United States Patent

Hindle et al.

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[54] **LOOMS FOR WEAVING**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**.....**139/180,** 139/76

[51] **Int. Cl.**.....**D03d 43/04**

[58] **Field of Search**.....139/171, 180, 179, 178, 77, 139/76

[56] **References Cited**

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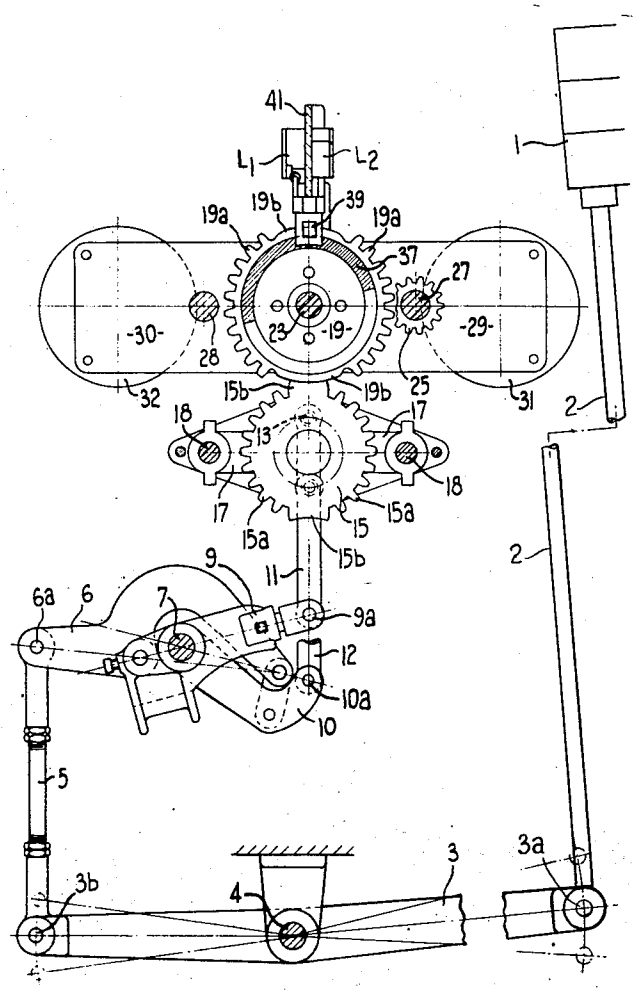
[57] **ABSTRACT**

A change-box loom has a displacement means for lifting and lowering the shuttle-boxes, the displacement means comprising one or more cranks or equivalent eccentrics couplable with a lever or combination lever connected with the shuttle-box, an individual drive motor for each such crank or equivalent eccentric and drivingly connected therewith, and a control means for energizing a selected motor or motors so as to rotate the or each related crank for a required change of cell, the control means operating to de-energize the motor or motors upon the completion of a half revolution of the crank and the drive coupling between the output shaft and the motor being arranged to ensure an accurate 180° rotation of the crank.

