

Oct. 10, 1944.

D. C. CHURCHILL

2,360,050

SHUTTLE DRIVE MECHANISM FOR LOOMS

Filed April 9, 1941

3 Sheets-Sheet 1

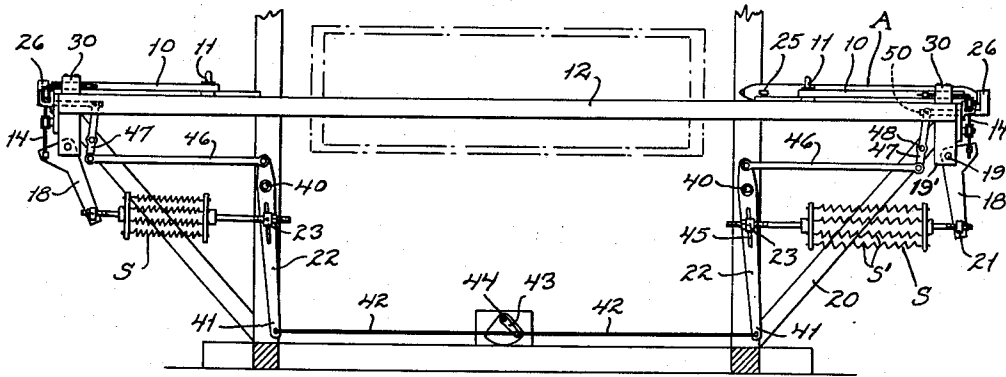


Fig. 1

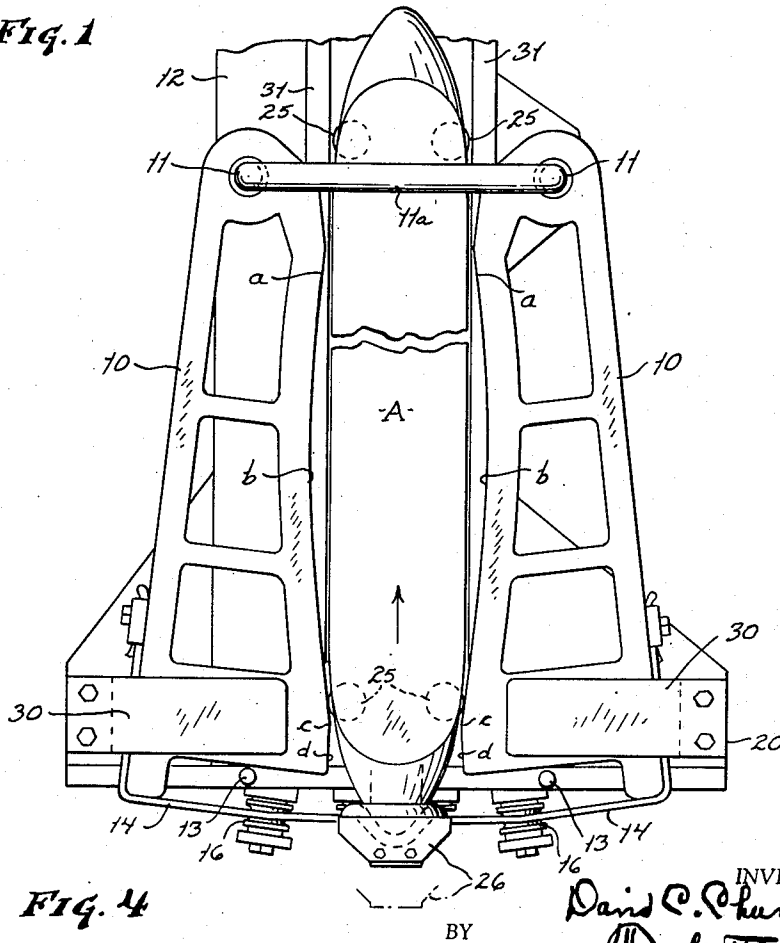


Fig. 4

INVENTOR.
David C. Churchill
Frank T. Smith
His Attorney

Oct. 10, 1944.

