June 9, 1953 G. O. PUERNER ET AL 2,641,661

LATERAL TIMER SWITCH

Filed Nov. 1, 1951 4 Sheets-Sheet 1

Fig. 1

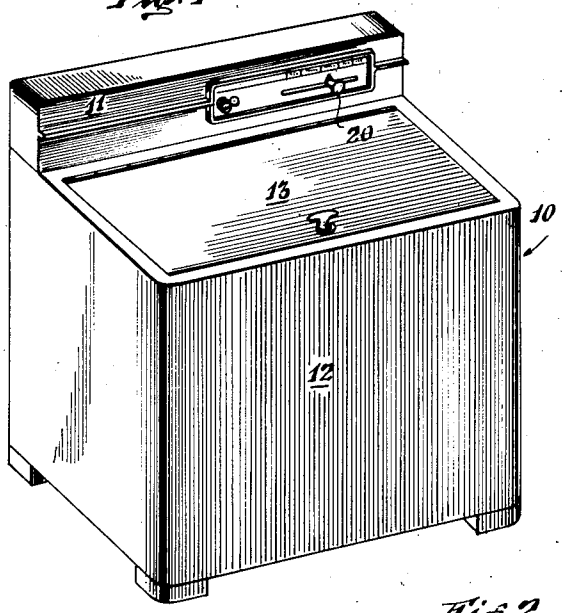


Fig. 9

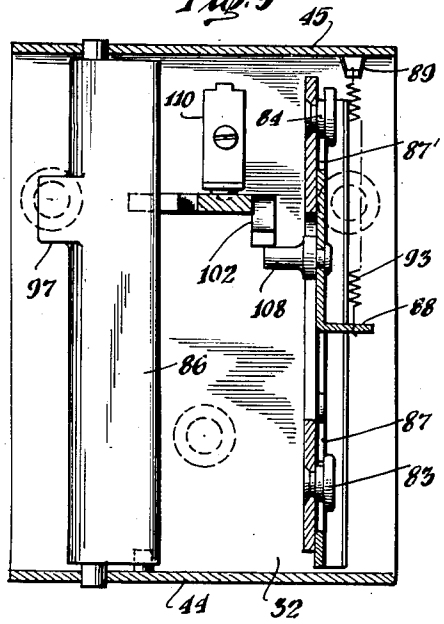


Fig. 2

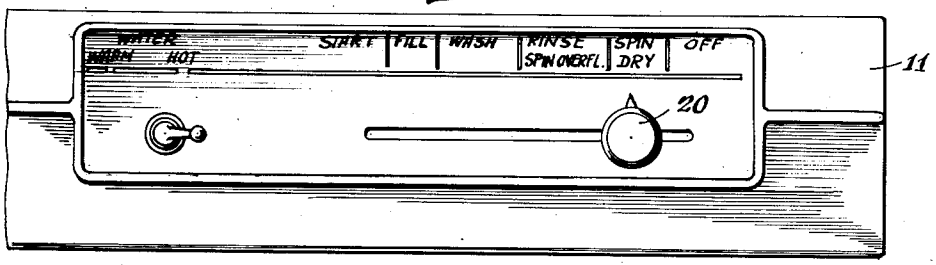
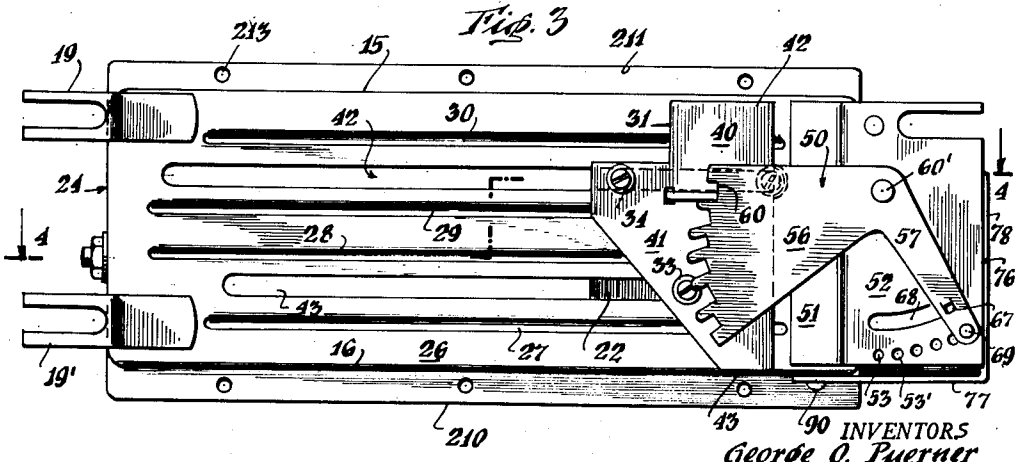


Fig. 3



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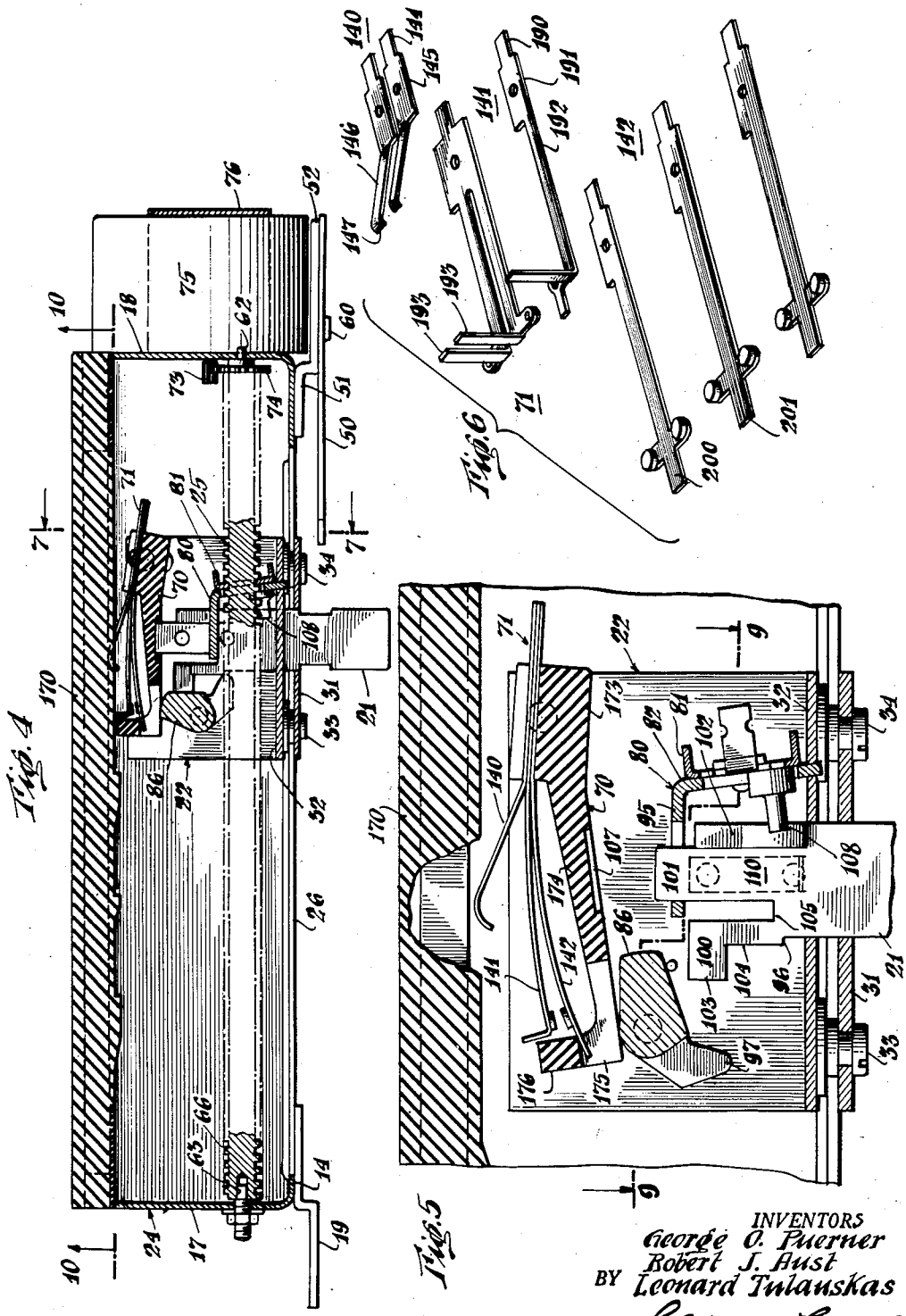


