July 14, 1931. J. LUCAS 1,814,757

AUTOMATIC SWITCH CAM

Filed March 5, 1929 3 Sheets-Sheet 1

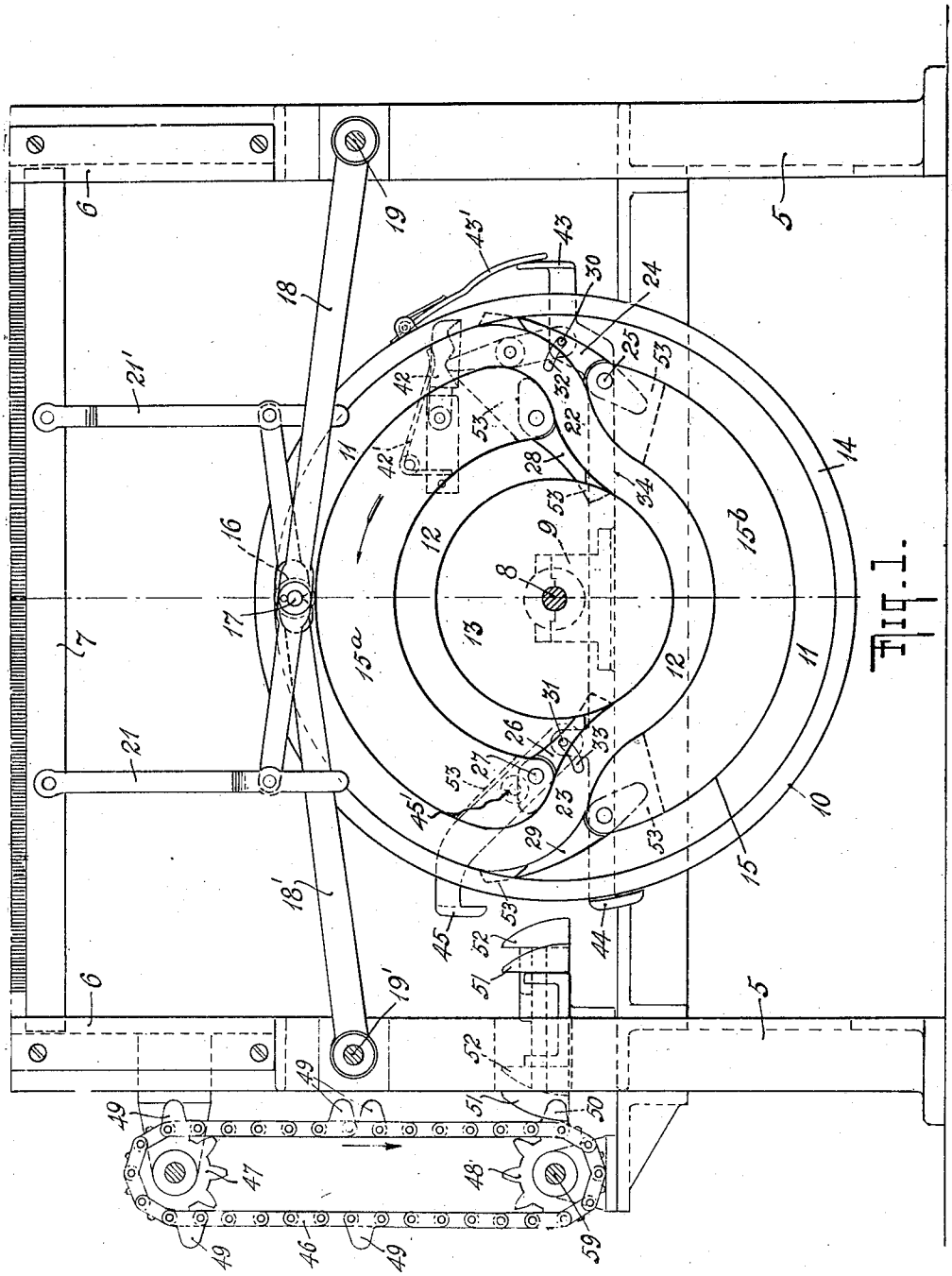


Fig. 1.