16 Claims, 6 Drawing Figures



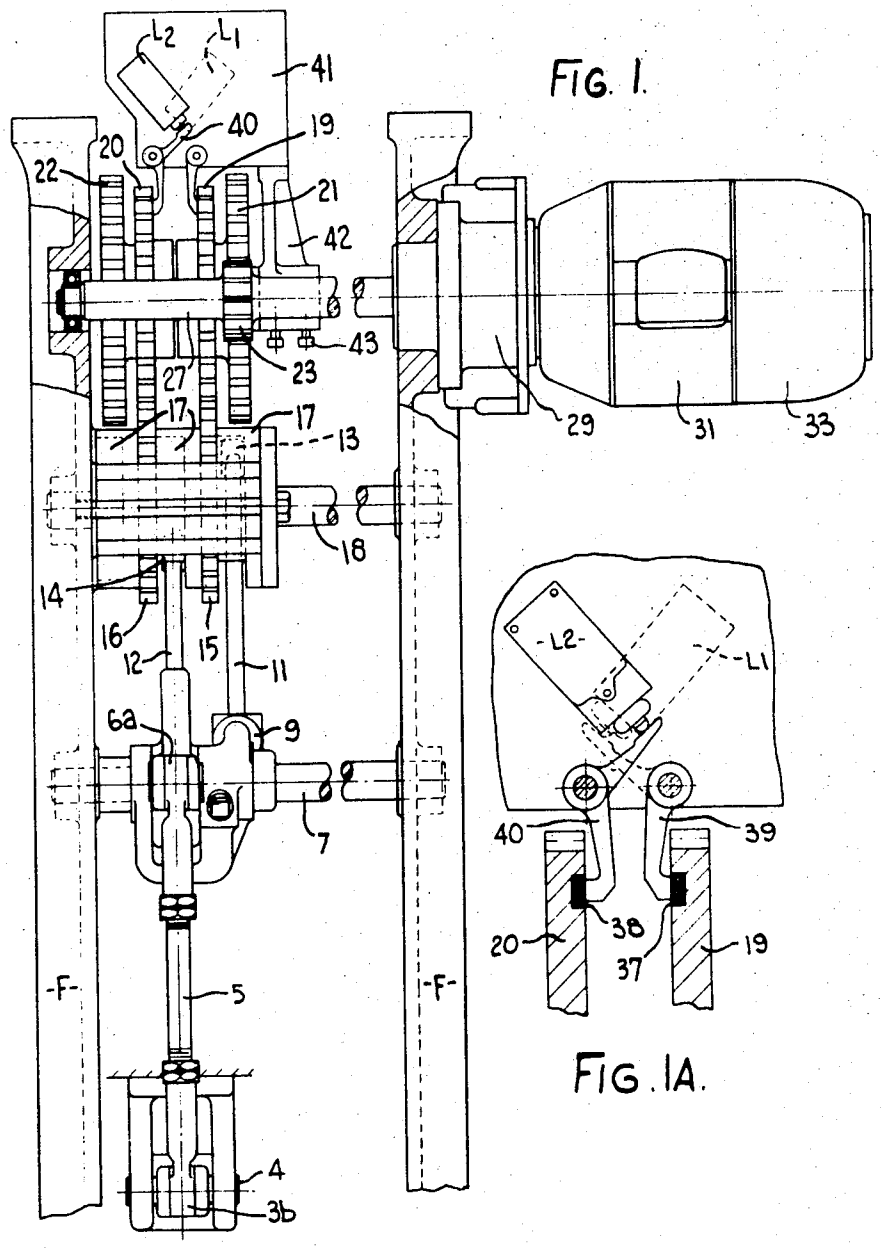


FIG. 1.

FIG. 1A.

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FIG. 2.

