

7. Sheets—Sheet 1.

No. 563,020.

Patented June 30, 1896.



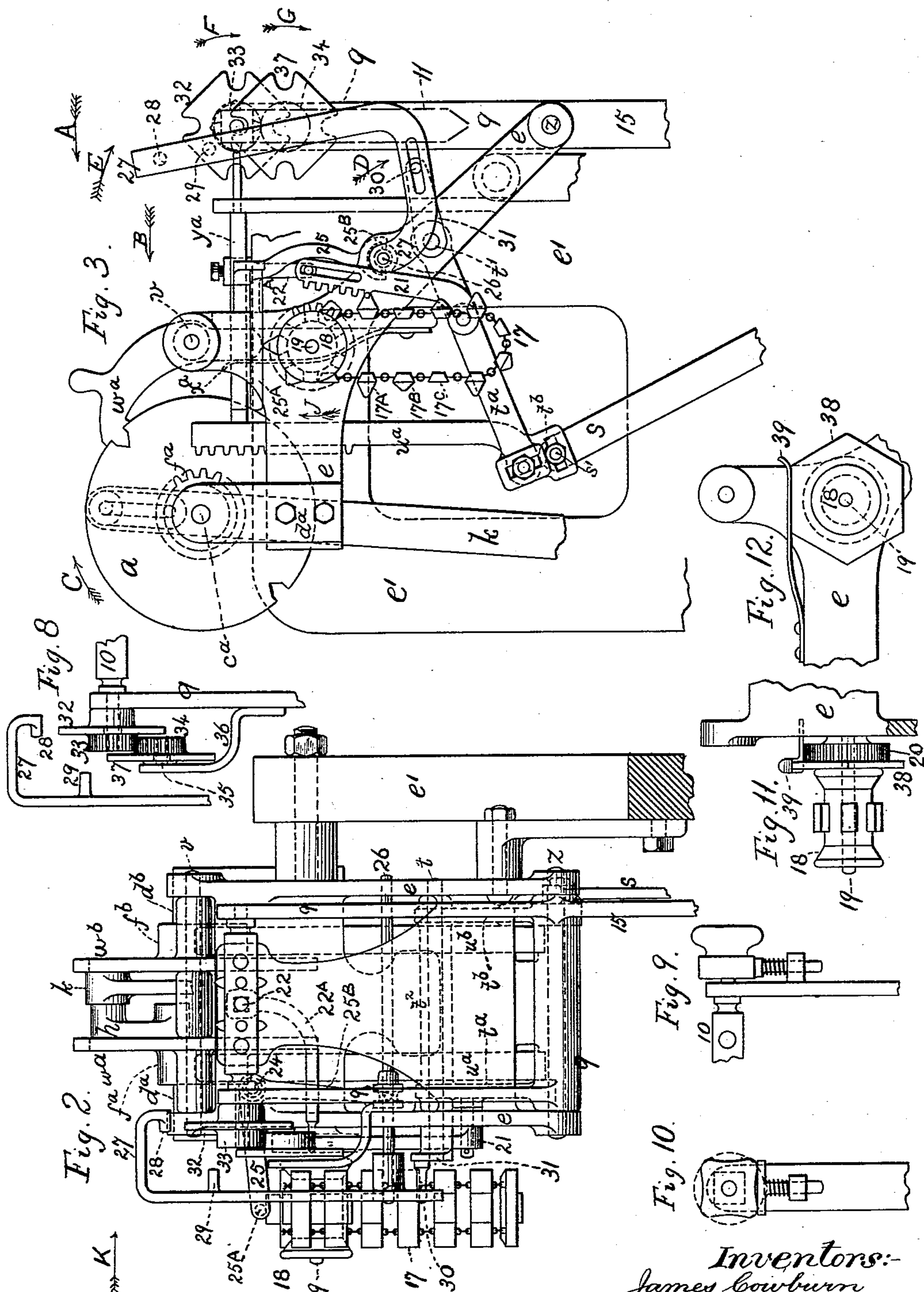
Inventors:-
James Cowburn
and Christopher Peck
by attorneys.
Brown & Seward

J. COWBURN & C. PECK.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 563,020.

Patented June 30, 1896.



Witnesses:
J. H. Haynes
George Barry

Inventors:
James Cowburn
and Christopher Peck
by attorneys
Brown & Howard

J. COWBURN & C. PECK.
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Fig. 3.^a

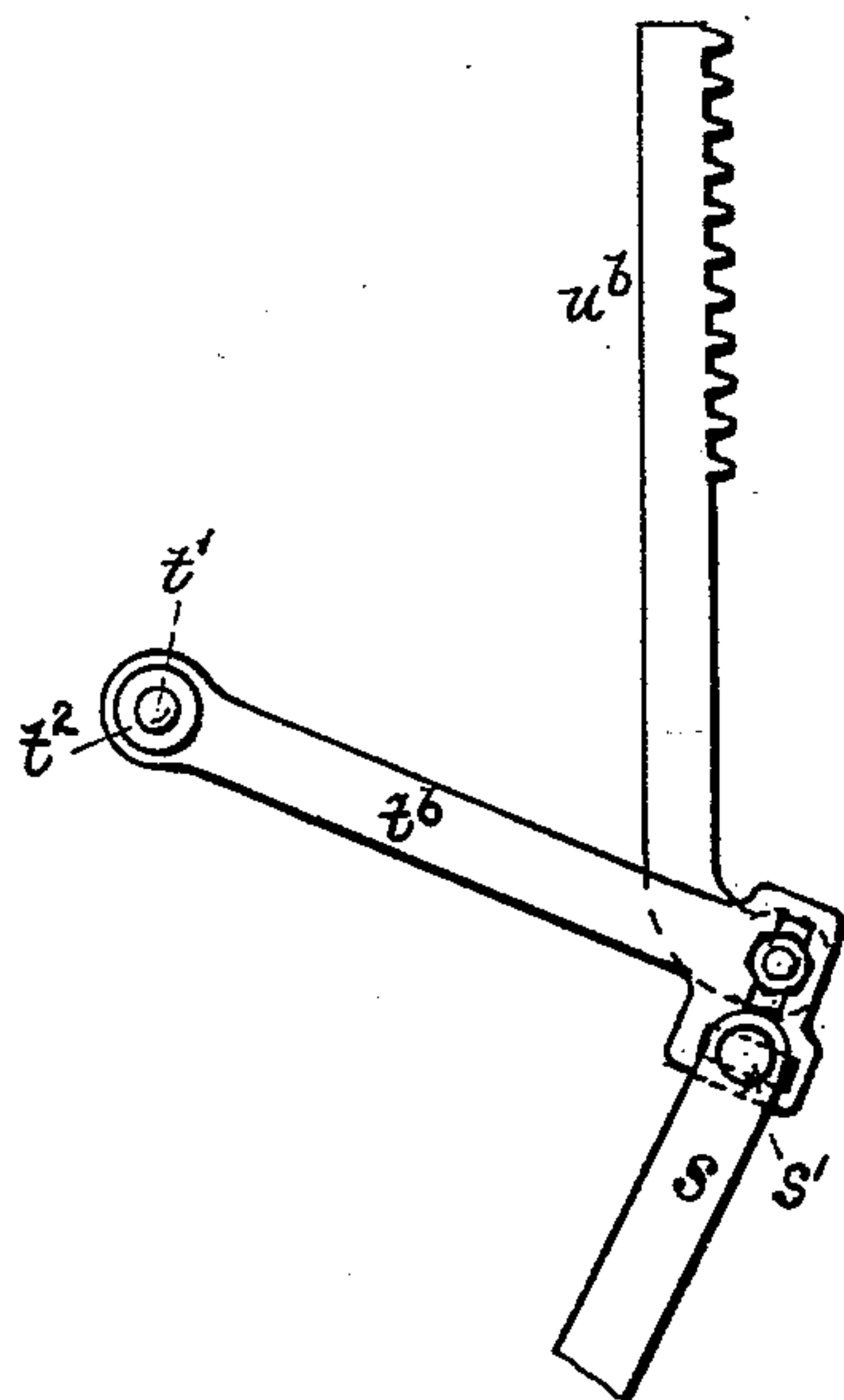
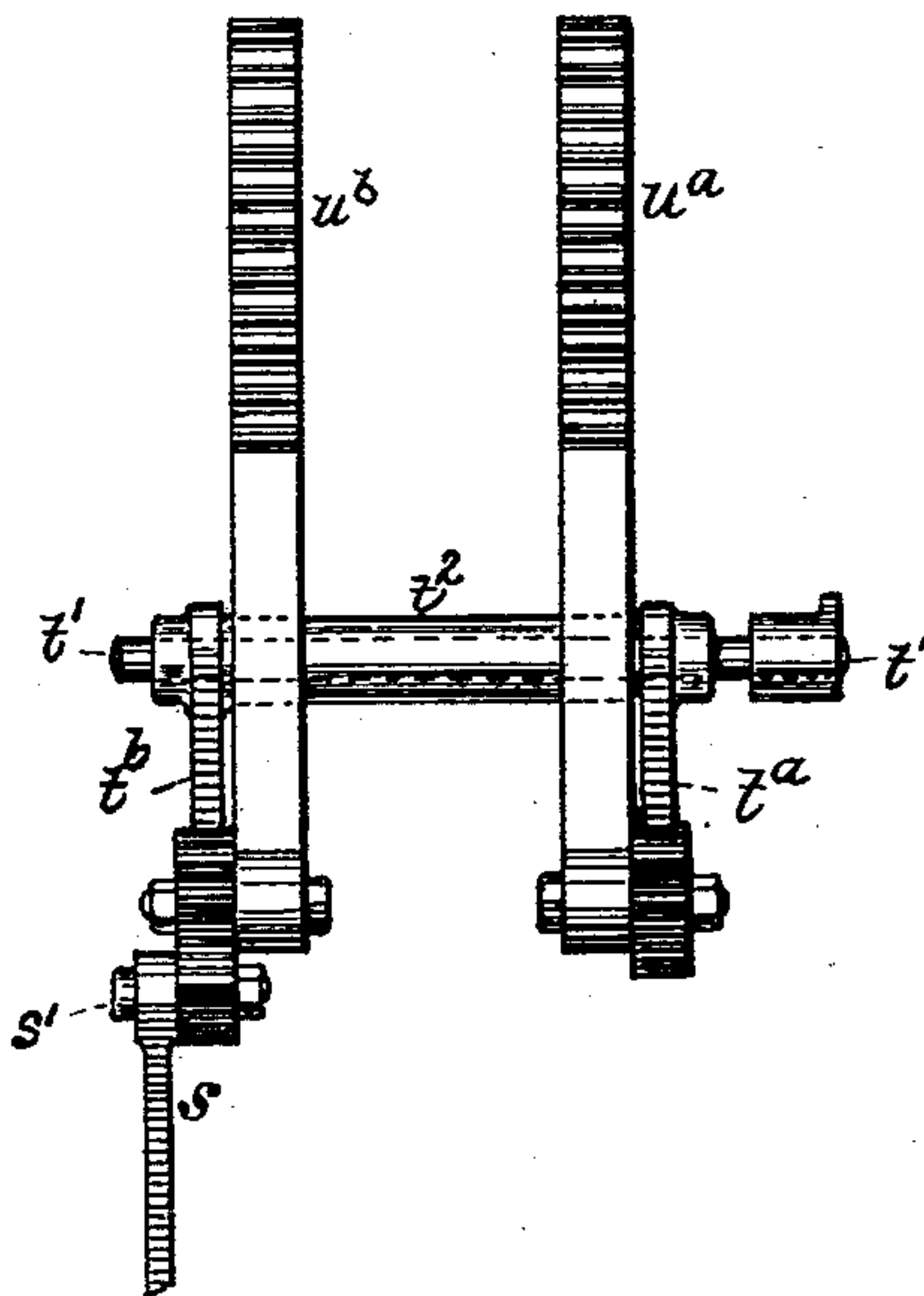


Fig. 2.^a



Witnesses:-
Trus Haynes
George Barry Jr.