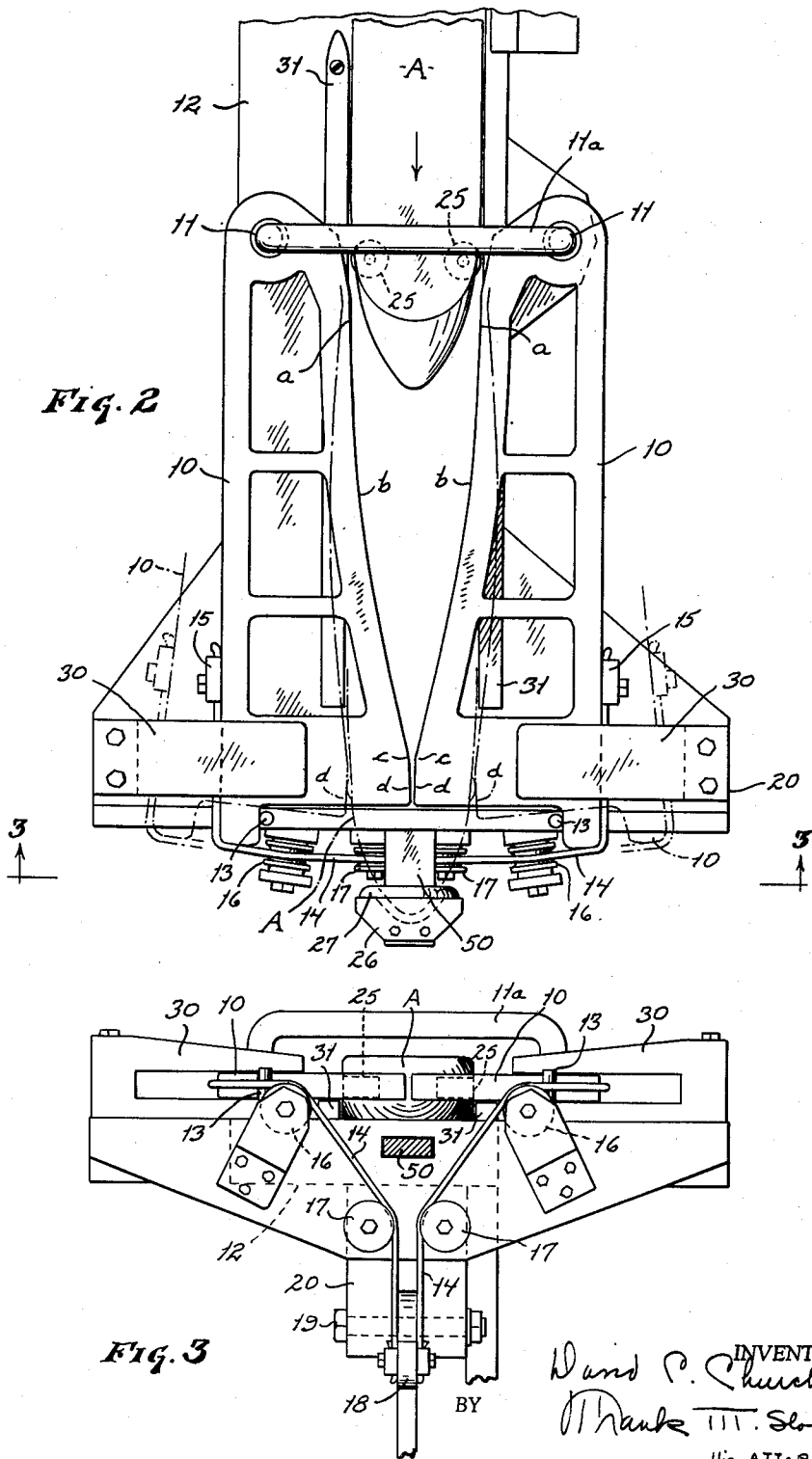
D. C. CHURCHILL

2,360,050

SHUTTLE DRIVE MECHANISM FOR LOOMS

Filed April 9, 1941

3 Sheets-Sheet 2



Oct. 10, 1944.