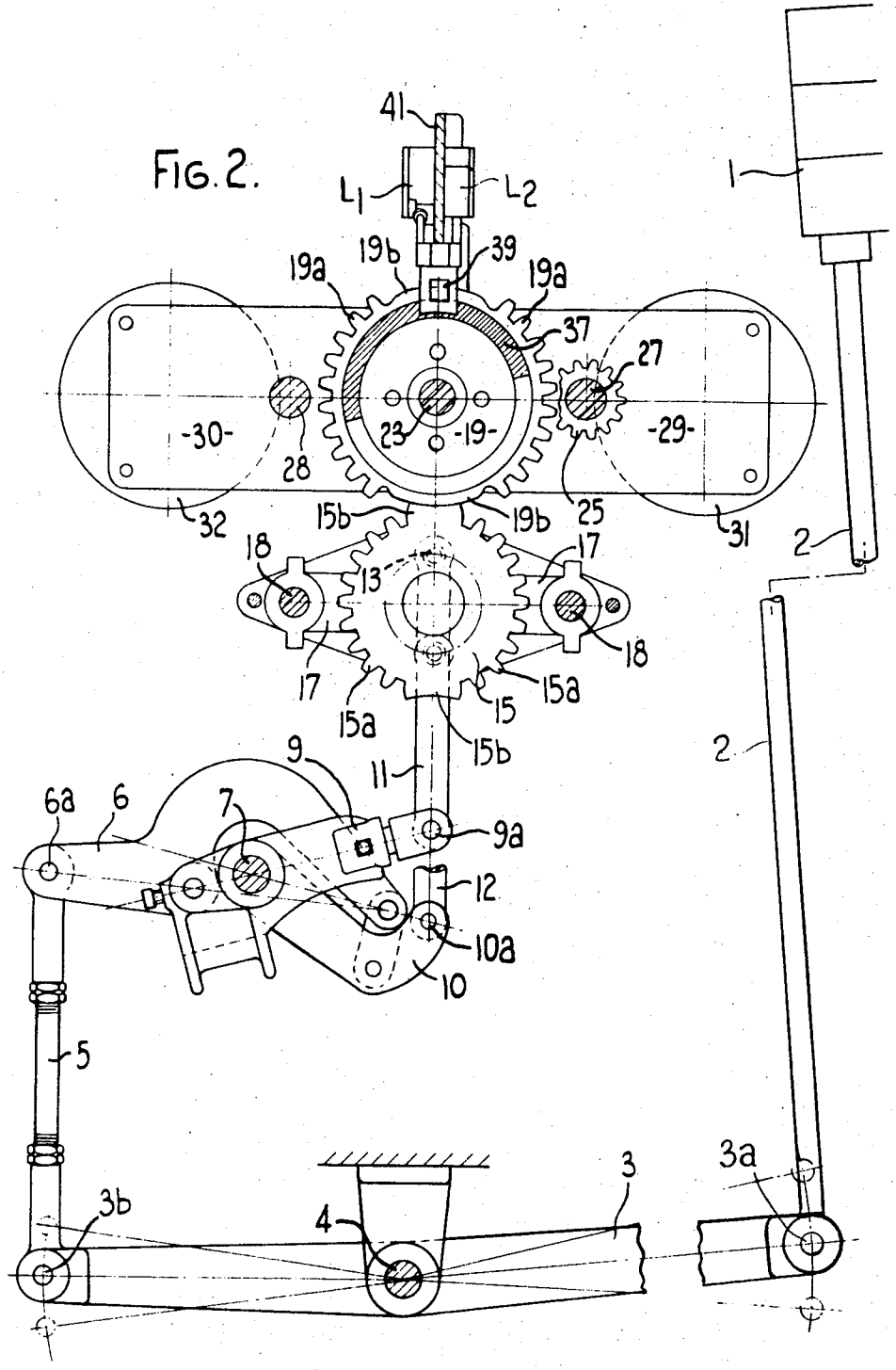
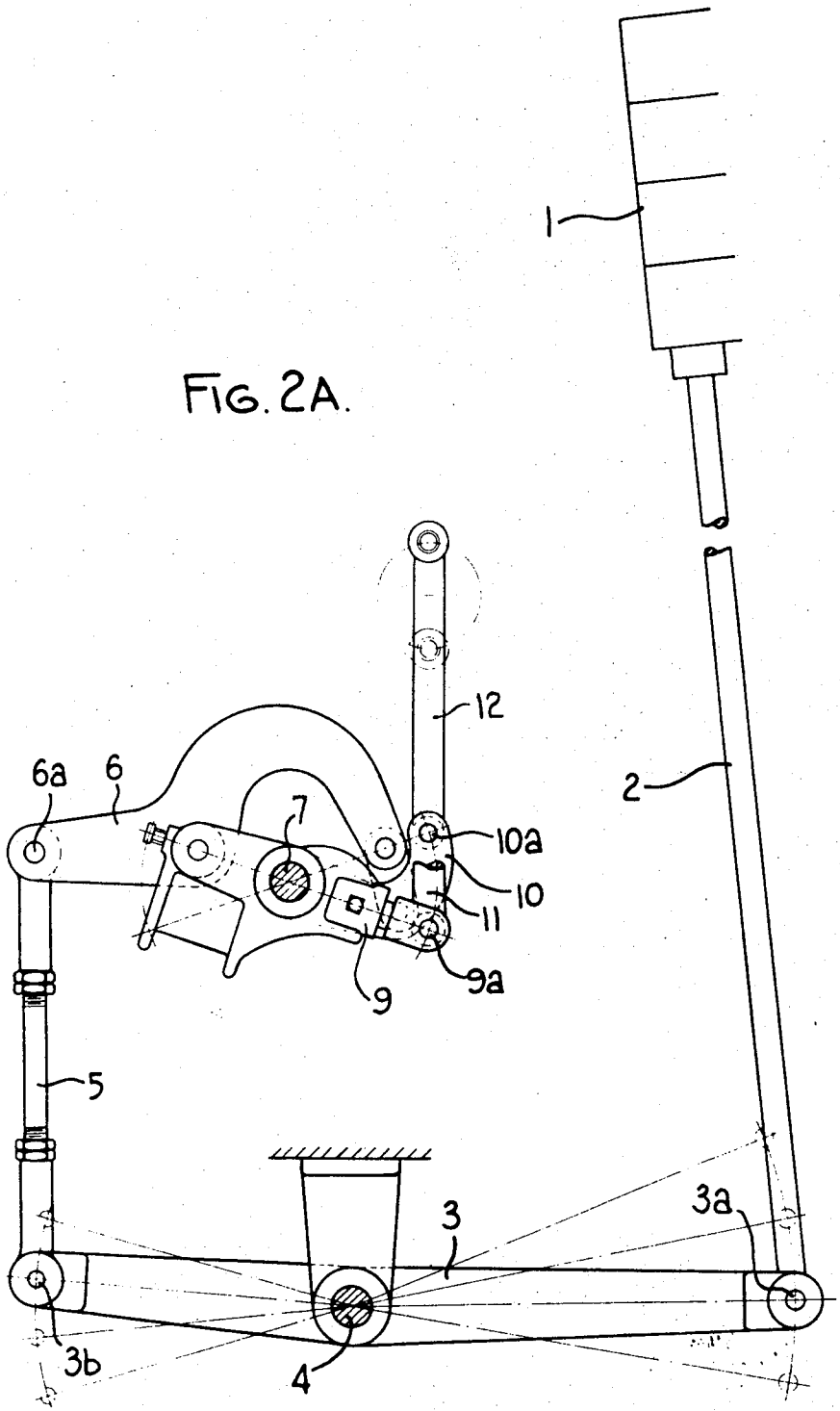

41
L1
L2
1
19a
19b
39
19a
37
27
-30-
23
-19-
-29-
28
32
15b
19b
25
31
2
18
13
17
18
17
15a
15
15a
15b
2
9
11
6a
6
7
9a
12
10a
10
5
3
3a
3b
4

FIG. 2A.



