Oct. 14, 1947. T. T. WOODSON 2,429,084

ADJUSTABLE CAM

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Fig. 1.

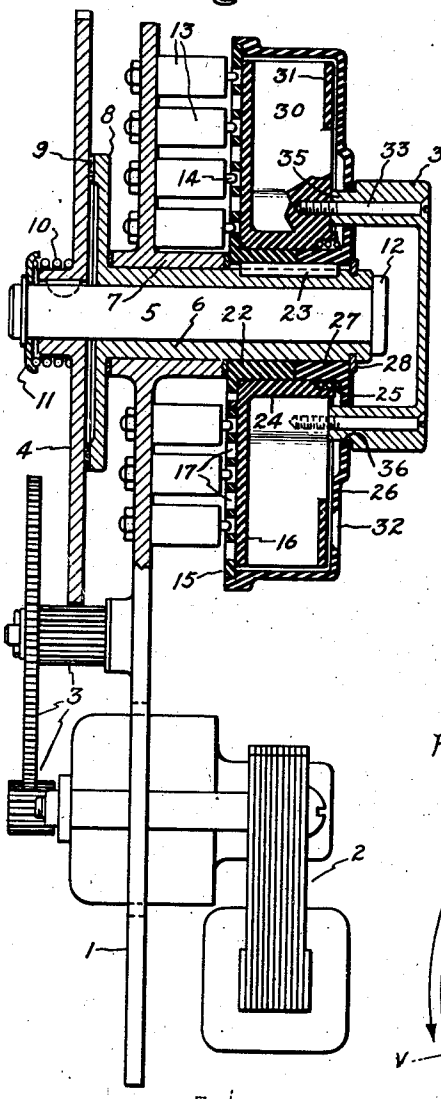


Fig. 2.

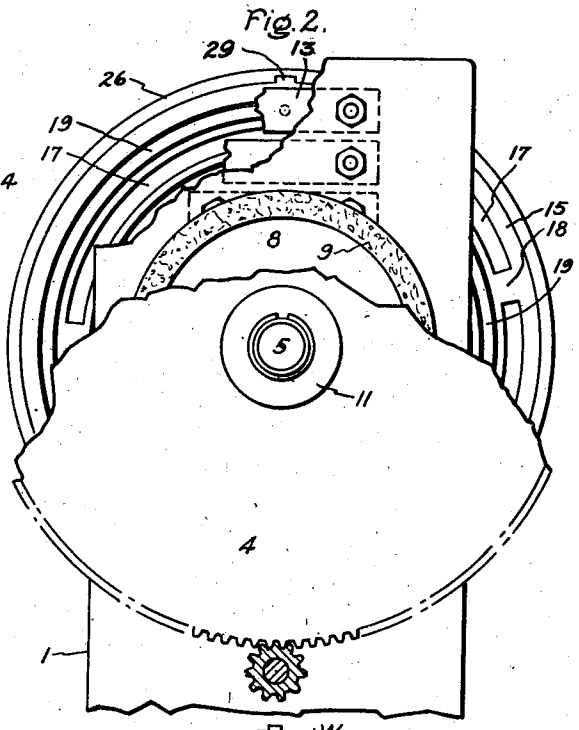


Fig. 3.

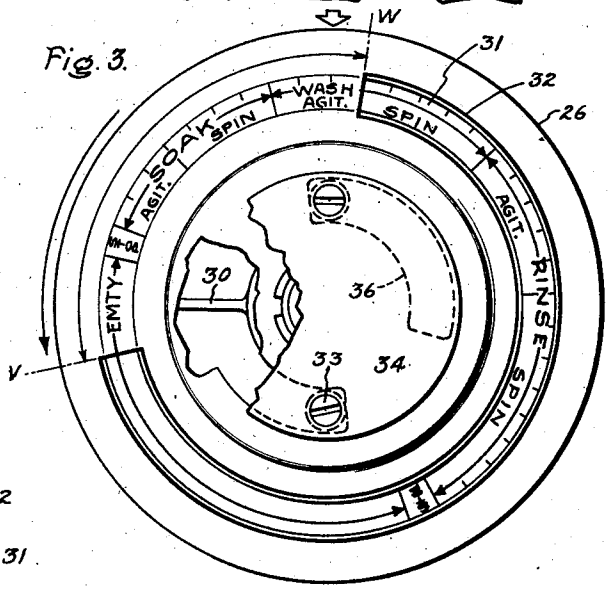
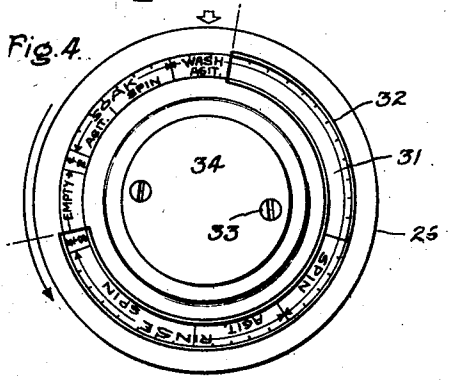