D. C. CHURCHILL

2,360,050

SHUTTLE DRIVE MECHANISM FOR LOOMS

Filed April 9, 1941

3 Sheets-Sheet 3

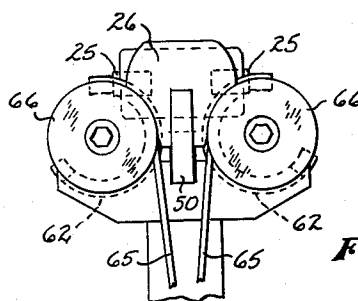
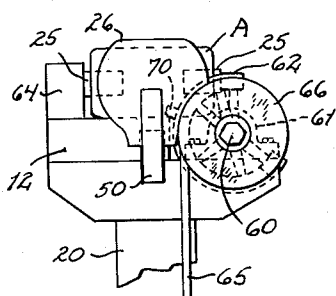
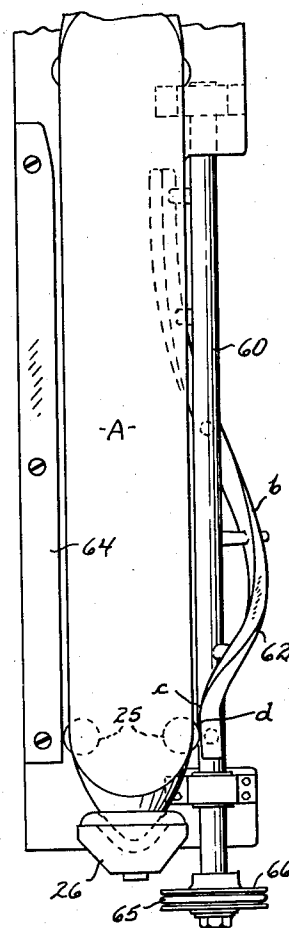
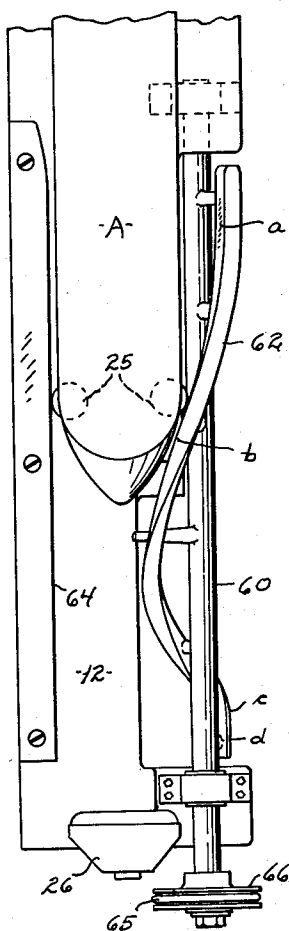
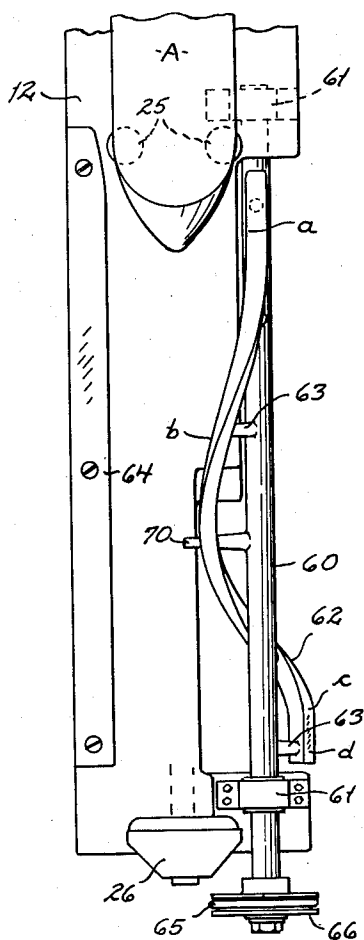


Fig. 8

Fig. 9

BY

David C. Churchill INVENTOR.
 Thank III. S. L.
 HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,360,050

SHUTTLE DRIVE MECHANISM FOR LOOMS

David C. Churchill, Berea, Ky.

Application April 9, 1941, Serial No. 387,670

15 Claims. (Cl. 139—145)

My invention relates to looms and relates particularly to shuttle drives therefor.

An object of my invention is to reduce the friction of contact of the shuttle upon impact at each end of the shuttle race in order to minimize energy loss.

Another object of my invention is to store the energy which has been reserved upon the shuttle achieving its "home" or fully stopped position whereby the major part of said energy is returned to the shuttle for the return flight thereof.

Another object of my invention is to secure the useful purposes of my invention, as described and claimed in co-pending application, which is issued into Letters Patent No. 2,261,873, dated November 4, 1941, and which has been designated as my "bow-string" case, in a shuttle-receiving mechanism of the cam type.

