United States Patent

Hindle et al.

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[54] LOOMS FOR WEAVING

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[52] **U.S. Cl.**.....**139/1,** 139/304

[51] **Int. Cl.**.....**D03d 51/02,** D03d 49/20

[58] **Field of Search**.....139/1, 1 E, 304, 313, 329, 139/324, 325

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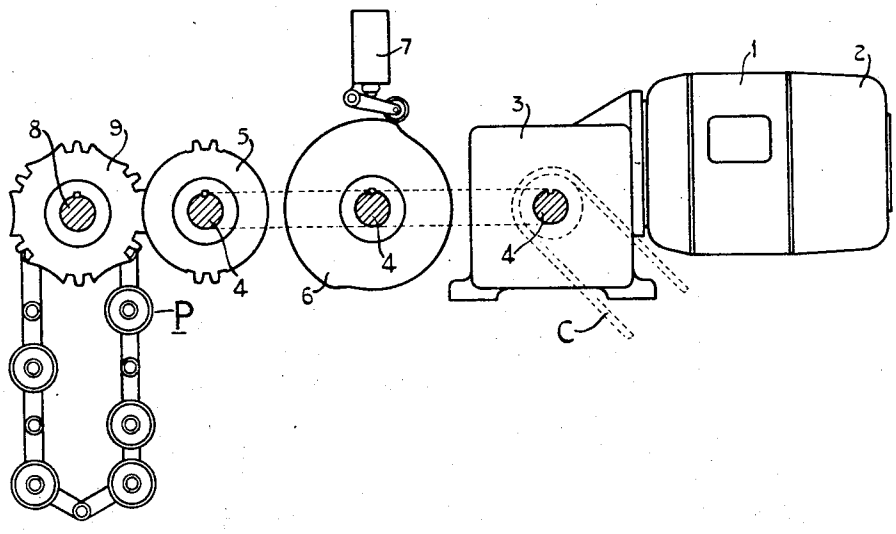
[57] **ABSTRACT**

A reversible drive mechanism for a loom component, for example a pattern barrel or a cloth take-up roll, which component is to be driven in stepwise manner at an appropriate time in the loom cycle comprises a drive motor for the component and an electrical control means whereby the motor is started and stopped periodically all in proper synchronism with the loom operation. The control means is of a kind which is self setting in that it includes a first two-position starting-switch adjustable between its two positions by a first actuator operable at predetermined times in the loom cycle and a second two-position stopping-switch adjustable between its position by a second actuator operable upon the completion of a requisite movement of the loom component, the switches being arranged in series with each other and with a solenoid coil for the motor contactor. Upon the completion of a required movement of the loom compartment, the second two-position stopping-switch changes over so that the electrical circuit to the drive motor is broken, the circuit being remade on subsequent change-over of the first two-position starting-switch.

Hand-operated switchgear is provided to enable the motor, or motors, to be electrically reversed, whereby the loom component, or components, may be caused to rotate in either the forward or reverse direction, as required, the timing of the step-by-step movement in relation to the loom crankshaft being maintained for either direction of rotation.

