide for selective skipping of one or more of the spin cycles by applying power to line 46 to advance CSR, spin skip control panel switches SKS-1, SKS-2, SKS-3 are connected in series with respective normally-open *g* contacts of the spin relays between line 46 and the line sections 80a, 80b, 80c respectively, so that as CSR advances to a spin contact for which a skip switch is closed, immediately on energization of the respective RS relay, power is applied from the CSR spin contact, through contacts *a*, *d*, lines 80f, 80a, and then: for spin cycle 3½ skip, further through RS-1g and SKS-1 to 46; for cycle 4½ skip, further through RS-1b, 80b, RS-2g, SKS-2 to 46; and for 9½ skip, further through RS-1b, 80b, RS-2b, 80c, RS-3g, SKS-3 to line 46.

*Spin type operation.*—With this FIG. 4 modification affording spin cycles, the operations generally are identical to those previously described with respect to FIGS. 2 or 3 at the integrally numbered cycle stepping relay positions from R-1 to R-10 inclusive. However, for example, after the completion of the third cycle with the cycle stepping relay on its contact 3, upon closure of contacts 57a energizing line 46 to reset the TSR and to advance

the CSR to first spin position 3½, line 44 power is applied through CSR to energize the spin relay RS-1. This closes contacts RS-1f, RS-1a and RS-1d to apply power from CSR to line 90 shifting the washer motor transmission 13 to spin speed; energizing RSD-1 to begin timing a 1 minute delay period before closing its contacts RSD-1a to put line 44 power on TSR reset and CSR cycle advance line 46, ultimately to terminate spin; putting line 44 power on 80f to energize the dumping relay 56, opening dump valve 20 and keeping power off the timer motor in 52; and by opening contacts RS-1b preventing line 80f power from energizing the delay timer actuating device 57c, disabling the cycle start function thereof. When RSD-1a closes after 1 minute, CSR-*a* and TSR-*r* are energized to advance to and begin cycle 4; thereby de-energizing RS-1 with the closing of RS-1b restoring the continuity from TSR-*w* to timer 56.

However, if the spin skip switch SKS-1 is "on," closed, a skip of the spin ensues immediately upon energization of RS-1, by power application to cycle advance line 46 through the path above noted.

A precisely similar sequence of operations occurs when the cycle stepper relay advances to the 4½ contact energizing RS-2 and thereby again RSD-1; or with skipping to cycle 5 when SKS-2 is closed.

In a similar manner when the cycle stepper relay advances to position 9½, RS-3 is energized, RS-3b opens to interrupt the path to 57; RS-3d and RS-3a close respectively to energize dump relay 56 opening 20 and to energize the spin delay relay RSD-2 initiating the 3 minute delay period, therefore spin cycle time, before closure of its contacts RSD-2a to advance CSR-*w*, terminating spin, with advance of the cycle stepping relay to position 10 for the terminal turn-off operations and warning.

The separate spin delay relay RSD-2 is thus used solely because of the desire to have a longer spin timing effected thereby, three minutes in contrast with the one minute period common to the first two spin cycles which therefore may be accommodated by the single spin delay relay RSD-1.

It may be noted that since the contact sets in interlock relay 50 are both simultaneously transferred from one setting to the other only by energization of the appropriate solenoid (despite use of terms "normally-open" and "normally-closed"), if for any reason, e.g., flushing the machine, it is desired to interrupt operations even in the middle of a particular cycle, this may be done merely by opening master switch 40, yet have operation again take up at the point of interruption merely by again closing the master switch.