WITNESS
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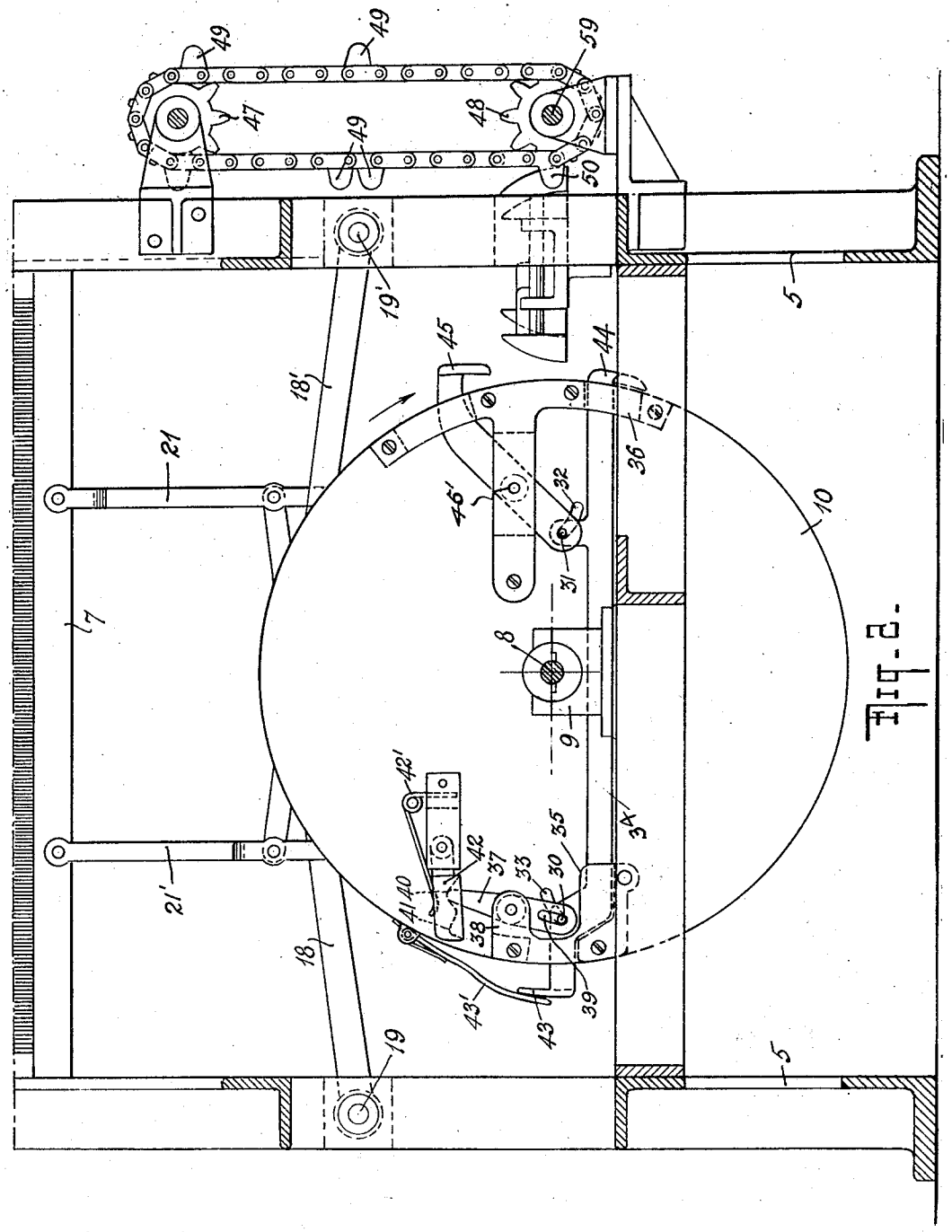


Fig. 2.