18 Claims, 7 Drawing Figures



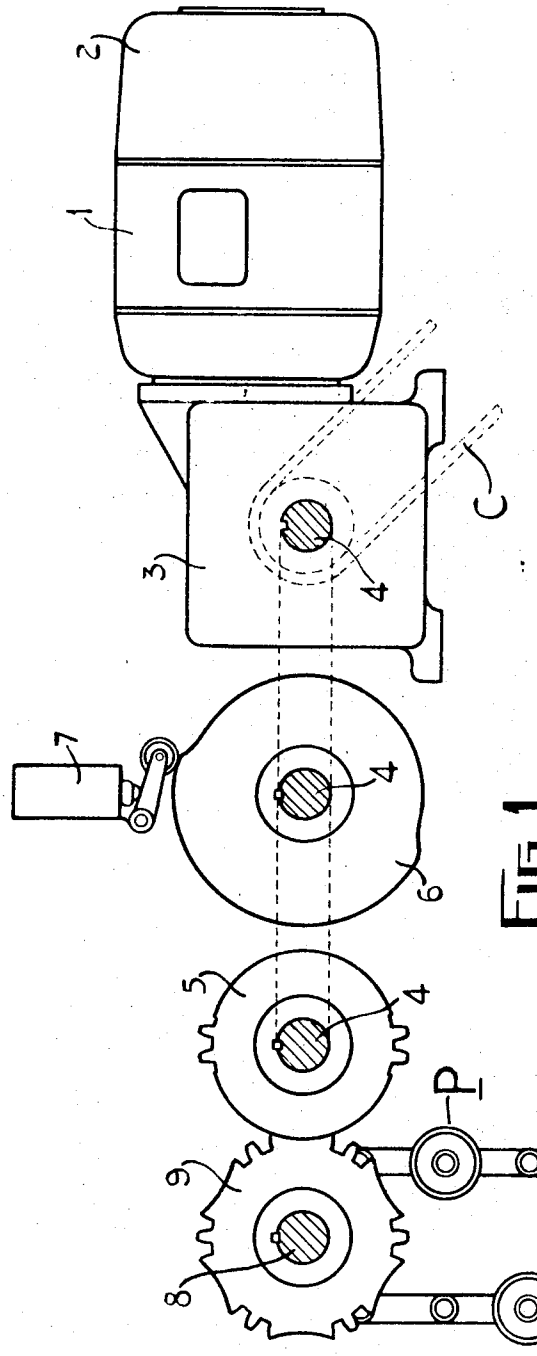


FIG. 1

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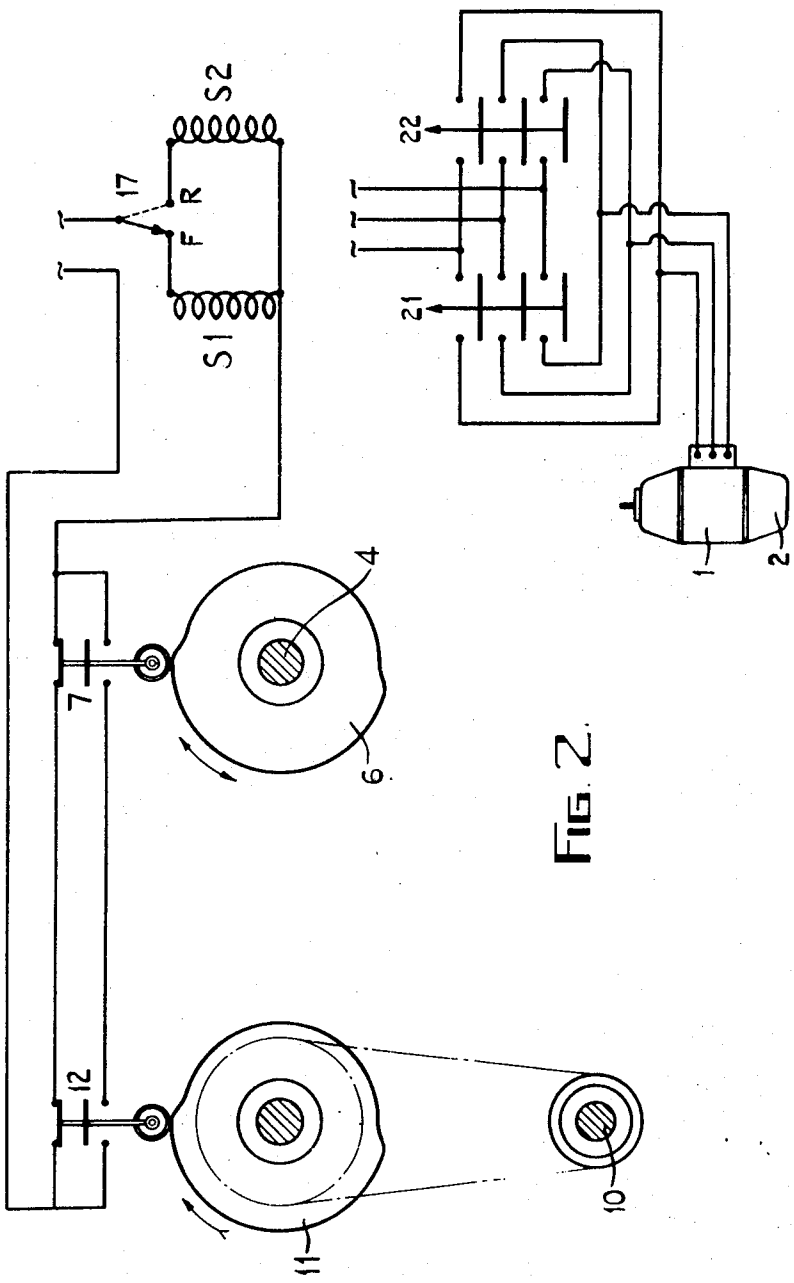

FIG. 2.

