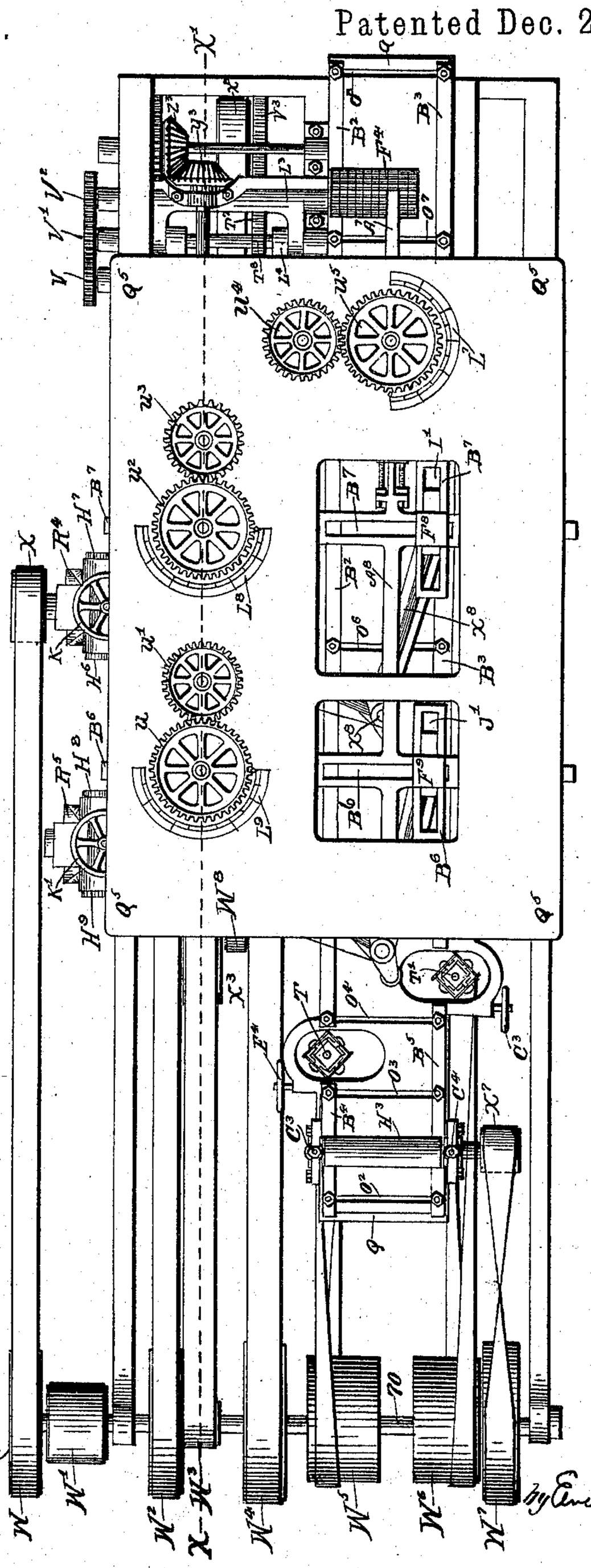
(No Model.) 11 Sheets—Sheet 1.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 1.



Witnesses
William J. Brown
W. S. Jarboe

Inventor
Henry Harrer
by Church & Appleman
Attorneys.

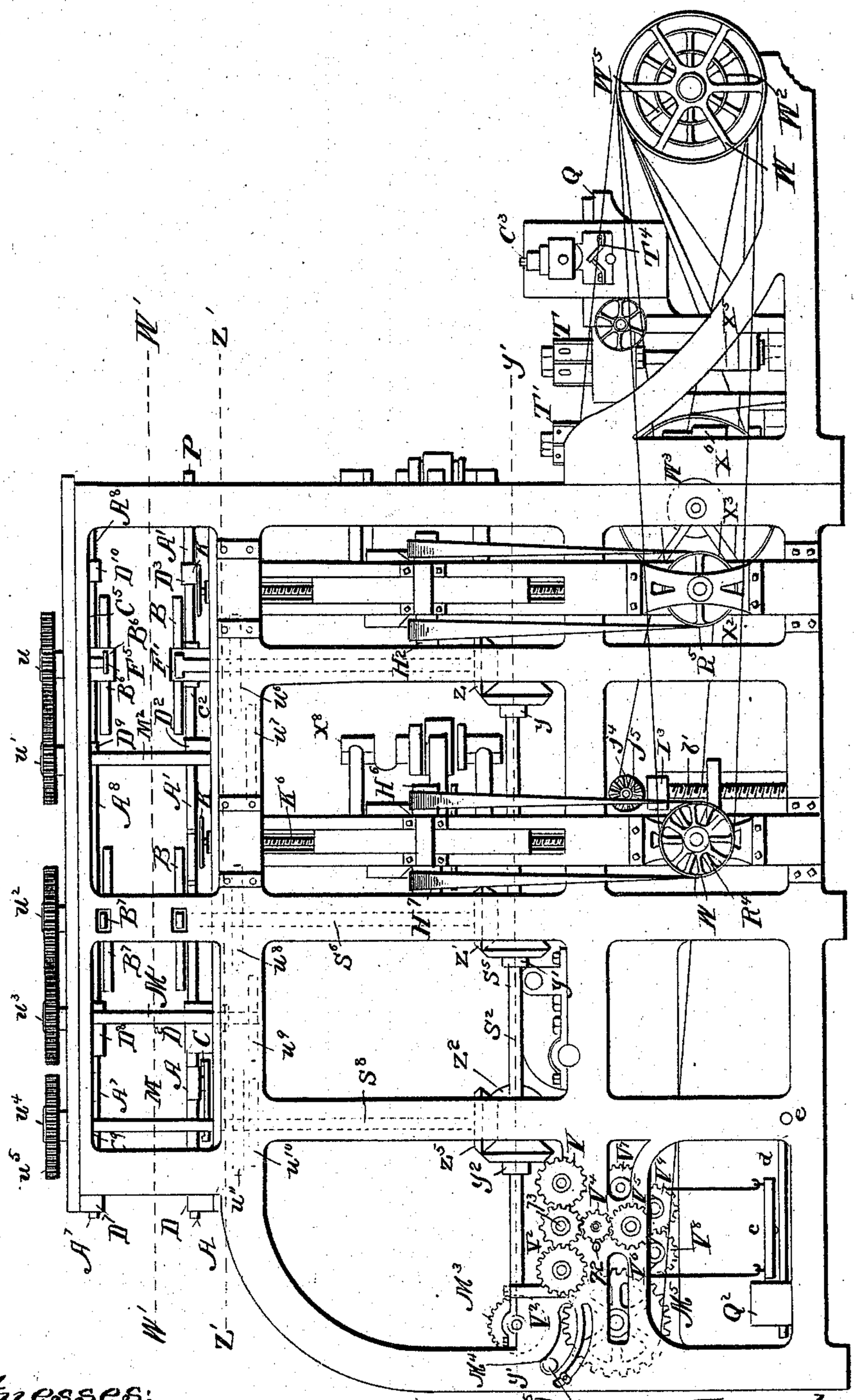
(No Model.) 11 Sheets—Sheet 2.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig. II.



Witnesses:
J. B. McGhee.
J. P. Appleman.

Inventor:
Henry Harrer
by Ferd. Appleman
atty.

(No Model.)

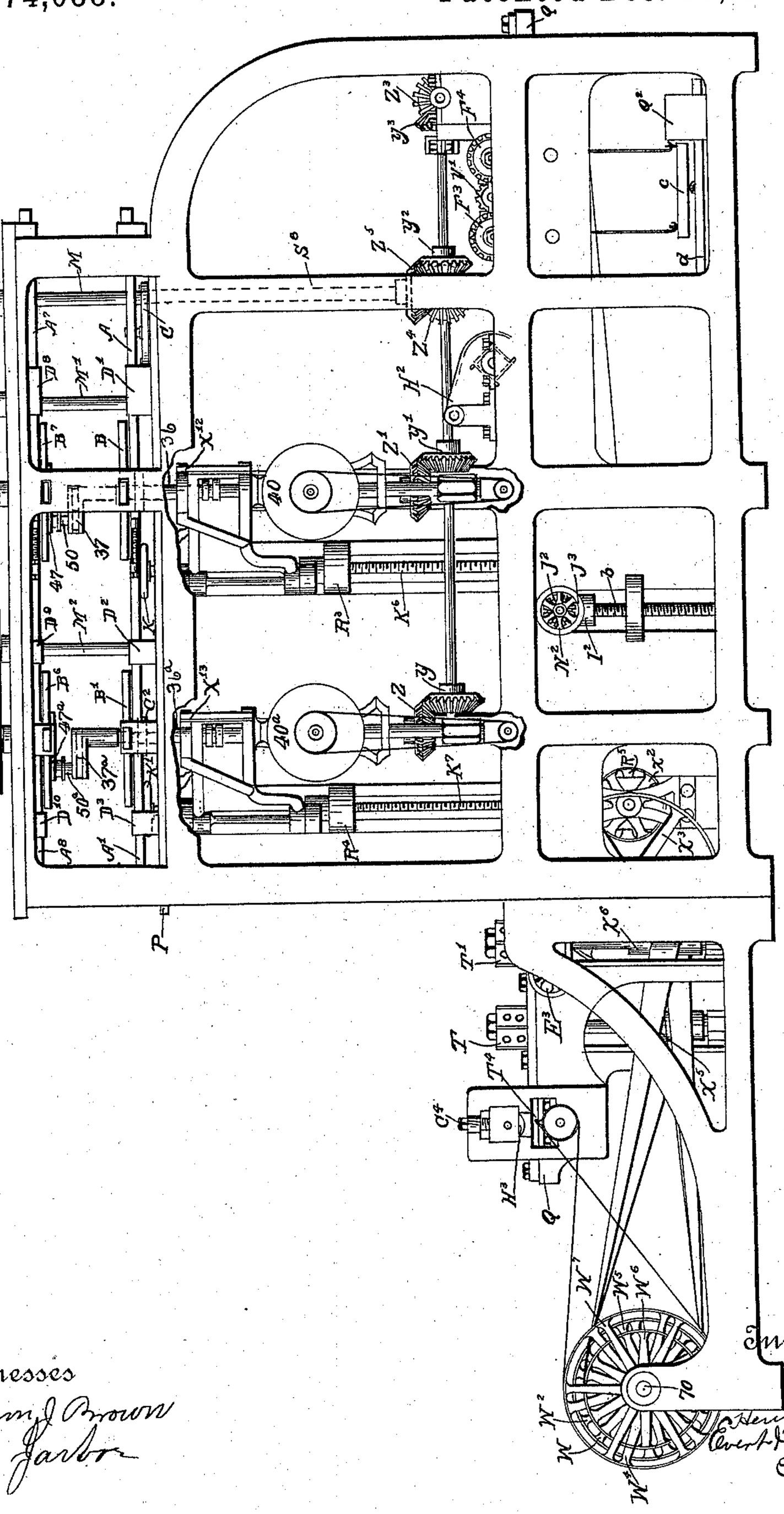
11 Sheets—Sheet 3.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig. 3.