Fig. 4.



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Fig. 5.

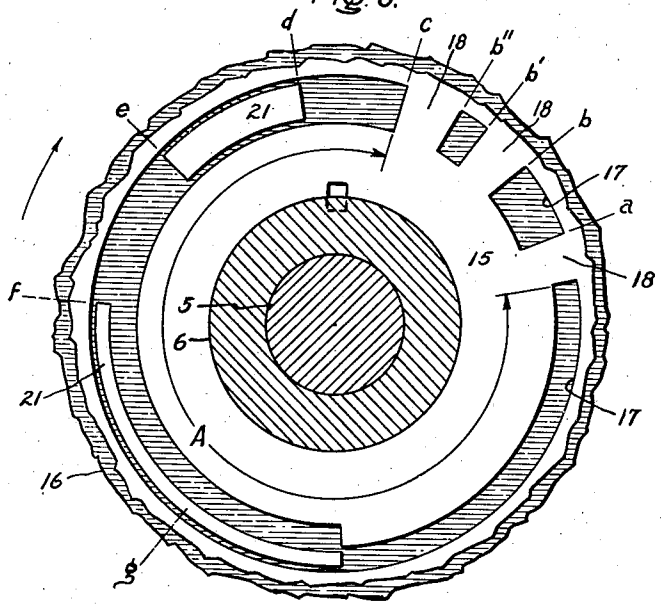
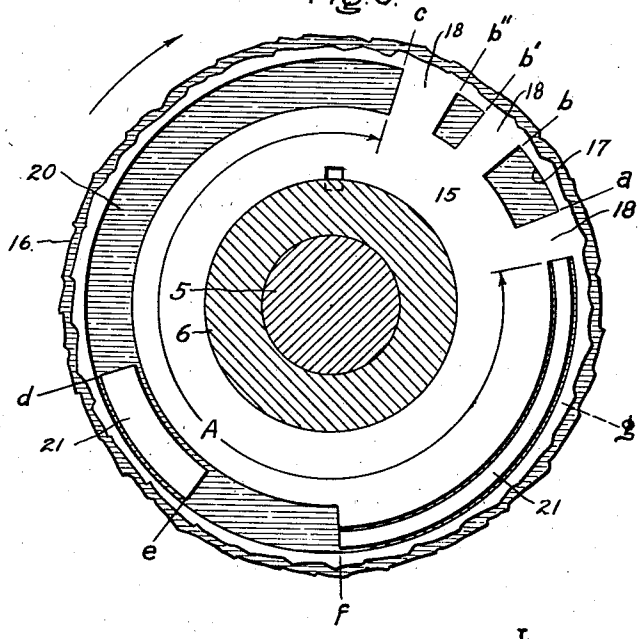


Fig. 6.



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Fig. 7.

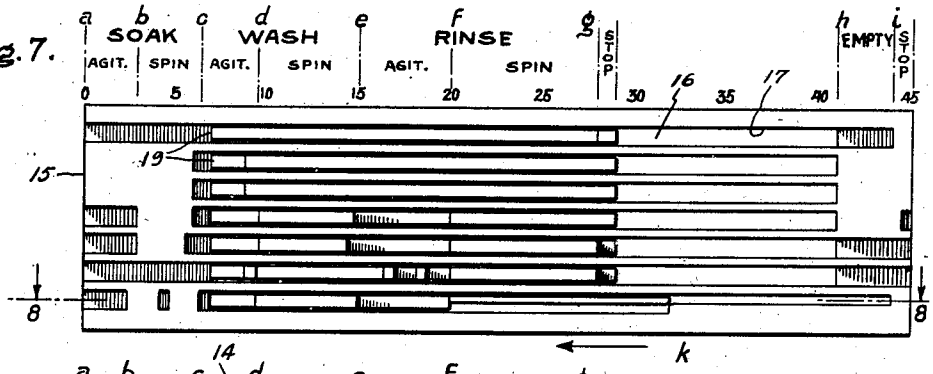


Fig. 8.

