H. RIEHL.

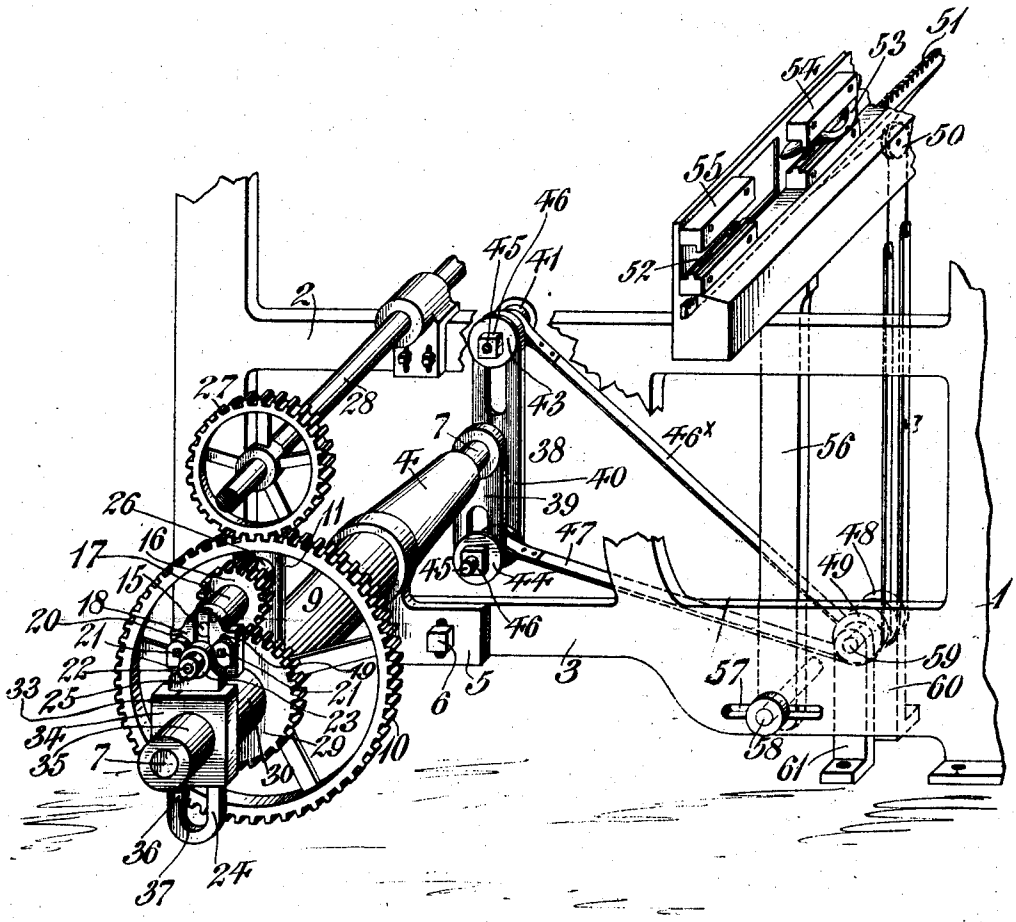
MECHANISM FOR OPERATING SHUTTLES OF NARROW WARE LOOMS.

APPLICATION FILED FEB. 1, 1905.

901,834. Patented Oct. 20, 1908.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses

L. Bouville,

P. F. Nagle.

Inventor

Henry Riehl.

By Wiederhein & Fairbanks.

Attorneys.

H. RIEHL.

MECHANISM FOR OPERATING SHUTTLES OF NARROW WARE LOOMS.

APPLICATION FILED FEB. 1, 1905.

901,834. Patented Oct. 20, 1908.

3 SHEETS—SHEET 2.

fig. 2.