Witnesses
William J. Brown
W. S. Jarboe

Inventor
Henry Harrer
by
Evert & Appleman
Attorneys,

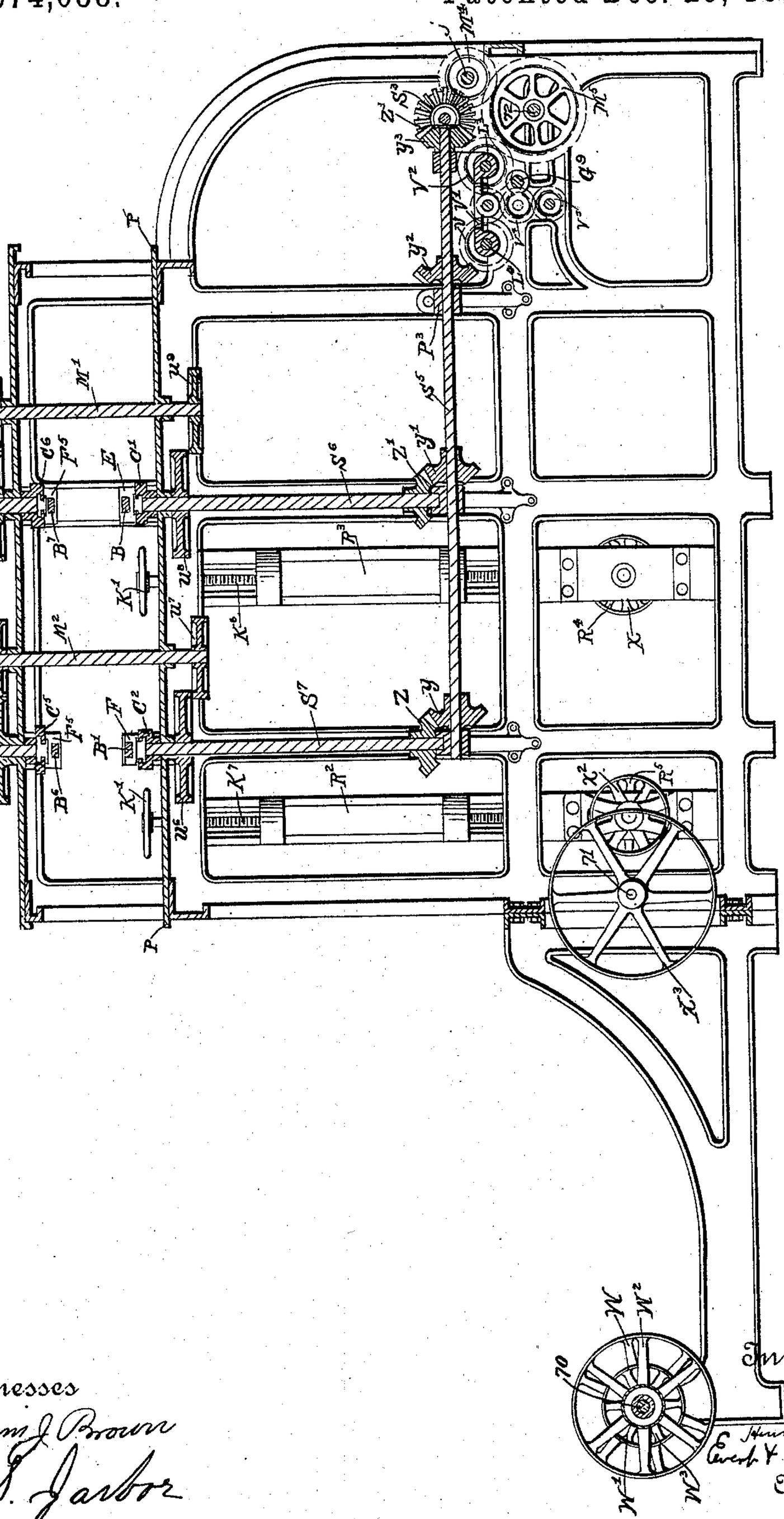
(No Model.) 11 Sheets—Sheet 4.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig. 4.



Witnesses
William J. Brown
N. S. Jarboe

Inventor
Henry Harrer
by Church & Appleman
Attorneys.

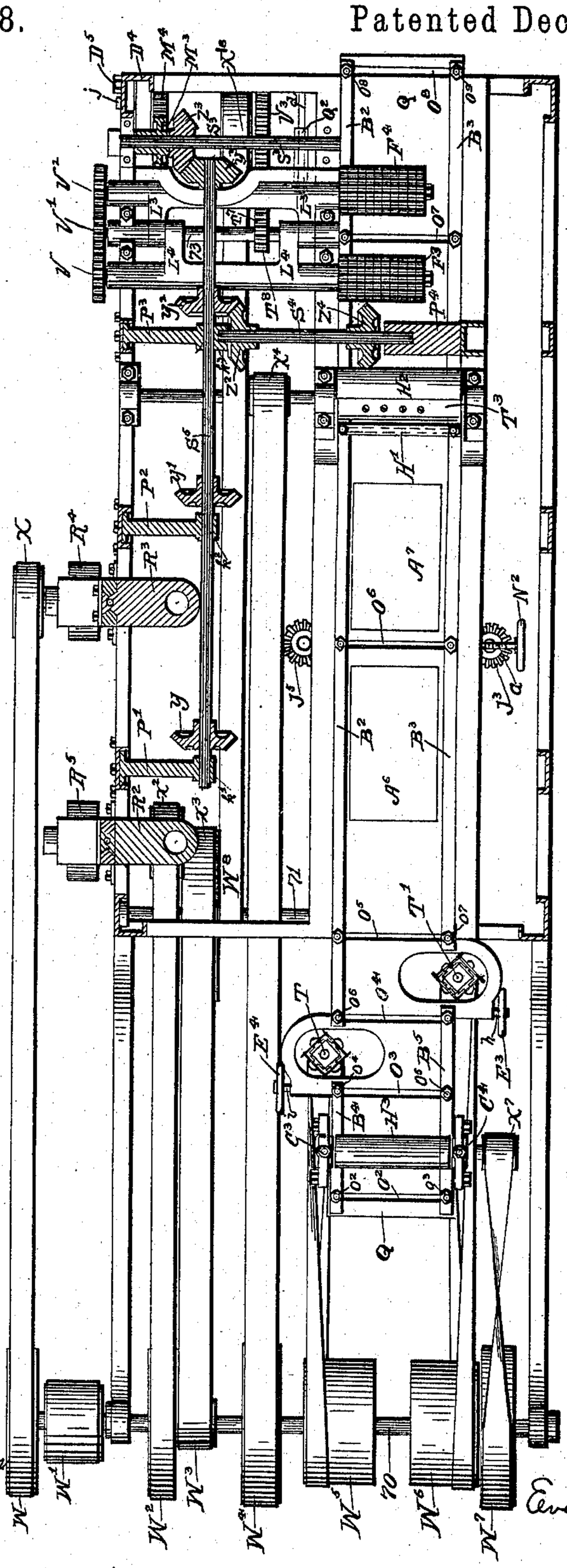
(No Model.) 11 Sheets—Sheet 5.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 5.



Witnesses
William J. Brown
W. S. Barbour

Inventor
Henry Harrer
by
Evert & Appleman
Attorneys.

(No Model.) 11 Sheets—Sheet 6.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 6.

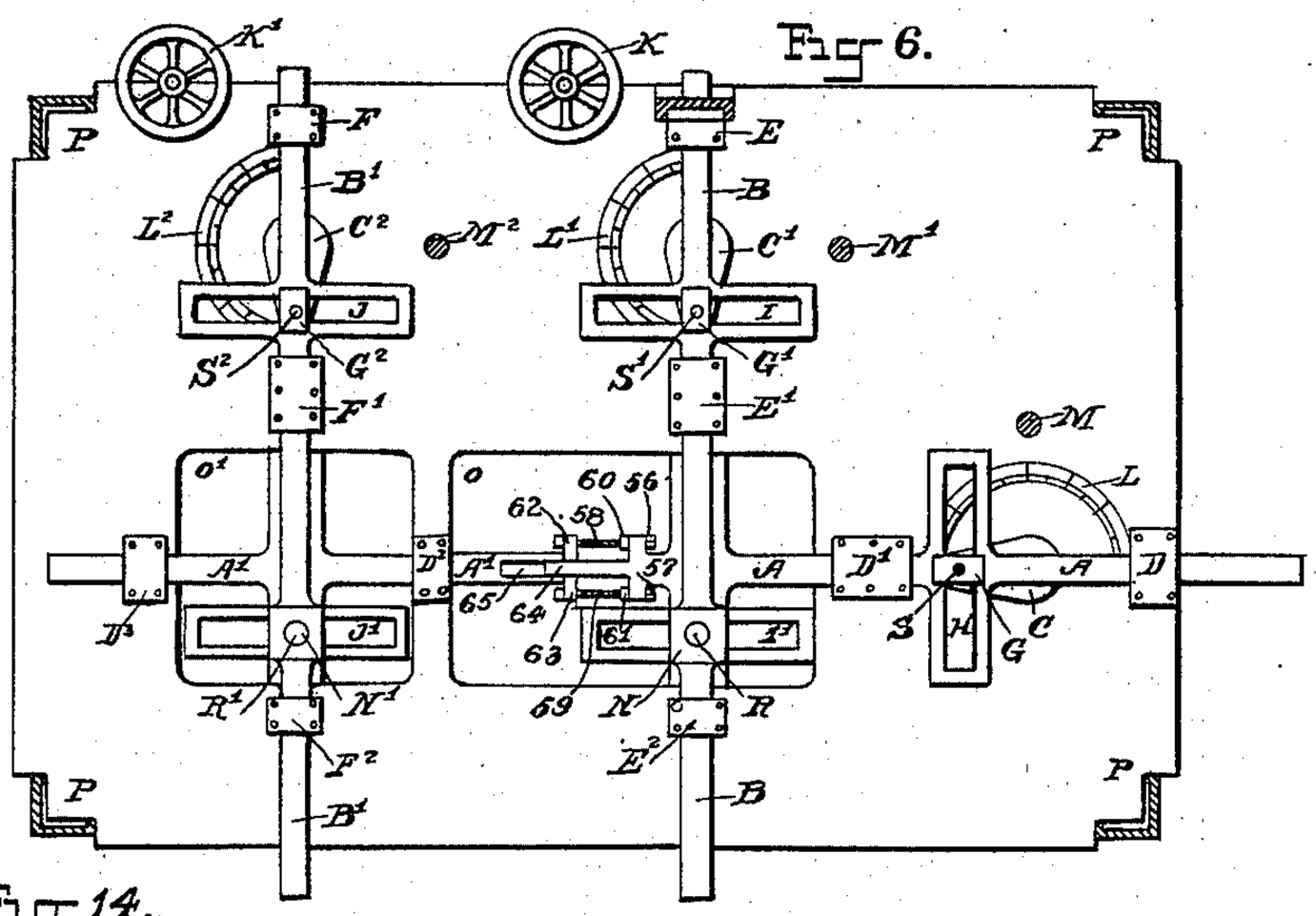


Fig 14.