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AUTOMATIC SWITCH CAM

Filed March 5, 1929 3 Sheets-Sheet 3

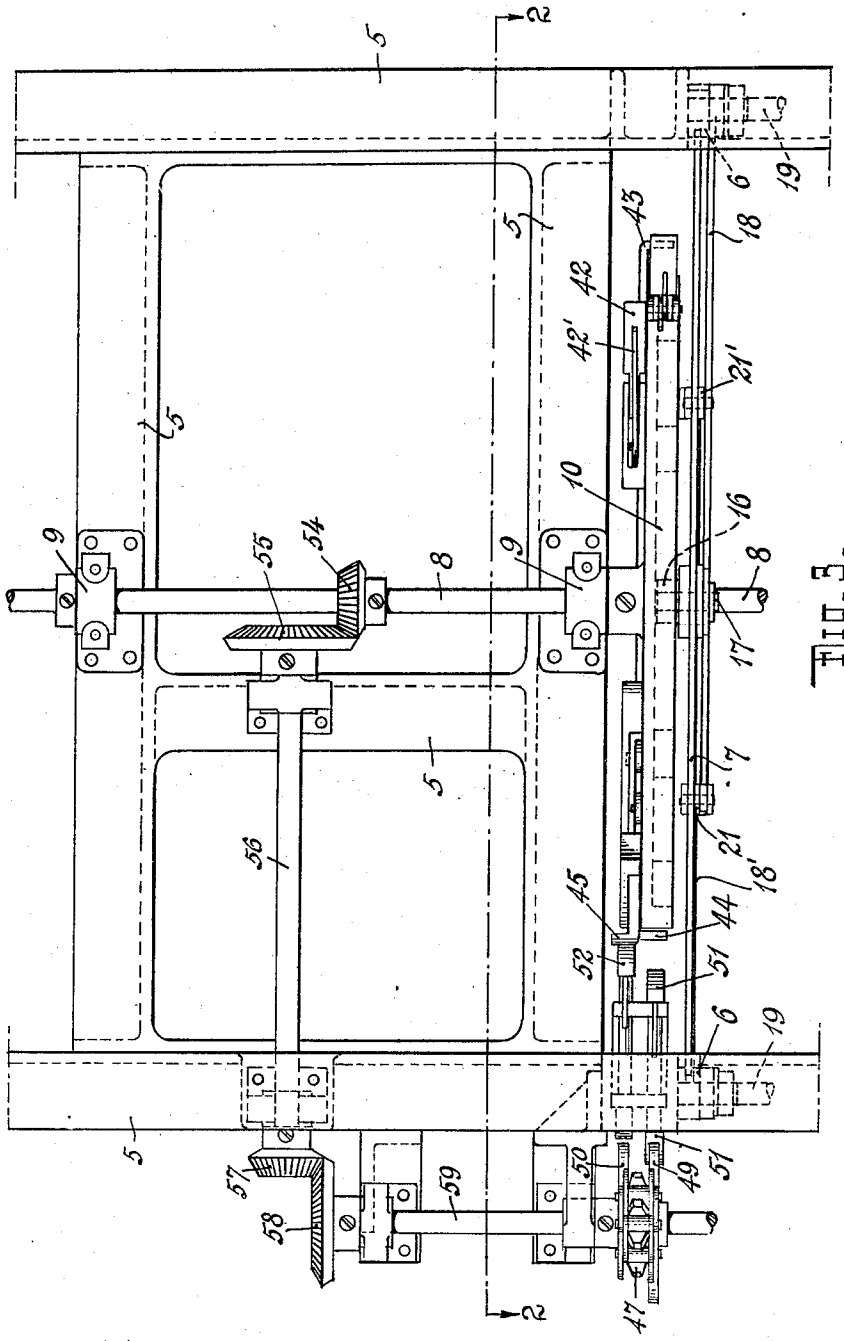


Fig. 5.

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Patented July 14, 1931 1,814,757

UNITED STATES PATENT OFFICE

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AUTOMATIC SWITCH CAM

Application filed March 5, 1929. Serial No. 344,150.