Inventors:-
James Cowburn
and Christopher Peck
by attorneys
Rownt & Seward

(No Model.)

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J. COWBURN & C. PECK.
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Fig. 4.

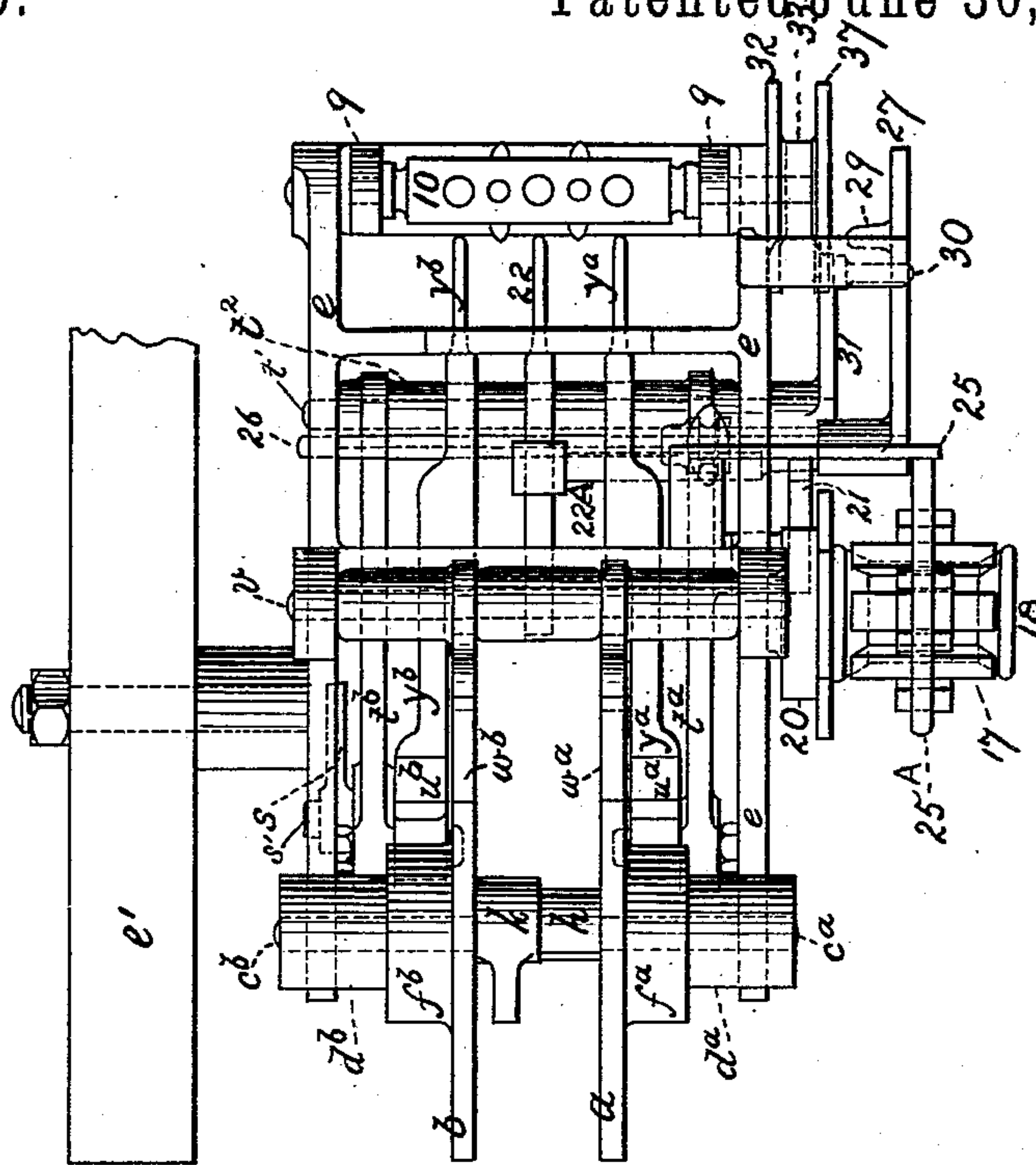
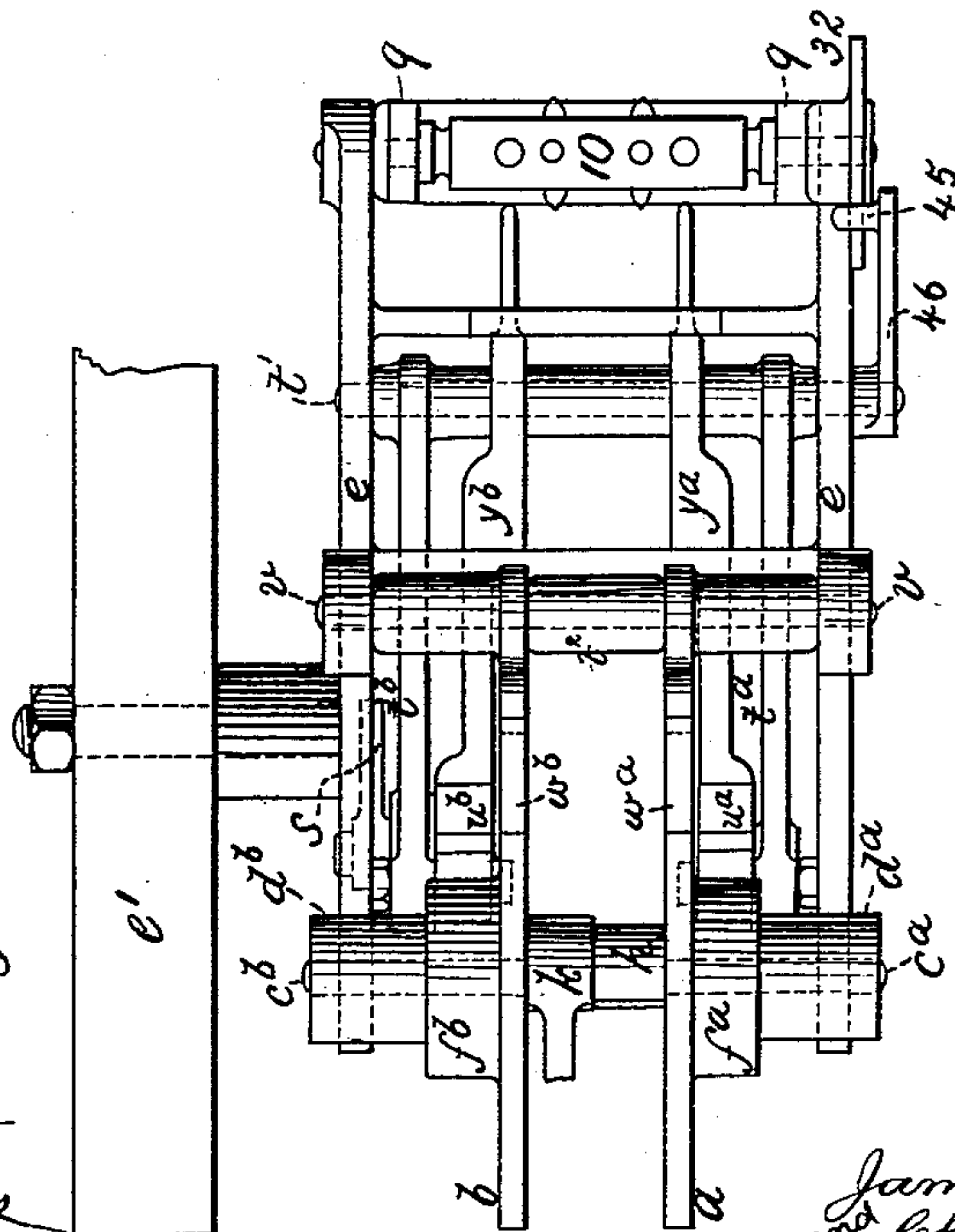


Fig. 27.



Witnesses:-
Fred Haynes
George Barry Jr.

Inventors:-
James Cowburn
and Christopher Peck
by attorneys
Brown & Howard

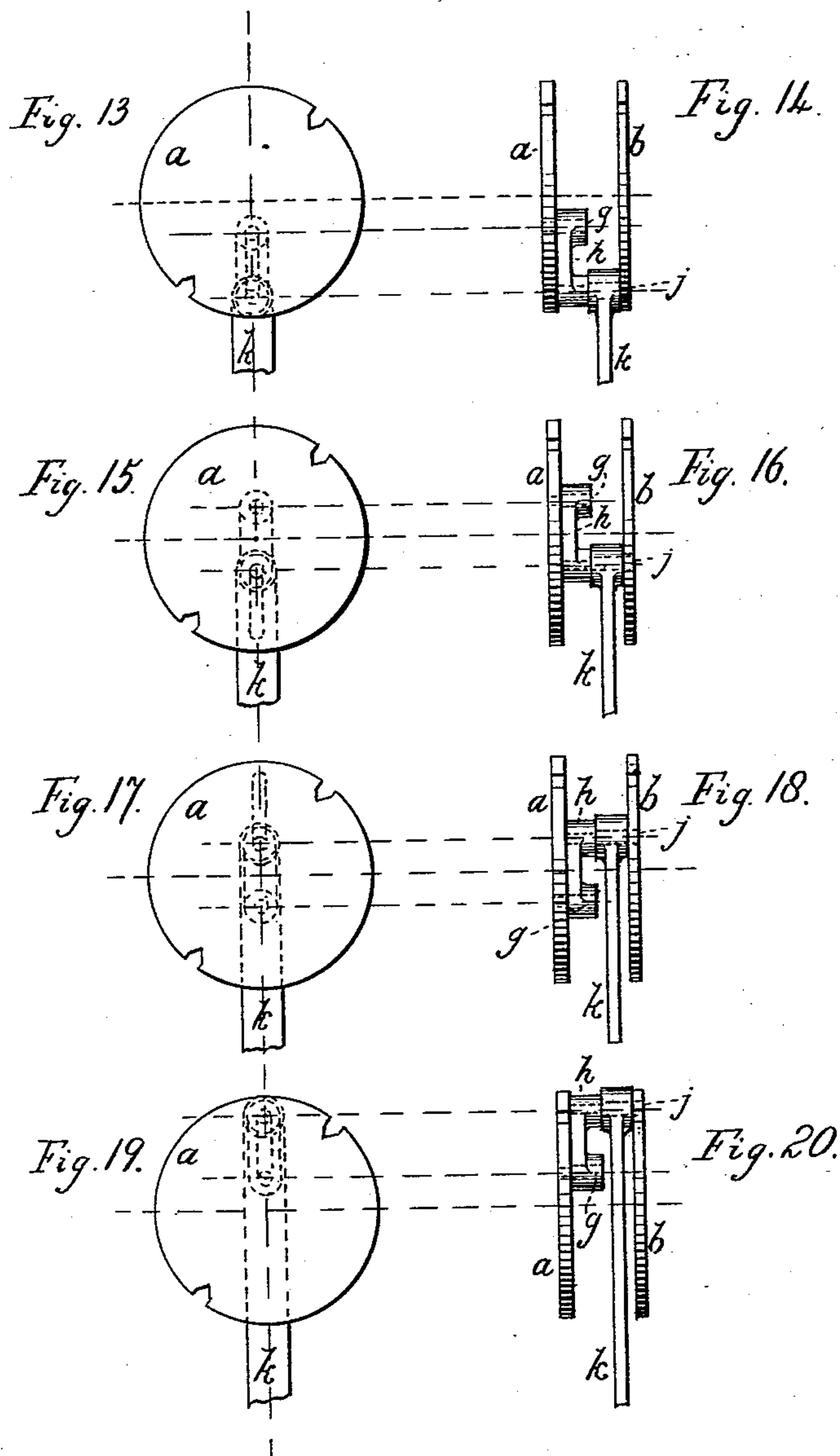
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7 Sheets—Sheet 5.