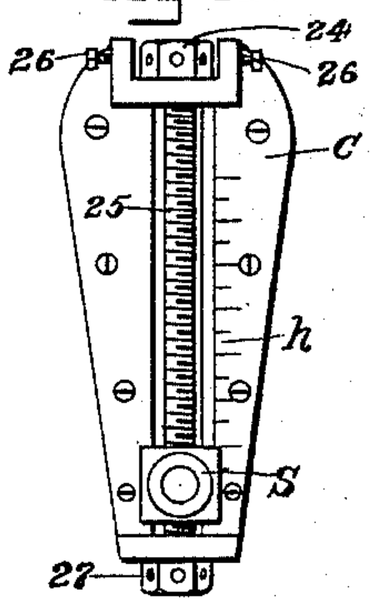


Fig 15.

Fig 17.

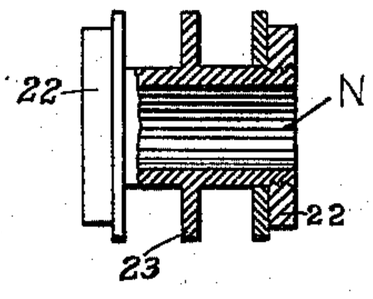


Fig 16.

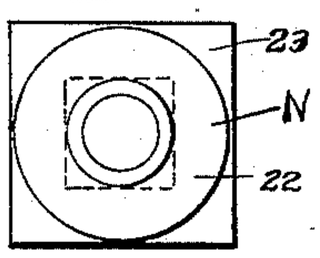


Fig 18.

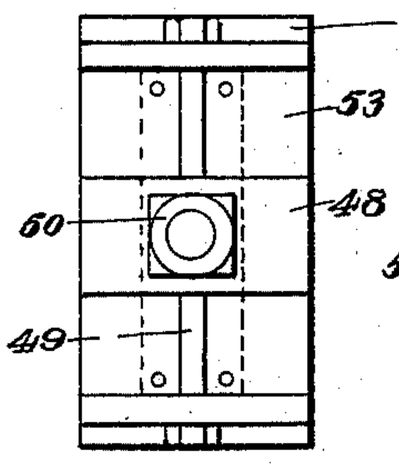


Fig 19.

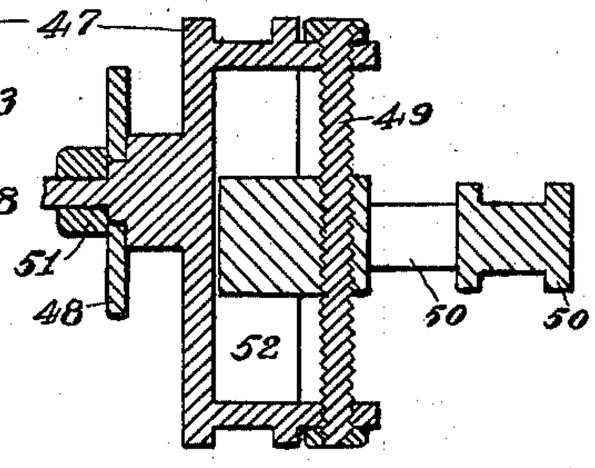


Fig 20.

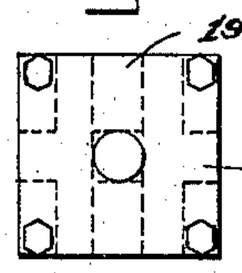


Fig 21.

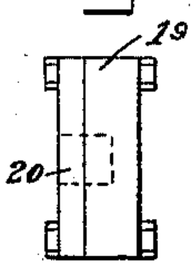
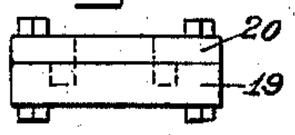


Fig 22.



WITNESSES:
William J. Brown
W. S. Parker

INVENTOR
Henry Harrer
BY Evert & Appleman,
ATTORNEYS.

(No Model.) 11 Sheets—Sheet 7.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 7.

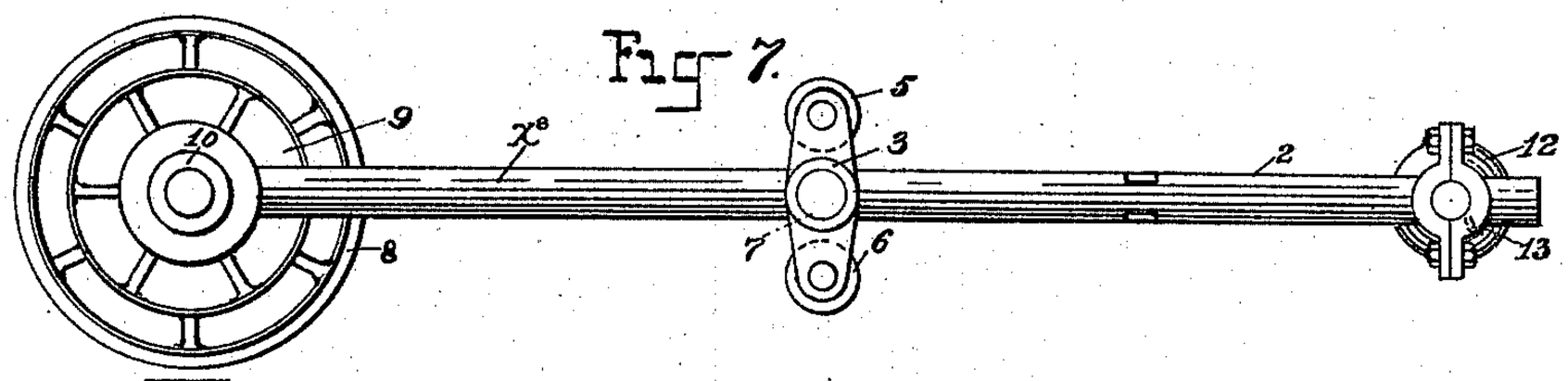


Fig 8.

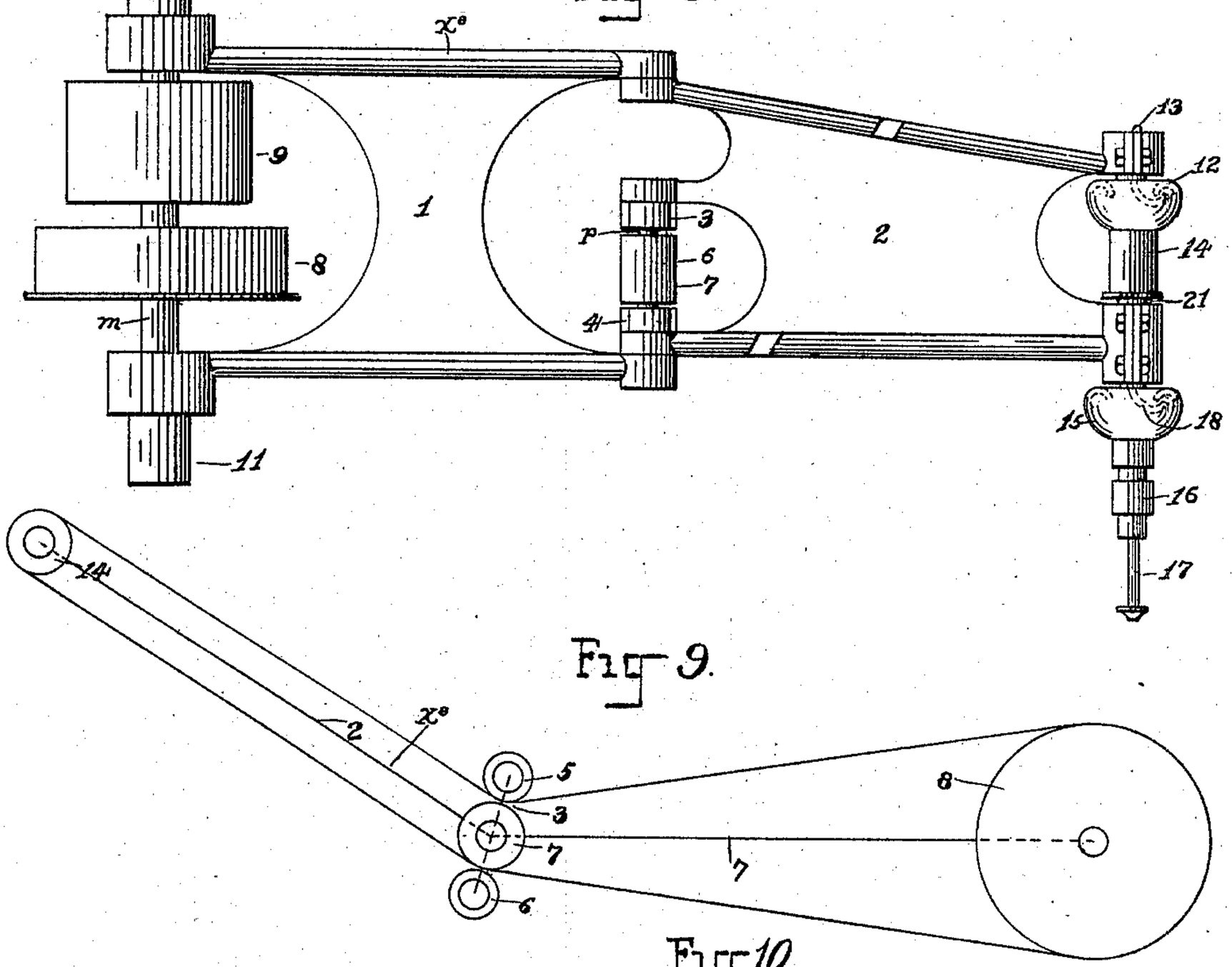
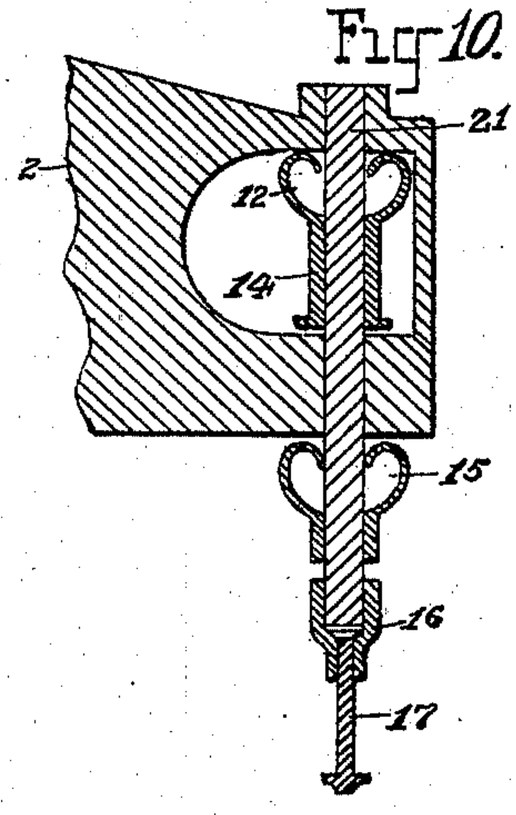


Fig 9.