I claim:

1. For laundry apparatus and the like including a liquid containing vessel, an electric motor-driven agitator means mounted in said vessel, and a plurality of solenoidally-controlled liquid inlet valves and a dump valve connected to said vessel, a control system manually programmable at an operator's panel for automatically carrying out an overall cycle sequence of a series pre-selected of operational cycles, a plurality thereof being pre-selectable in respective duration, comprising:

a time control and selection branch including

a set of like time selection rotary switches each serving to select the duration of a corresponding potential operation cycle and having all like positional fixed contacts commonly connected and having respective selector arms;

each contact representing a duration increasing by fixed intervals from zero to a maximum;

a time stepping relay

having contacts successively connected to successively positioned commonly connected fixed contacts of the time selection switches; and

having a solenoidally stepwise advanced and solenoidally zero reset movable contact arm;

timer means producing when operating timing pulses

13

14

at constant intervals applied to advance the time stepping relay;

a liquid selection and level controlling circuit branch including

a set of like liquid selection rotary switches each serving to select liquid admitted to the vessel in a corresponding potential operation cycle and having all like positioned fixed contacts commonly connected to respective solenoids controlling said liquid inlet valves and having respective liquid selector arms;

each contact position thereby representing a selection of a distinct liquid charge to the vessel;

and normally-closed liquid level switch means connected in series with said solenoids controlling said liquid inlet valves and responsive, by opening, to attainment of a desired liquid level in said vessel and thereby closing a said inlet valve;

means including

cycle stepping relay means

having successive fixed contact positions corresponding respectively to potential operational cycles plus a last or termination contact position for a termination cycle; and

having a solenoidally advanced, and solenoidally reset, movable contact arm means for power application to each fixed contact position;

and connecting means connecting each said time selector switch arm and also connecting each said liquid selector switch arm to a corresponding fixed contact position of the cycle stepping relay;

whereby, with power applied to said cycle relay arm means, power is available at the time stepping relay arm, for each potential operational cycle represented by a said selector switch, when the time stepping relay reaches a contact position corresponding to the selected operation duration setting of a respective selector switch while the cycle stepping relay arm is at a fixed contact position connected to the arm of the respective selector switch;

relay means energized by power on the time stepping relay arm

effective while energized

to maintain said solenoidally operated dump valve open, to disable said liquid selection and control circuit from operating any liquid inlet valve upon closing of liquid level switch means during dumping; and

to de-energize and disable said timer means from producing timing pulses at an operational point representing substantially the start of an operational interval upon a resumed operation thereof;

the last said relay means upon de-energization enabling said timer means to operate and said dump valve to close;

dump timer means energized by power on the time stepping relay arm to time and produce a pulse at the end of a pre-determined period allotted for dumping at the end of an operational cycle, the last said pulse applied to a reset solenoid of said time stepping relay and to an advance solenoid of said cycle stepping relay, thereby to begin a succeeding cycle;

a termination circuit branch providing a connection from said termination contact position to a cycle stepping relay reset solenoid and effective to cut off power to said agitator means, when the cycle stepping relay reaches said termination contact position.

2. A system as described in claim 1, wherein said selector switches have zero position contacts connected to the advance solenoid of the cycle stepping relay, whereby with said cycle stepping relay arm reaching a contact corresponding to a selector switch set on zero position, the cycle stepping relay is advanced to a succeeding contact position.

3. A system as described in claim 1, wherein said liquid level switch means includes

a plurality of normally-closed liquid level control switches opening at different liquid levels attained in said vessel; and

normally-open switches, corresponding in number to said liquid selector switches, each of said level control switches connected in series with at least one of said normally-open switches; each of said normally-open switches closed by the cycle stepping relay arm reaching a corresponding position.

4. A system as described in claim 1, wherein the said means including the cycle stepping relay includes a single bank cycle stepping relay and, as said connecting means, function relays having solenoids respectively connected to cycle relay contacts at, and respectively energized by said cycle stepping relay reaching, each of the contact position corresponding to a said time selector switch, each said function relay having at least two normally-open relay contact sets having one side commonly connected to the corresponding cycle relay contact, and other sides respectively connected to corresponding time selector switch and liquid selector switch arms.

5. A system as described in claim 4, wherein certain of said function relays each have a further normally-open contact set with one side commonly connected with the one side of said two contact sets, and other side of each connected to a respective solenoidally operated composition dispensing valve discharging into said vessel.