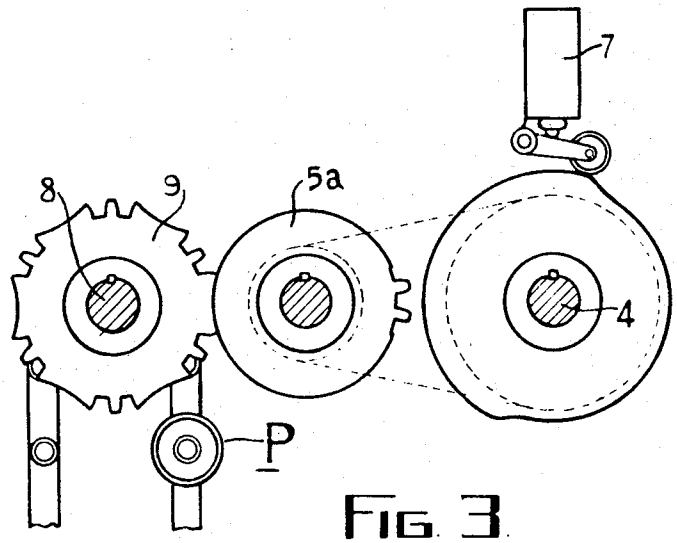

FIG. 3

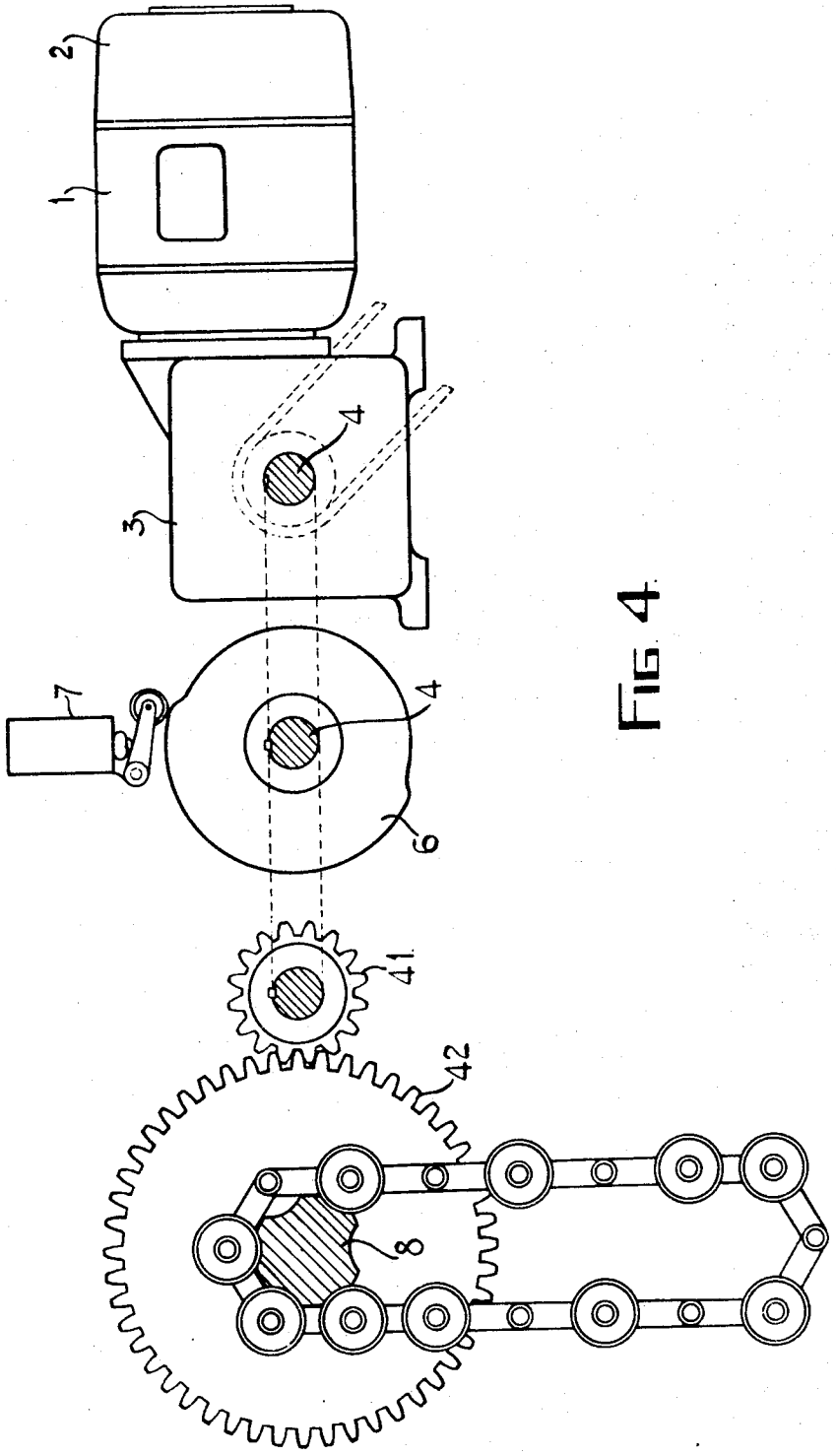

FIG. 4