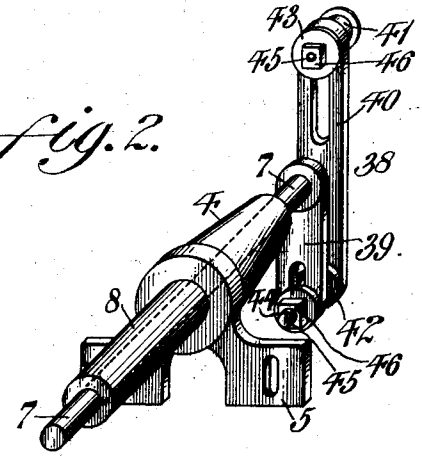


fig. 4.

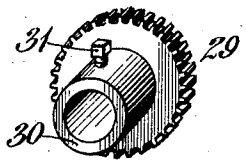


fig. 3.

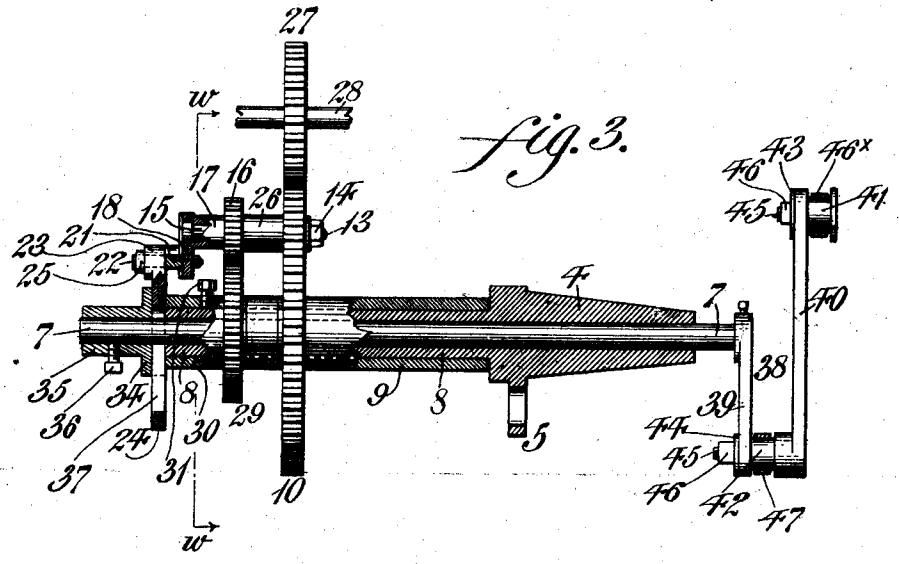
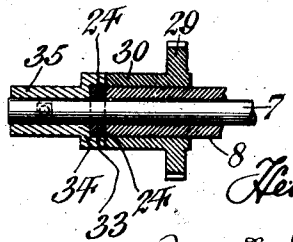


fig. 12.



Witnesses.

L. Bourille,

O. F. Cragle.

Inventor

Henry Riehl.

By Wiedersheim & Fairbanks.

Attorneys.

H. RIEHL.

MECHANISM FOR OPERATING SHUTTLES OF NARROW WARE LOOMS.

APPLICATION FILED FEB. 1, 1905.

901,834. **Patented Oct. 20, 1908.**

3 SHEETS—SHEET 3.

fig. 5.

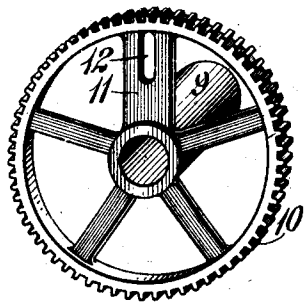


fig. 7.

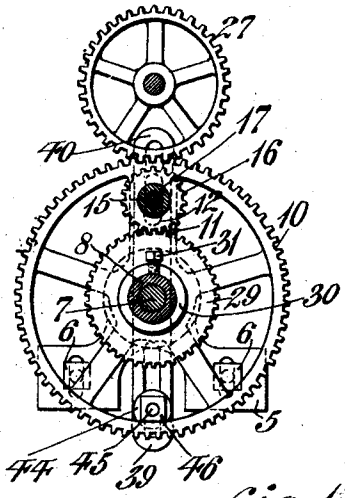


fig. 6.

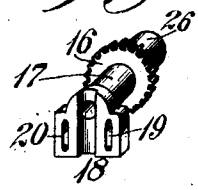


fig. 11.