Fig. 4

Fig. 5

Fig. 6

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LATERAL TIMER SWITCH

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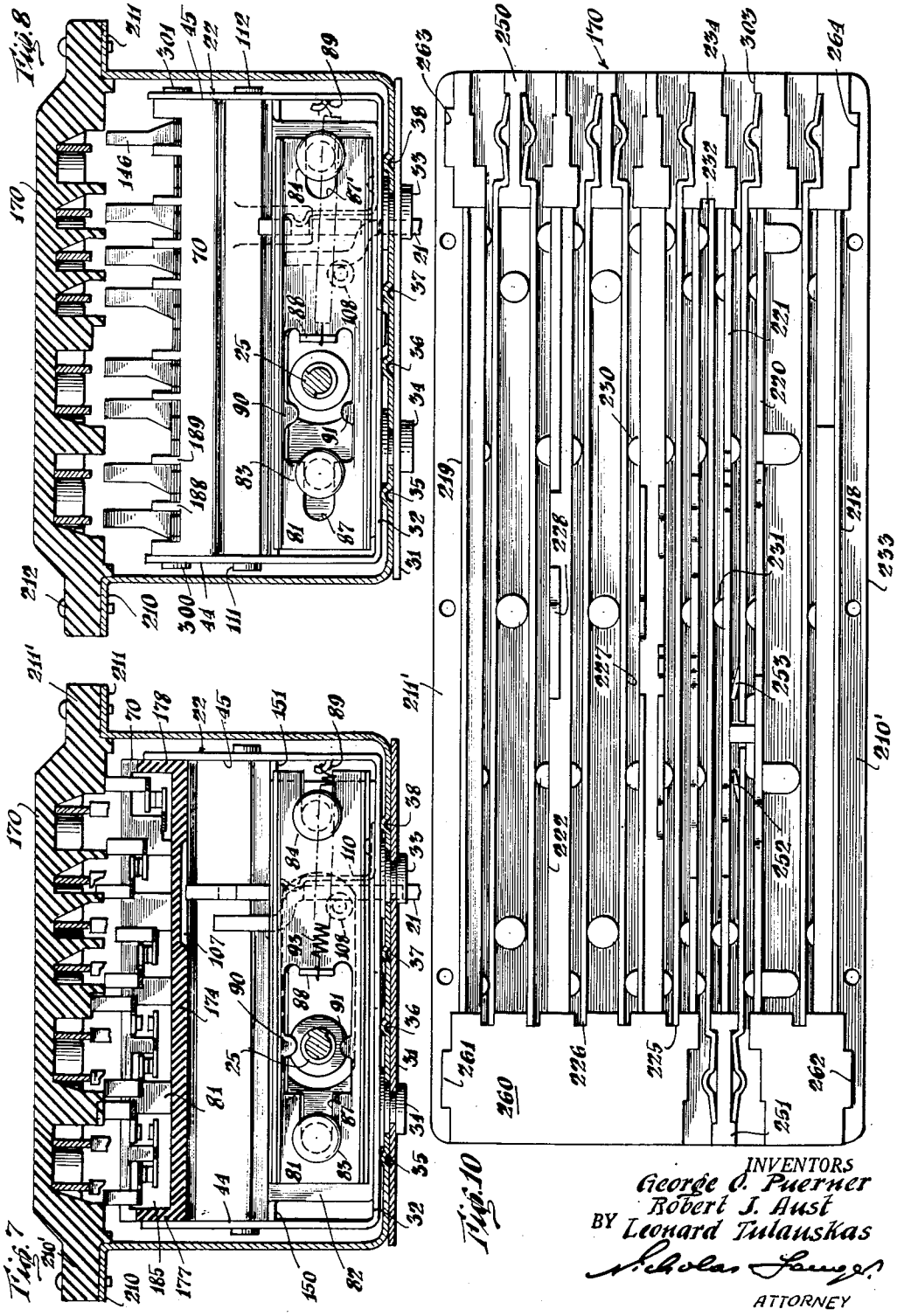