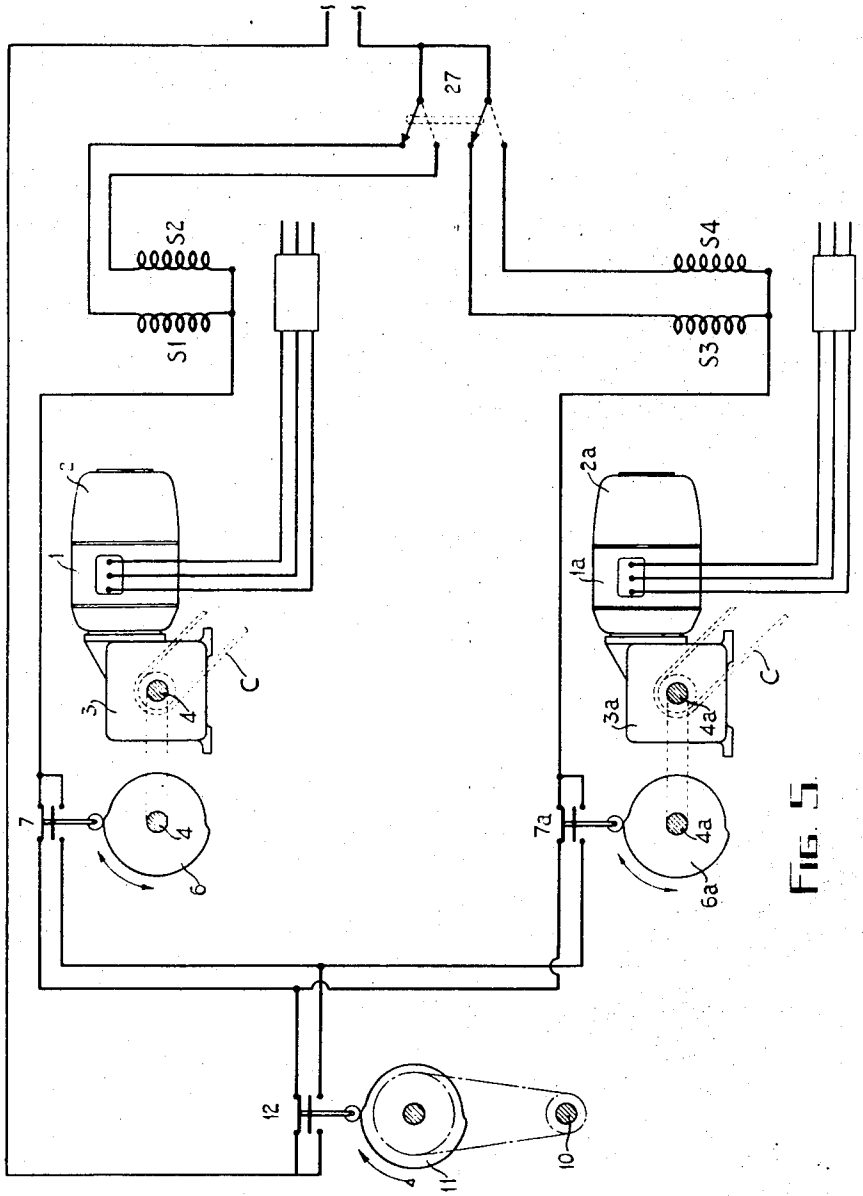

FIG. 5

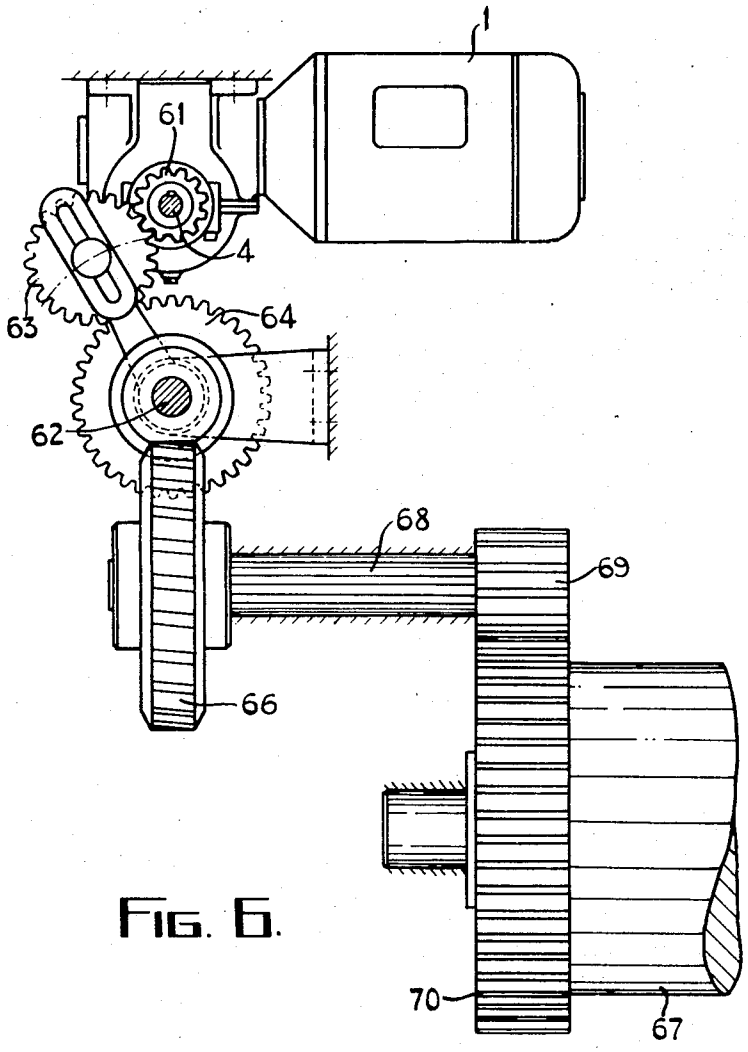

FIG. 6.