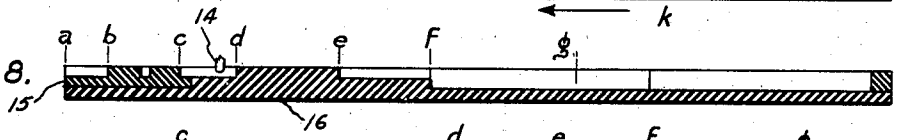


Fig. 9.

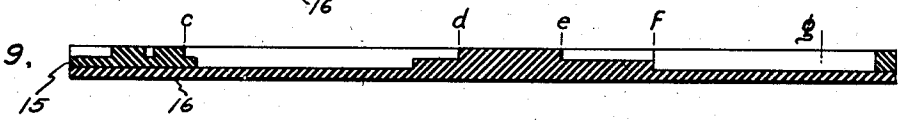
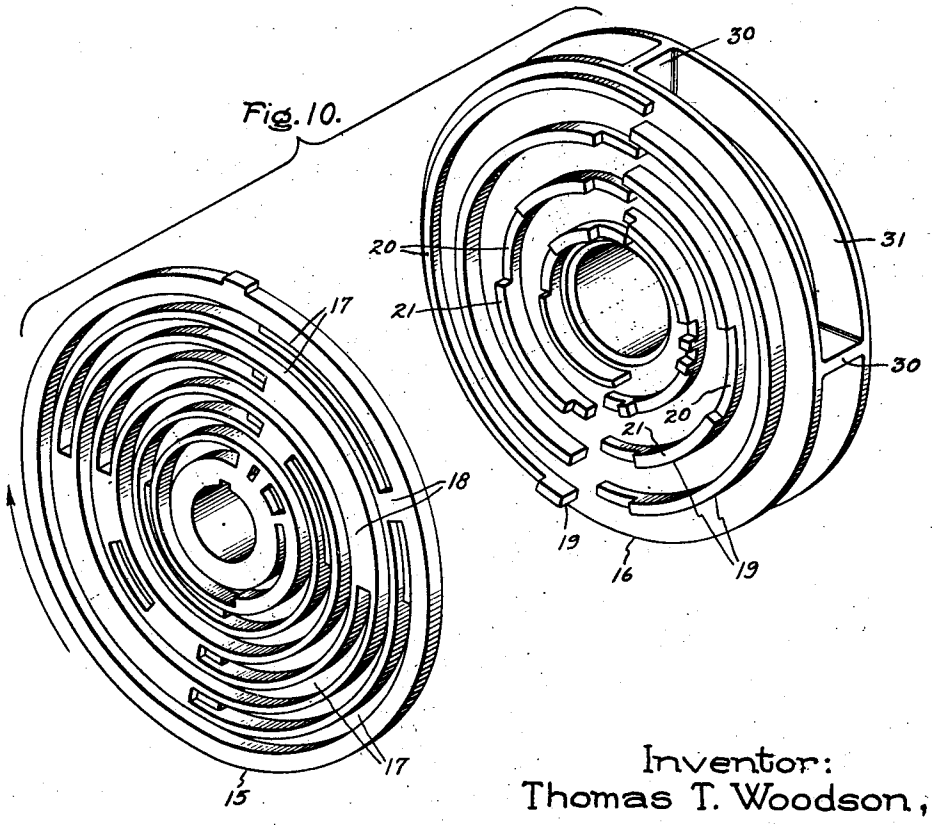


Fig. 10.



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UNITED STATES PATENT OFFICE

2,429,084

ADJUSTABLE CAM

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Application March 1, 1946, Serial No. 651,155

3 Claims. (Cl. 74—568)

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The present invention relates to automatic control mechanism for initiating and timing a cycle of operations. It is especially well adapted for use in connection with automatic domestic clothes washing machines.