Certain other objects of my invention are gains in efficiency and in power saving and still other objects will become apparent from a purview of the drawings, in which:

Fig. 1 is a front elevational view of a fly shuttle mechanism which is the first embodiment of my invention;

Fig. 2 is a plan view of one of the shuttle receiving portions and the shuttle of Fig. 1, said shuttle being shown approaching its "home" position;

Fig. 3 is a view taken from the plane 3—3 of Fig. 2;

Fig. 4 is a plan view similar to Fig. 2, but showing the shuttle as starting its outward flight;

Fig. 5 is a plan view of a shuttle receiving portion of another embodiment of my invention; the shuttle being shown as approaching contact with said shuttle receiving device;

Fig. 6 is a view similar to Fig. 5 but the shuttle in this figure is illustrated in a further advanced position;

Fig. 7 is a view similar to those shown in Figs. 5 and 6 showing the shuttle in its "home" or fully stopped position and illustrating the final position of the shuttle receiving device of Fig. 5;

Fig. 8 is an end view of the shuttle box showing an association with the source of power drive; and

Fig. 9 is an end view of the shuttle box showing another embodiment of my invention, which essentially consists of a duplication of the shuttle receiving device of Figs. 5 to 8 inclusive.

The shuttle drive of the present invention is adapted to a power loom or to a manually or foot driven loom, and accordingly in the draw-

ings and particularly in Fig. 1. Reference is hereby made to any well known loom structure for the other parts of a loom, and may be particularly made to my prior patents, Nos. 1,858,482 and 2,261,873, for showings of various loom constructions to which my present invention is adapted.

In the embodiment illustrated in Figs. 1 to 4, the flying shuttle A is received and stopped by a pair of plate cams 10 which, on being forced apart by the shuttle against the action of a spring device S, absorb the kinetic energy of the shuttle and convert it into potential energy stored in the spring. Subsequently, this potential energy is reconverted into kinetic energy on propelling the shuttle to the opposite side of the loom. At each cycle, additional energy is introduced into the spring device S, to replace that lost through friction, by a timed power device later more fully described.

Referring to the drawings, and particularly to Figs. 2 and 3, it will be seen that the two plate cams 10 are pivoted at 11 on the shuttle race 12. For rigidity and convenience, the pivots may take the form of a U-shaped bar 11a crossing above the line of flight of the shuttle A. The normal or idle position of the cams is that shown in full lines in Fig. 2 where their further approach is limited by stop pins 13. The cams are urged forcibly toward each other by the spring device S through the intermediacy of cables 14 which may be secured, as at 15, to the respective cams and then pass over pulley sheaves 16 and 17, Fig. 3, so as to be pulled upon vertically by the shorter arm of a bellcrank 18 pivotally secured at 19 to an extension 19' of the frame 20 of the lay, the cables 14 being secured to the shorter arm of the bell crank. As seen in Fig. 1, the spring device S, which may conveniently be composed of a plurality of individual tension springs S' or other spring means, exerts its force upon the longer arm of the bell crank 18 through a pivoted connection at 21. The opposite end of spring device S is anchored to a lever 22 through a second pivotal connection at 23.

The cams 10 are adapted to receive the swiftly moving shuttle with no appreciable amount of shock. To this end, the shuttle is fitted with ball bearing rollers 25 and their first contact with the cams is on a surface very nearly parallel to their line of approach, in the region designated by a in Fig. 2. Upon further entry of the shuttle, the cams are wedged apart as the rollers engage the curved surface b, thus storing energy in the

spring device S. As the rollers approach the point C of the curve, the kinetic energy has been nearly completely absorbed and just as the shuttle is coming to a stop, the surface of the cams changes rather abruptly into a region d, constituting a dwell on the cam.

The shuttle comes to rest against a positive stop, illustrated at 26, which may be suitably padded as at 27 to minimize shock. The parts are now in the broken line position of Fig. 2 wherein the cam plates are swung to their extreme outer positions and the shuttle rollers 25 engage the regions d of the cam surfaces. To retain the shuttle against the stop until the time for its release, the cams in this region are preferably formed with a slight reverse taper, as indicated by the broken lines of Fig. 2.