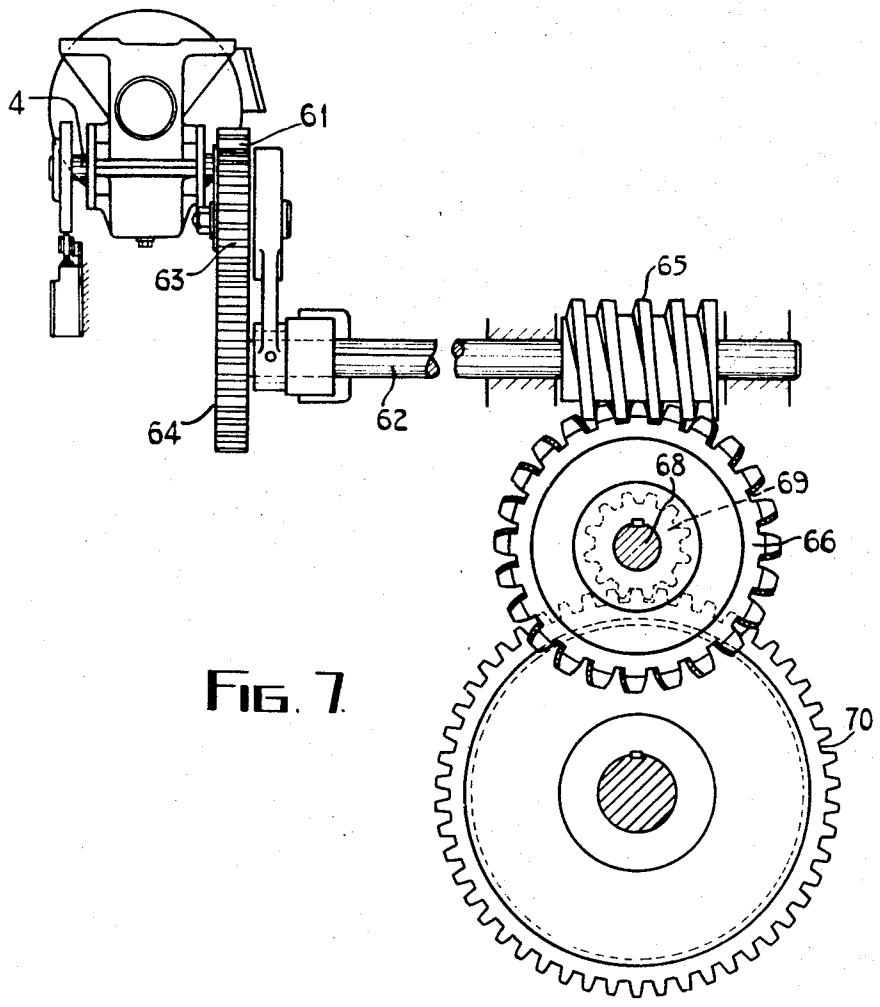

FIG. 7

LOOMS FOR WEAVING

This invention relates to looms for weaving, and more particularly to improved means for rotating, in either the forward or reverse direction, the pattern barrel or barrels of loom dobbies in exact synchronism with the loom crankshaft, which improved means may alternatively or additionally be employed for rotating the cloth take-up rolls of a loom.

The usual practice is to drive the pattern barrel or barrels and the take-up rolls from the loom crankshaft by purely mechanical transmission, the transmission including a clutch mechanism to enable the barrels and rolls to be reversed when necessary. Reversal of the barrel or barrels in this manner involves the provision of angular play, or lost motion, in the clutching and reversing arrangements, in order that the rotation of the barrel or barrels in both directions shall occur at the correct point in the loom cycle.

In the case of heavy and/or wide looms it is convenient to divide the dobby mechanism into two parts, one part being located at each end of the loom. This practice is advantageous because it enables the dobby components to be made more robust, and also more accessible. When, however the dobby mechanism derives its power and timing from the loom crankshaft and/or its conditional components are mechanically actuated by the pattern-chain, then it is necessary to locate one-half of the pattern-chain and, therefore, a pattern barrel, at each end of the loom. This duplication raises problems concerned with ensuring, at all times, correct synchronism of the two pattern barrels and their chains with each other and with the loom crankshaft. These problems are accentuated in practice because the barrels occasionally require to be mechanically declutched and re-clutched in the reverse direction for the purpose, for example, of removing faulty weft from the woven fabric.

According to the present invention a drive mechanism for a rotatable loom component, for example a pattern barrel or cloth take-up roll, adapted to advance such component in stepwise manner in synchronism with loom operation, comprises a respective electric drive motor drivingly connected with the component, and a control means for the said motor, the control means including two-position starting- and stopping-switches arranged in sequence, a first actuator means controlling the starting-switch and adapted cyclically to actuate the same in synchronism with loom operation and at a predetermined position in The loom cycle, and a second actuator means operable to actuate the stopping-switch upon the completion of a predetermined angular movement of the component, as initiated by actuation of the starting-switch, the switches being so arranged that on completion of a requisite angular movement of the component the second actuator means operates to cause the stopping-switch to open the electric circuit to the motor thereby to stop the latter, the circuit remaining open until the next succeeding actuation of the starting-switch by the first actuator means whereon the motor is again started.