In the automatic operation of domestic washing machines, the washing of the clothes in soapy water is an intermediate operation which is preceded and followed by one or more other operations. Such preceding and following operations may be each for a predetermined fixed period of time. The intermediate washing operation, however, should be adjustable as to time so as to permit the operator to, in advance, set the length of the washing time for a period suited to the clothes being washed.

The object of the present invention is to provide an improved automatic control mechanism which can be quickly and easily set to adjust an intermediate operation of a cycle of operations for the desired length of time; and which at the same time is simple in structure and reliable in operation.

For a consideration of what I believe to be novel and my invention, attention is directed to the following specification and to the claims appended thereto.

In the drawing, Fig. 1 is a side elevation, partly in section of an automatic control mechanism embodying my invention; Fig. 2 is a rear view with parts broken away for illustrative purposes; Fig. 3 is a front view of the control dial with parts broken away for illustrative purposes; Fig. 4 is a front view of the dial with parts in a position different from that of Fig. 3; Figs. 5 and 6 are views on an enlarged scale of parts of the structure showing the parts in two different positions; Fig. 7 is a developed view of the control cam surfaces; Figs. 8 and 9 are longitudinal section views taken on line 8—8 of the developed cam surfaces as shown in Fig. 7, illustrating parts in two different positions, and Fig. 10 is a perspective view of the two members which go to make up the cam surfaces.

Referring to the drawing, 1 indicates a back plate or base on which is mounted a suitable timing motor 2 connected through reduction gearing 3 to a timing gear 4 which has its hub keyed to a timing shaft 5. The gearing is proportioned to turn timing shaft 5 at a desired speed. For example, one revolution in forty-five minutes may be satisfactory for a usual washing machine cycle. Shaft 5 is rotatably carried in a sleeve 6 journaled in a hub 7 on plate 1. At its left-hand end (Fig. 1) sleeve 6 is provided with an integral flange 8

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which at its periphery carries a friction clutch ring 9 which engages the face of gear 4. The friction clutch ring is pressed into engagement with the face of gear 4 by a spring 10 positioned between gear 4 and a collar 11 on the adjacent end of shaft 5, the other end of shaft 5 having a flange 12 which abuts the end of sleeve 6. Thus it will be seen that timing shaft 5 is connected to sleeve 6 through a spring loaded disk clutch.

Fixed on plate 1 is a series of electric switches 13, seven being shown in the present instance. They are arranged in a straight line. The switches have operating buttons 14 which are biased to an "out" position and are pushed inward against the biasing force to actuate the switch mechanisms. Any suitable type of switch such as a snap action switch may be used and they may be connected into electric circuits to effect, in the case of a washing machine control, the several desired washing machine operations.

The switches are operated by a cam structure comprising two cam disks 15 and 16 shown in perspective in Fig. 10. Cam disk 15 is provided with a series of rings of concentric arcuate slots or depressions 17 between which are lands 18, there being one ring for each switch 13. The switch buttons 14 stand in line with such rings of slots and lands. When a button is in a slot, it wil be in its "out" position. When engaged by a land between two slots, it will be actuated to its "in" position. Thus each ring of lands and slots forms in substance an annular cam for actuating a switch. The slots and lands for the several rings are of different numbers and arrangements to give desired switch actuations as more fully explained hereinafter. Cam disk 16 is provided on its face with arcuate ribs 19 (Fig. 2) which are positioned in slots 17 of disk 15. Ribs 19 are of less circumferential extent than the slots 17 in which they are positioned so that disk 16 may be turned to a limited extent relatively to disk 15. In ribs 19 are depressions or recesses 20 (Fig. 10). Thus it will be seen that ribs 19 comprise depressions 20 and lands 21 which also form cams for actuating the several switches 13, the switch buttons 14 being "out" when in line with a depression 20 and being pushed "in" when in line with a land 21. There are thus provided in substance seven annular cams, one for each switch, each comprising lands and depressions on disks 15 and 16. The slots or depressions 17 in which projections 19 are located extend entirely through disk 15; the others need be deep enough only to receive the switch buttons 14 and are shown as not extending entirely through the disk.