My invention relates to cam-operated mechanism of the type which is adapted to assume different positions or perform different movements alternatingly and more particularly to an automatic switch cam whereby such positions may be assumed and maintained or such movements performed in any desired sequence and for any predeterminable periods of time.

While my invention in its broader aspects is capable of being utilized to great advantage in numerous types of mechanisms and machines wherein one or more elements are moved to and maintained at different positions or are given different movements in regular sequence and for uniform periods of time, it is of particular advantage in those instances in which such positions or movements are assumed or performed in irregular sequence and for arbitrarily adjustable and variable intervals of time.

It is an object of the present invention to provide an automatic switch cam of this kind which is simple in construction, smooth and positive in operation and so extremely compact that a large number of them may be arranged upon the same driving shaft within a limited space to operate a large number of movable elements of a machine.

In order that my invention may be better understood I shall describe the same in connection with a loom, and more specifically with the harness movement of such machine. In the accompanying drawings which show, by way of example, my novel switch cam in association with a machine of this type, Fig. 1 is a front elevation of my improved automatic cam and a portion of the harness frame of a loom operated thereby; Fig. 2 is a rear view thereof taken along the line 2—2 of Fig. 3, and Fig. 3 is a plan view of the same and associated driving mechanism.

In the simple type of loom, designed to weave such materials as muslin and cambric, the warp threads are drawn off a warp beam journalled at one end of the loom and divided into two sets of alternate threads which, at a point intermediate the length of the machine, are threaded through two harness frames, the other ends of the threads being wound on a cloth or take-up roller journalled at the other end of the machine, as shown in my Patent No. 1,623,258, dated April 5, 1927. These harness frames are arranged to be moved in alternate and reverse directions to produce the shed, through which a properly synchronized shuttle is shot or projected, or positively moved as shown in my above-cited patent, to lay the filler or weft threads across the warps, after which the beater mechanism is operated to compact the filler threads.

In a loom of this kind, each harness frame is given a regular alternate movement up and down, the frame being maintained in its upper or lower position sufficiently long to permit the shuttle to pass through the shed and the beater to act, whereupon the harness is reversed. The cloth so produced has a weave of simple character, the warp yarns passing alternately over and under the filler threads.

In the weaving of more complicated patterns, the harness frames are maintained in their adjusted positions during two or more picks of the machine, while greater complexity of design may be obtained by dividing the warp threads into more than two groups, each group being connected to a separate harness frame, and moving each frame independently of the other frames. It will be apparent that by employing a large number of frames and by imparting to each frame, or group of frames, different cyclic movements from those of the other frames or groups of frames, i. e. by controlling the intervals of time during which each particular frame remains in its upper or lower position—very beautiful patterns may be woven. The illustrated embodiment of the present invention shows a preferred cam construction for operating the harness frames to produce the shed whereby the up and down movement of each frame may be controlled according to a selected pattern, the cam mechanism being so compact that a large number of cams may be housed within a comparatively small space, so that a correspondingly large number of harness frames may be employed and consequently

designs of great intricacy and variety obtained.

In the drawings the numeral 5 indicates a portion of the frame of the loom, such frame being provided with opposed vertical guides 6 within which slides a harness frame 7. A cam shaft 8 is journalled in bearings 9 supported in any suitable manner upon the frame of the machine. Mounted on the shaft 8 is a cam 10 having a pair of concentric cam grooves 11 and 12. The cam grooves are defined by a central boss 13, an external flange or ring 14 and an intermediate annulus 15. The grooves are of sufficient width to receive a follower or roller 16 upon whose spindle 17 are pivotally mounted, intermediate their ends, two levers 18 and 18′ which at their outer ends are pivoted upon pins 19, 19′ to the frame 5 of the machine. At their other ends the levers 18, 18′ are connected to links 21, 21′ which are pivoted to the harness frame 7. It will be evident that when the roller 16 is confined within the outer groove 11, the frame 7 will be in its raised position and will remain in such position so long as the roller remains in such groove; when the roller 16 is confined within groove 12 the frame will be in its lower position.