Fig. 8

Fig. 7

Fig. 10

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LATERAL TIMER SWITCH

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Fig. 11

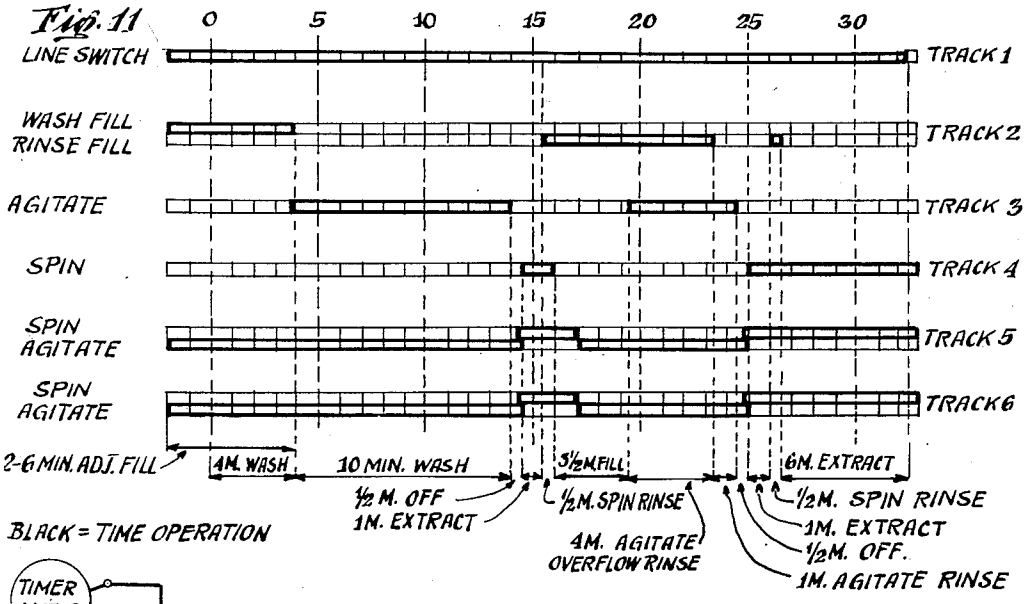
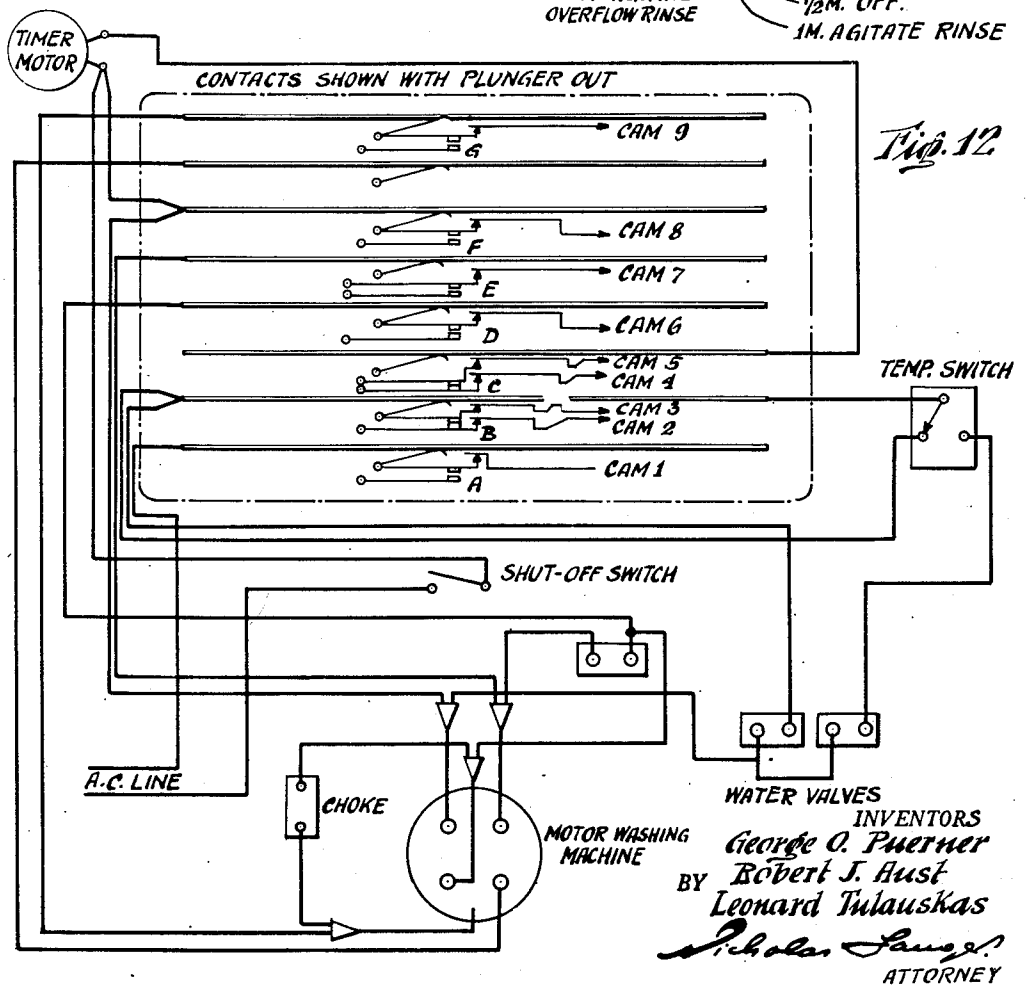


Fig. 12



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UNITED STATES PATENT OFFICE

2,641,661

LATERAL TIMER SWITCH

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Application November 1, 1951, Serial No. 254,424

21 Claims. (Cl. 200—33)

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This invention relates to control devices for sequentially opening or closing a series of electrical circuits at predetermined points in a cycle for definite durations therein, and is particularly pertinent to the sequential control circuit-activating means in automatic washing machines which determine the automatic performance of a series of washing operations.

Automatic washing machines have been used for years in which a series of controlled operations is made possible by actuation, in sequence, of mechanisms providing a series of cyclic movements or effects. The operations in these machines, for the most part, are controlled by means of a timing arrangement comprising a series of cams rotatable about a common axis, each of said cams being shaped so that on the rotation about the axis, associated circuits might be activated in accordance with the setting of each cam.

In contradistinction to such radial control devices, the present invention is specifically directed to a linear method of making and breaking one or more pairs of contacts, with each pair being acted upon one or more times during a prescribed period and in a controlled sequence, but where, however, the means being activated by the cams is a movable contact actuating mechanism driven in a linear or straight line direction.

Thus, the present invention comprises a straight line control device in which the sequence of control is established by the continuous movement in a straight line of an actuating member or members in association with fixed cam surfaces. In such a control device, any number of make and break contact mechanisms may be established without concern for the radial limits formerly necessitated by the circumferential dimensions of rotatable cams positioned about a central axis.

Therefore, an object of the present invention is to provide a control device for controlling a plurality of electrical circuits for a predetermined time interval and for a predetermined number of such intervals, as desired.

It is still a further object of the present invention to provide a control device for the control of a series of electric circuits in a sequential pattern lasting for a predetermined time and operating at a predetermined point in a washing cycle.

Still another object of the present invention is to provide a linearly moving sequential control device for activating a series of electric circuits.

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Still another object of the present invention is to provide in a control device, electrical contact mechanism traveling in a straight line direction for initiating a series of operations determined by the linear position of such mechanism in its line of travel.

Another object of the present invention is to provide in a sequential control device, travel means operating in a longitudinal direction for engaging a series of cam surfaces in said control device, said travel means containing a novel contact mechanism operative in conjunction with said fixed cam surface to initiate a series of operations for an automatic washing machine.

Still another object of the present invention is to provide in an automatic control device for a washing machine, depending upon the relation of a series of cams with associated contactor mechanism for the successive operations thereof, a new construction for said cam surfaces in a longitudinal pattern whereby rapid operation of said contacting mechanism in a substantially positive manner is obtained by dividing the necessary control for said series of operations between two or more adjacent cam surfaces arranged in such fashion that successive control movement for the operations need not take place on the same cam surface but may be arranged to be carried between two or more of said cam surfaces so that each of said cams is adapted to have greater physical and constructional strength.

A still further object of the present invention is to provide a sequential control device having improved features of construction and operation, thus providing for simplicity in the maintenance thereof.

With the above and other objects as will appear as the description proceeds, this invention resides in the novel construction and combination and arrangement of parts substantially as hereinafter described, and as more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the invention may be made as come within the scope of the invention and the claims.

The accompanying drawings illustrate an embodiment of the invention constructed in accordance with a best mode for the practical application of the principles thereof, and in which:

Fig. 1 is a pictorial representation of an automatic washing machine having the linear sequential control mechanism of the present invention shown in operative position thereon;

Fig. 2 is an amplified face view of the dial associated with the linear control device for indicating the sequence of operation for the wash-

ing machine and as indexing the cam positions in the linear control device so as to activate the moving contactor mechanism at the determined station therealong to perform the desired operation of the washing machine;

Fig. 3 is a bottom view of the case of the sequential control apparatus embodying the present invention and depicts variable means for controlling the water fill time for the washing machine, depending on the water pressure being used, and also showing the bottom of the case as adapted to hold the movable carriage thereon for movement thereof in a longitudinal direction;

Fig. 4 is a cross-sectional elevational view taken along line 4—4 of Fig. 3, as adapted to constructionally illustrate means for progressing the actuator or contactor carriage in a straight line excursion so as to be operated upon by a series of cam structures positioned at the top of said control mechanism;

Fig. 5 is an elevational view of the traveling actuator mechanism adapted to constructionally illustrate some of the novel features thereof;

Fig. 6 is an expanded view of the spring mechanism mounted upon the traveling carriage of said control device, said mechanism having a multiple spring construction adapted to provide the necessary wiper and contact arrangement for use in conjunction with the cam structure of said device;

Fig. 7 is a cross-sectional, elevational view taken along line 7—7 of Fig. 4 as adapted to illustrate the construction of the contactor mechanism in operative relation between said contactor mechanism and the surfaces of the terminal block of the invention;

Fig. 8 is a cross-sectional, elevational view of said contactor mechanism adapted to illustrate the relationship between said mechanism and associated terminal block surfaces;

Fig. 9 is a cross-sectional, elevational view of the contactor mechanism as taken along line 9—9 of Fig. 5;

Fig. 10 is a face view of the terminal and cam block used in conjunction with the traveling contactor mechanism of the sequence control device of the present invention;

Fig. 11 is a time cycle chart functionally illustrating the time sequence of the separate washing operations controlled by the present sequential control device; and

Fig. 12 is an electrical circuit diagram illustrative of the circuit arrangement of the contactor mechanism establishing the separate sequences of the washing cycle, as directed by the novel control mechanism of the present invention.