Fig 10.



WITNESSES:

William J. Brown.

W. S. Jarboe

INVENTOR

Henry Harrer

BY

Evert & Appleman

ATTORNEYS,

(No Model.)

11 Sheets—Sheet 8.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 31.

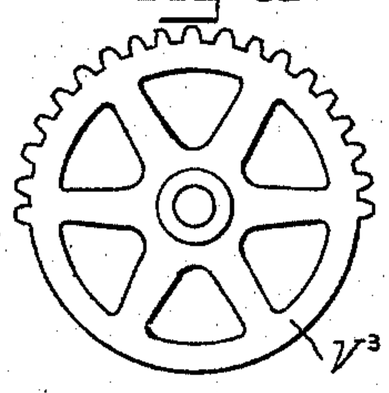


Fig 12.

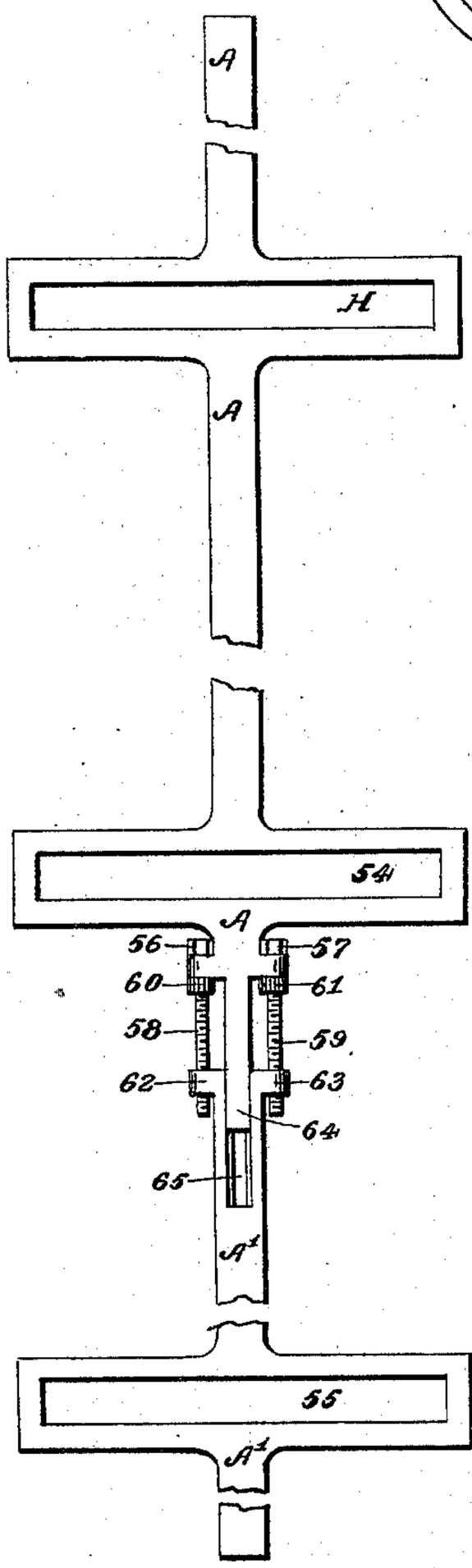


Fig 13.

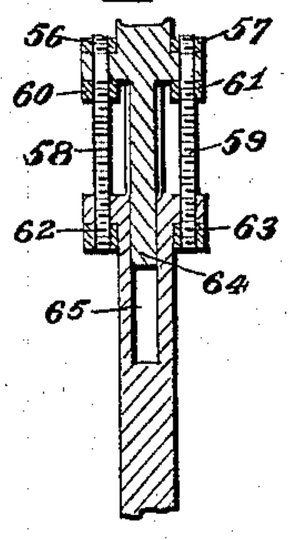


Fig 29.

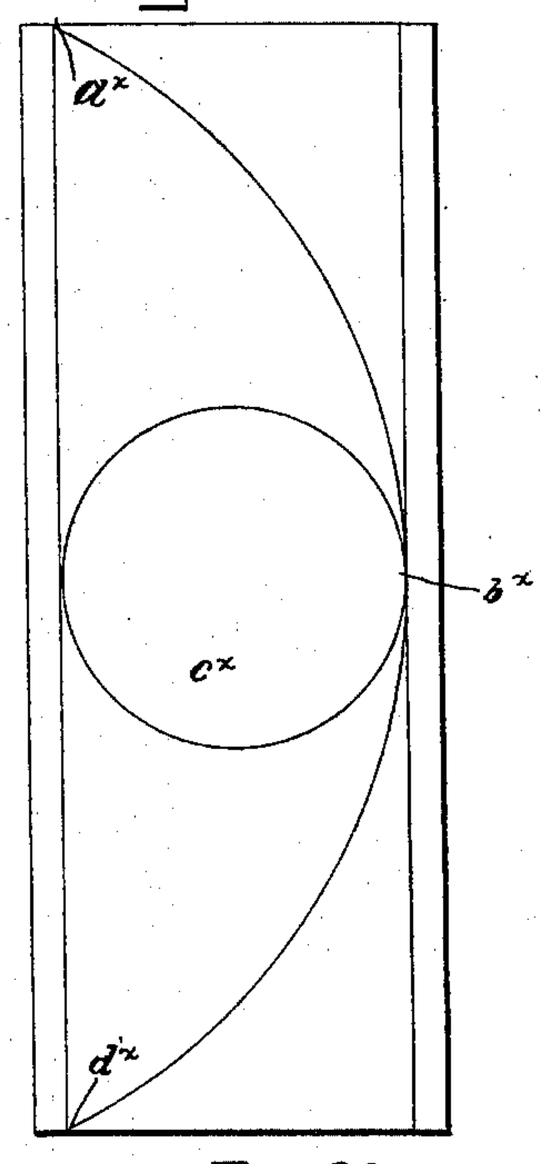


Fig 30.

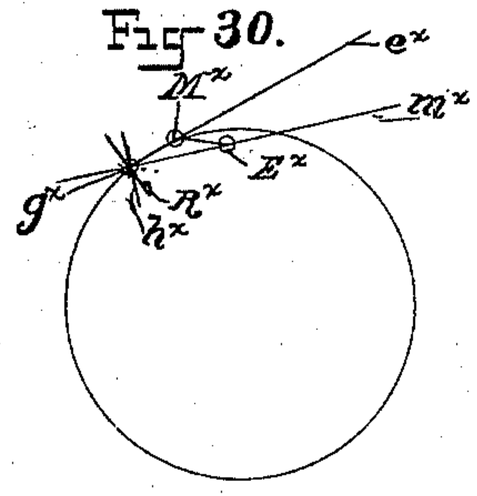
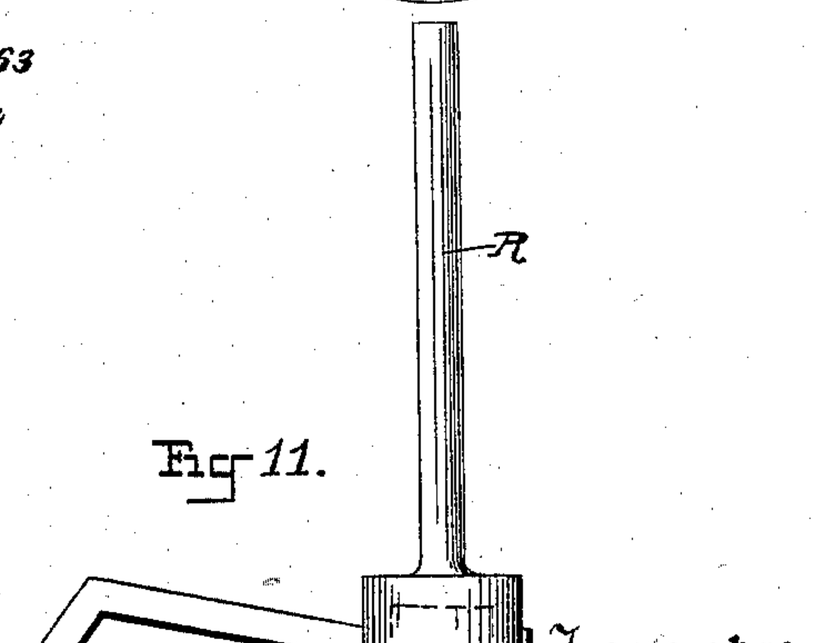


Fig 11.



Witnesses
William J Brown
W. S. Jarboe

Inventor,
Henry Harrer

By Evert & Appleman
Attorneys.

(No Model.)

11 Sheets—Sheet 9.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig 24.

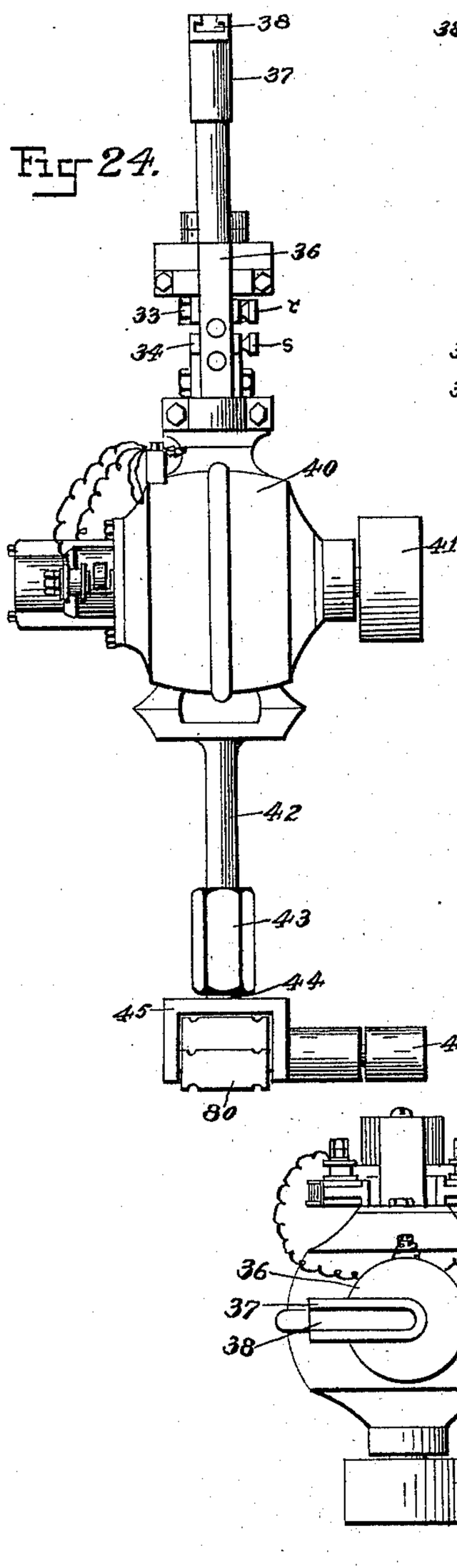


Fig 25.