Each pattern barrel, or equivalent device, is positively rotated in a step-by-step sequence by a respective electric motor driving through a speed reducing gearbox and through final gears, the barrel being turned

through any appropriate fraction (such as one-sixth or one-eighth) of a revolution in synchronism with a continuously revolving controlling-shaft, such as a loom crankshaft, every time the motor is started. The motor is started in response to the changing-over of a two-way starting-switch actuated by a timing-cam which revolves continuously at one-half the speed of the controlling shaft, and is subsequently stopped in response to a two-way stopping-switch being duly changed-over by a stopping-cam, driven by the motor itself, upon such stopping-cam having completed its allotted half-revolution, which it may readily be arranged to do within a pre-determined fraction of the time occupied by one complete revolution of the controlling shaft. The motor is provided with a brake which is released when the motor is energized and applied when it is subsequently de-energized, thereby serving to bring the motor and its associated gearing promptly to rest.

In response to the above mentioned cam-actuated change-over switches, the power supply to each such motor is controlled by a pair of three-pole contactors, whereby the motor may be caused to rotate in either direction as determined by a hand-operated two-way switch which provides the choice of either forward or reverse direction of the barrel's step-by-step rotation. As will be apparent, this hand-operated reversing-switch is of the multi-pole type when controlling more than one motor.

Since each rotary step of the pattern barrel is initiated by the continuously revolving timing-cam at an appropriate point in the loom cycle, such timing is exactly maintained when the motor is reversed in order to reverse the barrel and its pattern-chain.

When two such motorised pattern barrels are to be driven in synchronism with each other and with the controlling shaft, both motors are started in response to the one starting-switch actuated by the continuously revolving timing-cam, but subsequently each motor is independently stopped when its self-driven stopping-cam, having completed its allotted half-revolution, duly changes-over its own stopping-switch, thereby switching-off its operative contactor and de-energizing the motor and its brake.

Even when a single pattern barrel, located at one end of a loom or in any other convenient position, is adapted by electrical means to control the conditional components of both parts of a two-part dobby, it is nonetheless convenient to rotate the barrel in the manner herein described because of the facility with which the barrel's direction of rotation may be reversed, while maintaining its correct timing in relation to the loom crankshaft, either occasionally for the purpose of removing faulty weft, or at specified intervals as a routine feature of the weave pattern.

The cloth take-up rolls may be driven from the described mechanism of a motorised barrel, or barrels, by any suitable form of gearing, including change-gears as necessary to suit the desired pick density. In such case, reversal of the motor or motors serving to drive the pattern barrel or barrels reverses both barrels and take-up rolls simultaneously.

Alternatively, and preferably, the take-up rolls are driven by a separate electric motor provided with suitable speed-reducing gear and a cam-actuated stopping-switch, exactly as above described for the purpose of

rotating a pattern barrel, in which case the barrel or barrels and the take-up rolls can be reversed either together or independently, as required.

The take-up rolls of wide looms may be provided with central bearings, in which case each half-length is conveniently driven at its outer end through suitable reduction gearing by a separate electric motor. Both of these motors are readily synchronized with the loom crankshaft in the particular manner herein described.

The one change-over starting-switch actuated by a timing-cam revolving continuously at one-half of the crankshaft speed may serve to start all the motors employed on any one loom for driving the barrel or barrels and the single or double-ended take-up rolls, but each such motor, is subsequently stopped by its own stopping-switch when the cam it drives has completed the allotted half-revolution.

In a modification, one timing-cam and starting-switch is provided to start the motorised barrel or barrels, and another timing-cam with its own starting-switch is provided to start the motorised take-up. This duplication of the timing-cams, which both revolve continuously at one-half of the crankshaft speed, enables the motorised barrels and the motorised take-up to be energized at different points in the loom cycle, as is desirable in some applications of the invention.

The invention will now be described further, by way of example only, with reference to the accompanying drawings, of which:

FIG. 1 shows, diagrammatically, one form of motorised pattern barrel;

FIG. 2 is a diagram of the circuitry employed for one motorised pattern barrel or a single-ended take-up motion;

FIG. 3 shows a modified form of intermittent gears for driving the pattern barrel or barrels;

FIG. 4 is a view corresponding to FIG. 1 showing an alternative drive connection to the intermittent gears shown in FIGS. 1 and 3;

FIG. 5 is a diagram of the circuitry employed for two motorised pattern barrels, or one motorised barrel and one motorised single-ended take-up motion, or a double-ended take-up motion powered by two separate motors; and

FIGS. 6 and 7 are front and end elevations respectively of the drive transmission for a motorised single-ended take-up motion embodying the invention;

Referring to FIG. 1, an electric motor 1 is provided with brake 2 which is released when the motor is energized, and automatically re-applied when it is subsequently de-energized.

The motor 1 drives an output-shaft 4 through a speed reducing gear-box 3. Fixed on the output-shaft 4 are a stopping-cam 6 and a pinion or driver-gear 5, which latter meshes with and drives a space-gear 9 fixed on a barrel-shaft 8, which, in this example, rotates in 60° steps, and moves a pattern chain P one pitch or step at a time.