Generally speaking, the present invention comprises a method of making and breaking one or more pairs of contacts in a controlled sequence cycle for an automatic washing machine and wherein each pair is activated one or more times in a prescribed period and in a controlled sequence.

In the present invention, the means for activating the electrical circuits is supplied by a contact mechanism which travels in a straight line direction and is activated by a series of fixed cams arranged on a block adjacent thereto. The operation of the contactors on the make and break of the contacts depends on the relationship of the point of travel of said contacting mechanism to said series of fixed cams spread out in a longitudinal fashion along said terminal block.

In the operation and construction of the mechanism, a synchronous motor is used, with a suitable gear reduction to rotate a lead screw. The lead screw is connected through a disengageable coupling to a movable carriage on which is mounted a plurality of contact springs. These contact springs are so arranged that they make and break contact as the carriage is advanced by lead screw and by their cooperation with a series of cam surfaces which are disposed in a plane parallel to the lead screw axis.

The disengagement of the coupling is accomplished by a handle, slidable in a direction perpendicular to lead screw axis, and whose bearings are in the movable carriage. Outward movement of said handle disengages the carriage from the lead screw and contact springs from cam surfaces. This disengagement is necessary for resetting the carriage to the starting point. Inward movement of the handle causes engagement of carriage to screw and contact springs to their respective cam surfaces.

Referring now particularly to the accompanying drawings, in which like numerals indicate like parts throughout the several views, in Figs. 1 and 2, numeral 10 designates the outer shell or cabinet of a washing machine utilizing the present invention. This outer shell has mounted upon it a bracket control panel 11 which allows access to the control mechanism of the invention. A portion of the outer face of said panel includes a linear dial or indicating face for the control mechanism, as hereinafter described.

The lower portion 12 of the washing machine cabinet provides a tub and agitator into which the laundry or clothes may be placed by opening the cover 13 of the cabinet. Included in the cabinet is a drive mechanism for the laundry tub and agitator, but inasmuch as the tub and drive mechanism form no particular part of the present invention, which is merely restricted to the timing control for the operating mechanisms, these have not been disclosed in detail.

Placing the actuator carriage of the control mechanism at the "Start" position of the cycle (Fig. 2) initiates the washing machine operation. If the carriage is not at the starting point, the carriage may be set thereat by retracting or pulling out knob 20 which is attached to a plunger 21, shown in Fig. 4, of the control mechanism. The extraction or pulling out of plunger 21 allows the actuator carriage 22, as hereinafter described, to become free of its advancing means or lead screw 25 and to be moved along the bottom face 26 of the casing 24 to the initial starting point, as shown in Figs. 3 and 4. The casing 24 may be fabricated of aluminum or other suitable material and comprises a rectangular U-shaped bin structure having an underside 14, side walls 15 and 16, and end walls 17 and 18. The entire casing may be fabricated of one piece and has slotted brackets 19 and 19' welded thereto for use in mounting the casing on panel 11. Lead screw 25 having a plurality of inclined teeth, for moving the coupled carriage as hereinafter described, is rotatably mounted in the lengthwise direction of casing 24 by means of projection 62 and screw 63 supported on side walls 17 and 18 of the casing. By the type of mounting thus provided, the worm drive is thus enabled to be rotated by the synchronous motor 75.

The bottom plate 26 has a plurality of ridges 27–30 formed inwardly so as to stiffen and flatten the bottom on which the actuator carriage 22 may slide in conjunction with the carriage plate 31

placed beneath said bottom face. This carriage plate may be of any configuration but is shown as a large figure "4" having sections 40, 41 and edges 42, 43. The carriage plate 31 and the U-shaped actuator carriage or cradle 30, which has a bottom wall 32, are joined together for moving on the rails 35–38 of the bottom face of the casing by means of spacing studs 33 and 34 adapted to clamp the carriage plate and the actuator carriage on either side of the bottom face so as to ride freely within slots 42 and 43 cut thereinto. Thus, this actuator carriage, which includes the U-shaped supporting carriage having side walls 44 and 45 and bottom wall 32, is adapted to move along the underside of the casing to any particular point thereon corresponding to a predetermined operation for the control mechanism.

Though the various operations performed by automatic washing machines may vary somewhat in their specific nature, and perhaps also in their sequence, the basic operations performed by such a machine is illustrated by the dial markings shown in Fig. 2. As noted, one of the operations is a fill operation which allows the necessary water to flow into the tub of the machine to a certain level at the beginning of the laundry cycle. Since a determined amount of water must be placed in the tub at the end of a definite time interval, any variation in water pressure due to the locating of the machine will affect the amount of water in the tub. To compensate for this, and to regulate the amount of water that may be placed in the tub during the determined time interval, known as the "fill interval," an adjustable fill cam 50 is provided so as to determine the proper fill period for the washing cycle. This adjustable or variable fill cam assembly is attached to the bottom of the casing 24 adjacent the end supporting the drive motor.

The variable fill cam assembly 50 comprises a base structure having sections 51 and 52, with section 51 being adapted to be welded to the underside of the casing 24. Section 52 of the base structure is bent slightly from its associated section 51 and comprises a series of indexing holes 53, 53', and an arcuate slot 68. Moveable in an arc on said base is a semaphorically or fan-shaped member comprising a V-shaped section 56 integrally attached to a narrow sleeve section 57 which is bent at an angle thereto. The fan-shaped structure is rotatable as by means of a rivet or guide pin 60 shown connected to the base structure. The periphery of the fan-shaped structure has been cut out to form six notches, each of which is placed on an expanding radius so that notch 60 is at less of a radius than notch 65. At the end of the fill cam sleeve section there is placed a positively acting detent or nib 69 which is adapted to fall within or engage each of the indexing holes 53 so as to maintain a step-by-step adjustment of the fill cam. An ear 67 formed inwardly of the sleeve portion 57 is cut so as to intrude within the arcuate slot 68 in the base so as to restrict the maximum movement of the cam.

The operation of the fill cam is such as to determine the starting position of the actuator or contact carriage. This is done by determining where one of the fill cam notches stops the carriage plunger to determine the initiation of the starting cycle. Since it is evident that the radial movement of the fill cam in its indexing relationship will determine the radial position of each of the slots, a variable means is assured for initiating the washing cycle, depending upon the water pressure of the location. In the operation of the machine, it is usual that the fill cam is pre-set prior to the installation of the automatic washing machine and adjusted for the water pressure expected at the location. Once said adjustment is made as determined by the location of the automatic washing machine, then there need be no further adjustment of the fill cam. This then provides also the feature of permitting adjustment via the front of the machine through the plunger slot.