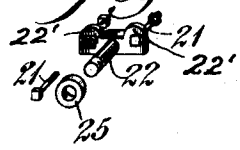


fig. 8.

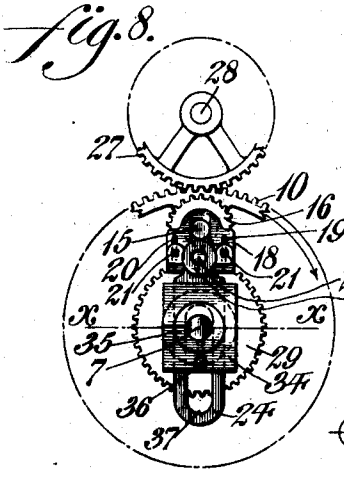


fig. 13.

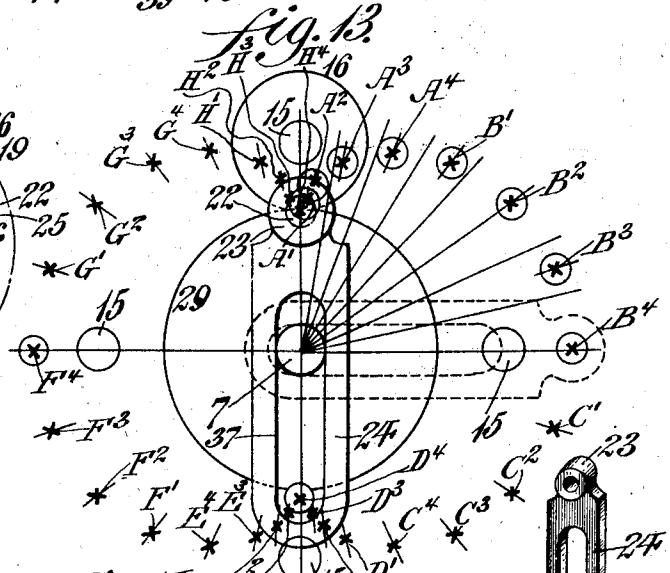


fig. 9.

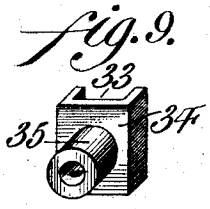


fig. 14.

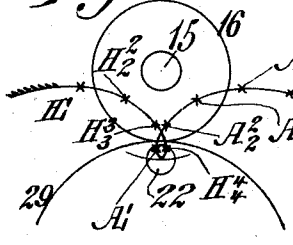


fig. 10.

Witnesses

L. Louville,

P. F. Nagle.

Inventor

Henry Riehl

By Wiederseim & Laubach.

Attorneys.

UNITED STATES PATENT OFFICE.

HENRY RIEHL, OF PHILADELPHIA, PENNSYLVANIA.

MECHANISM FOR OPERATING SHUTTLES OF NARROW-WARE LOOMS.

No. 901,834. Specification of Letters Patent. Patented Oct. 20, 1908.

Application filed February 1, 1905. Serial No. 243,618.

To all whom it may concern:

Be it known that I, HENRY RIEHL, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Mechanism for Operating Shuttles of Narrow-Ware Looms, of which the following is a specification.

The object of my invention is to produce a variable speed motion for shuttles.

A further object of my invention is to secure rapid movement of the shuttle during its passage through the shed and slow movement or positive "dwell" at the extremities of motion.

A further object of my invention is to provide a movement in which the extent of the variation in speed is adjustable.