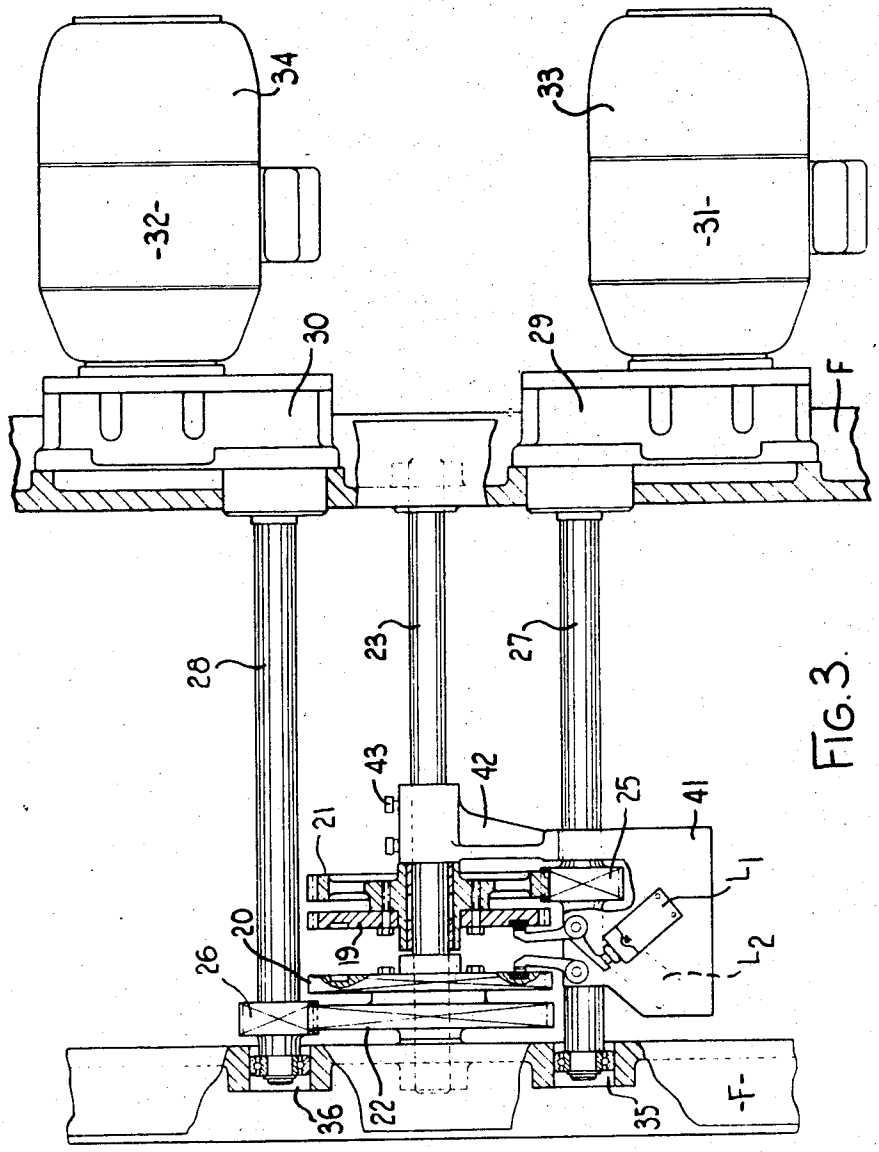
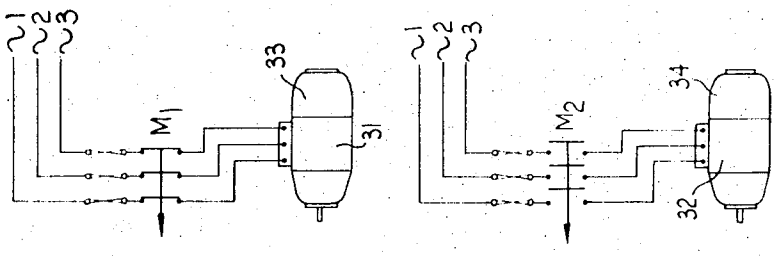


FIG. 3.