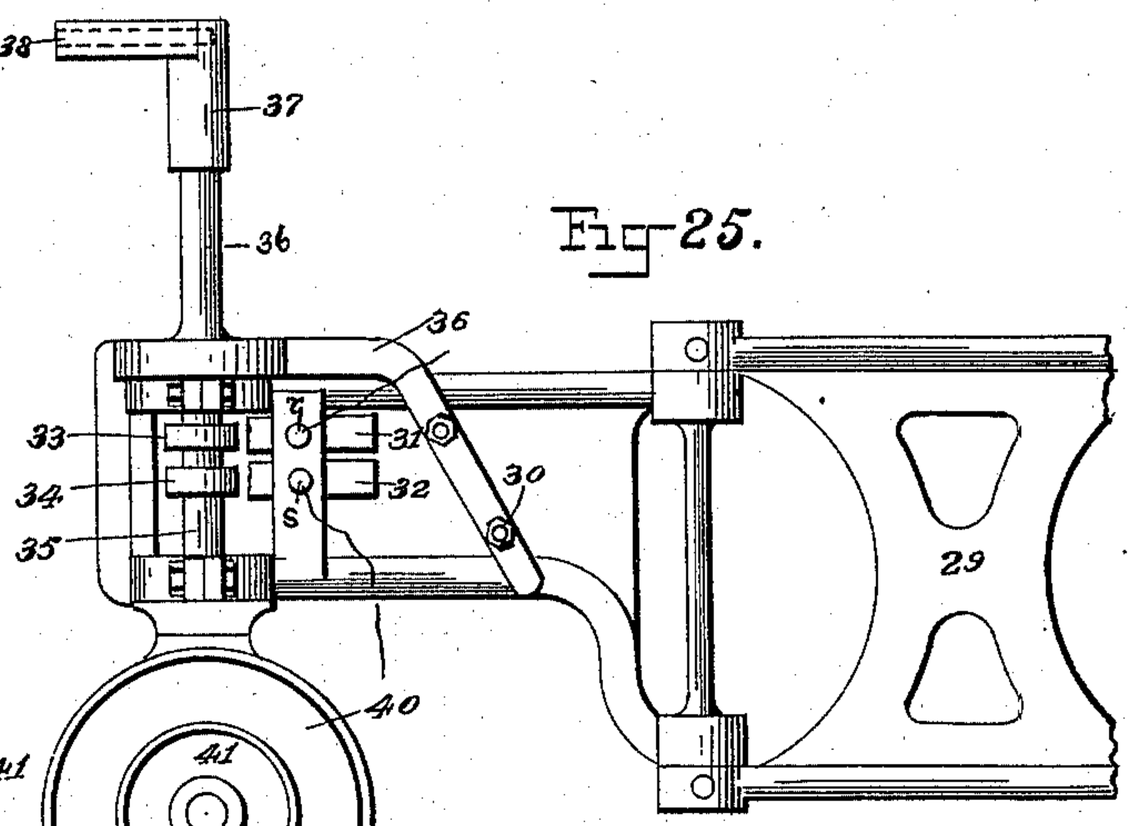


Fig 26.

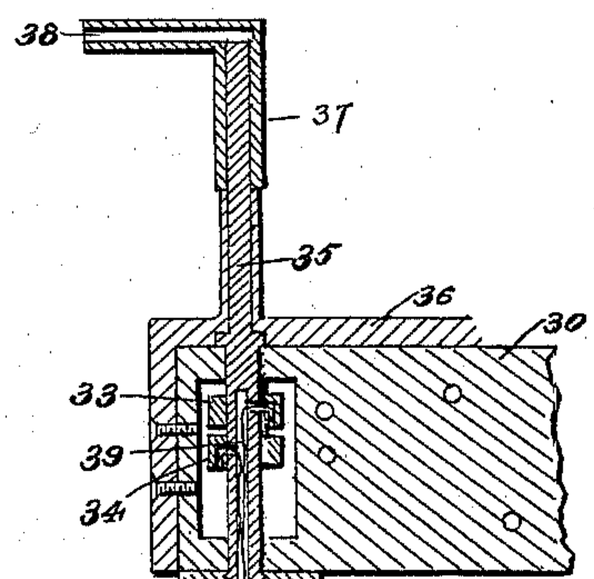


Fig 23.

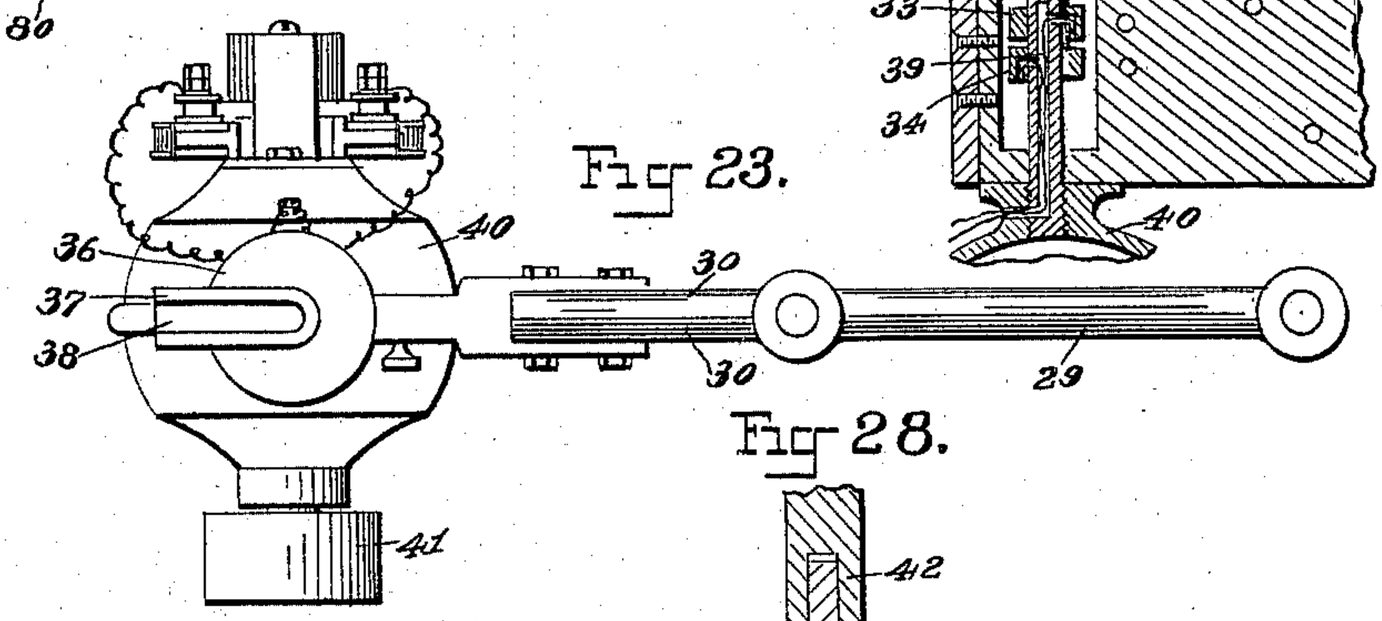


Fig 28.

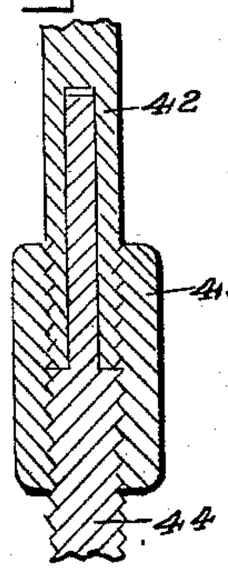
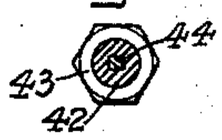


Fig 27.



Witnesses,
William J. Brown
W. S. Jarboe

Inventor.
Henry Harrer

By Evert & Appleman
Attorneys

(No Model.) 11 Sheets—Sheet 10.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

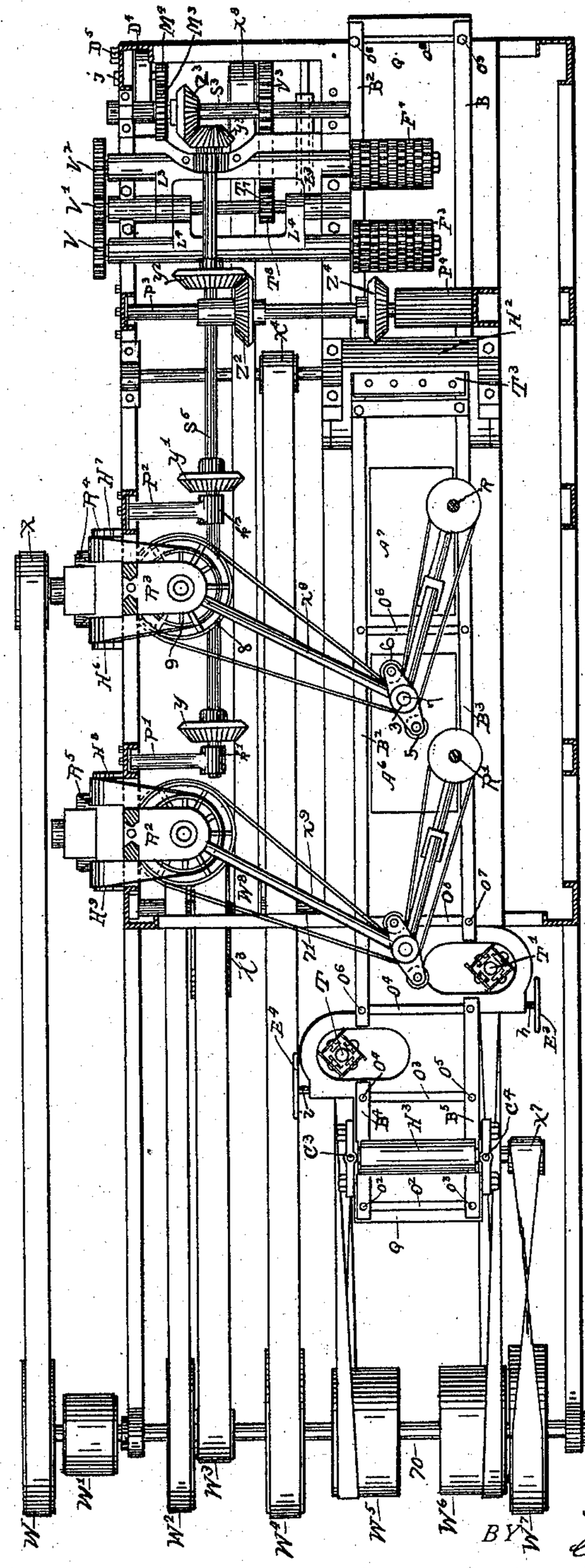


FIG 2.