J. COWBURN & C. PECK.
SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 563,020.

Patented June 30, 1896.



Witnesses:
Fred Haynes
Gales P. Moore

Inventors:
James Cowburn
and Christopher Peck
by attorneys
Rowntree & Co.

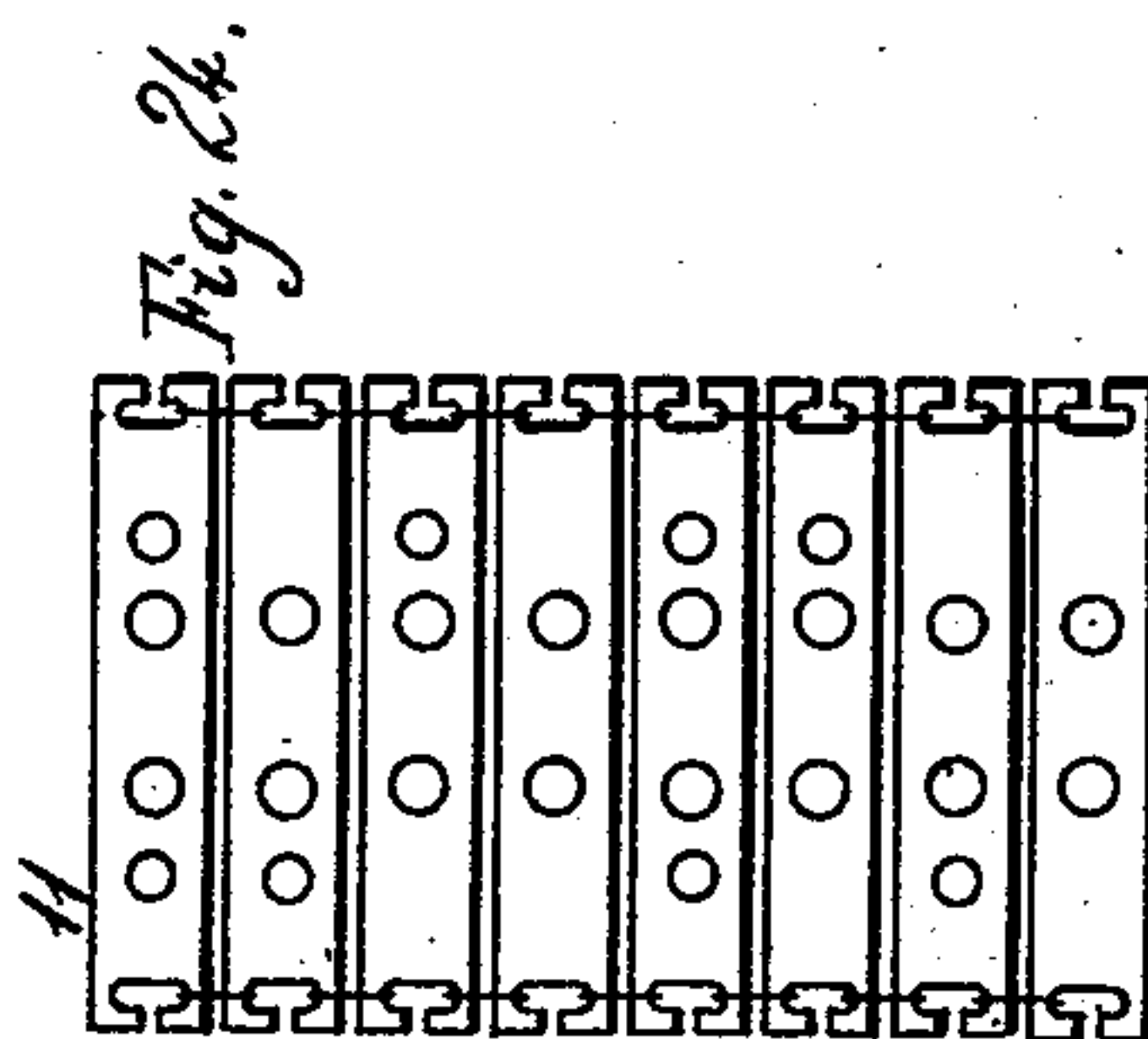
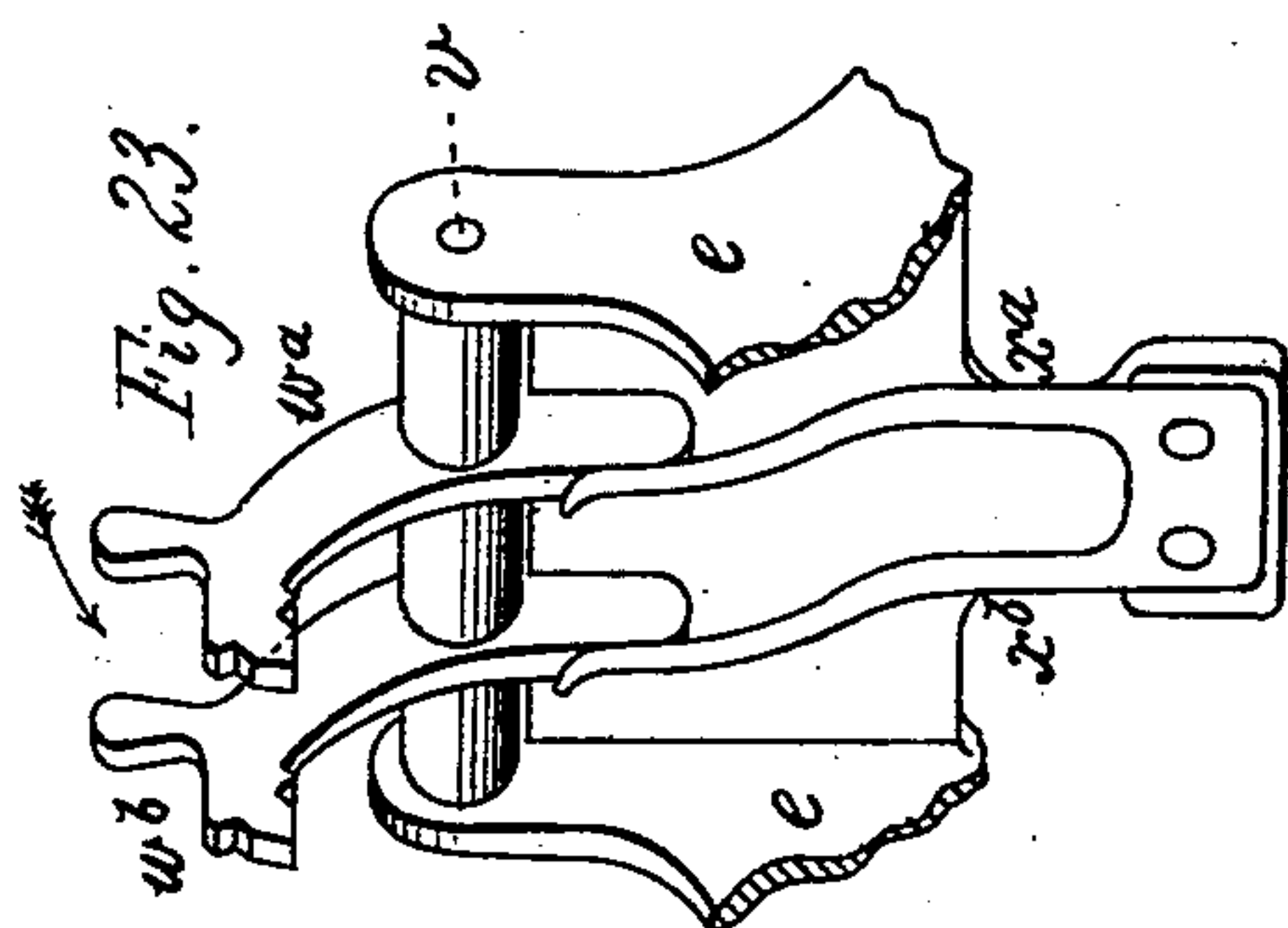
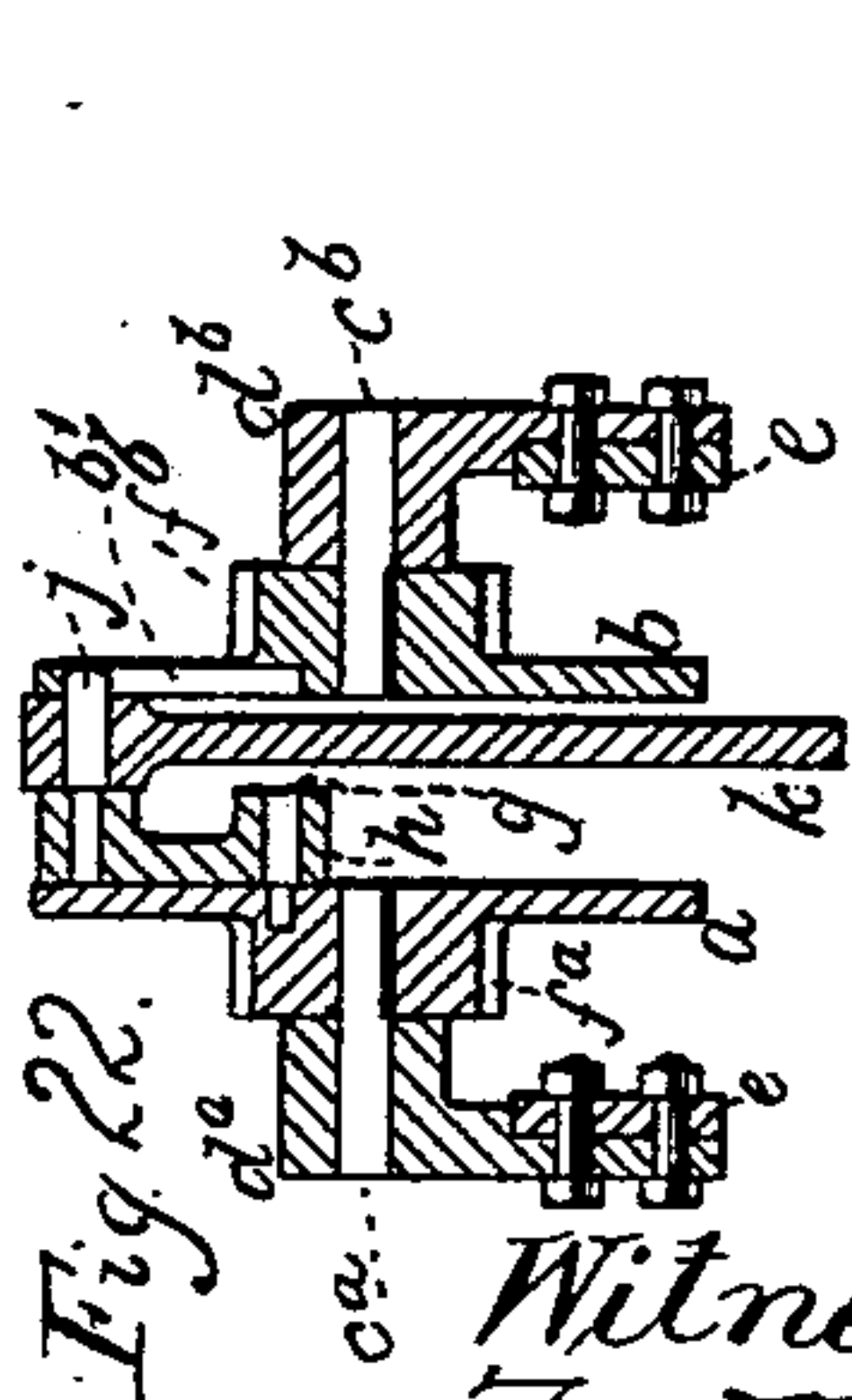
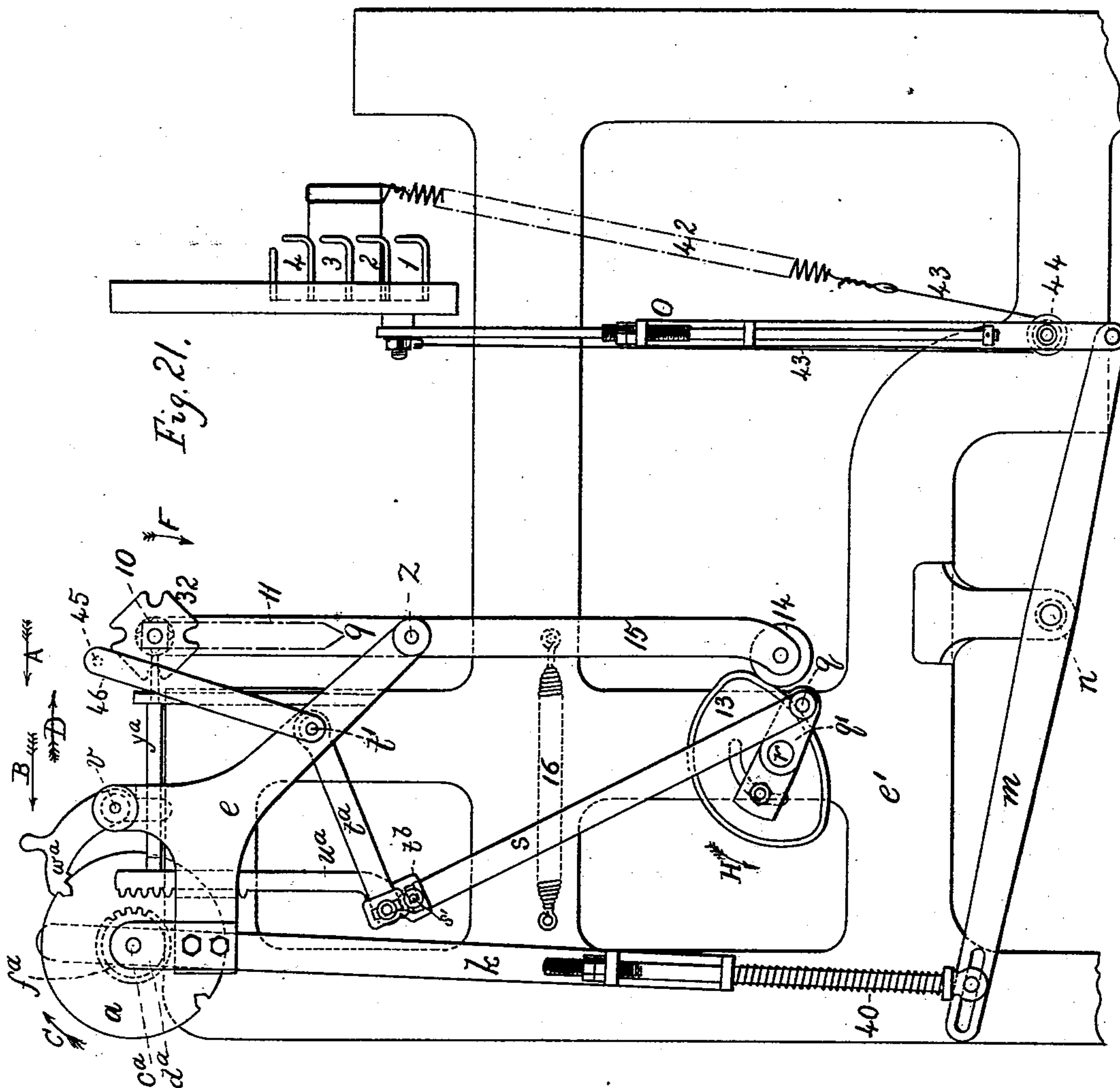
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J. COWBURN & C. PECK.
SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 563,020.