The cam plates are preferably made as light in weight as practicable to reduce their inertia and thus increase their efficiency in energy transference by reducing stress and its consequent increases in strength of parts, friction, etc. To this end, they may be formed as shown, as an open framework supporting the actual cam track b. The plates are, in turn, supported by slotted members 30 rigid with the shuttle race and frame of the lay of the loom. To confine the shuttle to a rectilinear path, the usual guides 31 are provided at either side of the shuttle race.

It is to be understood, of course, that the mechanism described may be duplicated at the opposite side of the loom, as illustrated in Fig. 1, the shuttle carrying a pair of rollers 25 at each end for contact with the respective pairs of cam plates.

At the proper time in the cycle of operation, the shuttle is ejected from the mechanism at one side of the loom with sufficient force to cross the shuttle race and engage that on the other side. To effect this ejection, the stop 26 is caused to move inwardly a short distance, pushing the shuttle until the rollers pass the point c and engage the start of the curve b. The forces exerted by the cams upon the rollers are now in oblique directions, the components transverse to the shuttle race cancelling each other but the components parallel thereto adding together to force the shuttle ahead. As the shuttle accelerates in speed, the cams also approach each other with a greater and greater speed and the net result is that the shuttle is snapped forward and across the loom at a high velocity.

The curve of the cam plates may take various forms depending on the particular mode of acceleration desired, that shown in the drawings being one form which is applicable. The action upon the shuttle is very similar to that upon a slippery melon seed, for example, when the seed is gripped between the thumb and index finger and then, on applying pressure, is projected precipitately into space. In this case, the fingers correspond to the cam plates and by squeezing the seed initially in its central, parallel sided region, corresponding to regions d on the curves, a comparatively high potential energy can be produced. After this, by rolling the fingers slightly, contact is made on the gradually tapering end of the seed, corresponding to the rollers 25 being advanced past the point c, and the stored energy is released as the tapering end slips out from between the forcibly approaching fingers, the velocity of the seed being many times that of the fingers themselves.

It will be noted that the curve in the case of the melon seed is that of the seed itself whereas

in the drawings herein a roller on the shuttle traverses a curve on the cam plate, but it is also within the teaching of this invention to so arrange the parts that a spring pressed roller may act upon a properly curved shuttle.

As previously mentioned, additional energy must be supplied, during each cycle to replace that lost through friction. With the energy absorbing and storing mechanism of this invention, this loss is only a very slight percentage of the total and may be conveniently replaced by a slight additional stretching of the spring S. Referring to Fig. 1, it will be seen that each spring device is anchored at 23 to a lever 22, pivoted on the frame at 40. The ends 41 of the levers are connected by a tension cord 42 and through the latter are reciprocated by an arm 43 on a timed driving shaft 44 which may be driven by a motor or by hand or foot power through mechanism, not shown. By thus rocking the lever 22 inwardly toward the center of the loom, the spring device S is stretched a slight amount and this amount may be adjusted by varying the position of the pivotal connection 23 in relation to the pivot 40, as by means of a slot 45.

The movement of the shuttle stop 26 is also obtained from the rocking of lever 22. The slide bar 50, as illustrated in part in Figs. 2 and 3, the showing being continued by the dotted lines indicated at 50 in Fig. 1, carries the shuttle stop 28 and is hingedly connected to the downwardly extending lever 47 which is pivoted to the frame 20 at 48. At its lower end, the lever 47 is hingedly connected to the reciprocatory bar 46 joined to the upper end of the rock lever 22 which receives its motion through the instrumentality of the motor mechanisms 43 and 44 through cords 42. The arrangement of the parts is such that during the latter portion of the inward rocking of lever 22, and after the spring device S has been thereby additionally tensioned, the stop 26 will move the shuttle from its idle position into contact with the driving portion of the cam plates, as illustrated in Fig. 4.

The various parts are shown in Fig. 1 in the positions they assume immediately upon the arrival of the shuttle at its right hand "home" position. The shuttle has spread the cam plates 10 apart, thus pulling the cables 14 inwardly to rock the bellcrank 18 and stretch the spring device and the shuttle is in contact with the stop 26 and at rest. The various parts at the left hand side of the loom are in the position they assume immediately upon the ejection of the shuttle. The lever 22 has been rocked inwardly additionally stretching the spring device S, the stop 26 has been drawn inwardly to start the shuttle, and the spring device has contracted to rock the bellcrank 18 and pull the cables 14 downwardly to bring the cam plates 10 together against their inner stops.