Figure 1 is a perspective view of the inside of a loom showing the preferred form of my invention and the shuttle and operating rack controlled thereby. Fig. 2 is a perspective view of the shaft, surrounding frame member and double crank shown in Fig. 1. Fig. 3 is a side elevation partly in section of a portion of Fig. 1 showing the shaft gearing and double crank. Figs. 4, 5 and 6 are perspective views of gears shown in Fig. 3. Fig. 7 is a transverse section upon the line *w—w* of Fig. 3 looking toward the double crank. Fig. 8 is an end elevation of a portion of my construction showing the gearing and the block and link used therein. Fig. 9 is a perspective view of the block in which the link shown in perspective in Fig. 10 slides. Fig. 10 is a perspective view of the link which slides in the block shown in perspective in Fig. 9. Fig. 11 is a perspective view of an adjustable stud and means of attachment for said stud. Fig. 12 is a partial section upon line *x—x* Fig. 8. Figs. 13 and 14 are diagrammatic views upon an enlarged scale showing the path of the pin upon which the link of Fig. 10 is pivoted.

Similar letters of reference indicate corresponding parts in the figures.

Referring to the drawings. Upon the usual loom frame 1 having cross-pieces 2 and 3 thereon, I adjustably mount bearing 4 by bracket 5 and bolts 6, the bearing 4 is hollow permitting passage and internal bearing of shaft 7 therein. A portion of bearing 4 is cylindrically finished upon the exterior at 8 to provide a bearing for sleeve 9 of the gear 10, one of whose arms 11 is provided with a slot 12 in which is secured a stud 15 upon which the gear 16 is adapted to turn. This stud 15 is secured by the nut 14 screwed upon the reduced end 13 of said stud. Gear 16 is provided with an extension 17 carrying guide 18 having elongated openings 19 and 20 for the adjustment of the bolts 21 by which crank 22 is adjustably secured. The crank 22 has apertured ears 22′ laterally projecting therefrom or attached thereto through which the bolts 21 project by means of which the crank is adjusted.

It will be evident that the crank 22 may be placed in the position shown against guide 18 and secured therein at any point by bolts 21 and that the amount of throw of said crank 22 from its center of revolution in stud 15 may be correspondingly varied. The crank may be located at any distance from the plane of bolts 21 and the eccentricity of the crank 22 with respect to stud 15 may be varied by changing the relative position of said stud 15 and crank 22 or made practically zero by removing said crank and the part to which it is attached from said slide and replacing it on the same in a reversed position. The crank 22 affords bearing for the collar 23 of the link 24 which collar is retained thereon by nut 25.

The gear 16 is provided on its other side with an extension 26 which may evidently, however, be formed as a collar separate therefrom. The gear 10 is driven by the gear 27 mounted upon any suitable shaft 28 preferably the lay driving shaft. Meshing with gear 16 is a gear 29 provided for convenience with sleeve 30 which may evidently be made separate therefrom, the gear being attached to the immovable hollow extension of bearing 4 either directly or as in the form shown through the sleeve by set screw 31.

It will be evident that the form of gearing as thus far described, constitutes a planetary system having the gear 29 fixed and the gear 10 rotatable about the same axis and carrying pinion 16 about the fixed gear 29 and in mesh therewith.

Continued revolution of the gear 27 and correspondingly of the gear 10 results in the rotation of the crank 22 uniformly about the stud 15. There is also revolution of the crank 22 about the shaft 7 but at varying rates of speed, inasmuch as during a portion of the revolution the pinion upon the stud 15 is being carried forward by the gear 10 while the crank 22 is being moved in a reverse di-

rection by its reverse rotation about its stud 15. This epicycloidal movement has been illustrated diagrammatically in Figs. 13 and 14, in the first of which the special case has been considered of adjustment of the crank 22 to lie exactly in line with the pitch circle of pinion 16. That is, the distance between the centers of the stud 15 and the crank 22 is the same as the distance from the center of the stud 15 to the circumference of the pitch circle of the gear 16, so that the path of movement of said crank 22 is a true epicycloid. In Fig. 14 the case has been considered of the extension of this crank 22 beyond the line of the circumference of the pitch circle, as shown, resulting in accurate epitrochoidal movement of said crank 22, thereby causing a greater reverse movement of said crank 22 in space, due to its rotation about its own axis relative to its direct movement in space due to revolution about the shaft 7. This results in an actual reversal of movement of the shaft 7 during the time corresponding to the loop of Fig. 14.

Fig. 13 shows thirty-two positions representing a complete movement of the crank 22 about shaft 7.