Patented June 30, 1896.



Witnesses:-
Frid Haymer
George Barry Jr

Inventors:-
James Cowburn
and Christopher Peck
by attorneys
Brown & Seward

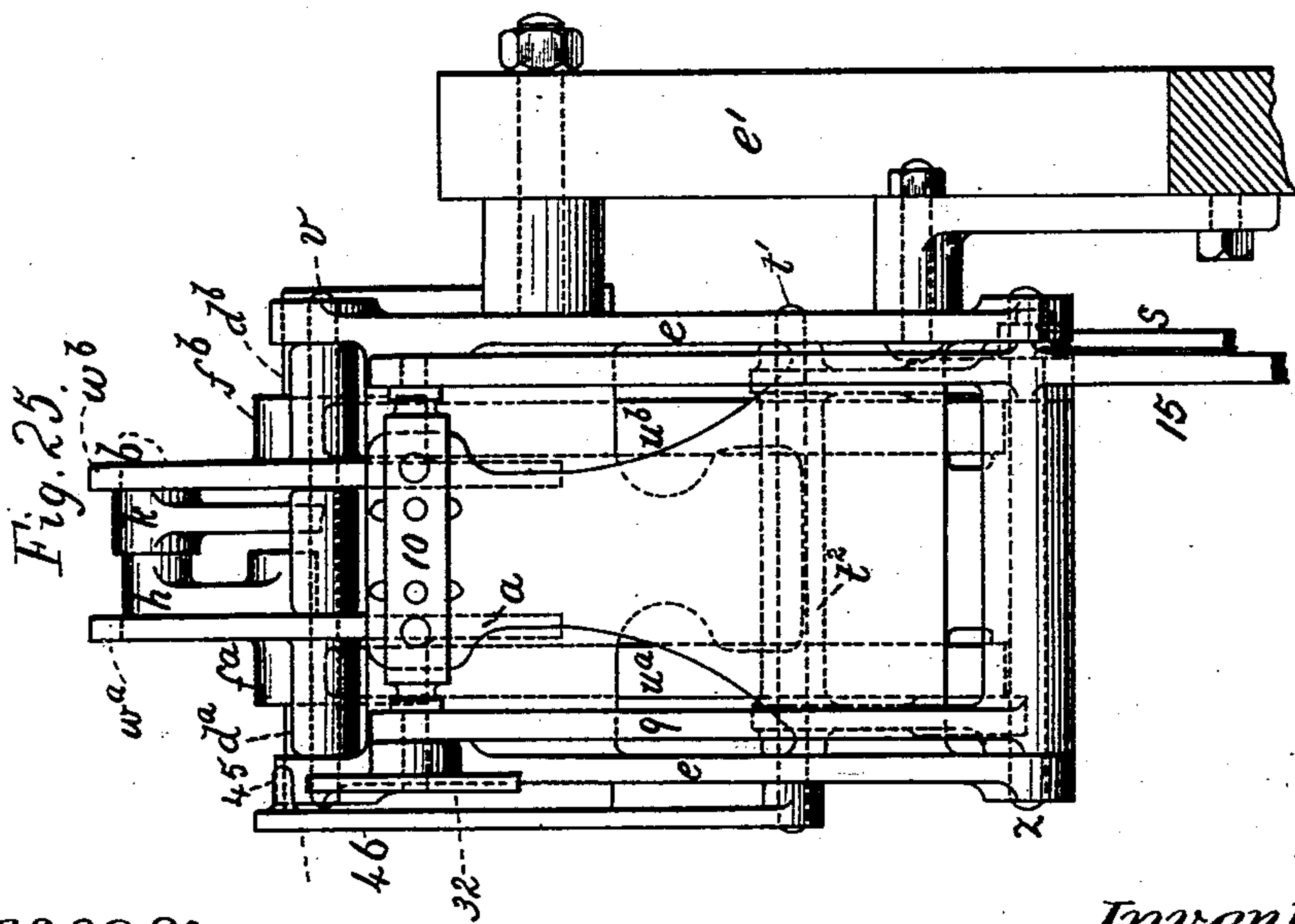
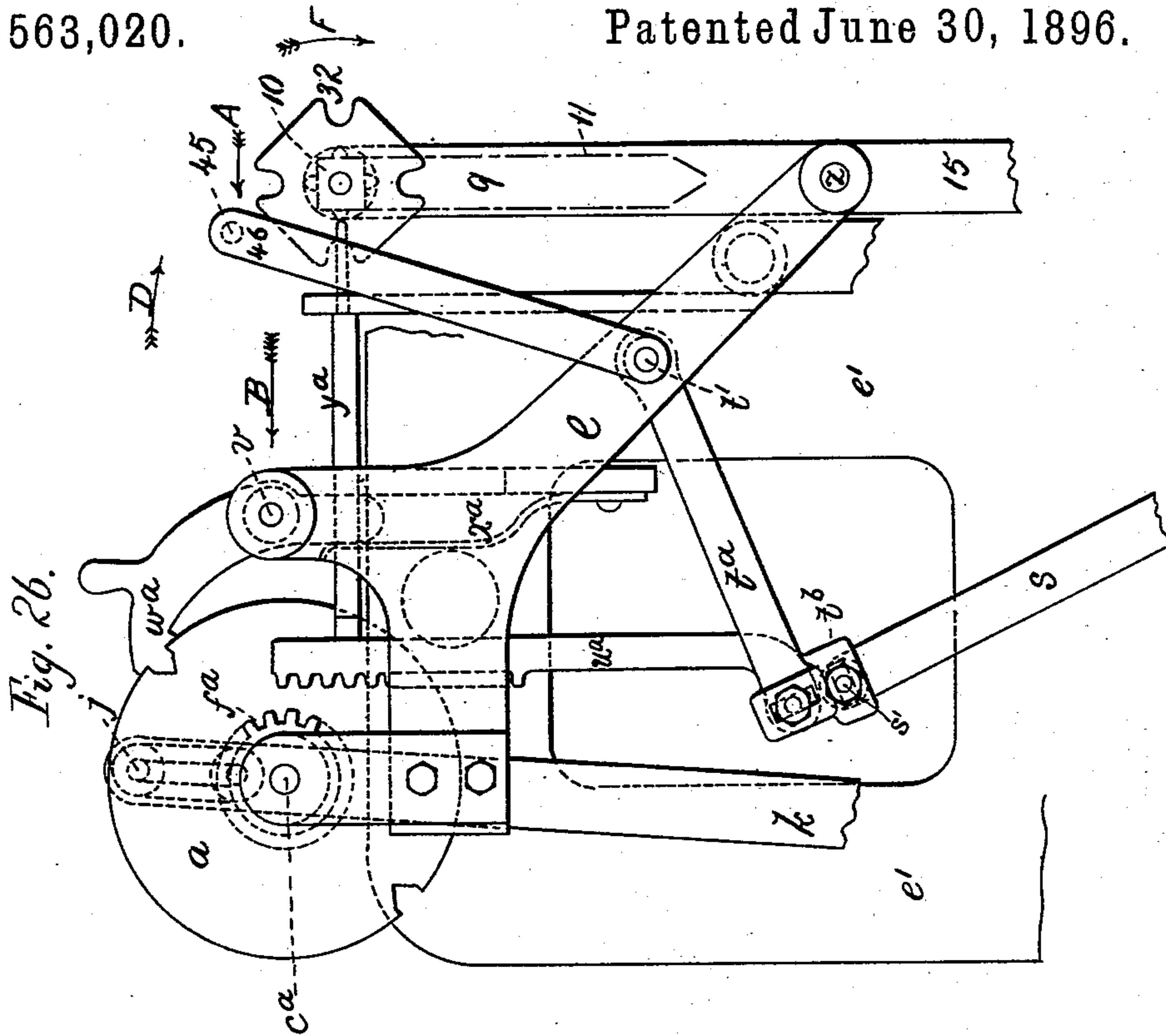
(No Model.)