1
2
3
M1
33
31
M2
34
32

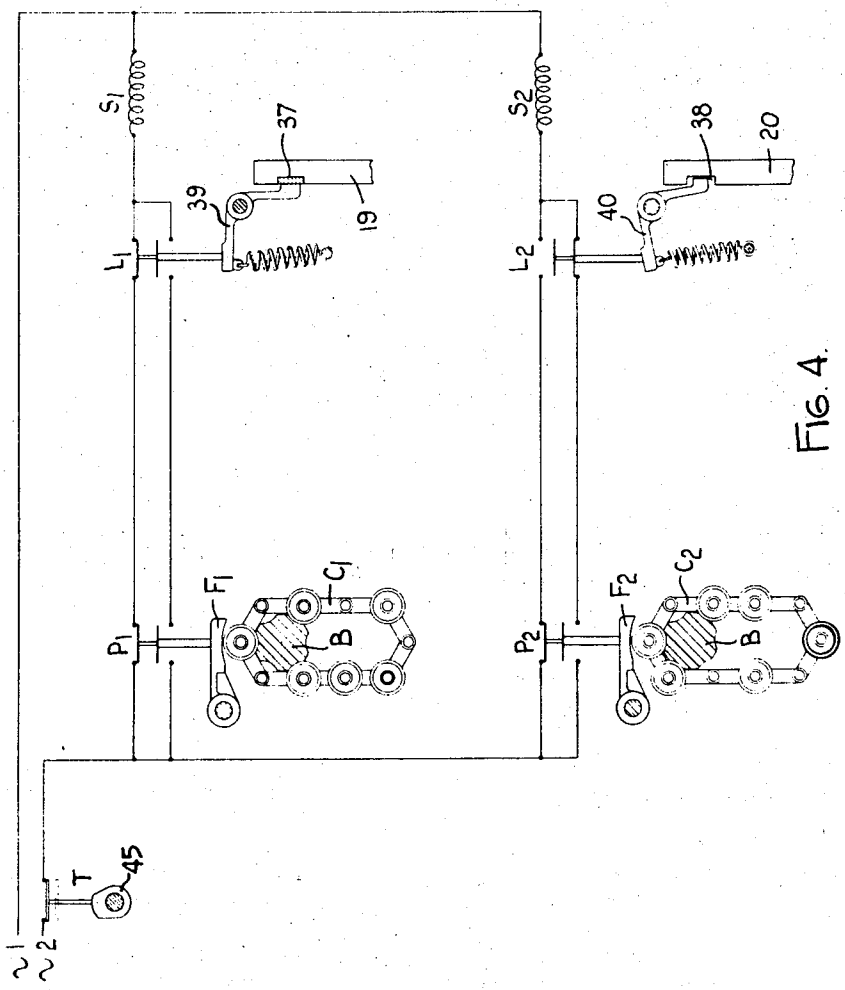

S1
37
39
19
L1
S2
38
20
40
L2
P1
F1
C1
B
P2
F2
C2
B
T
45
1
2

FIG. 4.

LOOMS FOR WEAVING

This invention relates to improvements in looms for weaving, and more particularly to improvements in means for the lifting and lowering of shuttle-boxes with two or more cells.

The usual practice is to operate a two-cell shuttle-box by a single crank or eccentric, and a three-or-four-cell shuttle-box by two cranks or eccentrics acting on various forms of combination lever or levers, the said cranks or eccentrics being rotated through a half-revolution at a time by mechanical clutch mechanism deriving power and timing from the loom crankshaft under the control of a patterning device.

According to the present invention a displacement means for lifting and lowering loom shuttle-boxes having two or more cells comprises one or more cranks (or equivalent eccentrics) couplable to a lever or combination lever connected with the shuttle-box the number of cranks being one in the case of a two-cell box and two in the case of a three-or-four-cell box, an electric motor in respect of each such crank and drivingly connected therewith, and a control means adapted to energize an appropriate motor or motors, and hence rotate the related crank, for cell change according to requirements and to de-energize the same after a half-revolution of the crank, the drive connection between a motor and its related crank including means adapted to ensure an accurate 180° movement of the crank on each rotation thereof. Thus a two-cell shuttle-box is actuated by a single crank powered by a single electric motor, and a three-or four-cell shuttle-box is actuated through any known form of combination lever or levers by two cranks each separately powered by an electric motor, the proportions of the combination lever or levers being selected according to the number of cells in manner known per se, the provision of a respective electric motor for each crank eliminating the intermittent mechanical clutch mechanisms necessary in conventional structures.

The electric motors for this purpose are each equipped with a friction-brake of known type which is released when the motor is energized and is applied by spring pressure when it is subsequently de-energized. The purpose of these brakes is to stop the motors reasonably promptly when they are de-energized but, as will be apparent from what follows, the stopping power of the brakes is not solely relied upon to ensure that the motor-driven cranks are rotated precisely through a half-revolution. In practice, any unavoidable slight inequality in the braking power of the brakes does not impair the precision of the cranks' half-revolutions.

One form of the invention will be further described with reference to the accompanying drawings, of which

FIG. 1 is a rear elevation of the electric box motion as arranged for operating a three or four cell shuttle-box; the only difference being in the combination levers;

FIG. 1A is a detail, to a larger scale, showing one arrangement of the cam-actuated limit switches;

FIG. 2 is a side elevation corresponding to FIG. 1;

FIG. 2A is a view corresponding to a part of FIG. 2 and shows a combination lever system for use in operating a four-cell shuttle-box;

FIG. 3 is a corresponding plan view; and

FIG. 4 is a diagram showing the circuitry for the electric box-motion illustrated in FIGS. 1, 2 and 3.