As previously stated, the sequential operations of the automatic washing machine controlled by the present invention comprise a linear mechanism adapted to initiate the individual operations of the washing cycle. These operations are controlled by the make and break of circuits arranged in accordance with the position of a series of cam surfaces placed in a linear fashion along a terminal block, shown in Figs. 4 and 10. As the actuator or contact carriage is moved in a straight line fashion by means of a rotating worm driven by a synchronous motor, a series of contacts carried on the actuator carriage will be electrically connected to a set of terminal strips carried on the block to complete the combinations of circuits necessary to the sequential series of operations in accordance with a definite scheme and time plan, as shown by Figs. 11 and 12. Thus, in accordance with the travel of the carriage as determined by the rotation of the driving worm, circuits will be completed or broken, depending upon the make and break arrangement of the contact mechanism as actuated by the cam surfaces of the terminal block. Thus the operation of the contactors depends on the relationship of point of travel of the mechanism to the series of fixed cam surfaces which have been formed in the adjacent terminal block.

Figs. 4–10 are directed to showing the constructional features and operation of the contactors carried on the actuator carriage or assembly in relation to the linearly molded cam surfaces of the terminal block so as to control the making and breaking of the electrical circuits motivating the operation of the working cycle.

A contactor carriage or cradle 22 carries a carriage contact supporting block 70 which is adapted to support a contact spring and wiper mechanism 71, hereinafter described, for activation by the cam surfaces of the control device. The entire contactor carriage assembly is moved by means of a turning lead screw or worm 25, the speed of rotation of which depends on the reduction gear arrangement consisting of gears 73 and 74 as driven by means of a synchronous motor 75 attached to gear 73. A motor bracket 76 supports the motor and connects the same to the switch casing 24. This bracket supports the motor by maintaining the same therein by means of wall 77 and side 78 and two finger-like arms (not shown) which are adapted to penetrate and to be hooked under the wall of the casing 24. The wall of the bracket 77 is also joined to a side of the casing as by means of rivet or screw 90, so that the bracket is solidly fixed to the casing to support the motor therein. The motor also includes two electrical leads (not shown) for bringing the electric current thereto so as to motivate the same.

In order to move the carriage assembly along the driving worm 25, a coupling arrangement for coupling the contactor carriage or assembly to the teeth of the driving mechanism or worm is provided for connecting and disconnecting the

worm from the carriage assembly. The coupling assembly includes the plunger 21 whose movement up and down either connects the assembly to the teeth 66 of the worm or disconnects the same therefrom on the downward thrust. As hereinafter described, the position of the contact carrying block 70 will also be adjusted by the movement of the plunger. Thus, in effect, the plunger adjusts the relationship of the contact mechanism to the cam surfaces of the terminal block while at the same time providing the necessary movement for engaging or disengaging the driving worm from the actuator carriage assembly. A contact carrying block 70 of the carriage 22 is adapted to maintain and support novel contact assembly 71, as will be presently described.

The mechanism for coupling the carriage 22 to the rotating worm gear 25 consists mainly of a plunger 21, supported in a bearing fashion by the carriage. The plunger is so constructed that individual sections are adapted to move a cam bar 86 and a screw latch member 81 which is adapted to interlock with the rotating screw drive by means of a pair of ears 90 and 91, which engage the threads 66 of the worm. This screw latch member 81 is adapted to be mounted on the back side 82 of a carriage bracket 80 and to be movable thereon in a sidewise direction through the cooperation of a pair of guide pins 83 and 84 staked to the carriage bracket. A pair of slots 87 and 87' are formed in latch member 81, whereby the body of the guide pins move therein with the heads thereof forming a surface so that the latch may easily move between the pins and the bracket surface for an extent within the slots. Both the carriage bracket and the screw latch, which are in face-to-face juxtaposition, are so cut as to allow the worm drive to pass therethrough. A portion of the latch member is bent at right angles thereto to form a notched hook 88 which, in conjunction with an ear 89 struck out of one side of the U-shaped carriage structure, enables the mounting of a biasing spring 93 to be contained between the struck-out ear and the notched hook so as to be adapted to return the latch member to its proper position if and when said latch member is moved laterally so as to stretch the spring.

By moving the latch member laterally, it is seen that the two ears 90 and 91 of the latch member are enabled to engage the threads 66 of the worm drive for movement of the carriage therealong. This decoupling and coupling of the latch member, and hence the ears thereof, of the worm member is accomplished by means of the plunger 21 acting in cooperation with cam bar 86. As seen in the drawings, particularly Figs. 5, 7, 8 and 9, the cam bar 86 comprises a metal bar pivotally mounted between the side walls 44, 45 of the U-shaped carriage and has an integrally formed appendage or hook 97 which operates in conjunction with the plunger to aid the coupling or decoupling arrangement between the carriage and the worm drive and also to support contact block 70 as hereinafter described. The carriage bracket 80, which has a side 82 placed in juxtaposition to the screw latch member as before stated, also has bent at right angles thereto a second surface 95 which is also contained between the side walls of the U-shaped actuator carriage as by extensions 150 and 151 connected thereto.

Carriage plate 31, formerly described, has a slot cut therethrough and U-shaped carriage 22 has an aperture cut through its lower base portion, whereby plunger 21 is adapted to extend therethrough with a shoulder 96 thereof adapted to be supported on plate 31 in a manner such that said plate 31 provides a bearing surface therefor.

Carriage bracket 82 has apertures cut therethrough so as to allow the top portions of the plunger to penetrate therethrough. The top portion of the plunger has a tined or forked configuration, having three prongs 100, 101 and 102. The first prong 100 has a large T appearance, consisting of a head section 103, a neck portion 104 integrally joined thereto. This tine is adapted, upon movement of the plunger, to engage the cam bar to rotate the same and to bear thereagainst. Section 100 of the plunger is integrally connected to a midportion 101 thereof by means of a shoulder 105 which, when the plunger is pushed in, bears against the carriage bracket 80 so as to provide a stop for the plunger. Section 100 is adapted to cooperate with cam bar 86 so as to move the same toward the terminal block 170 of the control device. When the plunger is retracted or pulled out, the support which this midportion 100 affords to the cam bar 86 is removed, allowing the contacting elements to be lowered away from the terminal block of the device.

The third portion 102 of the plunger comprises an integrally formed finger portion which is laterally displaced from the other two portions of the plunger so as to act in cooperation with a cam pin 108 to displace the screw latch for coupling or decoupling the entire assembly of the worm drive. As the plunger is withdrawn, the cam pin 108 moves a distance determined by the lateral displacement of the plunger portion from the main portions thereof so that the pin is guided up the surface thereof so as to displace and maintain the screw latch member in a position away from the threads of the screw drive. When in this position, as shown in Fig. 8, the return spring 93 is extended and upon the release of the cam pin 108 by pushing the plunger inwardly, the spring will return the screw latch to the position wherein the ears will engage the screw drive, as in Fig. 7, so as to couple the same thereto for movement in a straight line direction. At the same time, the cam bar 86 will lift the contact block 70 so that the engagement between the contactors contained within the contact block and the cover terminal block 170 will be made for the sequential control of the washing operations. An indexing spring 110 comprising a resilient biasing member is also placed to one side against the plunger so as to aid in maintaining and indexing the same in its proper operational position.

The actuator carriage, besides being coupled to the driving means, is also adapted to maintain and support the contact block including the make and break members or contacts and the terminal wipers of the device. At one end of the U-shaped carriage 22, apertures are formed for containing the bosses 300, 301 which adapt the carriage block to be movably maintained in the U-shaped structure or cradle while the other end is supported by the cam bar 86, as described. As the cam bar 86 is acted upon by the plunger, the actuator base will be placed in and out of juxtaposition with the terminal block. When the plunger is pushed in, the cam bar acts to support the contact base in such manner as to place the same in operation along the worm as the member is driven. Upon pulling the plunger out, the contact bar is rotated

so that the entire contact base is pushed away from the terminal block by the action of biased spring 140. By this means, proper positioning of the entire contact block may be obtained by mere movement of the plunger which actuates the cam bar so as to raise or lower the entire contact block. Further, this cam bar 66 rigidly supports the entire contact block 70 in a substantially firm fashion.