In accordance with the present invention I provide automatically operated mechanism for switching the roller 16 from one groove to the other, the roller remaining in either groove for predetermined lengths of time; after which said mechanism becomes operated to switch the same into the other groove; in other words, my improved automatic switch cam operates to keep the harness frame 7 alternately in lowered or in raised position for predetermined periods so that the warp threads connected to such harness frame can be raised or lowered after any desired number of picks. To effect such switching movement I provide a pair of circumferentially spaced, non-intersecting grooves or channels 22, 23, preferably diametrically opposed, designed to connect the grooves 11 and 12 to effect switching of the roller 16 from the outer groove 11 to the inner groove 12 and vice versa, respectively. The annulus 15 is thus divided into two sections 15*a* and 15*b*. A switch 24 is pivoted at 25 upon the annulus section 15*b*, the switch being movable into engagement with either the flange 14 or the annular section 15*a*. When in the position shown in Fig. 1, the switch 24 operates to switch the roller 16 from the groove 11 into the groove 12. It will be obvious that when the switch is engaged with the annulus section 15*a* the roller 16 will continue to travel within the groove 11 past the switch 24. To effect switching of the roller from the groove 12 into the outer groove 11, I provide a switch 26 pivoted at 27 upon the annulus section 15*a* at a point approximately diagonally opposite to the pivot 25; this switch, in the position shown in Fig. 1, operates to direct the roller 16 from the inner to the outer groove. The switch is movable against the annulus section 15*b*, in which position it permits the roller to travel within the groove 12 without switching the same into the groove 11, so that the harness frame connected to the roller 16 remains in its lower position. Bridge members or guiding switches 28 and 29 pivoted to the annulus are provided which operates to direct the roller 16 from the grooves 22, 23 into the grooves 11 and 12 respectively. These bridge members, as explained below, are engaged and shifted into proper position by the roller 16 itself.

In order to control the periods of time during which the rollers are retained in either of the grooves 11 or 12, i. e. for how many revolutions of the shaft 8 and consequently for how many picks of the machine, I provide mechanism for automatically operating the switches 24 and 26 at predetermined instants. In the embodiment of the invention illustrated in the drawings the switches are provided with pins 30 and 31 respectively, which pass through curved slots 32 and 33 in the cam 10 and likewise pass through apertures in a controlling lever 34 which is arranged to slide longitudinally along the rear face of the cam 10 and is retained by the guides 35 and 36 (Fig. 2). As indicated in the drawings, the curved slots 32 and 33 are at an angle to each other so that as the controlling lever 34 moves longitudinally it partakes also of a slight rotary movement in a plane parallel to that of the cam. The lever 34 is so connected with the switches 24 and 26 that both are in switching or in non-switching position at the same time. When the controlling lever is shifted to the right as shown in Fig. 1 (or to the left as shown in Fig. 2) the switch 24 is in operative position to switch the roller from the outer to the inner cam groove, while switch 26 is in position to switch the roller from the inner to the outer groove. In order to retain the controlling lever 34 in either of its end positions and prevent accidental movement thereof, I provide a detent mechanism in the form of a lever 37 pivoted to a bracket 38 fixed at the rear of the cam 10, the lever having an elongated slot 39 which receives the pin 30. The free end of the lever 37 is arranged to engage in either of two cam notches 40 or 41 cut within a pivoted arm 42 which is held in yielding engagement with the lever 37 by means of a spring 42′.

The lever 34 is provided at its opposite ends with tappets 43 and 44 for a purpose to be described hereinbelow. If desired a spring-pressed wear plate 43′ may be pivoted on the cam and so disposed as to cover the tappet 43. An additional or auxiliary controlling lever 45 is pivoted 45′ upon an extension of

the bracket 36 and engages the pin 31. The lever 45 is movable inwardly about its pivot to shift the pin 31 within its slot 32 and thereby operate the controlling lever 34 and the switches connected thereto. The end of lever 45 projecting beyond the circumference of the cam 10 is offset a short distance rearwardly of the tappet 44 (see Fig. 3).