The shaft 4 is rotated by the motor a half-revolution at a time, as determined by the stopping cam 6, the cam 6 actuating a change-over stopping-switch 7.

Referring to FIG. 2, a controlling shaft 10, which in the case of a loom is the crankshaft, revolves continuously and drives a timing-cam 11 through a 2:1 reduction gear and, therefore, at half the speed of the controlling shaft 10. The timing-cam 11 actuates a change-over starting-switch 12, which latter is thus changed-over at each successive half-revolution of the cam.

Cams 11 and 6 have similar profiles, each comprising two sectors of slightly different radius joined by two short ramps spaced diametrically-opposite each other on the cam periphery. The displacement of the cams is such as to actuate i.e. change over, the starting-switch 12 and the stopping-switch 7, which, being provided with springs, follow the profiles of the negative cams.

The switches 7, 12 are of two-way or change-over effect, and are interconnected in the particular manner shown in FIG. 2. A hand-switch 17 in the circuit may be in either the F (forward) or the R (reverse) position, thereby determining whether contactor solenoid-coil S1 or S2 shall be energized and, therefore, the direction in which the barrel fixed on shaft 8 is to be rotated.

When the timing-cam 11 changes over the starting-switch 12, the circuit is completed through the then closed contacts in the stopping-switch 7, and thence through the pre-selected solenoid-coil, S1 or S2, this condition of the circuit being shown in FIG. 2. As a result, corresponding contactor 21 or 22 closes to energize the motor 1 and its brake 2. The motor continues to run, thereby rotating shaft 4 through a half-revolution, until the motion is terminated by cam 6 changing-over the stopping-switch 7, such changing-over switching-off the operative contactor which thus opens to de-energize the motor and its brake.

After the motor 1 has been stopped in the above manner, all the components indicated in FIG. 1 remain stationary until the continuously revolving timing-cam 11 (FIG. 2) has completed its current half-revolution, whereupon it again changes-over the starting-switch 12, thereby initiating a further step in the barrel's intermittent rotation, and so on.

The intermittent gears 5 and 9 shown in FIG. 1 are so proportioned that the increment of rotation of the barrel shaft 8 is one-sixth of a revolution while the driver-gear 5 and shaft 4 are turning through about one-half of their allotted half-revolution, the remaining half of such motion producing no movement of the barrel shaft 8.

In a modification, (shown in FIG. 3), the intermittent gears are so proportioned that the driver-gear 5*a* turns through a complete revolution while the space-gear 9 and barrel-shaft 8 are turned through one-sixth of a revolution. In such case, the cam 6 for actuating the limit-switch 7 is so geared as to rotate through a half-revolution while the modified driver gear 5*a* makes one complete revolution.

In a further modification (shown in FIG. 4) the intermittent gears 5 and 9 of FIG. 1 are replaced by an ordinary pair of spur-gears 41,42 having a ratio of three to one, in which case, the barrel shaft 8 will be turned through one-sixth of a revolution while shaft 4 turns through its full half-revolution.

Two such motorised pattern barrels may be operated in a step-by-step sequence in synchronism with each other and with the controlling shaft 10 in the manner shown by FIG. 5. The motors 1 and 1*a*, in the manner already described with reference to FIGS. 1 and 2, drive through their respective speed-reducing gear-boxes 3 and 3*a*, and rotate their output-shafts 4 and 4*a* through a half-revolution at a time, together with the

stopping-cams 6 and 6a, which actuate their respective stopping-switches 7 and 7a. Each motor is likewise provided with a pair of contactors powered by solenoid-coils S1, S2 and S3, S4, which are selected by the hand-operated double-pole change-over switch 27, according to whether the motors and the pattern barrels they drive are required to rotate in the forward or reverse direction.

In operation, the continuously revolving timing-cam 11 changes-over the starting-switch 12, whereupon the circuits for the selected solenoids (S1 or S2, and S3 or S4) are completed through the respective stopping-switches 7 and 7a. The motors thus simultaneously started, continue to run and to drive their respective stopping-cams 6 and 6a, which, upon completion of their allotted half-revolution, separately change-over their respective stopping-switches 7 and 7a, thereby switching-off the operative contactors and de-energizing their motors and brakes. Meanwhile, the timing-cam 11 continues to revolve and upon completion of its current half-revolution, the starting- switch 12 is again changed-over to initiate a further energization of the motors and, therefore, a further step in the synchronized rotation of both barrels.

The cloth take-up rolls may be driven by the barrel motor, or motors, in which case any convenient form of mechanical transmission, such as the driving chain C shown in FIGS. 1 and 5, may be employed to transmit the intermittent rotation of shaft 4 (or/and shafts 4a) to the take-up rolls.

Alternatively, and preferably, the take-up rolls are independently driven by a separate motor, or motors, controlled in the particular manner described with reference to FIGS. 2 and 5. The hand-operated reversing switch 27 of FIG. 5 has a separate pole for each motor to be controlled, or the motors for the barrel and take-up respectively may be separately reversed.