Disk 15 has its hub 22 fixed to sleeve 6 by a key 23 so it turns with the sleeve. Disk 16 has its hub 24 journaled on hub 22. The two disks are held frictionally in engagement with each other with ribs 19 in slots 17 by a spring 25 positioned between the end of hub 24 and the adjacent wall of a cup-shaped dial 26 having a hub 27 fixed to sleeve 6 by key 23 and held against axial movement by a suitable washer 28 fixed in an annular groove at the end of sleeve 6. The cup-shaped dial 26 is keyed to the periphery of disk 15 as is indicated at 29 in Fig. 2. Attached to disk 16 by a plurality of radially extending ribs 30 is a sector 31 carrying legends visible through an arcuate window 32. Fixed to disk 16 by screws 33 which screw into ribs 30 is a knob 34 for turning disk 16 relatively to disk 15. Knob 34 has feet 35 through which screws 33 pass. Feet 35 extend through arcuate slots 36 in dial 26, the slots being of a length to permit of the desired turning of disk 16 with respect to disk 15. In this connection it is to be understood that the friction between friction ring 9 and gear 4 is greater than that between disks 15 and 16 so that whenever knob 34 is turned within the limits of slots 36, disk 16 will be turned relatively to disk 15. The two disks will be turned together by turning dial 26, slipping the clutch ring 9 on gear wheel 4.

Referring now to Figs. 5 and 6, there is shown a single cam ring on an enlarged scale for the purpose of illustrating the adjustment of the disks 15 and 16. The innermost cam ring is shown, the remaining cam rings being broken away. Disk 15 has the slots 17 between which are the lands 18. One slot 17 extends throughout the major portion of the circumference of the disk as indicated by line A. Beneath disk 15 is the disk 16 (shown shaded) having the lands 21 which project into such one slot 17 and between which are the depressions 20. In Fig. 5 disk 16 is shown as having been adjusted in a clockwise direction to its extreme position in this direction with respect to disk 15. Assume that the point *a* is the beginning of a cycle and that a switch is positioned with its actuating button at this point. Assume also that the disks are being rotated together in a clockwise direction by the timing motor. From point *a* to point *b* the switch button will be over a depression so that it will be in its "out" position; from point *b* to point *b'*, it will be over a land so it will be in its "in" position; from point *b'* to point *b''*, it will again be over a depression, and from point *b''* to point *c*, it will again be over a land. Up to this point, there have been four actuations of the switch and it will be noted that all these actuations have been effected by cam means on disk 15 alone. From point *c* to point *d* is a depression, this being the length of slot 17 between the trailing end of the land on disk 15 and the leading end of the land on disk 16. From point *d* to point *e* is a land on disk 16 and from point *e* to point *f* is a depression on disk 16. Beginning at point *f* is a land which continues until the cycle ends at point *g* due to the operation of other of the switches. It is to be noted particularly that the one actuation from point *c* to point *d* is from a point on disk 15 to a point on disk 16 and that the remaining actuations are between points on disk 16.

Referring now to Fig. 6, disk 16 is shown as having been rotated in a counterclockwise direction with respect to disk 15 which has resulted in increasing the length of the depression between *c* and *d*. The length of the other depressions and lands have remained the same. Thus the length of time of the intermediate operation occurring between points *c* and *d* has been increased. In the case of an automatic washing machine, this would be the washing period. The period of time between points *c* and *d* in Fig. 5 would be the minimum washing time. The period of time between points *c* and *d* in Fig. 6 would be the maximum washing time. By intermediate adjustments of the distance between points *c* and *d* intermediate lengths of washing times may be obtained. The cycle may be repeated by turning the two dials 15 and 16 as a unit to again bring point *a* on disk 15 into line with the switch buttons.

In the present instance, seven switches 13 are shown, this being the number required to carry out the successive operations required for one desired cycle of operations. In the case of each switch, the positioning of it for the initial fixed length operation is effected by lands and depressions on disk 15; the positioning of it for the final fixed length operations is effected by lands and depressions on disk 16; and the positioning of it for the variable length intermediate operation is effected by depressions between lands, one of which is on disk 15 and the other on disk 16. In carrying out a cycle of operations an "out" position of a switch 13 may be either an open position or a closed position and likewise for an "in" position. Or a switch may close contacts in both its "out" and "in" positions. However, the arrangement of the switches must be such that the intermediate variable length operation is carried out when all switches are in their "out" positions.