Fig. 14 represents a portion of a revolution of the crank with positions noted at the same intervals as in Fig. 13.

In Fig. 13 A', A^2, A^3, A^4, B', B^2, B^3, B^4, C', C^2, C^3, C^4, D', D^2, D^3, D^4, E', E^2, E^3, E^4, F', F^2, F^3, F^4, G', G^2, G^3, G^4, H', H^2, H^3, H^4 represent the successive positions of the center of the crank 22 upon successive angular movements of pin 15 eleven and a quarter ($11\frac{1}{4}$) degrees about shaft 7. The corresponding actual angular advance of crank 22 for each of these equal movements of the gear 10 is represented by the angular movement upon the drawing relatively to each starting point, that is, by the angular distance separating the radii drawn through the successive points. It will be seen from this diagram that the movement of the crank 22 and therefore of the collar 23 of the link 24 pivoted upon it, is rapid in proximity to the end of the first and third quarters from the position shown in Fig. 1 and slow, practically stationary, in proximity to the extremity of the second and last quarters. Link 24 has been shown in this figure in the position in which it is placed at the beginning of the movement from that shown in Fig. 1 and pin 15 is indicated in its four positions at the four quarters.

In Fig. 14 positions corresponding to A', A^2, A^3, A^4, H', H^2, H^3, H^4, are shown as A^1, A^2, A^3, A^4, B', H', H^2, H^3, H^4.

In all of the views shown gear 29 is twice the diameter and consequently contains twice the number of teeth located upon gear 16, in order that there may be two complete cycles of epicyclodial movement of crank 22 for each complete rotation of the gear 10. It will be evident that any even multiple relation may exist between gears 29 and 16. Thus if gear 29 be six times the size of gear 16 there would be six complete cycles. Other relations also might exist between gears 29 and 16 if the movement be so timed that the innermost epicycloidal portion is always coincident with the extremity of the shuttle's movement. Other intermediate transmitting mechanisms than the double crank may then be necessary.

Link 24 passes through slide 33 of block 34 which is secured to the shaft 7 by the collar 35 and set screw 36. Link 24 is slotted at 37 in order that it may straddle shaft 7, which could, however, be avoided by placing block 34 at the end of the shaft. It will be evident that link 24 and therefore block 34 and shaft 7 partake of variable angular movement due to the variable angular movement of the crank 22.

Upon the opposite end of the shaft 7 from block 34 is located an adjustable double crank 38 comprising slotted arms 39 and 40 of which one is secured to the shaft 7. They are united by crank pin 42 and the arm 40 carries a crank pin 41. These pins are held by washers 43, 44 and bolts and nuts 45 and 46. The positions of the crank pins are adjusted so that they are suitably placed in the slots to cause the desired throw. They are distant 180°. Straps $46^{\times}$ and 47 surround them and pass over pulleys 48 and 49 and reversely over pulley 50, as indicated diagrammatically in Fig. 1. These are attached to opposite ends of rack 51 so that as one tightens upon said rack the other slackens and permits its movement, in whichever direction this movement be. Rack 51 turns pinions 52 which are so arranged that always one of said pinions is in engagement with the shuttle 53 moving in guides 54, 55 and passing through the shed during this movement. Lay sword 56 is mounted on pin 58 which is capable of adjustment in slot 57. Pulleys 48 and 49 are supported upon shaft 59 between brackets 60 and 61.

In operation the crank describes an epicycloidal movement about the axis of the shaft and carries with it angularly the link or bar 24 which communicates the same angular movement to the shaft and double crank causing opposite movement of the two straps and consequent motion of the shuttle. The crank pin movement may be changed from true epicycloidal movement by adjustment of the crank toward or from its center of rotation, the greatest variation in angular speeds of the crank being secured at the greatest distance from the center.