Mounted at one side of the frame 5 is a timing chain 46 guided by sprockets 47 and 48, the shaft of the latter sprocket being preferably approximately in horizontal alignment with the shaft 8 of the cam 10. One or more lugs 49 are rigidly mounted upon the chain substantially in the plane of the tappets 43, 44, and one or more lugs 50 are similarly mounted in the plane of the offset end of lever 45 (see Fig. 3), and are adapted to engage sliding dogs 51 and 52, respectively, mounted upon the frame 5. The parts are so positioned and dimensioned that upon engagement of the sliding dog 51 by a lug 49 the former is shifted to the right into the path of either of the tappets 43 or 44 of the controlling lever 34. The parts are so timed that the lug will remain in engagement with the sliding dog 51 as either of such tappets comes into engagement with the opposite cam face of the dog, so that if the tappet is in its outer position it will be forced inwardly by the dog, the sprocket 48 taking up the thrust. In this way the controlling lever 34 and the switches 26 and 28 operated thereby are shifted into the reverse position. Upon continued movement of both the cam 10 and the timing chain, the lug 49 will be disengaged from the dog 51, so that as the other extremity of the lever 34 comes into registry with the dog it will move it toward the left idly without being itself displaced from its shifted position in which it is resiliently held by the detent mechanism 37, 42. The roller will then continue to travel along the same path during successive rotations of the cam 10 until the controlling lever 34 is again shifted.

In a similar fashion, the lug or lugs 50 will engage and shift the dog 52 to the right as shown in Fig. 1 and will remain in engagement with the dog until after the latter has forced the lever 45 inwardly to shift the controlling lever 34 to the left (Fig. 1). It will be seen by reference to Fig. 1 that during the time interval indicated by the distance between the lower left-hand lug 49 and the lug 50 the roller 16 has alternately traveled in one half of the groove 11 and in one half of the groove 12, so that the harness frame 22 has been shifted upwardly and downwardly during each revolution of the cam, i. e. for each two picks. In the position of the parts shown, the dog 52 has been forced to the right by the lug 50 and is in the path of the lever 45. Upon further rotation of cam 10, the lever 45 will be forced inwardly, i. e. rotated clockwise about its pivot, and thereby shift the lever 34 to the left, whereupon the switches 24 and 26 will be moved into inoperative position against the annulus sections 15*a* and 15*b*. The tappet end 43 will now be depressed and the end 44 extended. The roller 16 will therefore move past the switch 24 and will remain in the outer groove 11. When the roller 16 encounters the bridge member 29 it will throw the latter across the groove or channel 23 and thus travel smoothly past the same. The roller will remain in the outer groove 11 and the harness frame 7 will be held in raised position until the dog 51 is moved to the right by the first of the succeeding pair of lugs 49 shown on the right run of the chain, the lever 34 being then shifted upon depression of the tappet 44 by the dog and the switches thrown into operative switching poistion, the roller being then switched into the inner groove 12 by the switch 24. The tappet 43 is now in extended position. Before the roller (now in groove 12) reaches the switch 26, the second of the pair of lugs 49 engages the dog 51 and keeps it in shifted position, so that the tappet 43 is depressed by the latter and the lever 34 again shifted, this time to throw the switches into inoperative position against the annulus sections 15*a*, 15*b*. The roller will then travel smoothly past the groove 23, now closed by the switch 26, and when it approaches the groove 22 it will throw the bridge member 28 across such groove. The harness will now be held in its lower position until the controlling lever 34 is again shifted through the agency of either of the dogs 51, 52.

It will be clear from the above that by means of my improved cam switch and timing mechanism the harness frame can be held in raised or in lowered position for any desired number of picks. The pattern of the woven fabric will obviously depend upon the number and position of the lugs 49 and 50 on the timing chain 46.