WITNESSES.
John Gaither
C. L. Reese

INVENTOR.
Henry Harrer
by Ernest G. Siggerman
ATTORNEYS

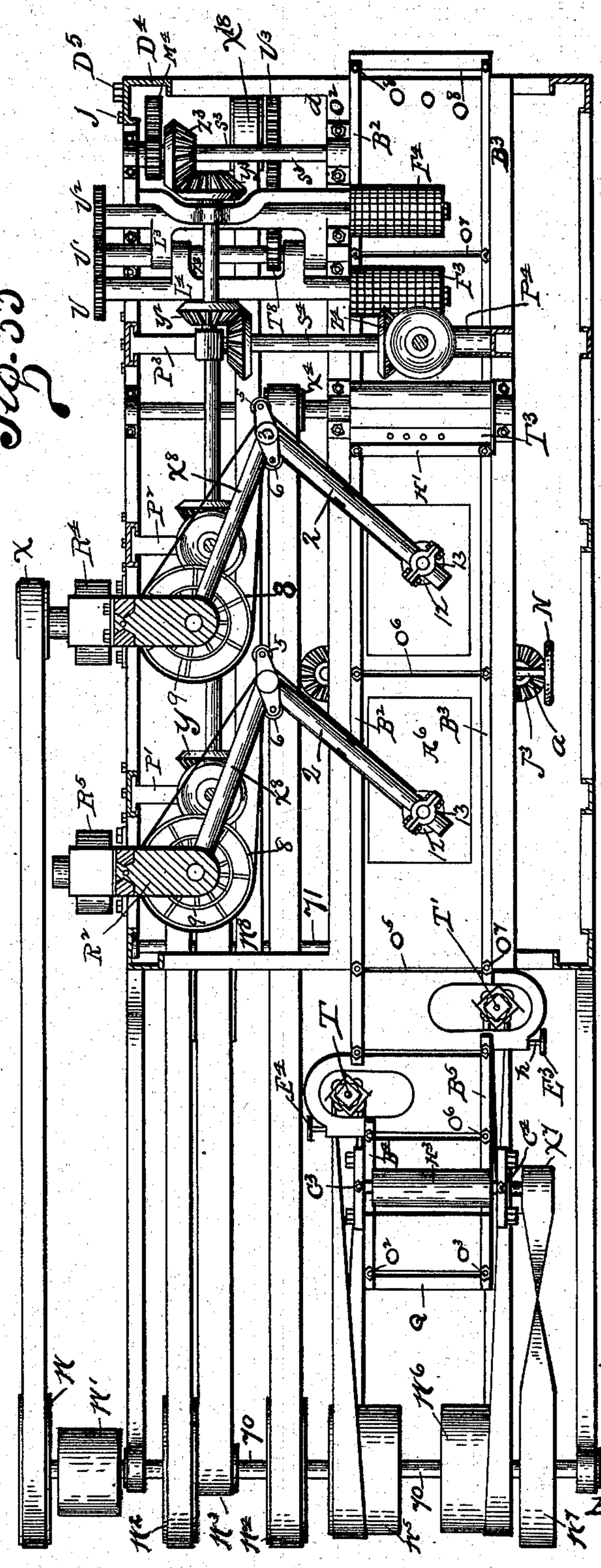
(No Model.) 11 Sheets—Sheet 11.

H. HARRER.

WOODWORKING MACHINE.

No. 574,088. Patented Dec. 29, 1896.

Fig. 33.



Witnesses:
A. R. Appleman Jr.
A. Macaleer

Inventor:
Henry Harrer.
Everett Appleman
By
Atty's

UNITED STATES PATENT OFFICE.

HENRY HARRER, OF ALLEGHENY, PENNSYLVANIA.

WOODWORKING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 574,088, dated December 29, 1896.

Application filed February 17, 1894. Serial No. 500,493. (No model.)

To all whom it may concern:

Be it known that I, HENRY HARRER, a citizen of the United States of America, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Woodworking-Machines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to certain new and useful improvements in woodworking-machines, and relates more particularly to that class known as "carving," "molding," "planing," and "shaping" machines.

The object of the invention is to provide novel means whereby boards or other objects to be carved may be continuously or intermittently fed under a carving-knife; furthermore, to carve various designs on the surface of the board and produce a wavy or scalloped edge on either side.

The invention further contemplates to employ in combination my curve-scriber, patented January 2, 1894, No. 511,772, which has for its object the provision of novel means for producing a mechanism for drawing, carving, marking, and the like, and for describing mechanical motions along circles of any desired diameter, ellipses of any major or minor axes, lines at any angle to a fixed right line, within the limits of zero and one hundred and eighty degrees, parabolas, and innumerable other closed curves whose equations may be readily calculated; furthermore, in combination with a uniform motion along a right line to draw a cycloid and an indefinite number of other mathematical curves; furthermore, to produce an innumerable number of designs, consisting of curves and lines of different degrees and angles. The above-described mechanism is employed and operated in conjunction with the present machine for the purpose of guiding the cutter, and thus producing the various designs as heretofore mentioned, or such a modification of them as will be produced by a combination of these movements along with a uniform motion in a straight line.

The invention broadly consists in the novel construction, combination, and arrangement of parts to be hereinafter more particularly described, and specifically pointed out in the claims.

In describing the invention in detail reference is had to the accompanying drawings, forming a part of this specification, and where in like letters and numerals of reference indicate similar parts throughout the different views, in which—

Figure 1 is a plan view of the complete machine, showing the relative position of the different parts. Figs. 2 and 3 are rear and front elevations, respectively. Fig. 4 is a vertical sectional view taken along the line X X′ of Fig. 1 and looking from the front in the direction of the rear elevation. Fig. 5 is a transverse sectional view taken along the line Y Y′ of Fig. 2. Fig. 6 is a similar view taken between the line W W′ and Z Z′ of Fig. 2 and illustrating a top view on the line W W′. Fig. 7 is a plan view of a double-hinged arm carrying on its free end a surface-carver or a shaper which rotates about a vertical axis. Fig. 8 is a side elevation of the same. Fig. 9 illustrates clearly the *modus operandi* of the same. Fig. 10 is a vertical detail sectional view of a part of the same. Fig. 11 represents a vertical shaft adapted to be secured to the arm illustrated in Figs. 7 and 8 and by which means the carving-knife is guided in the predetermined path of travel. Fig. 12 is a double arm composed of two sections carrying transverse slotted heads. Fig. 13 is a vertical sectional view of the connecting portion of the two sections of the arm shown in Fig. 12. Fig. 14 is a crank carrying an adjustable crank-pin shown in detail in Fig. 15. Figs. 16 and 17 are respectively the plan and sectional views of a slide carried at the intersection of the slotted heads and through which the shaft shown in Fig. 11 passes. Figs. 18 and 19 are respectively the underneath and sectional views of a slide carrying an adjustable pin adapted to fit into the adjusting-arm of the motor shown in Figs. 24, 25, and 26, to be hereinafter more particularly referred to. Figs. 20, 21, and 22 are the plan, end, and side views of a clamp arranged at the center of one of the slots of a slotted head similar to that shown in Fig. 12. Through the center of this clamp the shaft shown in Fig. 11 is also adapted to pass. Fig.

23 is a plan view of a double-hinged arm carrying a motor driving a cutter-head which rotates about a horizontal axis. Fig. 24 is an end view of the same. Fig. 25 represents a side view of the same. Figs. 26, 27, and 28 are detail sectional views of parts of the same. Figs. 29 and 30 are intended to more clearly illustrate some of the many motions produced by my improved woodworking-machine. Fig. 31 is a plan view of an intermittent gear-wheel. Fig. 32 is a plan sectional view taken on the line V V′ of Fig. 2. Fig. 33 is a sectional view on a horizontal line below the plate P.

Referring to Fig. 5 of the drawings, we get a plan view of all the essential parts of the mechanism, except those relating to the carving attachment. A table Q is provided to support the lumber while the operations of planing, matching, and molding are being performed. The height of this table may be adjusted to accommodate the thickness of the lumber by turning the hand-wheel N^2, keyed on the end of a shaft *a*, said shaft carrying the miter gear-wheels J^2 and J^4, (see Figs. 2 and 3,) which mesh with the miter gear-wheels J^3 and J^5, respectively. The miter gear-wheels J^3 and J^5 are secured to two screw-threaded shafts *b b*, on the shoulders of which the table Q is supported, by means of the projecting pieces I^2 and I^3. These screw-threaded shafts are free to move in or out of the female screws fixed to the framework of the mechanism. Thus by turning the hand-wheel N^2 the screw-threaded shafts are rotated and the table raised or lowered in suitable guides attached to the framework. In the upper face of the table Q transverse trapezoidal slots O^2, O^3, O^4, O^5, O^6, O^7, and O^8 are formed with the smaller of their parallel sides in alinement with the surface of the table. Bolts o^2 o^3 o^4 o^5 o^6 o^7 o^8 o^9, whose lower heads are of trapezoidal section, are adapted to fit in these slots. These bolts pass through the bars B^2, B^3, B^4, and B^5, which serve as guides for the lumber passing along the table. Hence by adjusting the said bars and tightening said bolts the machine is adapted to feed lumber of various widths and in varying relations to the center line of the table Q, which center line is the center of figure of all carvings.

It will be seen that all the main driving-pulleys are fixed to a common shaft 70, to which motion is communicated by means of a belt which drives the pulley W′. Motion is communicated to the driven pulley X^3 by means of the driving-pulley W^3. On the same shaft 71 with X^3 is arranged the pulley W^8, by means of which motion is transmitted to the pulley X^8. On the same shaft 72 with X^8 is fixed the gear-wheel V^3. Said wheel may be either a continuous or intermittent gear-wheel. If the former, it provides for a continuous feed of the lumber; if the latter, it provides for alternately moving the lumber and retaining it stationary at regular intervals. V^3 gears with T^7, which in turns gears with T^3, which is attached to the same shaft 73 with the gear V′.