7 Sheets—Sheet 7.

J. COWBURN & C. PECK.
SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

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Witnesses:-

Fred Haynes
George Barry

Inventors:-

James Cowburn
Christopher Peck
by attorneys
Brown & Howard

UNITED STATES PATENT OFFICE.

JAMES COWBURN AND CHRISTOPHER PECK, OF ECCLES, ENGLAND.

SHUTTLE-BOX-OPERATING MECHANISM FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 563,020, dated June 30, 1896.

Application filed November 19, 1895. Serial No. 569,389. (No model.) Patented in England April 26, 1888, No. 6,209, and February 28, 1889, No. 3,544; in Germany April 2, 1889, No. 53,354; in France January 10, 1891, No. 210,702; in Switzerland January 20, 1891, No. 3,321; in Spain March 28, 1891, No. 11,666; in Italy March 31, 1891, No. 29,108, and in Austria-Hungary August 13, 1891, No. 2,223 and No. 2,127.

To all whom it may concern:

Be it known that we, JAMES COWBURN, manager, of 108 Barton Lane, and CHRISTOPHER PECK, manufacturer, of Albert Mill
5 Silk Street, Eccles, in the county of Lancaster, England, have invented a new and useful Improvement in Shuttle-Box-Operating Mechanism for Looms, (for which we have obtained Letters Patent of the United Kingdom of Great Britain and Ireland, No. 6,209,
10 dated April 26, 1888, and No. 3,544, dated February 28, 1889; brevet d'invention of the Republic of France, No. 210,702, dated January 10, 1891; patent of the Republic of
15 Switzerland, No. 3,321, dated January 20, 1891; patent of importation of the Kingdom of Italy, No. 29,108, dated March 31, 1891; patent of the Kingdom of Spain, No. 11,666, dated March 28, 1891; patent of the Austro-
20 Hungarian Empire, No. 2,223 and No. 2,127, dated August 13, 1891, and for which a patent of the Empire of Germany, No. 53,354, dated April 2, 1889, has been granted to Carl Fleer, of Rheydt, Rhenish Prussia, in the Empire of
25 Germany, on our behalf,) of which the following is a specification.

Our invention relates to looms for weaving which are provided with three or four rising-and-falling shuttle-boxes, and has for
30 part of its object the provision of simple, efficient, and advantageous means for effecting the raising and lowering of the rising-and-falling shuttle-boxes of looms and the provision of simple, efficient, and advantageous means by which the pattern-chain employed in a loom in order to cause the shuttle-boxes of such loom to be moved in the
35 manner requisite may be very readily caused to move in one direction or the other or remain stationary, as may be necessary or desirable in the weaving of a cloth or fabric; and our invention has also for a part of its object to enable the shuttle-boxes and the pattern-chain of a loom to preserve their
40 proper relative positions when the loom is turned backward for unweaving or any other purpose.

Our invention is illustrated in the accompanying drawings.

In the accompanying drawings, in which 50 the same letters of reference are applied to corresponding parts in all the figures, Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 illustrate the application of our invention to a loom provided 55 with four rising-and-falling shuttle-boxes, and Figs. 21, 22, 23, 24, 25, 26, and 27 illustrate the manner in which the means which we employ according to our invention to effect the raising and lowering of the shuttle- 60 boxes of a loom may be employed without the means which we employ according to our invention for enabling the pattern-chain which is employed to control the raising and lowering of the shuttle-boxes to be moved in 65 one direction or the other or to remain stationary, as may be desirable.

Fig. 1 is a side elevation of a portion of a loom to which our invention is applied. Fig. 2 is a front elevation, Fig. 3 a side elevation, and Fig. 4 a plan drawn upon a larger 70 scale than Fig. 1 and illustrating certain of the parts shown in Fig. 1. Fig. 2^a is a rear elevation, and Fig. 3^a a side elevation taken from the left hand of Fig. 2, showing the 75 racks employed in conjunction with the disks illustrated in Figs. 1, 2, 3, and 4, the arms to which such racks are connected, and a portion of the connecting-rod by which such 80 arms receive motion. Fig. 5 is a vertical section through the disks illustrated in Figs. 1, 2, 3, and 4 and the crank and a portion of the connecting-rod used therewith. Fig. 6 is a perspective view illustrating the bell- 85 crank levers used in conjunction with the disks illustrated in Fig. 5 and also springs used in conjunction with such bell-crank levers and a spring used in conjunction with one of the darts or needles illustrated in 90 Figs. 2, 3, and 4. Fig. 7 is a front view of a portion of the pattern-card chain employed in the loom illustrated in Fig. 1. Fig. 8 is a front elevation showing certain parts more clearly than Fig. 2. Fig. 9 is a front elevation and Fig. 10 a side elevation illustrating 95 one form of device which we employ to prevent the pattern-card chain employed in the loom illustrated in Fig. 1 from being moved

except at the proper times. Fig. 11 is a front elevation and Fig. 12 a side elevation illustrating means by which the lag-chain employed in the loom illustrated in Fig. 1 may be prevented from being moved except at the proper times. Figs. 13, 15, 17, and 19 are diagrammatic side views and Figs. 14, 16, 18, and 20 are diagrammatic front views illustrating the action of the crank-pins, crank, and disks illustrated in Figs. 1, 2, 3, 4, and 5. Fig. 21 is a side elevation of a portion of a loom with four rising-and-falling shuttle-boxes, having applied to it the means which we employ according to our invention for effecting the raising and lowering of the shuttle-boxes. Fig. 22 is a vertical section through the disks employed in the loom illustrated in Fig. 21 and the cranks and a portion of the connecting-rod used therewith. Fig. 23 is a perspective view illustrating the bell-crank levers used in conjunction with the disks illustrated in Fig. 22 and also springs used in conjunction with such bell-crank levers. Fig. 24 is a front view of a portion of the pattern-card chain employed in the loom illustrated in Fig. 21. Fig. 25 is a front elevation, Fig. 26 a side elevation, and Fig. 27 a plan drawn upon a larger scale than Fig. 21 and illustrating certain of the parts shown in Fig. 21.

According to our invention we provide in a loom provided with three shuttle-boxes or in a loom provided with four shuttle-boxes an arrangement of a crank-pin and a crank, which may be turned into and held in the various positions requisite by the turning into and holding in certain positions of one or other or both of two disks to which we cause motion to be imparted by means of racks, and one of which disks we provide with a stud or crank-pin upon which is mounted the said crank, which can be turned about such crank-pin or stud by means of the second disk.

In order to facilitate the description of the arrangements which we employ, we will first describe the arrangement of crank-pin or stud and crank which we employ and the disks used with such arrangement of crank-pin or stud and crank, and the means by which such disks are turned into and held in the required positions, but as each disk which we employ in a loom, whether such loom be provided with three or four rising-and-falling shuttle-boxes, is moved into and held in the positions requisite by means of parts which are in part the same as, and in part similar, to the parts by which the other disk used in such loom is moved into and held in the positions requisite, we will in the accompanying drawings, except in the case of the disks employed and the crank-pin or stud and crank carried thereby, apply the same letters of reference to each of the several similar parts. In order to render it easy to distinguish whenever it may be necessary or desirable to do so between the similar parts, we have added as an affix to the reference-letter applied to each of such simi-

lar parts the reference-letter applied to the disk in conjunction with which such part is employed.

In Figs. 1, 2, 3, 4, and 5, *a b* are the two disks employed in our arrangement for effecting the movement of the rising-and-falling shuttle-boxes. The disks *a b* are respectively mounted fast upon axles *ca cb*, which are respectively mounted and capable of being revolved in brackets *da db*, each of which is secured to one arm of a bracket *e*, secured to one of the end frames of the loom, that is to say, to the end frame *e'*. Upon the disk *a* is formed a pinion *fa*, and upon the disk *b* is formed a pinion *fb*. Fast with the disk *a* is a stud or crank-pin *g*, carried by and free to be turned, upon which is an arm or crank *h*. Fast with the arm or crank *h* is a stud or crank-pin *j*, which is embraced by the upper end of a connecting-rod *k*, the lower end of which is jointed to a lever *m*, carried by and free to be oscillated on a stud *n*, carried by a bracket secured to the end frame *e'* of the loom. To the lever *m* is jointed the lower end of a connecting-rod *o*, secured at its upper end to the rising-and-falling shuttle-boxes 1, 2, 3, 4. The stud or crank-pin *j* projects into a radial slot *b'*, formed in the disk *b*, the said slot providing a sliding engagement between the crank-pin and the disk *b*.