In the embodiment illustrated in Figs. 5 to 8 inclusive, the cam surface which coacts with the rollers 25 of the shuttle takes the form of a helical trackway. A shaft 60 is rotatably mounted in bearings 61 carried by the shuttle race 12 and carries a spiral bar 62, as by means of posts 63. The distance of the bar from the axis of the shaft 60 is everywhere constant, so that as it rotates about said axis, the bar, at its uppermost region, is adapted to contact the roller 25. In the embodiment shown, the opposite roller 25 coacts with a fixed guide 64, parallel with the path of travel and hence as the shuttle enters the device the helical bar is cammed aside, rotating the

shaft. A cable 65 is secured to a drum or sheave 66, fixed on the shaft 60, and may operate in a manner similar to that of cables 14 in Figs. 1 to 4 to stretch a spring device S, the spring only being indicated in Fig. 8.

As will be seen in Fig. 5, the initial portion *a* of the trackway 62 is substantially parallel to the path of travel of the approaching shuttle and normally at such a position as to be only lightly brushed by the roller 25 upon first contact. This normal or idle position is maintained by a limit device which may take the form of a stop pin 70 carried by the trackway and adapted to contact a fixed member such as the shuttle race 12. The trackway at first curves gently from the initial region and then more abruptly in the region *b*. As the shuttle roller, as shown in Fig. 6, progresses farther and farther along this curve, the kinetic energy of the flying shuttle is transferred into potential energy of the spring device S. Just as its available store of energy is expended, the shuttle passes a transition point *c* and comes to rest at a dwell *d* of the trackway and against the stop 26. This final position is illustrated in Fig. 7. As in the case of the plate cams of Figs. 1 to 4 inclusive, the region *d* may have a slight reverse taper so as to maintain the shuttle against the stop.

Upon ejecting the shuttle, the stop 26 is moved inwardly as by the mechanism of Fig. 1, to a position where the roller 25 is acted upon by the spiral trackway. Here again the action is that of an ejected melon seed, the spring device S forcibly revolving the trackway 62 to impart velocity to the shuttle.

In Fig. 9, a further modification of my invention is illustrated, this embodiment utilizing two opposing spiral trackways 62, as shown in Figs. 5 to 8 inclusive; these corresponding to the two opposing cam plates 10, illustrated in Figs. 1 to 4. A pair of cables 65 lead downwardly and may be conveniently secured to a bellcrank such as that at 18 in Figs. 1 and 3, or directly to spring device S, Fig. 8.

Other forms and arrangements of parts may be utilized to apply the "melon-seed drive" principle of the invention to a shuttle and it is not intended to be limited to the particular embodiments illustrated herein.

I claim:

1. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse the race in alternate directions, shuttle receiving and throwing means at each side of said race comprising a cam element, the inner surface of which is engaged by anti-friction means carried by a lateral outer surface of the received shuttle, resilient means associated with said cam element tending to force a portion of said element to an inwardly disposed position from which it is laterally outwardly displaced by the reception of the oncoming shuttle, the engaged surfaces of said received shuttle and of said cam element being suitably correlatively formed as to frictionally initially restrain the received shuttle from rebounding movement and the resilient means being tensed by the outward movement of said cam element, shuttle throwing means deriving energy from the said loom source of power to displace said cam element inwardly to exert squeezing force on the received end of the shuttle to forcibly shoot the shuttle from the displaced cam element to the opposite side of the loom race.

2. A shuttle operating mechanism for looms

having a source of power, comprising a shuttle race, a shuttle adapted to traverse the race in alternately different directions, shuttle receiving and throwing means at each end of said race comprising a plurality of elements each having inwardly facing surfaces engaged by anti-friction means carried by laterally outer surfaces disposed on either side of said raceway of the received shuttle, resilient means associated with said elements tending to force them to an inwardly disposed position, from which they are outwardly laterally displaced by the reception of the prow of the incoming shuttle, the engaged surfaces of said received shuttle and of said elements being suitably correlatively formed as to frictionally initially restrain the received shuttle from rebounding movement and the resilient means being tensed by the outward movement of said elements to momentarily store most of the kinetic energy of the stopped shuttle as potential energy in said resilient means, and shuttle ejecting means deriving an additional amount of energy from the loom source of power, and timed by the loom mechanism to contractingly displace said elements inwardly to increase the shuttle squeezing force thereof on the received end of the shuttle, the engaged surfaces of the shuttle and of said elements being cooperatively so formed and relatively so displaced by said shuttle ejecting means as to forcibly squeeze and eject the shuttle from the displaced and contracting elements to the other side of the loom race.