Any suitable type of timing mechanism may be employed to effect movement of the switches 24 and 26 at the proper moments; if desired, a drum may be used in place of the timing chain 46, the drum having pins or lugs thereon which perform the same function as the lugs 49 and 50.

It will be noted that the switches 24 and 26 and also the bridge members 28 and 29 have curved faces which form continuously smooth curves with those faces of the boss 13, the annulus 15 and the outer flange 14 against which they contact. In this way the roller 16 is constantly confined to a definite path and is given a smooth and continuous movement free from shocks and jolts. In order to ensure such result, the free ends of the switches and bridge members are reduced in thickness and are received in channels or cutouts 53 in whichever of the elements 13, 15 and 14 they are thrown against; the shoulders

formed by such reduction in thickness may act as stops to limit the movement of such switches and bridge members.

The cam 10 and the chain 46 may be synchronized in any desired manner. In Fig. 3 the cam shaft 8 is shown as provided with a gear 54 which meshes with a gear 55 mounted on a counter-shaft 56 having a fixed pinion 57 thereon meshing with a gear 58 on the shaft 59 of the sprocket 48.

The extent of vertical movement of the frame 22 may be varied by varying the length of the levers 18 and 18′ between the pin 17 and the links 21 and 21′.

My improved switch cam can be made very thin, so that a large number may be arranged on the shaft 8 within a limited space, such cams being capable of operating twice their number and, with suitable connections, even more, of harness frames, so that very complicated and beautiful patterns may be woven with the aid thereof.

The cam grooves need not, of course, be circular or concentric though such is the case when my invention is applied to a loom; the grooves may have any form dictated by the requirements of the machine or mechanism with which the cam is to be used. My improved cam may, in general, be employed to produce rectilinear, oscillatory or rotary motion of alternating different distances, amplitudes or orbits and the appended claims are to be interpreted as broadly as the state of the art will permit.

Variations may be resorted to within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. In combination, a shaft, a cam thereon having a pair of separate grooves and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, and a second switch pivoted adjacent to the other channel and movable across the other groove.

2. In combination, a shaft, a cam thereon having a pair of separate grooves and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, and a connection between said switches whereby the latter may be simultaneously operated.

3. In combination, a shaft, a cam thereon having a pair of separate grooves and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, and timing mechanism associated with said switches and synchronized with said shaft and operative to throw said switches into operative or inoperative position at predetermined instants.

4. In combination, a shaft, a cam thereon having a pair of grooves and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever connected to said switches, and timing mechanism associated with said switches and synchronized with said shaft and operable to shift said lever to throw said switches into operative or inoperative position at predetermined instants.

5. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, and a bridge member pivoted adjacent each channel and movable across the groove not crossed by the associated switch.

6. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent to each channel and movable across the groove not crossed by the associated switch, and a controlling lever connecting said switches whereby the latter may be simultaneously operated independently of said bridge members.

7. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent to each channel and movable across the groove not crossed by the associated switch, a controlling lever connecting said switches wherby the latter may be simultaneously operated independently of said bridge members, and timing mechanism operable upon said lever to shift the same at predetermined instants.

8. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent each channel and movable across the groove not crossed by the associated switch, a controlling lever connect-

ing said switches whereby the latter may be simultaneously operated independently of said bridge members, said lever being provided at its ends with tappets extending beyond the periphery of said cam, and timing mechanism adapted to engage either of said tappets at predetermined instants to effect shifting of the lever.

9. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent to each channel and movable across the groove not crossed by the associated switch, and a controlling lever connecting said switches whereby the latter may be simultaneously operated independently of said bridge members, said lever being provided at its ends with tappets extending beyond the periphery of said cam, timing mechanism adapted to engage either of said tappets at predetermined instants to effect shifting of the lever, and detent mechanism for resiliently holding said lever in its shifted position.

10. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent to each channel and movable across the groove not crossed by the associated switch, and a controlling lever connecting said switches whereby the latter may be simultaneously operated independently of said bridge members, said lever being provided at its ends with tappets extending beyond the periphery of said cam, and timing mechanism adapted to engage either of said tappets at predetermined instants to effect shifting of the lever, said mechanism including a slidable dog and a timing chain having lugs thereon engageable with said dog to shift the same into the path of said tappets.

11. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever connecting said switches and provided at its ends with tappets extending beyond the periphery of the cam, an auxiliary lever pivoted intermediate its ends upon said cam and engaging said controlling lever to shift and be shifted by the same, said auxiliary lever having a tappet end and extending beyond the periphery of the cam, and timing mechanism located at one side of said cam and provided with members adapted to engage and shift the tappets on either of said levers at predetermined instants.

12. In combination, a shaft, a cam thereon having a pair of grooves and a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever connecting said switches and provided at its ends with tappets extending beyond the periphery of the cam, an auxiliary lever pivoted intermediate its ends upon said cam and engaging said controlling lever to shift and be shifted by the same, said auxiliary lever having a tappet end and extending beyond the periphery of the cam but offset axially from the tappets on the controlling lever, and timing mechanism located at one side of said cam and provided with axially offset members adapted to engage and shift the tappets on either of said levers at predetermined instants.

13. An automatic switch cam comprising a disk having a pair of concentric grooves therein and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a shaft rigid with said cam for rotating the same, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, and timing mechanism associated with said switches and synchronized with said shaft and operative to throw said switches into operative or inoperative position at predetermined instants.

14. An automatic switch cam comprising a disk having a pair of concentric grooves therein and a pair of circumferentially spaced non-intersecting channels connecting said grooves, a shaft rigid with said cam for rotating the same, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever connected to said switches, and timing mechanism associated with said switches and synchronized with said shaft and operative to shift said lever to throw said switches into operative or inoperative position at predetermined instants.

15. An automatic switch cam comprising a disk having a pair of concentric grooves therein and a pair of spaced channels connecting said grooves, a shaft rigid with said cam for rotating the same, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever

connected to said switches, an auxiliary lever pivoted intermediate its ends upon said cam and engaging said controlling lever to shift and be shifted by the same, and timing mechanism located at one side of said cam and adapted to shift either of said levers selectively at predetermined instants.

16. An automatic switch cam comprising a disk having a pair of concentric grooves therein and a pair of spaced channels connecting said grooves, a shaft rigid with said cam for rotating the same, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, a controlling lever connected to said switches, an auxiliary lever pivoted intermediate its ends upon said cam and engaging said controlling lever to shift and be shifted by the same, said controlling lever having tappets extending beyond the periphery of said cam and said auxiliary lever having a similar tappet offset axially from those of the other lever, and timing mechanism located at one side of said cam and adapted to shift either of said levers selectively at predetermined instants, and including a pair of slidable dogs and a timing chain having lugs therein engageable with said dogs to move the same into the path of said tappets.

17. An automatic switch cam comprising a disk having a pair of concentric grooves therein and a pair of spaced channels connecting said grooves, a shaft rigid with said cam for rotating the same, a switch pivoted adjacent to one channel and movable across one of said grooves, a second switch pivoted adjacent to the other channel and movable across the other groove, and a bridge member pivoted adjacent to each channel and adapted to be moved across the groove not crossed by the associated switch, said switches and bridge members being adapted to be thrown across opposite ends of the respective channels to close the same to confine a roller in either of the concentric grooves.

18. Mechanism for reciprocating a reciprocable element comprising in combination a pair of intersecting levers pivoted to each other at the point of intersection, a roller mounted on the pivot connecting said levers, a shaft, a cam thereon having a pair of concentric grooves adapted to receive said roller and having a pair of spaced channels connecting said grooves, a switch pivoted adjacent to one channel and movable across one groove, a switch pivoted adjacent to the other channel and movable across the other groove, a bridge member pivoted adjacent to each of said channels and adapted to be moved across the groove not crossed by the associated switch, timing mechanism for operating said switches at predetermined instants, said levers being pivoted at one end thereof in fixed relation to said cam, and a reciprocable element operatively connected to said levers at the other end thereof.

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