Carriage contact block 70 supports (1) the contact springs having the contacts and cam followers, and (2) the trolley contact springs which wipe the terminal strips of the terminal block, as hereinafter described. The block is an unitarily formed molded structure adapted to be rotatably mounted in oppositely situated apertures formed in the side walls of the U-shaped actuator carriage or cradle, as by means of two pivots or bosses 200, 201. The block (Fig. 5) comprises a clamping section 173 on which the contact spring and wiper assemblies are clamped, thus to form the multi-part spring assembly 71, and has a sloping base section 174 joined thereto. The sloping section 174 has portions of its far end opposite the clamping section apertured to form a plurality of rectangular cut-outs 175 therethrough, with a series of partitions formed therebetween separating the individual cut-out sections.

At right angles to the apertures formed in the sloping base is an integrally joined end wall 176 which is connected at each end thereof by the side walls 177, 178 of the contact block. This end wall 176 of the contact block has also been constructed to form a series of cut-outs separated by end ribs such as 180 and 181. As shown in Figs. 5 and 7, several of these ribs and a portion of the thickness of the end wall are utilized to retain the fixed contacts of the contact springs to meet the opposing movable contacts directed by the cam followers on the contact springs when acted upon by the cam surfaces of the facing terminal block. The apertures, such as aperture 185, cut in the contact block allow for unrestricted movement of the contact springs, and hence the contacts therewithin upon pressure being exerted on the fingers of the contact springs.

The clamping section of the contact base has been divided by a series of integrally formed molded partitions or septa 188 and 189 into a plurality of individual chambers into which the ends of the contact springs and wiper fingers are adapted to be fastened. The contact springs and wipers comprise, as shown in Fig. 6, a plurality of individual spring assemblies 140, 141, 142, combined to form the multi-part contact spring and wiper assembly 71. The separate assemblies 140–142 are fitted over one another in a manner shown in Figs. 5 and 6. The terminal or trolley wiper assembly 140 comprises a resilient member having tail portion 144 and a clamping portion 145 joined thereto, said clamping portion having a hole passed therethrough so as to conform to the holes found in the other conjoining assemblies so as to align the same for fastening to the contact block. Joined to the clamping portion 145 of each trolley spring and being integrally formed therewith, is a finger portion 146 bent up and at an angle to the midportion. The portion has a brush terminus 147 arced at the end thereof and joined to the finger. These brush portions are adapted to ride on the terminal strips of the facing terminal block so as to make contact therewith.

Each of the other contact finger assemblies which is joined with the wiper spring assembly to form the multi-part assembly 71, comprises a tail portion 190, a mid-clamping portion and a main portion 192 placed in the same plane as the midportion and an end portion. In contact assembly 141, however, bent at right angles to the main portion 192 thereof, are spring fingers or cam followers 193, 193', the tips of which are adapted to ride along the cam surfaces of the associated terminal block to be moved vertically thereby relative to the fixed contacts of contact assembly 142.

As previously described, the end wall of the assembly block has been apertured so that tips, such as 200, 201 of contact assembly 142, may be anchored thereby so as to provide the retention between the fixed and movable contacts as actuated by the cam surfaces of the terminal block. This method of anchoring is shown in Fig. 5, where the tip portion of assembly 142 is biased against one of the cut-out portions of the end of the contact block. It is to be noted that this method of mounting the multi-part spring assembly provides sufficient resiliency, as shown in the figure, for the proper follow-through necessary in the make and break of the contact. It is also to be noted that in the manufacture of the multi-part contact assembly, each of the separate assembly may be joined to the separate springs therein at the tail end thereof by a metal binding element which may be shorn after the entire assembly is staked on the assembly block.

The construction of the multi-part contact and wiper spring assembly herein provided, provides means for decreasing the effective accumulation of tolerances which must be made in providing the aligning of the contact springs in a relation to the associated terminal block. Thus there is provided a means of exactly maintaining the spacing between the cam followers and the cam surfaces of the control device.

As stated, the contactor assembly coupled to the driver worm travels in a straight line direction therealong and the sequential operations of the washing machine are determined by the completion of electrical circuits which are made on the closing or opening of combinations of pairs of contacts which provide electrical paths to the terminal strips included in the terminal base, shown in Fig. 10, via the wiper fingers. The contacts are closed or opened in accordance with the activation of the cam followers joined to the contact members. These cam followers are moved vertically by the cam surfaces spread along the terminal block, shown in Fig. 10. Thus the contacts are closed or opened in accordance with the predetermined pattern to establish electrical circuits as shown in Figs. 11 and 12 so as to provide the necessary operations for the automatic washing machine.

The terminal block, as shown in Fig. 10, is adapted to be mounted on extensions or lips 210 and 211 of the casing 24 (see Figs. 7 and 8) by means of integrally molded flanges 210' and 211' and a plurality of aligned apertures through which clamp studs 212 may be inserted to tightly clamp the same to the casing.

Terminal block 170 is a molded one-piece construction wherein all necessary outlets and slots are cut and all raised surfaces are integrally formed such as to provide thin partitions, cam surfaces, terminal carrying posts and plug walls. These partitions, etc., are integrally molded to the lower face of the terminal block and extend

therefrom in a vertical direction so as to be upright thereupon. Anchoring slots for staking the terminal strips in a substantially tight manner are also cut or molded in the raised structure.

Thus, the terminal block is constructed with aligning strips 218, 219 on opposite sides of its lengthwise wall 233 so as to aid in positioning the terminal block on the case in a positive and essentially tight fashion. The cams such as 220, 221, 222, etc., are longitudinal in extent and comprise narrow slabs whose surfaces have predetermined indentations or cut-outs such as 227, 228 along which the cam followers of the contact assembly travel and are adapted to be moved vertically as determined by the configuration thereby at predetermined points therealong. Thus, as the cam followers travel along these cam surfaces, they will be raised or lowered in accordance with the cut-out configuration of each cam. The terminal strips such as 225, 226, are fabricated as a plurality of metal strips and are longitudinally disposed adjacent said cams and are maintained in an upright manner by being held at various points therealong by insulative terminal posts such as 230, 231, and slots such as 232, cut within the cross-wise wall 234 of the terminal block. Thus the terminal strips are adapted to be insulatively mounted in a substantially fixed manner in the terminal block.

The ends of said terminal strips are brought out to integrally molded and formed plug sections such as 250, 251 of the terminal block for connection to a male connecting plug, as desired. The terminal strips in the plug or sockets formed in the terminal block are bent to have a resilient V-shaped construction so as to engage the plug with adequate force. The barrier 303 prevents the terminal strips from becoming disengaged with the terminal block. Further, the terminal strips which do not extend the full length of the board may have ears such as 252, 253 integrally cut therefrom to lie against any one of the molded partitions. This, to further aid in the mounting of the terminal strips within the terminal block.

To aid in completely insulating the terminal strips from the casing on which it is mounted, rectangular insulative strips such as 160 having extensions 261, 262 are adapted to fall within grooves 263, 264 at the ends of the terminal block so as to prevent any unwanted contact between the terminal strips and the casing and to insulate the same therefrom.

It is to be noted that the physical construction of the cam surfaces as provided in the terminal block is indeed a novel one, since if the cam surfaces require changes in action in rapid succession, then the changes may be achieved with facility by splitting the action between two or more cam surfaces so that the successive operations do not necessarily take place on the same cam surface. By this construction, the physical sturdiness of the cams has been greatly enhanced.