Where I refer in the claims to epicycloid I wish to be understood as including also those curves lying on either side thereof, formed under similar conditions of travel and known as epitrochoids. In the true epicycloidal movement there will be no absolute dwell but only a slow motion of the crank at

the extremities of the second and fourth quarter. Reduction of throw of the crank will increase the speed at this point relatively and reduce that at the extremity of the first and third quarters, reaching a limit when the crank is adjusted so as to have no throw, at which time its path becomes an exact circle. After the crank passes the line of the pitch circle of the gear 16 in its outward adjustment it reaches a point of absolute dwell where the curve of its travel retraces its path slightly, and further increase of throw results in the loop of Fig. 14 which may be greatly enlarged and in which there is a short reversal of motion having the same effect in practice as a longer absolute dwell. The shuttle may thus be moved at any rate from true uniform motion to one having almost any desired amount of rest within the end guides and correspondingly increased speed in crossing the center.

The sun gear and the planetary gear operated about the same serve to impart to the shaft a plurality of cycles of speed variation per rotation of the shaft.

It will be evident that various changes may be made by those skilled in the art, which may come within the scope of my invention and I do not therefore desire to be limited in every instance to the exact construction herein shown and described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In shuttle operating mechanism, a shuttle-actuating rack, a shaft, connections between said rack and shaft, planetary gearing arranged to revolve about said shaft, a crank mounted upon the planet of said gearing and connections between said crank and said shaft.

2. In a shuttle operating mechanism, a shuttle-actuating rack, a shaft, means for connecting the shaft and rack, sliding means engaging said shaft, a crank engaging said sliding means and means for causing said crank to travel about the shaft in epicycloidal movement.

3. In a shuttle operating mechanism, a shaft, planetary gearing surrounding said shaft, a crank connected with the planet gear and means for forming a sliding connection between said shaft and said crank.

4. In shuttle operating mechanism, planetary gearing, a rotatable shaft, a guide mounted transversely of the planet gear, a crank adjustable along said guide and means for connecting said crank and said shaft.

5. In a shuttle operating mechanism, a shaft, a crank, means for causing revolution of the crank to produce angular movement of the shaft, means for giving said crank epicycloidal movement about said shaft and means for changing the epicycloidal movement.

6. In a shuttle operating mechanism, a shaft, a double crank upon one end thereof, shuttle moving mechanism, straps connecting said double crank and shuttle moving mechanism and means, embodying a second crank adjustable radially for giving an angular movement to said shaft variant with the crank adjustment.

7. In a shuttle operating mechanism, a shuttle-actuating rack, a shaft, a shuttle, means for causing the reciprocation of said rack by the rotation of said shaft, a crank movable about said shaft, sliding means connecting said crank and shaft, and means for adjustably varying the rate of angular movement of said crank about said shaft.

8. In a shuttle operating mechanism, a shuttle-actuating rack, a shaft, means for converting the rotation of said shaft into reciprocations of said rack, a crank movable about said shaft and slidably connected therewith, and means for varying the movement of said crank from continuous variable angular movement to alternate reversals of movement.

9. In a shuttle operating mechanism, a driving shaft, a driven shaft, gearing intermediate said driving and driven shafts, means including planetary gearing for securing adjustable relative angular movement of said shafts, a shuttle-actuating rack, and means for varying the reciprocation of the rack in agreement with the variation of angular speed of said driven shaft.

10. In a shuttle operating mechanism, a driving shaft, a spur gear thereon, a driven shaft, a gear loosely mounted about said driven shaft, a gear fixed about said driven shaft, a pinion mounted upon the loose gear and in mesh with said fixed gear, a crank rigid with said pinion and having an adjustable throw, sliding means connecting said crank and driven shaft, a shuttle-actuating rack and means for converting the movement of said driven shaft into reciprocations of said rack.

11. In a shuttle operating mechanism, a shuttle-actuating rack, straps connected thereto, a stationary member having outside and inside bearing surfaces, a shaft rotatable within said member, connections between the said shaft and said straps, a gear loosely mounted upon the outside of said member, a gear fixed to said stationary member, a pinion mounted upon said loose gear eccentrically thereof and in mesh with said fixed gear, a crank adjustable to different throws about the center of said pinion, slotted means for adjustably imparting motion from said crank to said shaft and means for driving the loose gear.