Referring to FIGS. 1 and 2, a three-cell shuttle-box is indicated at 1, and is capable of being lifted and lowered by its lifter-bar 2, the lower end of such lifter-bar 2 being secured by pin 3*a* to the forward arm of a transmission lever 3 adapted to swing on its fixed fulcrum bar 4 in the usual manner. The rear arm of lever 3 is secured by a pin 3*b* to a transmission link 5, the upper end of such link being attached, by a pin 6*a*, to the output arm 6 of combination levers which swing on their fixed fulcrum bar 7, carried in the box-motion frames F. The combination levers are of well-known construction, and any other known form of combination lever, or levers, suitable for operating either three or four-cell shuttle-boxes may be employed with corresponding effect.

In the present example, the two input arms, 9,10, are each separately oscillated by the connecting-rods 11,12, the lower ends of which connecting rods are respectively secured to the input arms 9,10 by pins 9*a* and 10*a*, while the upper ends are connected to and actuated by crank pins 13, 14, fixed in crank-gears 15, 16 respectively.

In operation these two crank-gears are caused either to remain stationary or to rotate precisely through 180°, whereby the crank-pins 13, 14, change position from one dead-center to the other, thereby controlling the relative positions of the input arms 9,10, and, therefore, the resultant position of the output arm 6, which can thus assume any one of three positions as is required for the operation of a three-cell shuttle-box. It is also well-known that such combination levers may be so proportioned that the output arm 6 can assume any one of four positions, as is required for the operation of a four-cell shuttle-box, an appropriate combination lever system being shown in FIG. 2A, like reference numerals being used in such figure for the same or similar parts of FIG. 2.

Referring again to FIGS 1 and 2, the crank-gears 15,16 which rotate a half-revolution at a time, and always in the same direction, are preferably arranged to rotate on stub-axles fixed in spiders 17 supported on through-bars 18 fixed in the frames F. These spiders, as shown in FIG. 1, are preferably of the rimmed construction which provides lateral support for the interleaved crank-gears, as is fully described in United Kingdom Pat. No. 1,069,914.

The crank-gears 15,16 are driven by the driver-gears 19,20. Each driver-gear and crank-gear constitute a mating pair of mutilated or intermittent gears, which, however, are in constant mesh and alignment, as shown in FIGS. 1 and 2. The driver-gear 19 has two diametrically opposite sectors of normal teeth 19*a*, separated by two arcuate dwell sectors 19*b*. The mating c crank-gear 15 has two diametrically opposite concave-tipped locking teeth 15*b*, separated by two sectors of normal teeth, 15*a*.

As shown in FIG. 2, the pitch-line diameter of the driver-gear 19 is made about 25 percent larger than that of the crank-gear 15, whereby the arcuate dwell sectors 19*a* on the driver-gear extend over an angle about twice as large as that of each lock-tooth 15*b* on the crank-gear 15. The driver-gear thus has a certain amount of free or idle rotation before and after driving

the crank-gear through its precise half-revolution. As a result, the driver-gear **19** drives the crank-gear **15** through a half-revolution precisely while turning through only about two-thirds of its own half-revolution. During the remaining one-third thereof, the crank-gear remains stationary, in one or other of its dead-center positions, by reason of one of its lock-teeth **15***b*, being engaged with and locked by the arcuate dwell profile **19***b* of the driver-gear.

Referring particularly to FIG. **3**, the driver-gears **19, 20**, are each compounded with spur-gears **21,22**, respectively. Both these compounded pairs are rotatably mounted side by side on an axle-bar **23**, which also is supported in the frames F.

The spur-gear **21** is intermittently driven by a pinion **25** on a shaft **27**, which shaft **27** is the output shaft protruding from a gear box **29**, and powered by an electric motor **31**. This motor, as above mentioned, is equipped with an automatic friction brake, indicated at **33**. Similarly, the other spur-gear **22** is driven by a pinion **26** on an output shaft **28** protruding from a gear-box **30**, and powered by an electric motor **32**, with its brake at **34**. The output shafts **27, 28**, are supported at their outer ends by suitable bearings **35, 36** carried in the frames F.

The speed-reducing ratio of the gears in the boxes **29,30**, is chosen, in combination with the reduction provided by the spur-gears **21,25** and **22, 26**, so that the crank-gears **15,16**, turn through a half-revolution while the loom crankshaft turns through an angle of from 30° to 120° according to requirements.

The selecting devices may take any known form, but preferably comprise additional lines of bowls and tubes on the usual dobby pattern chain, each such line of bowls and tubes serving to operate a two-way pattern sensing switch which, in combine d circuitry with the associated two-way limit-switch actuated by the driver-gear as it turns through each half-revolution, determines whether or not the associated electric motor shall be energized during the next box-changing operation.