In the operation of the present control device, the contact springs are so mounted that in the engaged or running position, they are biased toward the cam surfaces. The breaking of a pair of contacts is accomplished quickly by the contact spring (closest of that pair to the cam surfaces) dropping at a right angle cut on its cam surface, while the mating contact is restrained by its cam surface from following the first spring in the direction of the cam surfaces.

The making of a pair of contacts is accomplished quickly by allowing the contact spring farthest from the cam surfaces to be forced into a right angle cut in the cam surface by its own spring bias. This action allows this contact to mate with another which was previously dropped into an open position by a similar cam action. A pair of these contacts coming into engagement with its cam surfaces will energize the timer motor, turn the lead screw, and advance the carriage through the timing cycle until this pair of contacts open automatically at the end of the cycle or until the plunger handle is pulled outward.

As seen, the contact springs are connected to spring riders or brushes which continuously engage the edges of the metal trolleys or terminal strips. These metal strips are so constructed that with their cooperative housing member, they form female connectors to which external wall connections are made as is general with such appliances.

In Fig. 11, a timing diagram is shown for accomplishing the sequential operation provided by the make and break of the circuits shown in electrical diagram in Fig. 12, in accordance with the following chart:

Period	Contacts						
	A	B	C	D	E	F	G
Wash-Fill	x	x	o	x	o	x	o
Agitate	x	o	x	x	o	x	o
Spin	x	o	x	o	x	o	x
Rinse-Fill	x	x	o	x	o	x	o
Agitate	x	x	x	x	o	x	o
Rinse-Fill	x	x	x	o	x	o	x
Spin	x	o	x	o	x	o	x

(x—contacts closed; o—contacts open.)

It is to be noted that the present invention, although directed toward the sequential control of the operations in a washing machine, is not to be restricted only to such application, but rather it is intended that the novel features of the lateral timer switch here described be applied to any and all purposes to which its use becomes obvious; for example, to any system whereby innumerable circuits are to be controlled in a sequential fashion, such as in computing devices or other such apparatus.

What is claimed is:

1. A control device for sequentially opening or closing a series of electrical circuits comprising a pair of contacts, one of which may be moved into engagement with the other of said pair for closing said electrical circuits, fixed terminal means, said pair of contacts being moved together in a straight line with reference to said terminal means situated adjacent said pair of contacts, and wiper means connecting said pair of contacts to said terminals to complete electrical circuits thereby, said wiper means adapted also to move concurrently with said contacts.

2. A control device for sequentially actuating a series of electrical circuits comprising plural contact means for closing and opening said electrical circuits, said plural contact means adapted to be moved together in a straight line direction, fixed terminal means cooperating with said plural contact means for opening and closing said electrical circuits situated adjacent thereto, wiper means connecting said plural contact means to said terminals while said plural contact means are moving in a straight line direction, said wiper means movable concurrently with said contact means, and means for driving said contact means along said direction so that a series of electrical circuits may be completed in accordance with a determined pattern as said contacts move.

3. A control device for sequentially actuating a series of electrical circuits comprising traveling means movable in a straight line direction, a plurality of terminal means placed above said traveling means adjacent thereto, said traveling means including pairs of contacts for closing and opening electrical circuits and wiper means for making connection to said terminal means, driving means for progressively activating said traveling means in a straight line direction, and means coupling said driving means to said traveling means so as to move the same therealong.

4. A sequential control device for actuating a series of electrical circuits comprising movable carrying means for a pair of contacts, one of said pair being fixed with respect to the other and being adapted to move into engagement therewith and adapted to move in a straight line direction, a plurality of fixed terminals placed adjacent thereto and above the same, terminal wiper means on said movable carrying means adapted to continuously make contact with said terminals while said carrying means is moved in a straight line direction, said wiper means being connected to said pair of contacts and coupling means adapted to connect said carrying means to said driving means so as to drive the same in said straight line direction.

5. A control device for sequentially activating a plurality of electrical circuits in a predetermined pattern and time sequence, comprising movable carrying means for supporting individual pairs of circuit closing contacts adapted to be moved in a straight line direction, terminal and cam means placed adjacent said contact means, wiper means on said carrying means for connecting said terminal means to said pairs of contacts for continuously maintaining electrical contact therebetween on the movement of said contact carrying means, driver means adapted to move said carrying means, and means adapted to couple said driving means to said carrying means so as to move the same with relation to said terminal and cam means.

6. A control device for sequentially activating a series of electrical circuits in a predetermined fashion and time arrangement, a contact carrying carriage including an insulative contact block adapted to support a plurality of contacts, a plurality of terminals and cam surfaces facing said contact block and positioned above the same, means for moving said carriage in a straight line direction, said means comprising a driving worm and coupling means for coupling said carriage to said worm, said coupling means further comprising a plunger movable in a vertical direction for engaging said worm, and said plunger including a midportion for positioning said contact block in operative relationship to said cams and said terminals while said actuator carriage is moved in a straight line direction by said worm.

7. A control device for sequentially activating a series of electrical circuits in a predetermined fashion and time arrangement, a contact carrying carriage including an insulative contact block adapted to support a plurality of contacts, a plurality of terminals and cam surfaces facing said contact block, means for moving said carriage in a straight line direction, said means comprising a driving worm and coupling means for coupling said carriage to said worm, said coupling means adapted to move said contact block into and out of operative relationship with said plurality of terminals.

8. A control device for sequentially activating a series of electrical circuits compriisng a driver worm driven by a motor, a contact actuator carriage mounted thereupon and adapted to be moved thereby, said actuator carriage comprising a contact carriage block for supporting a plurality of contacts and terminal wipers, a terminal facing said contact block and being positioned adjacent thereto, said terminal block including a plurality of cam surfaces and a plurality of terminal strips spread in a straight line direction thereupon, means for adjusting said contact block with reference to said terminal block to place the same in and out of position for activating said contacts upon movement of said worm, said means including a plunger having a tined configuration, one of said tines being adapted to move said contact block in and out of engagement with said terminal block whereby a plurality of electrical circuits may be completed through the activation of said contacts and the connections of the same to said terminals included in saidl terminal block at a predetermined positional and time sequence.

9. A control device for sequentially activating a series of electrical circuits in a washing machine comprising a casing, said casing having interconnected lengthwise walls and crosswise walls, a worm adapted to be movably mounted between said crosswise walls in a lengthwise direction, said worm comprising a plurality of inclined teeth, a motor, a reduction gear assembly placed intermediate said movable worm and said motor so that said worm may be driven thereby, a contact carrying carriage for supporting a plurality of contacts, said driving worm adapted to penetrate therethrough, means coupling said contact carrying carriage to said worm so that said contact carrying carriage is adapted to be moved thereby, a terminal block placed adjacent said contact carrying carriage along said lengthwise walls of said casing, said terminal block being an integrally molded structure including integrally formed cam surfaces, and adapted to contain a plurality of terminal strips connected to electrical circuits, said contacts on said carrying means being electrically connected to said terminal strips by a plurality of terminal wipers, cam follower means connected to said contacts to activate the same in accordance with the cam surfaces molded into said contact block, and means coupled both to said worm means and said contact carrying carriage to place the latter in operational position for activation by said cam followers of said contacts so as to determine the sequential operation of said control device in accordance with a predetermined time and positional arrangement.

10. A control device for sequentially activating a series of electrical circuits according to a predetermined fashion and time arrangement, said control features comprising a casing therefor, said casing having lengthwise and crosswise walls, a worm mounted in lengthwise direction in said crosswise walls of said casing, means for rotating said worm therein, contact carrying means connected to said worm and movable therewith, said contact carrying means further having a plurality of terminal wipers connected thereto, a plurality of terminal strips placed above said contact carrying means for connection to said terminal wipers, a plurality of cam surfaces positioned in a lengthwise direction along said casing, cam follower means adapted to be acted upon by said cam surfaces so as to

complete a predetermined sequence of electrical circuits upon the movement of said contact carrying means by said worm in a lengthwise direction.