From V′ motion is transmitted to V, whose shaft is carried in the arm L^4, and on the other extremity of whose shaft the toothed feed-roll F^3 is attached. V′ also gears with V^2, its shaft being mounted in an arm L^3, and on the other extremity of its shaft the toothed feed-roll F^4 is secured. The pieces or arms L^3 and L^4, carrying the journals of V^2 and V, respectively, are free to move about the axis 73 of V′. Two rods are suspended from L^3 and L^4, the extremities of which are joined by a connecting-bar *c*, at the center of which a lever *d* is attached, which lever has one of its extremities fixed to a shaft *e*, and from the other the adjustable weight Q^2 is suspended. The teeth of the gear-wheel V′ (see Fig. 2) also mesh with those of V^4, which in turn gear with V^5. On the shaft of V^5 another gear-wheel is attached, (not shown,) which gears with the two gear-wheels V^8 and V^9, which in turn gear with V^6 and V^7, respectively. On the same shafts with V^6 and V^7 are arranged two feed-rolls, (not shown in the drawings,) which are directly underneath of F^4 and F^3. Thus the lumber in being fed into the machine is gripped by two sets of feed-rolls above and below. As the shaft to which V^5 is fixed is stationary in position relative to the entire mechanism, while those of the gear-wheels V^6, V^7, V^8, and V^9 are movable, the axes of V^6, V^7, V^8, and V^9 are connected by links to the wheel which gears with both V^8 and V^9, to provide for continuous gearing. As the lumber moves under the action of the feed it passes under the chipper-bar H^2, and from thence under the cutter-head T^3, which planer molds and planes the lumber, and which is revolved by the pulley X^4, to which motion is communicated from the pulley W^4. It now passes under the bar H′, which serves to retain the lumber in position and prevents the same from warping. After passing under the bar H′ the carving is done, an operation which will be hereinafter more particularly described. From under the carving mechanism the lumber passes to the lateral cutter-head T′, whose position from the center line of Q may be adjusted by a screw *h*, operated by a hand-wheel E^3. The head T′ is driven by the pulley X^6, which receives motion from the pulley W^6, means being thus provided for planing, molding, or matching one edge of the lumber, a similar provision being made for planing, molding, or matching the other side by the lateral cutter-head T, which may be adjusted with respect to the center line of Q by a screw *i*, operated by the hand-wheel E^4. The cutter-head T is rotated by means of the pulley X^5, which receives motion from W^5. From the cutter-head T the lumber moves under the idler H^3. The latter's height above the table Q may be adjusted by the nuts C^3 and C^4. Said idle-roll presses the lumber down, so as to keep it in contact with the table Q, while the lower side of the board

is being planed by means of the cutter-head T^4, revolved by the pulley X^7, which in turn is driven by the pulley W^7.

On the same shaft with the pulley X^{18} and the gear-wheel V^3 there rotates the gear-wheel M^5, Fig. 4, which gears with the wheel M^4. Said wheel in turn gears with M^3. The axle *j* of M^4 is secured to an arm D^4, which is free to rotate about the shaft S^3, to which the wheel M^3 is fixed. The arm D^4 may be adjusted in position by means of the nut D^5. By the above arrangement of the arm provision is made to throw the wheel M^4 in gearing with M^5 if wheels of different diameters be substituted for it.

In addition to the wheel M^3 there is fixed on the shaft S^3 the miter gear-wheel Z^3, which meshes with the miter gear-wheel Y^3, fixed on the shaft S^5, which revolves in the journal-boxes K′, K^2, and K^3 of the arms P′, P^2, and P^3. The miter gear-wheels Y, Y′, and Y^2 are also fixed on the shaft S^5, the miter-gear Y meshing with the miter-gear Z, Fig. 4, rotating the shaft S^7, to which Z is fixed. To the shaft S^7 there is fixed the crank C^2 and the gear-wheel U^6, which may or may not gear with the wheel U^7 according to its adjustment on the shaft M^2, which is rotated thereby. On the upper end of the shaft M^2 the gear-wheel U′ is fixed and adapted to gear with the gear-wheel U on the same shaft to which the crank C^5 is arranged, and is thus operated, as will be readily understood.

The wheel Y′ gears with the miter-gear Z′ on the same shaft S^6, by which the crank C′ and the gear-wheel U^8 are rotated. A gear-wheel U^9 may or may not gear with the wheel U^8 according to its adjustment on the shaft M′, to which it may be adjusted in position. The gear-wheel U^3 is fixed on the shaft M and so arranged as to gear with the wheel U^2 on the same shaft carrying the crank C^6.

The gear-wheel Y^2 meshes with the miter-wheel Z^2, which is fixed on the shaft S^4, said shaft also carrying the miter gear-wheel Z^4. The latter meshes with the miter gear-wheel Z^5, keyed on the shaft S^8, on which the crank C and the gear-wheel U^{11} are fixed and rotated, Fig. 2. A gear-wheel U^{10} according to its adjustment on the shaft M, to which it is slidingly secured, may or may not gear with the wheel U^{11}. On the same shaft M with U^{10} the gear-wheel U^4 is rotated and through it the wheel U^5, with which it engages. On the same shaft with U^5 is arranged a crank C^a. (Not shown in the drawings, but which is an exact duplicate of the crank C.)

Referring to Fig. 6 in the drawings, we have a plan view of the plate P, with all the mechanism supported on its face. As heretofore mentioned, I have provided for the rotation of the cranks C, C′, and C^2, said cranks being all alike. Referring to Fig. 14 of the drawings, a plan view of the crank C is given, and in Fig. 15 a side view of the crank-pin S is shown, said pin being adjusted in position in reference to the center of rotation by turning the male screw 25, which fits in the female screw of the part S. The head of the male screw 24 is fixed to 25 and carries on its six faces small screw-threaded apertures, into which the screws 26 fit when driven home. By this means any jarring or other motion will prevent the screws 25 from turning after the position of S has been adjusted. The nut 27 being removable from the screw 25 to permit the crank C to be taken apart for purpose of cleaning or substituting new ones should the old ones become worn, said nut may also be secured by a small set-screw. On the surfaces of the crank is marked a graduated scale *h*, which simplifies the adjustment of S to any desired radius of rotation.

Referring therefore to Fig. 6 of the drawings, we see that about the center of rotation of each of the cranks C, C′, and C^2 there are marked the semicircular scales L, L′, L^2, respectively, and that the said cranks carry the crank-pins S, S′, and S^2. The pin S^2 of the crank C^2 passes through the center of the slide G^2, which vibrates in the slot J of the arm B′ as the crank is rotated. The arm B′ is reciprocated by the rotation of the crank C^2 moving in the slides F, F′, and F^2 and carrying two transverse slotted heads J and J′, the latter moving over the opening O′ cut in the plate P.

The pin S′ of the crank C′ passes through the center of the slide G′, which moves back and forth in the slot I of the arm B as the crank rotates. The arm B is reciprocated in the slides E, E′, and E^2 by the rotation of the crank C′ and carries the transverse slotted heads I and I′, the latter of which moves over the opening O of the plate P. The pin S of the crank C passes through the center of the slide G and moves it back and forth in the slot H as it rotates.

The arm A (shown more in detail in Fig. 12) carries the two transverse slotted heads H and 54 and is connected with the arm A′, carrying the transverse slotted head 55, by means of the screws 58 and 59. The heads of the screws 58 and 59 and the shoulders 60 and 61 are secured firmly to the screws in order that the latter may turn easily in their bearings. Two female screws are cut in the projecting pieces 62 and 63 of the arm A′, so as to fit the male screws 58 and 59. The projection 64 of the arm A fits into the slot 65 of the arm A′. By turning the heads 56 and 57 of the screws the distances of centers of the slots 54 and 55 from each other may be adjusted, the arrangement of the transverse slotted heads being such that in the process of reciprocation of the arms B and B′ and the compound slotted arm A and A′ the slot I′ is always over the slot 54 and the slot J′ always over the slot 55. At the intersection of the slots I′ and 54 and J′ and 55 the slides N and N′ (shown more in detail in Figs. 16 and 17) are carried. The slide N consists of three distinct parts—the center piece, having hole bored through its

center 23, two washers, and the nuts 22, which clamp the washers into position.

Through the cylindrical aperture of the slides N and N′ are passed vertical cylindrical bars R and R′, Fig. 6, one of which is shown more in detail in Fig. 11. These bars are free to turn in the apertures of the said slides and are bolted to the vertical cutter-arms X^8 and X^9, which arms are shown more in detail in Figs. 7 and 8 and their operation explained below. Thus the slides N and N′, by moving the bars R and R′, serve to guide the cutter-arms X^8 and X^9, to which they are attached.

I will now describe the arm carrying the shaper or surface-carver rotating about a vertical axis which is employed in combination with the above mechanism. In Fig. 7 I give a plan view of an arm carrying a vertical rotating cutter, and in Fig. 8 a side elevation of the same, while reference to Fig. 9 will serve to illustrate to the eye the mechanical principles involved. The pulley 8, which is fixed to the same axis with the pulley 9, is rotated by applying power to pulley 9. The shaft *m* of pulley 8 rotates in the journals of arm 1, and about the other extremities of arm 1 the arm 2 is free to rotate, being connected with it by means of pivots which are fixed on the arm 2, but move freely with the rotation of arm 2 in the bearings of arm 1. The small arms 3 and 4 are fixed to the same center axis *p*, about which the idle-pulley 7 revolves. These two arms 3 and 4 furnish the bearings for the other idle-pulleys 5 and 6. A little more space is left between the pulleys 5 and 7 and 7 and 6 than is required to admit the thickness of the belting.

A continuous belt is passed around the wheel 8, between the pulleys 6 and 7, around the pulley 14, and between the pulleys 5 and 7, to the starting-point. The pulley 14 is fixed to the shaft 21 and carries on its top a cardiodal enlargement 12, into which the oil from the upper bearing drips. Under the lower bearing of the shaft there is fixed another cup 15, having the cross-section of a cardiod, and finally at the end of the shaft 21 there is fixed a collar 16, to which in turn the shaper or vertical rotating surface-carver 17 may be attached. Following the belting, therefore, as it passes from the pulley 8 around the pulley 14 and back again to the pulley 8 we see that for all practical purposes the belting will be of the same length whichever angle the arm 2 makes with the arm 1. The line passing through the center of the pulley 5 and 6 will bisect the angle made by the belting whatever be the position of the arms 1 and 2 in reference to each other. Thus the strain will always be along the same line of 3 and 4, and by this means we have many advantages over that with two belts, one for each arm. The belt being longer we get some of the advantages of a longer belt, while we also get a closer contact of belting and pulleys. Inasmuch as the pulley 14 rotates very fast its journals require constant oiling to prevent the destruction of the bearings. To achieve this end, I enlarge the top of the pulley 14 into the vessel 12 and arrange beneath the lower bearing the vessel 15. The vessels 12 and 15 are partly filled with oil, into which the siphons 13 and 18 dip with their openings facing in a direction opposite to that of rotation. These siphons lead from the oil-cup to the top of the bearings of the shaft 21 and empty into grooves which are cut in the surface of these bearings. The oil, therefore, being forced up the siphons by its centrifugal force empties into the grooves of the bearings and gradually finds its way back into the oil-cups 12 and 15. The tops of the vessels 12 and 15 are turned inwardly for the purpose of preventing the oil from escaping.