Fig. 7 is a developed view of the cam surfaces. In Fig. 1, four of the switches 13 are shown as being on one side of the shaft axis and three as being on the other side which means that their initial or starting points for a cycle are displaced 180°. For purposes of illustration in Fig. 7, it has been assumed that all the switches are on the same side of the shaft axis, so their starting points are all together. The control mechanism is laid out for a washing machine wherein washing is performed in a basket by an agitator after which the basket is rotated at high speed for extracting water from the clothes. It may be a machine such as that shown in my application Serial No. 551,096, filed August 25, 1944, and the controller may carry out the operations shown in such application. There may be a soak period during which the clothes are first agitated in clean water and then spun to extract the water from the clothes; next a wash period during which the clothes are first agitated in soapy water and then spun to extract the soapy water from the clothes; and finally a rinse period during which the clothes are again agitated in clean water and then spun to extract the water. It is the "wash agitate" period which is adjustable as to length. The lands and depressions for the "soak agitate" and "soak spin" periods from *a* to *c* are a part of disk 15. The lands and depressions for the "wash spin" period, the "rinse agitate" period, and the "rinse spin" period from *d* to *g* are a part of disk 16. The depressions for the adjustable "wash agitate" period from *c* to *d* are those between the trailing ends of the final lands of disk 15 and the leading ends of the initial lands on disk 16.

Figs. 8 and 9 represent sections taken on line 8—8, Fig. 7, showing the two disks 15 and 16 in the two extreme adjusted positions corresponding to Figs. 5 and 6 respectively.

As is clear from Fig. 7, all the switches are not

actuated simultaneously at the beginning of an operation, some being actuated slightly ahead of others. This enables a desired change sequence in the circuit connections for initiating a new operation of the machine. However, from Fig. 7 it will be seen that in the case of each cam ring, the "wash agitate" cycle begins at *c* at a depression and ends at the beginning of a land at *d*.

Referring to Figs. 3 and 4, the dial **26** carries legends between points *v* and *w* for the initial operations by disk **15**. This arc corresponds in extent to the depressions and lands on disk **15** for the initial operation. The sector **31** carries legends for the intermediate adjustable operation and the final operations of disk **16**. Fig. 3 shows the dial adjusted for the minimum "wash agitate" period and Fig. 4 for the maximum "wash agitate" period.

Referring again to Fig. 7, after the machine stops at point *g*, the dials may be turned as a unit to a point *h* for a period which extends from point *h* to point *i*. This may be a period, in the case of a washing machine, during which water in the machine is pumped to a drain.

In the particular case for which the present control mechanism was laid out, it was desired that beyond point *f* (Figs. 5, 6, and 7), the particular switch actuated by the innermost cam ring be always in "in" position. To this end, disk **15** is provided with a land beginning at point *k* which also operates such switch and with which the adjacent land on disk **16** may overlap. Such an arrangement may be provided in connection with other of the cam rings if found desirable.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an automatic control mechanism, a cam structure comprising a first flat disk having therein on a plurality of concentric circles a plurality of concentric slots of lengths less than the circle on which they are located to provide a plurality of concentric lands and depressions, a second flat disk adjacent to a surface of the first

flat disk having concentric projections positioned in said concentric slots of lengths less than those of the slots in which they are located, said projections forming a plurality of lands, and means for turning the disks relatively to each other to vary the positions of the lands of the two disks with respect to each other and to vary the lengths of the spaces between the lands of the first disk and the lands of the second disk.

2. In an automatic control for a cycle of operations, a cam structure comprising a first flat member having a plurality of rows of slots therein which define cam depressions, surfaces of the member between said slots defining cam lands, a second flat member adjacent to a surface of the first flat member having projections thereon positioned in said slots to form cam lands said projections being of lengths less than the slots, and means for moving said members relatively to each other to vary the distances between the lands of the first flat member and the projections of the second flat member whereby the extent of the cam depressions between such lands and projections are adjusted.

3. In an automatic control mechanism, a cam structure comprising a first disk having over an arc thereof spaced slots which define lands and depressions for initial operations and a continuous slot on the circle of such arc, a second disk having over an arc spaced projections which are positioned in said continuous slot and form lands and depressions for subsequent operations, the arc of said projections being of less length than the slot in which they are located, and means for turning said disks relatively to each other to provide a depression of adjustable length between the lands of the respective disks for an intermediate operation.

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