11. A sequential control device as in claim 10, wherein said contact carrying means is connected to said worm by means of a coupling device, said coupling device adapted to be vertically moved up and down on said casing and comprising a plunger having a plurality of tines, one of which is longer than the other, another of said tines being displaced in a lateral direction and connected to said longer tine, a cam pin, a screw latch, said cam pin being connected to said screw latch, means adapted to fixedly support said screw latch in relation to said plunger, said screw latch being movable laterally thereon and being connected to said cam pin, said screw latch having a pair of ears situated on opposite sides thereof so as to fall within the teeth of said worm, biasing means adapted to return said screw latch to its position after lateral displacement of the same whereby on the movement of said plunger said cam pin is adapted to move on said laterally displaced tine so as to activate said latch in a lateral direction, thus to place said ears of said latch in or out of engagement with said worm.

12. A control device for sequentially activating a series of electrical circuits comprising an integrally formed metal casing having side and lengthwise walls, a rotatable worm drive having a plurality of teeth adapted to be supported by said side walls of said casing in a lengthwise direction at a discreet distance from the bottom thereof, an actuator carriage adapted to support a plurality of contacts and wiper assemblies comprising individual contact springs and wiper brushes, respectively, said carriage being movable on said worm in a lengthwise direction, a plurality of terminal strips and cams placed adjacent said contact and wiper assemblies, said cams being positioned lengthwise along said casing and having a plurality of terminals situated next thereto whereby said contacts and said terminal wipers when moved by said worm will engage said cam surfaces and said terminals, and means for placing said contacts in and out of operative position with respect to said cam surfaces and said wipers so that said actuator carriage may be adjustably positioned at any predetermined position along said worm in relation to said cam surfaces.

13. A control device for sequentially actuating a series of electrical circuits comprising contact means for closing and opening said electrical circuits, fixed terminal means, said contacts being moved in a straight line with reference to said terminal means situated adjacent said contact means, means connecting said contacts to said terminal means to complete electrical circuits thereby, said contact means comprising resilient members including a tail portion, a clamping portion, said clamping portion having an aperture therethrough so as to conform to other conjoining contact means, and a main portion connected to said clamping portion, said main portion being terminated by contact points, said means connecting said contacts to said terminals comprising wiper means including a tail portion, a midportion adapted to be clamped to the clamping portion of said contact means, a finger portion bent at an angle to said midportion, and a brush terminus connected to the end of said finger portion adapted to smoothly ride on the terminal strips of said device.

14. A control device as in claim 13, wherein a plurality of cam surfaces are placed adjacent said terminal means and above said contact means, cam follower means adapted to move said contact means vertically while said contacts are moved in a straight line with reference to said terminal means, said cam followers being placed at a right angle to said contact means and being connected thereto for movement by said cams.

15. A control device for sequentially activating a series of electrical circuits comprising traveling means movable in a straight line direction, a plurality of terminal means placed above said traveling means adjacent thereto, said traveling means comprising a U-shaped actuator carriage, a molded contact block adapted to be radially rotatably supported within said U-shaped carriage, said contact block having an end containing a plurality of apertures, a clamping section and an inclined portion connecting said end to said clamping section, said contacts adapted to be mounted and staked to said clamping end and resiliently biased within said apertures of said contact block, a plurality of wiper means connected to said contact means at said clamping portion of said contact block, said wiper means being adapted to make connection to said terminal means, a plurality of cams having cam surfaces positioned adjacent said terminal means, cam followers connected to said contact means, said cam followers adapted to be moved by said cam surfaces of said cams, and driving means for moving said traveling means in a straight line direction so that said contacts are moved in accordance with the position of said U-shaped carriage in relation to said cam surfaces of said device.

16. A control device for sequentially activating a series of electrical circuits comprising a casing, said casing having interconnected lengthwise walls and crosswise walls, a worm adapted to be rotatably mounted between said crosswise walls in a lengthwise direction, said worm comprising a plurality of inclined teeth, a motor, a reduction gear assembly placed intermediate said rotatable worm and said motor so that said worm may be driven thereby, contact carrying means for supporting a plurality of contacts, a terminal block including a series of terminal strips and a plurality of longitudinally disposed cam surfaces placed adjacent thereto and above said contacts, wiper means connecting said contacts to said terminal strips, means for vertically moving said contacts in accordance with the cam surfaces of said cams on said terminal block, coupling means for coupling said contacts to the teeth of said worm for movement therealong, and a dial placed on said casing having a plurality of indicia spread thereon, said dial indicating the position of said contacts in relation to said cams.

17. A control device for sequentially activating a series of electrical circuits comprising a casing, said casing having interconnected lengthwise walls and crosswise walls, a worm adapted to be rotatably mounted between said crosswise walls in a lengthwise direction, said worm comprising a plurality of inclined teeth, a motor, a reduction gear assembly placed intermediate said rotatable worm and said motor so that said worm may be coupled thereto and driven thereby, a contact block carrying a plurality of contacts, a terminal block including a series of terminal strips and a plurality of disposed cam surfaces

placed adjacent thereto and above said contacts, means connecting said contacts to said terminal strips, means for vertically moving said contacts in accordance with said cam surfaces, coupling means for coupling said contacts to the teeth of said worm for lengthwise movement thereof, means for determining the start position of said contact block, said means comprising a cam having a peripheral surface placed on said casing, said cam having a plurality of notches radially cut into the periphery of said cam, said notches being individually at different radii thereto so as to determine different start positions for said contact carrying means, and a dial placed on said casing including a plurality of indicia spread thereon so as to indicate the position of said contacts as they move in relation to said cams.

18. A control device as in claim 17, wherein said casing comprises a bottom wall having a plurality of ridges inwardly disposed therein and a plurality of slots cut lengthwise in said bottom wall, and where said contact carrying means comprises a U-shaped carriage adapted to be moved on said bottom wall of said casing by means of a plate disposed beneath said bottom wall of said casing, said plate being clamped to said U-shaped contact carrying means by means of spacing studs adapted to move freely within the slots of said casing.

19. A control device as in claim 18, wherein said contact block of carrying means comprises an integrally molded surface adapted to be radially movably mounted on said U-shaped carriage, a cam bar disposed beneath said terminal block rotatable within said U-shaped carriage and adapted to be activated and moved by said plunger of said control device so as to support said contact block in operative relationship to said cam surfaces of said terminal block.

20. A control device for sequentially opening or closing a series of electrical circuits, comprising a plurality of contacts, one of which may be moved into engagement with another of said plurality of contacts for closing said electrical circuits, fixed terminal means, and wiper means connecting said plurality of contacts to said terminal means, said wiper means and said plurality of contacts all movable laterally together in a straight line with reference to said terminal means.

21. A control device for sequentially opening or closing a series of electrical circuits, comprising a pair of contacts, one of which may be moved into engagement with the other of said pair for closing said electrical circuits, fixed terminal means, wiper means connecting said pair of contacts with said fixed terminal means, said wiper means and said pair of contacts all movable together concurrently in a straight line with reference to said terminal means, and means for determining if said pair of contacts shall be closed and at what point in said lateral movement thereof.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,906,976	Lazarus	May 2, 1933
1,964,846	Earnshaw	July 3, 1934
2,176,195	Bassett	Oct. 17, 1939
2,267,816	Chirelstein	Dec. 30, 1941
2,306,056	Harvey	Dec. 22, 1942