12. In a shuttle operating mechanism, a stationary member, a planetary gear mounted thereon, comprising a loose rotatable support, a fixed gear concentric with said member and a pinion mounted upon said loose ro-

tatable support in mesh with said fixed gear, in combination with a crank mounted upon said pinion, an arm engaging with said crank, a shaft rotatable within said member and operatively connected with said arm, means for driving the loose rotatable support, and shuttle-actuating means connected with said shaft.

13. In loom mechanism, a shaft, shuttle-actuating means operated thereby, a sun gear surrounding said shaft, a planet gear, a crank on said planet gear operatively connected with the shaft to impart angular movement thereto, and means for varying the throw of the crank.

14. In loom mechanism, a shaft, a shuttle-actuating rack operated thereby, a crank movable about said shaft, a rotatable support for said crank rotating about said shaft, connections between said crank and said shaft, and means for varying the distance of said crank from said shaft.

15. In a shuttle operating mechanism, the combination of a shuttle-actuating rack, a shaft, a double crank upon the shaft, connections between the double crank and the shuttle-actuating rack, a link connected with said shaft, a sun gear about the axis of the shaft, a planet gear operative about the sun gear, and an adjustable crank connection between said planet gear and link.

16. In a shuttle operating mechanism, a shuttle, a shaft, means for producing a complete reciprocation of said shuttle per rotation of the shaft, a planetary gearing whose sun and planet gears bear the relation of two to one, and means for converting the movement of said planet gear into variable angular rotation of said shaft.

17. In a shuttle operating mechanism, the combination of a shuttle-actuating rack, a shaft operatively connected therewith, and planetary gearing whose planet gear imparts angular movement to said shaft.

18. In loom mechanism, a shaft, a shuttle-actuating rack in operation driven thereby, a sun gear, a planet gear, a crank on said planet gear and means between said crank and shaft for transforming the revolution of said crank into angular movement of said shaft.

19. In loom mechanism, a shaft and means having its center of rotation in said shaft and surrounding the same for imparting thereto a plurality of cycles of speed variation during each rotation of the shaft.

20. In a shuttle operating mechanism, a shuttle-actuating rack, a double crank operatively connected therewith, a shaft connected with said double crank, a link angularly movable in agreement with said shaft, a crank engaging said link, and planetary gearing supporting said crank and adjustably connected therewith to provide variability of speed between said shaft and said planetary gearing.

21. In a shuttle operating mechanism, a driving shaft, a gear thereon, a driven shaft, a gear loosely mounted about said driven shaft, a gear fixed about said driven shaft, a pinion mounted upon the loose gear and meshing with said fixed gear, a crank rigid with said pinion, a slide connected to said shaft and a connection between the slide and said crank.

22. In a shuttle operating mechanism, planetary gearing, having the sun gear thereof fixed, a shaft concentric with said sun gear, means for revolving the planet gear, a crank upon said planet gear, a link connected with said crank, means for causing angular movement of said link to angularly move said shaft, and shuttle-actuating mechanism driven by said shaft.

23. In shuttle operating mechanism, planetary gearing, a shaft concentric with the sun gear, means for revolving the planet gear, a crank on said planet gear, connections between said crank and said shaft to cause angular movement of said shaft with revolution of said crank, and shuttle-actuating mechanism driven by said shaft.

24. In shuttle operating mechanism, planetary gearing, a shaft concentric with the sun gear, means for revolving the planet gear, a crank radially adjustable with respect to and mounted upon the planet gear, a link rotatably connected with the crank, a slide angularly movable with said shaft said slide and link being relatively movable, and shuttle-actuating mechanism driven by said shaft.

25. In shuttle operating mechanism, a sun gear, a planet gear, of smaller diameter than the sun gear, a shaft concentric with the sun gear, means for rotating and revolving the planet gear, a crank mounted to rotate and revolve with said planet gear, a connection between the crank and shaft which connection is angularly movable with respect to the crank and transversely movable with respect to the shaft, and shuttle-actuating mechanism driven by said shaft.

HENRY RIEHL.

Witnesses:
JOHN A. WIEDERSHEIM,
C. D. MCVAY.