As the disks *a b*, crank-pins or studs *g* and *j*, and arm or crank *h* form an important part of our invention by whatever means the disks *a b* may be turned, we will now describe the mode in which such disks *a b*, crank-pins or studs *g j*, and arm or crank *h* actuate the rising-and-falling shuttle-boxes 1, 2, 3, and 4 without referring to the means shown in the accompanying drawings as being employed to impart motion to the said disks *a b*.

If while the disk *a* is allowed to remain stationary in the position in which it is indicated in Fig. 5, the disk *b* be turned through one-half of a revolution from the position in which it is indicated in Fig. 5, the crank or arm *h* will be turned about the crank-pin or stud *g* from the position in which it is indicated in Fig. 5, in which the crank-pin or stud *j* is above the crank-pin or stud *g*, to a position in which the crank-pin or stud *j* is below the crank-pin or stud *g*, and a further turning of the disk *b* through half of a revolution into the position in which it is indicated in Fig. 5 will cause the stud or crank-pin *j* to be again above the stud or crank-pin *g*. If while the disk *b* is allowed to remain stationary either in the position in which it is indicated in Fig. 5 or in the position in which it is when turned through half a revolution from the position in which it is indicated in Fig. 5, the disk *a* be turned through half of a revolution from the position in which it is indicated in Fig. 5, the crank-pin or stud *g* will be turned into a position in which it is below the axis of the disk *a* and cause the stud or crank-pin *j* to be moved downward in the slot *b'* of the disk *b*, and by a further turning of the disk

a through half of a revolution into the position in which it is indicated in Fig. 5 the crank-pin or stud *g* will be turned again into the position in which it is above the axis of the disk *a*, that is to say, into the position in which it is indicated in Fig. 5, and the stud or crank-pin *j* will be moved upward in the slot *b'* of the disk *b*. If the disks *a b* be both turned simultaneously, so that each of them is turned through half of a revolution from or into the position in which it is indicated in Fig. 5, the stud or crank-pin *j* will be moved from the position at a certain distance above or below the axes of the disks *a b*, in which it was at the commencement of the said turning of the disks *a b*, to a position at an equal distance below or above the axes of the disks *a b*. The crank-pin or stud *j* being embraced by the upper end of the connecting-rod *k*, the upward and downward movements of the crank-pin or stud *j* will respectively cause downward and upward movements of the shuttle-boxes 1, 2, 3, and 4, and the eccentricity of the stud or crank-pin *g* in relation to the disk *a* being such that the turning of such stud or crank-pin from its highest position to its lowest position, and the turning of such stud or crank-pin *g* from its lowest position to its highest position will respectively cause the shuttle-boxes 1, 2, 3, and 4 to be raised and lowered through a distance equal to the distance between the center of one shuttle-box and the center of the next shuttle-box, and the eccentricity of the crank-pin or stud *j* in relation to the crank-pin or stud *g* being such that the turning of such crank-pin or stud *j* from a position above the crank-pin or stud *g* to a position below the crank-pin or stud *g*, and the turning of such crank-pin or stud *j* from a position below the crank-pin or stud *g* to a position above the crank-pin or stud *g* will respectively cause the shuttle-boxes 1, 2, 3, and 4 to be raised and lowered through a distance equal to twice the distance between the center of one shuttle-box and that next to it, the turning of one or other or both of the disks *a b* necessary to place such disks *a b* in any one of the several positions relative to each other in which they are indicated in Figs. 13 and 14, Figs. 15 and 16, Figs. 17 and 18, and Figs. 19 and 20 of the accompanying drawings will enable any one of the four shuttle-boxes 1 2 3 4 to be brought into position to deliver or receive a shuttle.

We will now describe the arrangements by means of which we enable the disks which we employ to be held securely in the positions into which they may be turned from time to time and the arrangements by means of which we enable the turning or remaining stationary of such disks to be controlled by means of the pattern-card chain which we employ, whether the said pattern-card chain be employed in conjunction with mechanism by means of which such pattern-card chain may while the loom is weaving be caused to revolve forward or backward or remain stationary for

any desired number of revolutions of the tappet-shaft of the loom, as in the arrangements illustrated in Figs. 1, 2, 3, and 4, or whether such pattern-card chain be employed in conjunction with mechanism by which it is caused to revolve in one direction only while the loom is weaving, and only revolve in the opposite direction when the loom is turned backward for unweaving or any other purpose, as in the arrangements illustrated in Figs. 21, 25, 26, and 27.

q is a crank-pin secured in an arm *q'*, mounted fast upon the shaft *r*, which may be the tappet-shaft of the loom, as in the arrangements illustrated in the accompanying drawings, or may be any other shaft which revolves at a suitable speed while the loom is weaving. The crank-pin *q* is embraced by the lower end of a connecting-rod *s*, connected by means of a stud *s'* to one end of an arm *tb*, which is formed upon a boss *t²*, mounted fast upon an axle *t'*, upon which boss *t²* there is also formed an arm *ta*. The axle *t'* is carried by and capable of being oscillated in the bracket *e*. To the arm *ta*, by means of a stud, is connected a toothed rack *ua*, capable of being at times caused to engage with the pinion *fa*, and to the arm *tb* a toothed rack *ub*, capable of being at times caused to engage with the pinion *fb*, is connected by means of a stud. The revolution of the crank-pin *q* will cause the arms *ta tb* to be oscillated about the axis of the axle *t'* and will cause the racks *ua ub* to be raised and lowered. Carried by the bracket *e* is a shaft *v*, upon which and capable of being oscillated thereon are mounted bell-crank levers *wa wb*. The bell-crank lever *wa* is formed with a catch adapted to engage with either of two notches formed in the disk *a*, and the bell-crank lever *wb* is formed with a catch adapted to engage with either of two notches formed in the disk *b*. Springs *xa xb*, secured to the bracket *e* and bearing, respectively, against the bell-crank levers *wa wb*, tend to press such bell-crank levers *wa wb* into engagement with the disks *a b*, respectively. When the bell-crank lever *wa* or *wb*, employed in conjunction with either of the disks *a b*, is in engagement with either of the notches in such disk the said disk will be prevented from rotating. In the bracket *e* are mounted needles or darts *ya yb*, which are capable of being moved lengthwise in the said bracket *e*. The needle or dart *ya* is formed with a shoulder which abuts against the lower arm of the bell-crank lever *wa*, and such needle or dart *ya* abuts at one end against the back of the toothed rack *ua*. The needle or dart *yb* is formed with a shoulder which abuts against the lower arm of the bell-crank lever *wb*, and such needle or dart *yb* abuts at one end against the back of the toothed rack *ub*. The racks *ua ub*, being situate to one side of the studs on which they are respectively mounted, tend to turn away from and out of gear with the pinions *fa fb*, in conjunction with which they are respectively employed.

Carried by the bracket *e* is a shaft or stud *z*, mounted and capable of being oscillated, upon which is a frame 9. In the frame 9 and capable of being revolved therein is mounted a pattern-chain barrel 10, around which passes a pattern-card chain 11, the construction of which is illustrated by Fig. 7, which shows a portion of such pattern-card chain.

The means by which the pattern-chain barrel 10 is revolved will be hereinafter described.

13 is a cam which is secured in position upon the tappet-shaft *r* of the loom in the arrangements illustrated in the accompanying drawings, but may be mounted upon any other shaft revolving at a suitable speed. The cam 13 is secured in position upon the tappet-shaft *r* by means of a set-screw passing through a slot formed in such cam 13 and screwed into an arm mounted fast upon the tappet-shaft *r*, the said slot and set-screw enabling the cam 13 to be adjusted into and secured in position upon the tappet-shaft *r*. The cam 13 by acting against a bowl 14, mounted upon an arm 15, formed upon the frame 9, causes such frame 9 to be oscillated in the direction indicated by the arrow A, and a spring 16, secured at one end to the arm 15 and at the other end to the end frame *e'* of the loom, causes such frame 9 to be oscillated in the direction opposite to that indicated by the arrow A. When the frame 9 is caused to move in the direction indicated by the arrow A, the pattern-card chain 11 around the barrel 10 will be moved toward the darts or needles *ya yb*, and by cards or plates adapted to act upon one or other or both of such darts or needles *ya yb* being provided at any part in the pattern-card chain 11, one or other or both of such darts or needles *ya yb* may be caused to be moved longitudinally in the direction indicated by the arrow B in each revolution of the tappet-shaft *r*, while if a card or plate or a suitable number of cards or plates adapted to leave either or both of the darts or needles *ya yb* unacted upon either or both of such darts or needles *ya yb* may be caused to remain unacted upon by the pattern-card chain 11 during a revolution or any required number of revolutions of the tappet-shaft *r*. When either of the darts or needles *ya yb* is moved longitudinally in the direction indicated by the arrow B, the toothed rack *ua* or *ub*, in conjunction with which such dart or needle is employed, will be caused to gear with the pinion *fa* or *fb* upon the disk *a* or *b*, in conjunction with which such rack *ua* or *ub* is employed, and the bell-crank lever *wa* or *wb* used with such disk will be moved out of engagement therewith.

The cam 13 and crank-pin *q* are so arranged that when the loom is weaving the dart or needle or darts or needles moved by the pattern-card chain 11 by any movement of the frame 9 in the direction indicated by the arrow A will cause the engagement of the rack or racks with which such dart or needle

or darts or needles is or are used with the pinion *fa* or *fb* or pinions *fa* and *fb* in conjunction with which such rack or racks is or are used to take place at such times as the racks are in the highest position into which they are moved by the crank-pin *q*. The cam 13 is so formed that when either of the racks *ua* or *ub* is placed in gear with the pinion *fa* or *fb* in conjunction with which it is used it will be kept in gear therewith, while the continued revolution of the crank-pin *q* causing the descent of such racks causes the said pinion and the disk *a* or *b* on which such pinion is formed to revolve through half a revolution in the direction indicated by the arrow C, and when the racks have been moved to their lowest position the frame 9 will be allowed to move in the direction opposite to that indicated by the arrow A, and cause the pattern-card chain 11 to recede from the dart or needle *ya* or *yb* or darts or needles *ya* and *yb* and allow the dart or needle or darts or needles previously forced in the direction indicated by the arrow B to be moved in a direction opposite to that indicated by the arrow B by the bell-crank lever or bell-crank levers, which bears or bear against such dart or needle or darts or needles being moved by the spring or springs *x* used therewith into engagement with the disk *a* or *b* or disks *a b* in conjunction with which such bell-crank lever or bell-crank levers is or are used. When the dart or needle which has acted on either of the racks is withdrawn therefrom, the rack upon which it acted will fall away from and out of gear with the pinion on which it acted. When the bell-crank lever *wa* or *wb*, used in conjunction with either of the disks *a b*, is in engagement therewith, such disk will be prevented from being turned, so that the bell-crank levers serve to retain the shuttle-boxes 1 2 3 4 in any position in which they are placed or caused to remain by the action of the pattern-card chain 11.