Referring now to FIG. **4**, the pattern chain barrel B, which, in this example, turns through 60° for each revolution of the loom crankshaft, carries two lines of bowls and tubes C **1** and C **2**, which respectively control the two electric motors **31** and **32**, employed to power the three cell box-motion at one end of the loom. By means of finger-levers F **1** and F **2**, the bowls and tubes successively actuate two-way pattern-switches P **1** and P **2**, which are interconnected with their associated two-way limit-switches L **1** and L **2**.

The limit-switches are respectively actuated by face cams **37** and **38** formed on the rims of the driver-gears **19, 20**, but the cams, if preferred, may be formed on or driven by the spur-gears **21,22** with equal effect. As indicated at **37** in FIG. **2**, the face cams may take the form of an annular groove machined in one side of the driver-gear, which groove may be filled-in, for about half its circumference, with an annular cam provided with a suitable ramp at each end, that is, approximately diametrically opposite. These cams, which may conveniently consist of nylon or similar plastic material, are indicated at **37** in FIG. **2**, and at **37** and **38** in FIG. **1A**, together with the bell-crank levers **39, 40**, which serve as cam-followers and to actuate the two-way limit-switches L **1**, L **2**, on the conclusion of each half-revolution of the driver-gears.

The limit-switches and their actuating bell-crank levers are mounted on the mobile panel **41** (FIG. **1**) carried on an arm **42**, pivoted on a fixed bar **23**. The exact timing of the actuation of the limit-switches L **1**, L **2** by their rotary cams **37, 38**, can readily be adjusted by swinging the arm **42** around bar **23**, and then securing the arm, and the limit-switches, in an appropriate angular position by set screws **43**, or equivalent clamping means.

Referring to FIG. **4**, the timing device, previously referred to, comprises a timing-switch T, which is arranged to close circuit at the particular time in the loom cycle appropriate for the commencement of the box-changing operation, and this switch is common to all the motors concerned with shuttle-box actuation at both ends of the loom.

The cam **45** rotates continuously at loom crank-shaft speed, and the lobe is arranged to retain the timing-switch in its closed condition until after the box-changing operation has been completed, whereupon the timing-switch re-opens in readiness for the next selection by the pattern-switches P **1**, P **2**, in combined circuitry with their associated limit-switches L **1**, L**2**. Thus the motors next required to be energized are first selected in the above manner, and then simultaneously started in response to closure of the timing-switch T, but are stopped individually by the opening of their respective limit switches L, L **2**.

The three-pole contactors controlling the current supply to the electric motors and their brakes are indicated at M **1** and M **2** in FIG. **4**, where S **1** and S **2** are the respective solenoid coils for closing the contactors.

The limit-switches L **1** and L **2** also serve to indicate dead-center positions occupied by the various crank-gears after every change, thereby simplifying the assembly and interpretation of the box pattern chain, since a bowl invariably indicates that the corresponding crank shall next assume or remain in a particular position (say UP) and a tube indicates that the crank shall next assume or remain in the opposite position (say DOWN).

As will be apparent, a two-cell shuttle-box may be actuated in a similar manner, but in such case the combination levers are replaced by a simple lever of the First Order, which is oscillated about its fulcrum by a single crank-gear powered by a single electric motor. The output arm of the simple lever can then assume either of two positions as is required for the operation of a two-cell shuttle-box. Only one line of bowls and tubes is required to control a two-cell box-motion at one end of the loom. If the motions are to be applied to both ends of a loom, then the number of lines of bowls and tubes and all the other components must be duplicated.

A mechanical escapement designed to give-way on overload is preferably included in the linkage serving to transmit the motion of the cranks or of the combination levers to the shuttle-boxes. In the event of a misplaced shuttle obstructing the free movement of the shuttle-box the consequent relative displacement of the escapement components is utilized to actuate a micro-switch, whereupon the electric current supply to the box-motion motors and, if so desired, also to the loom driving motor, is promptly interrupted.

Alternatively or additionally an electrical escapement, with the same general effect, comprises an overload relay included in the circuit of each electric motor used to power the box-motion, whereby in the event of mechanical obstruction, the electric current supply to the box-motion and, if so desired, also to the loom driving motor, is promptly interrupted.

While the accompanying drawings show the limit-switches L 1 and L 2 actuated by face-cams 37 and 38, edge-cams may alternatively be employed with equal effect.

Shuttle-boxes with more than four cells can readily be operated on the same principle.

The above described combination of individual electric motors which, when intermittently energized under the control of a selecting device comprising interconnecting pattern-switches and limit-switches, and a timing-switch, drive mutilated crank-gears a half-revolution at a time, may also be employed to actuate the jack-Levers of a positive dobby for controlling and operating the heald shafts of a weaving loom.