6. A system as described in claim 3, wherein the said means including the cycle stepping relay includes a single bank cycle stepping relay and, as said connecting means, function relays having solenoids respectively connected to cycle relay contacts at, and respectively energized by said cycle stepping relay reaching, each of the contact positions corresponding to a said time selector switch, each said function relay having at least three normally-open relay contact sets, one contact set of each being a said normally-open switch of the liquid selection and level control branch, two other contact sets having one side commonly connected to the corresponding cycle relay contact, and other sides respectively connected to corresponding time selector switch and liquid selector switch arms.

7. A system as described in claim 6, wherein certain of said function relays have a further normally-open contact set with one side commonly connected with the one side of said two other contact sets, and its other side connected to a solenoidally operated composition dispensing valve discharging into said vessel.

8. A system as described in claim 1, for use where said agitator is an article-receiving drum rotatably mounted in said vessel and rotationally driven through electric motor drive means providing a normal agitating rotational speed and a higher extraction spin speed, wherein

said cycle stepping relay has at least one fixed contact position corresponding to a potential spin operational cycle;

spin relay means having

a solenoid energized by the cycle relay arm arriving at said position;

a normally-open contact set connected to said electric motor drive means and upon closing causing said drive means to shift to spin speed; second and third normally-open contact sets, and normally-closed contacts;

said normally-closed contacts interposed between said dump timer means and the time stepping relay arm, to disable the dump timer means response during a spin operation;

a spin timer connectable by the said second normally-open contact set to said one fixed contact position of the cycle relay and at end of a pre-determined spin interval applying a pulse to said cycle relay advance solenoid;

said third normally-open contact set connected in series

15

with the second set to the said relay means for maintaining the dump valve open to energize the same.

9. A system as described in claim 1, wherein said cycle stepping relay means comprises at least first, second and third banks of fixed contacts with respective movable contact arms, all having like positioned fixed contacts corresponding to said potential operational cycles, and one of said banks having a further fixed contact corresponding to a termination cycle and serving to apply power to the cycle relay reset solenoid;

said connecting means comprising conductors respectively connecting the first bank contacts directly to the corresponding time selector switch arms, and other conductors respectively connecting the liquid selector switch arms directly to respective corresponding contacts in the second bank;

said third bank having fixed contacts controlling respective current cycle indicating lamps and a plurality of the last said contacts controlling respective dispensing valves discharging to said vessel; the movable contact arms for the three said banks commonly connected to a power source for said system.

10. A system as described in claim 9, wherein said cycle stepping relay includes a fourth bank and having movable contact arm insulated from the arms of the said three banks, the solenoids controlling said liquid inlet valves being connected in series between the fourth bank arm and respective commonly connected contacts of the liquid selection switches;

said system including a plurality of normally-closed liquid level switches opening at different liquid levels in the vessel and each connected to at least one of the fixed contacts of the fourth bank, every contact in the fourth bank at a position corresponding to one of said time selector switches connected to a liquid level selector switch.

11. A system as described in claim 9, for use where

16

said agitator is an article-receiving drum rotatably mounted in said vessel and rotationally driven through electric motor drive means providing a normal agitating rotational speed and a higher extraction spin speed, wherein

said cycle stepping relay has at least one fixed contact position corresponding to a potential spin operational cycle;

spin relay means having

a solenoid connected to a contact in one of said banks at said position to be energized by a cycle relay arm arriving at said position;

a normally-open contact set connected to said electric motor drive means and upon closing causing said drive means to shift to spin speed; second and third normally-open contact sets, and normally-closed contacts;

said normally-closed contacts interposed between said dump timer means and the time stepping relay arm, to disable the dump timer means response during a spin operation;

a spin timer connectable by the said second normally-open contact set to said one fixed contact position of the cycle relay and at end of a predetermined spin interval applying a pulse to said cycle relay advance solenoid;

said third normally-open contact set connected in series with the second set to the said relay means for maintaining the dump valve open to energize the same.

12. A system having a plurality of cycle relay positions corresponding to potential spin cycles, respective spin relay means and timer means, and interconnections thereof as described in claim 8.

#### References Cited

#### FOREIGN PATENTS

|         |        |                |
|---------|--------|----------------|
| 590,899 | 7/1947 | Great Britain. |
| 743,786 | 1/1956 | Great Britain. |

WILLIAM I. PRICE, *Primary Examiner.*