We will now describe the arrangements by means of which we enable the pattern-card chain employed in a loom to be caused to revolve forward or backward or remain stationary for any desired time while the loom is weaving, which are illustrated in Figs. 1, 2, 3, and 4 of the accompanying drawings. In these arrangements for enabling the pattern-card chain used for causing or controlling the raising and lowering of the shuttle-boxes employed in a loom to be caused to revolve forward or backward, or remain stationary for any desired time while the loom is weaving, which are particularly applicable for use in weaving patterns in which one portion of the pattern occurs at intervals and another portion is repeated several or a considerable number of times in succession, a lag-chain 17, passing around a lag-barrel 18, mounted and capable of being revolved upon a stud 19, carried by the bracket *e*, is employed. The lag-chain 17 is formed of lags of three different heights, such as the lags 17^A 17^B 17^C. Fast

with the lag-barrel 18 is a toothed wheel 20. Upon a stud secured to the arm *ta* is mounted a rack 21, which may be caused to engage or gear with the toothed wheel 20. In the bracket *e* is mounted a dart or needle 22, provided with an arm 22^A, by means of which the rack 21 may be moved into gear with the toothed wheel 20. The arm 22^A upon the dart or needle 22 passes into a slot formed in the rack 21. A spring 23, secured to the bracket *e*, and shown in Fig. 6 as being formed in one with the springs *xa xb*, tends to move the dart or needle 22 in the direction opposite to that indicated by the arrow B. Secured to the bracket *e* is a stud 24, mounted upon which and free to be oscillated thereon is a bell-crank lever 25. The bell-crank lever 25 is provided with a bar or finger 25^A, which projects over and is supported by the lags of the lag-chain 17. The bell-crank lever 25 is provided with jaws 25^B, which pass into a groove formed in a collar fast upon an axle 26, supported by and capable of being slid longitudinally and oscillated in the bracket *e*. Fast upon the axle 26 is an arm 27, provided with projecting pegs or studs 28 29. In the arm 27 is formed a slot, into which passes a pin 30, fast with an arm 31, secured upon the axle *t'*. Fast upon the axle of the pattern-chain barrel 10 is a notched wheel 32, and also fast upon the said axle is a toothed wheel 33, which gears into a toothed wheel 34, carried by and free to be turned upon a stud 35, secured to a bracket 36, secured to the frame 9. Fast with the toothed wheel 34 is a notched wheel 37. The notched wheels 32 and 37, the pegs or studs 28 and 29, and the toothed wheels 33 and 34 are shown more clearly in Fig. 8.

When the axle *t'* is oscillated by the revolution of the crank-pin *q*, the arm 31 and pin 30 will cause the arm 27 to be oscillated about the axis of the axle 26. When the axle *t'* is oscillated in the direction indicated by the arrow D, the pin 30 will cause the arm 27 to be oscillated in the direction indicated by the arrow E, and when the axle *t'* is oscillated in a direction opposite to that indicated by the arrow D the pin 30 will cause the arm 27 to be oscillated in the direction opposite to that indicated by the arrow E. As is clearly indicated in Figs. 2 and 8, the pegs or studs 28 and 29 are formed in such positions upon the arm 27 that according to the position in which such arm 27 and the axle 26 upon which it is mounted may be placed the peg or stud 28 may be placed in the plane of the notched wheel 32, or the peg or stud 29 may be placed in the plane of the notched wheel 37, or both of such studs 28 29 may be so placed as to be incapable of passing into engagement with either of the notched wheels 32 37. The placing of the arm 27 and axle 26 in different positions is accomplished by means of the lag-chain 17 and bell-crank lever 25, as will be hereinafter described. While the loom is weaving the movement of the arm 27 in the

direction indicated by the arrow E will take place during the time in which the pattern-card chain 11 is withdrawn from the darts or needles *ya yb*, and while the notched wheels 32 37 are in a position in which the peg or stud 28, if in the plane of the notched wheel 32, may be engaged therewith, or the stud 29, if in the plane of the notched wheel 37, may be engaged therewith, and the movement of the arm 27 in the direction opposite to that indicated by the arrow E will take place during the time in which the pattern-chain barrel 11 is being moved into a position in which a card thereon may, if it act upon the darts or needles *ya yb*, press and hold the racks *ua ub* in gear with the pinions *fa* and *fb*, respectively. While the loom is weaving the movement of the arm 27 in the direction opposite to that indicated by the arrow E will not cause any motion to be imparted to the notched wheel 32 or the notched wheel 37, although the peg or stud 28 may be in the plane of the notched wheel 32, or the peg or stud 29 may be in the plane of the notched plane 37. While the loom is weaving, if the peg or stud 28 is in the plane of the notched wheel 32, the turning of the arm 27 in the direction indicated by the arrow E will cause the notched wheel 32 and pattern-chain barrel 10 to be revolved through a quarter of a revolution in the direction indicated by the arrow F in each revolution of the shaft *r*, and if the peg or stud 29 is in the plane of the notched wheel 37 the turning of the arm 27 in the direction indicated by the arrow E will cause the notched wheel 37 to be revolved through a quarter of a revolution in the direction indicated by the arrow G in each revolution of the shaft *r*, and so by means of the toothed wheels 34 and 33 cause the pattern-chain barrel 10 to be revolved through a quarter of a revolution in the direction opposite to that indicated by the arrow F in each revolution of the shaft *r*.

In the position in which the parts are indicated in Figs. 1, 2, 3, 4, and 8 the lag-chain 17 is holding the bell-crank lever 25 in such position that the jaws 25^B hold the axle 26 in such position that the peg or stud 28 is caused to move in the plane of the notched wheel 32, so that while the loom is weaving and the shaft *r* is revolving in the direction indicated by the arrow H the pattern-card chain 11 will be caused to pass around the pattern-chain barrel 10 in the direction indicated by the arrow F so long as the cards or plates of the pattern-card chain 11, which are presented to the darts or needles *ya, yb*, and 22 by the pattern-chain barrel 10, are formed with holes which can pass over the end of the dart or needle 22, so that such dart or needle 22 is not acted upon by such cards or plates, but when the pattern-chain barrel 10 presents to the darts or needles *ya yb* 22 a plate or card which is imperforate at the portion thereof which is presented to the dart or needle 22 the next movement of the frame 9 in the direction in-

5 indicated by the arrow A will cause the dart or
 needle 22 to be moved in the direction indi-
 cated by the arrow B, and so cause the rack
 21 to be placed in gear with the toothed wheel
 20, so that the next downward movement of
 the rack 21 will turn the lag-barrel 18 in the
 direction indicated by the arrow J and cause
 the next lag of the lag-chain 17 to be brought
 into position beneath the bar or finger 25.
 10 A typical portion of the pattern-card chain 11
 is shown detached in Fig. 7 of the accompany-
 ing drawings. To retain the lag-barrel 18 in
 position after it has been turned by the rack
 21, we secure to the lag-barrel 18 a disk 38,
 15 having around its edge as many flattened por-
 tions as there are notches in the lag-barrel 18
 to receive the lags of the lag-chain 17. Se-
 cured to the bracket *e* is a spring 39, which
 bears upon the flattened portions of the disk
 20 38 and so tends to hold the lag-barrel 18 steady
 in any position into which it is turned by the
 rack 21. The spring 39 and disk 38 are shown
 in Figs. 11 and 12 of the accompanying
 drawings.
 25 Should the turning of the lag-barrel 18 by
 the rack 21 bring a lag, such as 17^c, into posi-
 tion beneath the bar or finger 25^a, the bar or
 finger 25^a will, by its weight, be caused to
 descend and rest upon such lag 17^c, and such
 30 movement of the bar or finger 25^a will cause
 the jaws 25^b of the bell-crank lever 25 to move
 the axle 26 and arm 27 in the direction indi-
 cated by the arrow K, thereby removing the
 35 peg or stud 28 out of the plane in which the
 notched wheel 32 moves and bringing the peg
 or stud 29 into the plane in which the notched
 wheel 37 moves. When the peg or stud 29
 has been so moved into the plane in which
 the notched wheel 37 moves, the next move-
 40 ment of the arm 27 in the direction indicated
 by the arrow E, caused by the continued rev-
 olution of the shaft *r* in the direction indi-
 cated by the arrow H, will cause the peg or
 stud 29 to turn the notched wheel 37 in the
 45 direction indicated by the arrow G and cause
 the pattern-chain barrel 18 to be revolved in
 a direction opposite to that in which it is re-
 volved when the stud 28 acts upon the notched
 wheel 32 while the loom is weaving. When
 50 the turning of the lag-barrel 18 by the rack
 21 brings a lag, such as 17^a, into position be-
 neath the bar or finger 25^a, the bar or finger
 25^a, being raised, will move the axle 26 and
 arm 27 in a direction opposite to that indi-
 55 cated by the arrow K, and thereby move the
 peg or stud 29 out of the plane in which the
 notched wheel 37 moves and bring the peg or
 stud 28 into the plane in which the notched
 wheel 32 moves. When the peg or stud 28 has
 60 been so moved into the plane in which the
 notched wheel 32 moves, the next movement
 of the arm 27 in the direction indicated by
 the arrow E, caused by the continued rev-
 olution of the shaft *r* in the direction indi-
 65 cated by the arrow H, will cause the peg or
 stud 28 to turn the notched wheel 32 and pat-

tern-chain barrel 18 in the direction indicated
 by the arrow F.

When the turning of the lag-barrel 18 brings
 a lag, such as 17^b, beneath the bar or finger 70
 25^a, the bell-crank lever 25 will be turned and
 move the axle 26 and arm 27 into such posi-
 tion that the pegs or studs 28 29 will be clear
 of the notched wheels 32 37 while the arm
 27 is oscillating, and at such times the pat- 75
 tern-chain barrel 10 will not be rotated.
 When the turning of the lag-barrel 18 brings
 a lag, such as 17^b, beneath the bar or finger 25^a,
 the next movement of the pattern-card chain
 11 toward the darts or needles *ya yb* 22 will 80
 again present to the dart or needle 22 the card
 or plate which, acting on such dart or needle
 22, caused the said lag 17^b to be brought be-
 neath the bar or finger 25^a, and so cause an- 85
 other lag of the lag-chain 17 to be brought
 beneath the bar or finger 25^a, and such other
 lag may either cause the pattern-chain bar-
 rel 10 to be turned in one direction or the other
 or may allow such pattern-chain barrel 10 to
 remain unturned. 90

We thus enable the pattern-card chain 11
 to be turned forward or backward or caused
 to remain stationary from time to time, as
 may be desired, and we are thus enabled to
 employ in weaving a given pattern a pattern- 95
 card chain of less length than would other-
 wise be required in weaving such pattern.