What we claim is:

1. A shuttle-box displacement means for lifting and lowering a shuttle-box having two cells, said means comprising a crank, a pivoted lever connecting the crank with the shuttle-box, an electric motor drivingly connected to the crank, and control means adapted to energize the motor and, hence, effect rotation of the crank, for cell changeover according to requirements and to de-energize the same after a half revolution of the crank, characterized in that the driving connection between the motor and said crank embodies a mutilated gear and a drive gear in mesh therewith adapted to ensure an accurate 180° movement of the crank on each rotation thereof.

2. A shuttle-box displacement means according to claim wherein said lever is pivoted intermediate its opposite ends and the ends are pivotedly connected to the crank and to the shuttle-box.

3. A shuttle-box displacement means according to claim 1 wherein the shuttle-box has three cells and there are two cranks and an electric motor drivingly connected to each crank.

4. A shuttle-box displacement means according to claim 1 wherein the shuttle-box has four cells and there are two cranks, each drivingly connected to a motor.

5. A shuttle-box displacement means as claimed in claim 1, wherein the drive gear has diametrically opposed arcuate dwell sectors thereon for cooperation with corresponding lock teeth on the mutilated gear.

6. A shuttle-box displacement means as claimed in claim 1 wherein free angular play is provided between the drive gear and the mutilated gear to give a free or idle rotation of the drive gear relative to the mutilated gear before driving connection therebetween.

7. A shuttle-box displacement means as claimed in claim 1 wherein said motor embodies a friction brake in manner known.

8. A shuttle-box displacement means according to claim 1 wherein there are two cranks, two motors and individual control means for each motor including a two-position pattern switch, a two-position limit switch in series electrical circuit with said pattern switch and a solenoid coil for the motor contactor, the pattern switch being adapted to be operated by a pattern finger acting in conjunction with a pattern-chain and the limit-switch being adapted to be controlled by cam means actuable according to the position of the crank.

9. A shuttle-box displacement means as claimed in claim 8 wherein the series electrical circuit of the individual control means of the respective motors are arranged in parallel, and such parallel electrical circuit is in series with a source of electrical power and a timing can, the said timing cam being adapted to be rotated at loom crankshaft speed to open the circuit during selection and setting of the control means.

10. A shuttle-box displacement means as claimed in claim 8 wherein the limit switches are actuated by cams carried by respective gear members in the drive transmission to the cranks, the said limit switches being angularly adjustable relative to the related gear member thereby to permit of a variation in the timing of their operation in the loom cycle.

11. A shuttle-box displacement means as claimed in claim 10 including a fixed shaft and a bracket supported upon the said shaft and angularly adjustable thereon.

12. A shuttle-box displacement means as claimed in claim 1 wherein a single crank is provided to operate a two-cell shuttle-box, the lever being a lever of the first order.

13. A shuttle-box displacement means as claimed in claim 1 further including a mechanical escapement in the linkage transmitting a motion from the lever to the shuttle-boxes, actuation of the escapement being adapted to actuate a micro-switch whereby the supply current to the box-motion motors, the loom driving motor or the electro-magnetic clutch for driving the loom is promptly interrupted.

14. A shuttle-box displacement means as claimed in claim 1 further including an electrical escapement comprising an overload relay in the circuit of each electric motor used to power the box motion, actuation of the escapement being adapted to actuate a microswitch whereby the supply current to the box-motion motors, the loom driving motor or the electro-magnetic clutch for driving the loom is promptly interrupted.

15. Shuttle-box displacement means for effecting movement of a shuttle-box having cells for positioning of the cells according to requirements, said means comprising a crank, a linkage including cranks pivoted lever connecting the crank with the shuttlebox, an electric motor drivingly connected to the crank, and control means adapted to energize the electric motor and hence effect rotation of the crank for cell change-over according to requirements and to de-energize the same after a half revolution of the crank, characterized in that said linkage is adapted to move the shuttlebox varying amounts as required according to the number of cells, and the driving connection between the motor and said crank embodies a mutilated gear and a drive gear in mesh therewith adapted to ensure an when the 180° movement of the crank on each rotation thereof.

16. Shuttle displacement means for moving a shuttle-box having cells for positioning of the cells according to requirements and number, said means comprising two cranks, linkage connecting the two cranks with the shuttlebox and two electric motors drivingly connected to the two cranks, said linkage comprising a rock shaft, first and second arms pivotally mounted on the rock shaft, means pivotally connecting one end of each of

the first and second arms to a respective one of the cranks, a linking arm, means pivotally mounting the linking arm at the other end of the first arm such that the latter pivot axis, the axis of the rock shaft and the pivot axis at the one end of said first arm lie along in straight line when the associated crank is in one position, means pivotally connecting the second arm to the linking arm such that the latter pivot axis, the pivot axis of the rock shaft and the pivot axis at the one end of the

second arm line along a straight line when the associated crank is situated diametrically opposite the position of the other crank, a rocker lever, and connecting rods pivotally connected at one end to the opposite ends of the rocker lever, the other end of one connecting rod being pivotally connected to the linking arm and the other end of the other rod being fixed to the shuttle-box.

* * * * *