3. A shuttle operating mechanism for looms comprising a shuttle race, a loom source of power, a shuttle adapted to traverse said race in alternate directions, shuttle receiving and throwing means at one side of said race comprising a cylindrical cam element having a helical trackway, said shuttle having anti-friction means carried thereby adapted to engage said helical trackway and resilient means associated with said cylindrical cam element whereby, as the oncoming shuttle progresses further along the helical trackway, the kinetic energy of the flying shuttle is stored in said resilient means, shuttle throwing means driving an additional amount of energy from the loom source of power adapted to revolve said helical trackway to exert squeezing pressure upon said shuttle whereby said shuttle is forcibly transversely squeezed and shot from the helical trackway to the opposite side of the loom, the loom source of power being aided by said stored energy in said resilient means.

4. A shuttle operating mechanism for looms comprising a shuttle race, a loom source of power, a shuttle adapted to traverse said race in alternate directions, said shuttle having anti-friction means carried thereby, means for receiving and throwing said shuttle disposed at each end of said race and comprising a pair of cylindrical cam elements each having a helical trackway associated therewith and adapted to be rotated about its associated cylindrical cam element whereby, as the oncoming shuttle progresses further along each of said helical trackways, the kinetic energy of the flying shuttle is stored in said resilient means associated with each of said cylinders, shuttle throwing means deriving an additional amount of energy from the loom source of power adapted to revolve each of said helical trackways to exert squeezing pressure upon said shuttle whereby said shuttle is forcibly transversely squeezed and shot from the helical trackways to the opposite side of the loom, the

loom source of power being aided by said stored energy in said resilient means.

5. In a loom, the combination of a source of power, a shuttle race, a shuttle adapted to traverse the said race in alternate directions, means for receiving and throwing said shuttle disposed at each end of said race and comprising a pair of cam elements each having inwardly confronting surfaces engaged by anti-friction roller means disposed between the cam elements and said shuttle, resilient means associated with said elements tending to force them to an inwardly disposed position from which they are outwardly and laterally displaced by the reception of the prow of the said oncoming shuttle, the initially engaged surfaces of said cam elements being substantially parallel with the flight of the shuttle adjacent curved surfaces of said cam elements then being engaged, the engaged curved surfaces of said elements and said receiving shuttle being so formed as to frictionally restrain the receiving shuttle from movement in the opposite direction, the resilient means associated with said cam elements being adapted to momentarily store the kinetic energy of the receiving flying shuttle and transform said kinetic energy into potential energy, shuttle ejecting means deriving an additional amount of energy from the loom force of power adapted to co-operate with said resilient means in effecting flight of said shuttle in the opposite direction, said potential energy being transformed into kinetic energy upon the application of the shuttle ejecting means, the cam elements adapted to be resiliently urged inwardly to effect squeezing pressure on the receiving end of the shuttle to forcibly shoot the shuttle from said cam elements to the other side of the loom race.

6. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse the race in alternate directions, anti-friction means carried by a lateral outer surface of the shuttle, means for receiving and ejecting said shuttle disposed at one end of the race and comprising a cam element, the inner surface of which is engaged by said anti-friction means carried by a lateral outer surface of the shuttle, means associated with said cam element adapted to transmit power thereto whereby upon the application of power from the loom source said cam element is adapted to exert squeezing pressure upon said shuttle whereby said shuttle is expressed with force towards the other side of the race.

7. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, said shuttle having roller means carried thereby, shuttle receiving and ejecting means at one side of said race comprising a cam element, said cam being so formed as to have an end portion disposed substantially parallel to the shuttle race and an intermediate curved surface whereat said shuttle is arranged to engage said cam by means of said roller means with gradually varying pressure, storage means associated with said cam whereby energy which is absorbed by said cam is received and stored in said storage means.

8. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, said shuttle having roller means carried thereby, shuttle receiving and ejecting means at one side of said race compris-

ing a cam element, said cam being so formed as to have its inner face disposed adjacent the shuttle race and end portions thereof disposed substantially parallel thereto, intermediate portions of said inner face being curved, said cam being pivotally mounted on the shuttle race whereby the said roller means carried by the shuttle contacts the cam with gradually varying tangential pressure whereby the flight of said shuttle is arrested.

9. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, said shuttle having roller means carried thereby, shuttle receiving and ejecting means at each end of said race comprising a pair of cam elements, each of said cams being so formed as to have an end portion thereof disposed substantially parallel to the shuttle race and to each other and intermediate curved surfaces and its other terminal portion further disposed substantially parallel to the race, each of said cams being pivotally mounted upon the race and adapted to have resilient means associated therewith normally urging the said cams of the pair of cam elements towards each other whereby upon engagement of the shuttle with the forward end portions of said cams said cams are forced outwardly relative to each other and pressure between the shuttle and cam elements is increased upon further travel of the shuttle towards "home" position, the rearward end portions of the cam surfaces retaining said shuttle at rest.

10. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, said shuttle having roller means carried thereby, shuttle receiving and ejecting means at each end of said race comprising a pair of cam elements, each of said cams being so formed as to have an end portion thereof disposed substantially parallel to the shuttle race and to each other and intermediate curved surfaces and its other terminal portion further disposed substantially parallel to the race, each of said cams being pivotally mounted upon the race and adapted to have resilient means associated therewith normally urging the said cams of the pair of cam elements towards each other whereby upon engagement of the shuttle with the forward end portions of said cams said cams are forced outwardly relative to each other and pressure between the shuttle and cam elements is increased upon further travel of the shuttle towards "home" position, stop means associated with said shuttle race adapted to receive the prow of said shuttle, the rearward end portions of the cam surfaces engaging said roller means when said shuttle comes to rest.

11. The process of receiving and discharging a shuttle from one end of a loom race to the other consisting in receiving it at one side of the race with squeezing pressure, exerting force from opposite sides of said race in oblique directions to said shuttle, the components of said force transverse to the shuttle race being equal and components of force parallel to said race being additive to expel the shuttle and cause the same to be expressed across said race.

12. The process of receiving and discharging a shuttle from one end of the loom race to the opposite end thereof which comprises applying force to a shuttle to pick the same across a shuttle race, receiving said shuttle at the ends of said

race with squeezing pressure, further exerting additional squeezing pressure upon said shuttle to expel said shuttle from said end of said race and causing the same to traverse the said race in an opposite direction.

13. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, said shuttle having roller means carried thereby, shuttle receiving and ejecting means at one side of said race comprising a cam element, said cam having a portion inwardly curved relative to the shuttle race, said cam being pivotally mounted at one end upon the shuttle race, said roller means being arranged and adapted to engage said cam element and to be received thereby with gradually varying pressure, said shuttle roller means forcing the curved portion of the cam element outwardly with respect to said shuttle race.

14. A shuttle operating mechanism for looms having a source of power comprising a shuttle race, a shuttle adapted to traverse the said race in alternate directions, shuttle throwing means, a cam disposed at an end of said loom race, said cam having an inner curved surface and an end portion that is substantially parallel with the flight of the shuttle, roller means carried by said

shuttle being adapted to engage the cam on said end portion of said cam and thereafter engaging said curved surface of said cam whereby wedging action is exerted upon said oncoming shuttle, the roller relieving frictional engagement with the curved surfaces of the cam, resilient means associated with said cam elements, whereby energy is absorbed through the cam, the kinetic energy of the oncoming shuttle being stored as potential energy in the resilient means utilized upon the application of additional energy from said shuttle throwing means to effect opposite flight movement of said shuttle.

15. A shuttle operating mechanism for looms having a loom source of power comprising a shuttle race, a shuttle adapted to traverse said race in alternate directions, roller means disposed between the shuttle and means for receiving and ejecting said shuttle, the said shuttle receiving and ejecting means disposed at one side of said race and comprising a cam element, said roller means disposed between said cam element and said shuttle whereby said roller means is interposed as an anti-friction means between said cam element and said shuttle when said shuttle engages said cam element and is received thereby with gradually increasing pressure.

DAVID C. CHURCHILL.

CERTIFICATE OF CORRECTION.

Patent No. 2,360,050.

October 10, 1944.

DAVID C. CHURCHILL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 14, claim 5, after "reception of" insert --anti-friction means carried by--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of February, A. D. 1945.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.