The connecting-rods *k o* are respectively
 formed in two parts and provided with
 springs 40 42. The spring 40 tends to force 100
 apart the ends of the connecting-rod *k*, in
 which it is employed, so that if the shuttle-
 boxes 1 2 3 4 should from any cause be pre-
 vented from rising when the disks *a b* or
 either of them are or is turned to cause the 105
 raising of the shuttle-boxes 1 2 3 4 no break-
 age or injury to the parts of the loom may be
 caused. The spring 42, connected at one end
 to the framework in which the shuttle-boxes
 1 2 3 4 are mounted and at the other end to a 110
 strap 43, which passes around a pulley or
 roller 44, mounted upon a stud secured in the
 lower part of the connecting-rod *o* and is se-
 cured to the upper part of the said connect-
 ing-rod *o*, tends to raise the shuttle-boxes 1 115
 2 3 4 and to draw the two ends of such con-
 necting-rod *o* together and counteracts the
 weight of the shuttle-boxes 1 2 3 4, so as to
 insure that the shuttle-boxes 1 2 3 4 shall be
 moved in accordance with the movements 120
 imparted to the lever *m*. If from any cause
 the shuttle-boxes 1 2 3 4 should be prevented
 from descending when the disks *a b*, or either
 of them, are or is moved to cause the descent
 of the shuttle-boxes 1 2 3 4, the spring 42 125
 will allow the connecting-rod *o* to be extend-
 ed and so prevent any injury or breakage of
 the parts of the loom from being caused.
 The nut and lock-nut upon the connecting-
 rod *k* serve to limit the extent to which such 130
 connecting-rod *k* may be allowed to be ex-
 tended, and the nut and lock-nut upon the

connecting-rod *o* serve to limit the extent to which such connecting-rod may be compressed.

When the loom illustrated in Figs. 1, 2, 3, and 4 is being turned backward for unweaving or any other purpose, the studs 28 29 will pass clear of the notched wheels 32 37 when the arm 27 is moving in the direction indicated by the arrow *E* and the pattern-chain 11, and it may be one or other or both of the disks *a b*, as the case may be, and it may be the reversing-chain or lag-chain 17 and shuttle-boxes will be maintained in proper position relatively to the pattern of the "piece" or "cloth" being woven. By means of the arrangements which we employ to effect or control the movements of the pattern-card chain 11 we are enabled to "reverse" the pattern-card chain 11 on "two picks" or any multiple of two picks.

In cases in which it is not desired to cause the pattern-card chain 11 to be turned backward except when the loom is turned backward for unweaving or any other purpose we employ the arrangements illustrated in Figs. 21, 22, 23, 24, 25, 26, and 27, which show a loom which, while generally similar to the loom illustrated in Figs. 1, 2, 3, and 4, is provided with a pattern-chain barrel 10, having mounted upon it a noggin-wheel 32, receiving motion by means of a stud 45, secured in an arm 46, secured upon the axle *t*, and is not provided with the arrangements above described as being employed to effect the reversing of the pattern-card chain 11 employed in the loom illustrated in Figs. 1, 2, 3, and 4.

The pattern-chain barrels 10 employed in looms constructed according to our invention may be held steady in the positions which they are required to occupy and prevented from being moved except when required by means of any suitable appliances—such, for instance, as that illustrated in Figs. 9 and 10.

If at any time it should be necessary for either of the disks *a b* to be moved by hand in order that the shuttle-boxes may be put in proper position relative to the pattern of the piece or cloth being, woven the catch or bell-crank lever employed in conjunction with such disk may be moved by hand and caused to release such disk and allow it to be turned in the manner requisite.

In the accompanying drawings the shuttle-boxes and the means for operating them are in Figs. 1, 2, 3, and 4 and Figs. 21, 25, 26, and 27 shown as being upon the left hand of the looms, but it will be obvious that looms may be constructed with the rising-and-falling shuttle-boxes and the means for operating them at either side or at both sides, as may be desired in any case.

The method of operating three rising-and-falling shuttle-boxes by means of our invention will be understood from the preceding explanation of the method of operating four rising-and-falling shuttle-boxes.

The arrangements of disks, arms, and crank-

pins employed according to our invention for effecting the movement of the shuttle-boxes of looms are of a very simple character and enable us to insure that the shuttle-boxes shall be moved into the various positions requisite with precision and without shock at the commencement and end of their movement, and also enable any shuttle-box to be brought into position to deliver or receive a shuttle, whatever shuttle-box may previously have been in position to deliver or receive a shuttle.

It is obvious that the disks *a* and *b* employed in accordance with our invention may be turned by means of racks operated otherwise than in the manner in which the racks *ua ub* above described are operated.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin *j* having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying the said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, connections between said crank-pin *j* and the shuttle-boxes, and means for rotating the said disks, all substantially as and for the purposes hereinbefore described.

2. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b* each provided with a pinion fast upon it, means for rotating the said pinions, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin *j* having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying the said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, and connections between said crank-pin *j* and the shuttle-boxes, all substantially as and for the purposes hereinbefore described.

3. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin *j* having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, means for rotating such disks separately or together, and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

4. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, each provided with a pinion fast upon it, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin *j*

having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying the said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, racks respectively placed when required in engagement with the pinions upon such disks for the purpose of rotating such disks separately or together, means for moving such racks, means for placing each of such racks in engagement with the pinion connected to the disk with which such rack is employed and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

5. In a loom having rising-and-falling shuttle-boxes, of the disks *a b*, a stud carried by one of said disks, an arm or crank on said stud provided with a crank-pin *j* having a sliding engagement with the other of said disks, the pinions *fa fb* respectively fast upon the disks *a b*, the racks *ua ub* for engaging with the said pinions *fa fb* respectively to impart motion thereto, the darts or needles *ya yb* and means for operating upon said darts or needles as required for the purpose of placing each of such racks in engagement with the pinion connected to the disk with which the said rack is employed, the rotary shaft *r* and its crank-arm *q'* and crank-pin *q* and the connecting-rod *s* and arms *ta tb* for imparting motion to such racks, and connections between said crank-pin *j* and the shuttle-boxes, all substantially as and for the purposes hereinbefore described.

6. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying the said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, bell-crank levers *wa wb* for holding such disks *a b* respectively in the position in which they may require to be held, means for rotating the said disks separately or together and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

7. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* on said stud provided with a crank-pin, having a sliding engagement with the other of said disks and capable of being raised and lowered by the rotation of the disk carrying the said stud and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, means for rotating such disks separately or

together means for holding such disks in the positions in which they may require to be held and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

8. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks an arm or crank *h* which is provided with a crank-pin *j* having a sliding engagement with the other of said disks and is mounted upon the said stud and capable of being raised and lowered by the rotation of the disk by which the said stud is carried and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, pinions *fa fb* fast to said disks, racks *ua ub* for engaging with said pinions to impart motion to the said disks *a b* respectively, means for moving such racks, means for placing each of such racks in engagement with the pinion connected to the disk with which such rack is employed, bell-crank levers *wa wb* for holding the said disks *a b* respectively in the positions in which they require to be held and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

9. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, each provided with a pinion fast upon it, a stud carried by one of such disks, an arm or crank *h* which is provided with a crank-pin *j* having a sliding engagement with the other of said disks and is mounted upon said stud and capable of being raised and lowered by the rotation of the disk by which the said stud is carried and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, racks *ua ub* placed when required in engagement with the said disks *a b* respectively to impart motion thereto, crank-pin *q*, connecting-rod *s*, and arms *ta tb* to impart motion to such racks, means for placing each of such racks in engagement with the pinion connected to the disk with which such rack is employed, bell-crank levers *wa wb* for holding the said disks *a b* respectively in the positions in which they require to be held and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

10. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* which is provided with a crank-pin *j* having a sliding engagement with the other of said disks and is mounted upon said stud and capable of being raised and lowered by the rotation of the disk by which the said stud is carried and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, pinions

fa fb fast to said disks, racks *ua ub* for engaging with said pinions to impart motion to the said disks *a b* respectively, means for moving such racks, bell-crank levers *wa wb* for holding the said disks *a b* respectively in the positions in which they require to be held, darts or needles *ya yb* to act upon the said racks *ua ub* respectively and upon the bell-crank levers *wa wb* respectively, a pattern-card chain and a pattern-chain barrel and means for presenting the said pattern-card chain to the darts or needles *ya yb* and means for causing the pattern-chain barrel to revolve and means for communicating the movement of the said crank-pin to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

11. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* which is provided with a crank-pin *j* having a sliding engagement with the other of said disks and is mounted upon said stud and capable of being raised and lowered by the rotation of the disk by which the said stud is carried and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, pinions *fa fb* fast to said disks, racks *ua ub* for engaging with said pinions to impart motion to the said disks *a b* respectively, means for moving such racks, bell-crank levers *wa wb* for holding the said disks *a b* respectively in the positions in which they may require to be held, darts or needles *ya yb* to act upon the said racks *ua ub* respectively and upon the bell-crank levers *wa wb* respectively, a pattern-card chain and a pattern-chain barrel and cam 13 lever 15 and frame 9 to present the said pattern-card chain to the darts or needles *ya yb* and means for causing the pattern-chain barrel to revolve and means for communicating the movement of the said crank-pin *j* to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

12. In a loom, the combination with rising-and-falling shuttle-boxes, of disks *a b*, a stud carried by one of such disks, an arm or crank *h* which is provided with a crank-pin *j* having a sliding engagement with the other of said disks and is mounted upon the said stud and capable of being raised and lowered by the rotation of the disk by which the said stud is carried and of being revolved about the axis of the stud by which it is supported by the rotation of the other of such disks, pinions *fa fb* fast to said disks, racks *ua ub* for engaging with said pinions to impart motion to the said disks *a b* respectively, a pattern-card chain 11 and a pattern-chain barrel 10, a notched wheel 32 and pinion 33 mounted upon the said pattern-chain barrel, notched wheel 37 provided with a pinion 34 gearing into the pinion 33 arm 27 with pegs or studs 28 29 to engage respectively with the notched wheels 32 37, arm 31 to oscillate the said arm 27 bell-crank lever 25 to move the said arm 27 laterally, lag-chain 17 for use with the said bell-crank lever 25, lag-barrel 18, rack 21 and toothed wheel 20 to impart motion to the said lag-barrel 18, dart or needle 22 to act upon the said rack 21 and press it into engagement with the toothed wheel 20, crank-pin *q*, connecting-rod *s* and arms *ta tb* to impart motion to the racks *ua ub*, bell-crank levers *wa wb* for holding the said disks *a b* respectively in the positions in which they may require to be held, darts or needles *ya yb* to act upon the said racks *ua ub* respectively and upon the bell-crank levers *wa wb* respectively cam 13, lever 15 and frame 9 to present the said pattern-card chain 11 to the darts or needles *ya yb* 22 and means for communicating the movement of the said crank-pin *j* to the shuttle-boxes of the loom, all substantially as and for the purposes hereinbefore described.

JAMES COWBURN.
CHRISTOPHER PECK.

Witnesses:

ARTHUR C. HALL,
HOWARD CHEETHAM.