When the take-up motion is separately driven by its own motor, or motors, the intermittent rotation of shaft 4 is transmitted to the take-up rolls by mechanical gearing in the manner clearly shown in FIGS. 6 and 7, a gear 61 secured to the shaft 4 driving a rotatably mounted worm gear shaft 62 through gears 63 and 64, and the shaft 62 carrying a worm 65 in mesh with a worm wheel 66 drivingly connected with rolls 67 through a driven shaft 68 and meshing gears 69, 70. The stopping-cam 6 is seen in FIG. 6, such cam being co-operable with the two position stopping-switch 7 as before. The step down ratio of the gearing is dependent, as is well-known in the art, upon the effective circumference of the take-up rolls and the required pick-density.

The ratio of the speed-reducing gear-box 3 and 3a is chosen so as to cause the shaft 4 to rotate one-half of a revolution during the maximum time allowable for such operation, which depends mainly upon the uniform speed of the controlling shaft 10, and the mean speed attained by the motor during its brief running periods. It has been found in practice that the motors attain their normal average speed in approximately two cycles, that is, in about 0.05 second, assuming a 50 cycles/second electric supply. The improved driving means is suitable, therefore, for use on heavy and/or wide looms running at speeds up to about 60-picks per minute.

Although ordinary switches with moving contacts are indicated in the accompanying drawings, it is clearly within the scope of the present invention to substitute these by any known form of proximity switch or solid-state switching device.

What we claim is:

1. In a loom having a predetermined operating cycle, rotatable means and drive mechanism for effecting advance movement of the rotatable means in stepwise manner in synchronism with the operating cycle, comprising an electric circuit, an electric drive motor operably connected in said circuit, said electric drive motor being drivably connected with said rotatable means, and control means for said electric drive motor, said control means including a two-position starting switch, a two-position stopping switch arranged in sequence with the aforesaid starting switch, a first actuator means controlling the starting switch and adapted cyclically to actuate the same in synchronism with said loom cycle and at a predetermined position in said cycle, and a second actuator means operable to actuate the stopping switch upon the completion of a predetermined angular movement of said rotatable means, as initiated by actuation of the starting switch, said starting and stopping switches being so arranged that on completion of a requisite angular movement of said rotatable means the second actuator means operates to cause the stopping switch to open said electric circuit to the motor, thereby to stop the latter, said electric circuit remaining open until the next succeeding actuation of said starting switch by said first actuator means whereupon said electric drive motor is again started.

2. Apparatus according to claim 1 wherein said rotatable means is a pattern barrel.

3. Apparatus according to claim 1 wherein the rotatable means is a cloth takeup roll.

4. Apparatus according to claim 1, wherein the drive connection between the electric drive motor and said rotatable means includes a drive gear and a space gear co-operable therewith.

5. Apparatus according to claim 4, wherein said electric drive motor is provided with a drive shaft, and wherein said drive gear is secured to an output shaft driven from the motor shaft via a reduction gear.

6. Apparatus according to claim 4 wherein the drive gear and space gear are selected to give a requisite increment of rotation of the space gear for a half rotation of said drive gear.

7. Apparatus according to claim 4 wherein said drive gear is mounted for rotation on a respective driver gear shaft and said drive gear shaft is drivingly connected with an output shaft driven from the motor via a reduction gear.

8. Apparatus according to claim 7 wherein the drive gear and space gear and the drive transmission ratio between the drive gear shaft and said output shaft are selected to give a requisite increment of rotation of the space gear for a full revolution of the driver gear.

9. Apparatus according to claim 1 wherein said second actuator means comprises a stop cam rotatable synchronously with the drive motor.

10. Apparatus according to claim 9 wherein the stop cam is an edge cam and such cam has two equal sectors of different radii.

11. Apparatus according to claim 9 wherein said stop cam is mounted on an output shaft connected with the motor through a reduction gear.

12. Apparatus according to claim 1 wherein the first actuator means comprises a timing-cam drivingly connected with a continuously rotating shaft.

13. Apparatus according to claim 12 wherein the said timing-cam is an edge cam and has two equal sectors of different radii, each sector corresponding to a respective position of the related switch.

14. Apparatus according to claim 1 including a manually actuable reversing switch means for controlling the direction of rotation of the motor.

15. Apparatus according to claim 1, in combination with a second electric drive motor, rotatable means drivingly connected with said second electric drive motor and control means for said second electric drive motor, said latter control means comprising a two-position stopping switch, an actuator means operable to actuate the stopping switch upon the completion of a predetermined angular movement of the related rotatable means, said first actuator means and related two-position starting switch of the control means of said first electric drive motor being in circuit with the control means of said second electric drive motor.

16. Apparatus according to claim 15 including a manually actuable reversible switch means for controlling the direction of rotation of the motor.

17. Apparatus according to claim 1, wherein there are contacts operable to initiate operation of the electric drive motor and wherein said two-position stopping and starting switches are included in electric circuits containing a solenoid coil or coils for effecting operation of said contacts.

18. Apparatus according to claim 1, wherein said rotatable means comprises two rotatable means, one comprising a pattern barrel and the other a cloth takeup roll and wherein the pattern barrel and cloth takeup roll are driven in stepwise manner from said electric drive motor.

* * * * *