Referring to Fig. 2, we see that motion is communicated from the pulley W to the pulley X and that on the same axis with X the fixed pulley R^4 rotates. The pulley 9 is rotated by the belting, which passes around R^4, over the idle-pulley H^6, around 9, over the idle-pulley H^7, back to the starting-point. The arm represented in Figs. 7 and 8 is fitted on the upright piece R^3 by means of the plugs 10 and 11, which fit into the apertures of the upper and lower projecting pieces of R^3, respectively. The arm is thus free to move about the center of the bearings on R^3.

By means of the hand-wheels K and K′ the screws K^6 and K^7 are turned. These screws pass through corresponding female screws cut in R^3 and R^2, respectively. Hence by turning the hand-wheels K and K′ the uprights R^3 and R^2 may be raised and lowered, and consequently the carving-arms X^8 and X^9, which they carry. From the pulley W^2 motion is transmitted to X^2, which is fixed on the same axis with a pulley R^5. A belt passes around R^5, over the idle-pulley H^9, around *g′*, over the idle-pulley H^8, back to the starting-point. To the arms X^8 and X^9 two vertical shafts R and R′ (shown in detail in Fig. 11) are attached by bolts to the sides and ends of the shafts which pass through the apertures of N and N′, respectively, Fig. 6. Thus are the vertical rotating cutters guided along the paths of the carver, which paths are determined by the relative speeds of rotation of cranks C, C′, and C^2, by the angles at which said cranks are set at the beginning of operation, and by the positions at which the pins S, S′, and S^2 are adjusted from the center of rotation, as fully described in my Patent No. 511,772, as heretofore stated.

It will be apparent that, since each arm describes and carves its independent curves when the lumber moves under the carver, the carvings of the arms X^9 are superposed on the carvings of the arms X^8. Consequently it will often be desirable to so adjust the mechanism that the carvings of the one arm are superposed on the other in a certain relation, (as that of symmetry, for example.) Therefore to accomplish this result the compound arm A and A′ is made adjustable as

to the distance between the centers of its transverse slotted heads 54 and 55. Furthermore, inasmuch as the direction in which a miter gear-wheel turns depends upon the particular extremity of the diameter of the wheel at which the miter-wheel turning the first meshes with it, it will be seen that the direction in which a curve is described by the carving-arm may be reversed by placing the wheels Y and Y′ so as to gear with the other side of the wheels Z and Z′ from that shown in the drawings, or by changing the relation of only one of the above-mentioned gears one of the curves will be described in one direction and the other in another. This will give important results, for if we set the mechanism so that each of the arms describes a circle and the one curve is described in a direction opposite from the other the two cycloidal curves which are carved on the surface of a moving board will have their cusps extending in opposite directions.

It was heretofore stated that the wheel V^3 (shown in detail in Fig. 3) might have either a continuous or intermittent gearing. If it is provided with a continuous gearing, the lumber is fed with a constant velocity across the machine and the curves produced on its surface by the carvers on the arms X^8 and X^9 will be regularly repeated. If, however, the wheel V^3 has an intermittent gearing, as, for example, if half of its circumference carried teeth and the other half cut down smooth to the depth of the teeth, then the lumber would alternately describe a curve resulting from a combination of the constant velocity of the board under the carver and the independent motion of the carver itself; but when the board is stationary the curve carved on its surface depends wholly on the motion of the carving-arms. Suppose the carving-arm X^9 is thrown out of engagement and only the arm X^8 is operated and is guided to describe a circle. Let the wheel M^3 have one-half the diameter of M^5, and let only one half of the circumference of the wheel V^3 be geared, while the other half is plain, and allow the wheel V^3 to be placed in such a position that it just begins to gear with its companion when the crank C has moved the arm B to its outer limit. Then placing the machinery in motion a cycloidal curve will be generated, beginning at the center of the curve until it reaches the cusp at $a^\times$, Fig. 29, then the opposite half of the same cycloidal curve until the carver reaches the center of the curve $b^\times$, the board then remaining stationary, and the circle $c^\times$ is described. Immediately upon completion of the same the board again moves and the semicycloidal curve $b^\times$ and $d^\times$ is described, and thus the design shown in Fig. 29 is constantly produced.

It will be observed that at times it may be desirable to employ only one carver. In such a case the one carver is thrown out of action by raising the cutter by means of turning one of the hand-wheels K or K′ and throwing the corresponding miter-gear on the shaft S^5 out of gearing with its companions.

It will also be desirable at times to carve figures on stationary blocks or boards, in consequence of which only the carving mechanism proper will be of use. The wheel V^3 will therefore be shifted out of gearing with its companions. One or two of the carving-arms can then be used in case of stationary carving. If both are used, two blocks can be carved at the same time with the same or different designs, as will be readily understood.

It will also be observed that in order to accomplish many of the results desired, and particularly pointed out in my Patent No. 511,772, it will be necessary that the pairs of miter gear-wheels, the ratio of whose diameter vary, be substituted for the pairs Z and Y, Z′ and Y′, and Z^2 and Y^2. It may also be found advantageous at times to use only the arms B or B′ or both in describing a certain curve on a moving board, in consequence of which the arms R and R′ must be retained in the center of the transverse slotted heads I and J, respectively, the latter being accomplished by means of a clamp, (of which Figs. 21 and 22 are respectively the plan end and side views.) Said clamp is adapted to fit on the arms B or B′ over the center of the slotted heads I or J and through the cylindrical opening in which the arm R (shown in Fig. 11) may pass.

In order to produce a wavy molding of different patterns, the revolving heads shown in Figs. 7 and 8 are provided with a vertical rotating shaper. Take out the sections A^6 and A^7 of the table Q, Fig. 5, and lower the arms X^8 and X^9, so that the lower edges of the shapers will be slightly below the surface of the table. After all the necessary adjustments of the cranks C, C′, and C^2 have been made and the mechanism put in operation boards moving along the table Q will have wavy molding cut on their edges. Attention is also directed to the fact that if it is desirable to use only one carving-arm in producing this molding it may be accomplished by dispensing with other parts of the mechanism, as heretofore stated.

From the above description it will be apparent that three distinct kinds of work can be produced by this mechanism with the vertical rotating cutter, and that a limitless number of designs may be produced, as heretofore fully explained.

A detailed description and explanation of the arm and adjusting mechanism of the cutter-head on a horizontal axis will now be given. In using this kind of a cutter-head all the mechanisms previously described, except the arms X^8 and X^9 and their attachments and the intermittent gear-wheel V^3, (in place of which a continuous gear-wheel is used,) are necessary.

The difficulty to be met in the use of a horizontal rotating cutter-head is the provision for constantly adjusting the head so that it

will be perpendicular to the tangent of curvature at the carving-point. The principle by which this difficulty is overcome is fully illustrated by means of the diagram Fig. 30. Suppose the mechanism is set to carve a circle on a stationary board and the cutter is at $g^{\times}$. Then $g^{\times} e^{\times}$ is the tangent of curvature at the point $g^{\times}$ and $R^{\times}$ is perpendicular to it; but suppose $g^{\times} e^{\times}$ is an arm and $R^{\times}$ a horizontal cutter fixed perpendicular to this arm and that a pin $M^{\times}$ moves always at the same distance in front of $g^{\times}$ and that arm $g^{\times} e^{\times}$ must pass through this pin, then for all practical purposes the arm $g^{\times} m^{\times} e^{\times}$ coincide with the tangent of curvature and consequently the cutter $K^{\times}$ with the normal; but when the board is moving along the table Q another motion influences the tangent of curvature. Suppose the board moves with such a velocity as to pass over the distance $M^{\times} E^{\times}$ while the carver is moved from $g^{\times} M^{\times}$. Then the line passing through $g^{\times}$ and $e^{\times}$, which is measured from $m^{\times}$, in the direction in which the board moves and parallel with its motion, which for all practical purposes will coincide with the tangent of curvature at the point $g^{\times}$, described on the moving board. Therefore if we have an arm always parallel to the direction of the moving board operating under the influence of the same law of motion as the arm carrying the carver and always kept in the same path of travel with the carver the same distance ahead of the carver and provided with an adjustable pin $e^{\times}$, which may be adjusted along a line parallel with the line of motion of the board and in the direction of this motion, then by adjusting $e^{\times}$ at the proper distance and causing the arm $g^{\times} l^{\times}$ to pass through $e^{\times}$ and consequently take the direction $g^{\times} m^{\times}$ the arm $g^{\times} l^{\times}$ will always practically coincide with the tangent of curvature, and $r^{\times}$, which consequently takes the position $h^{\times}$, will likewise coincide with the normal. In the former case the expression for the tangent is $\frac{dx}{dy}$. In the latter case the expression for the tangent is $\frac{dx}{dy+a}$.

Referring to Figs. 23, 24, and 25, we get the plan, end, and side views of a double-hinged arm carrying on its free end an electric motor which rotates a horizontal cutter-head fixed to a shaft rigidly attached to the motor. The motor and its rigid attachments may receive an independent motion about its vertical axis by means of an arm attached to the motor. One end of the arm 29 is fixed in the cylindrical bearings of the projecting pieces of either the uprights R^3 or R^2, so as to permit the arm 29 to swing about the center of these bearings with the two cylindrical plugs as pivots. To the other extremity of 29 is attached by means of pivots the arm 30, carrying the electric motor 40. There are two screws *r* and *s* on the arm 30, to which the wires conveying the current are attached. Said screws also serve to clamp the brushes 31 and 32, which bear upon the brass contact-wheels 33 and 34. The cylindrical shaft 35, to which the motor 40 is attached, is free to move with its weight in the bearings of the shaft 35 and has a shoulder in contact with the upper side of its bearing upon which the weight of the motor principally rests. The cylindrical shaft is provided with an aperture 39, Fig. 26, along its axis, from which the openings extend to the surface. The two wires pass from the motor through the lower opening, thence to the contact copper wheels 33 and 34, to which they are attached. At the base of the motor is fixed a vertical arm 42, which is connected to the arm 45, supporting the cutter-head by means of the female screw 43, which is threaded one-half with right-hand threads, the other half being provided with left-hand threads. By connecting the pulley 41 with the pulley 46 motion is communicated to the cutter-head 80. The cutter-head frame 45 carries a projecting piece 44, having formed on its end a long square plug, adapted to fit in the corresponding recess in the arm 42. The threads cut on said arm are left handed and those of 44 right handed. Hence by turning 43 the axis of the pulleys 41 and 46 are brought closer together or forced farther apart, according to the direction in which 43 is turned. Compensation is thus made for stretch in the belting. A cylindrical sheath 36 is attached to the extremity of the arm 30 and fits over the shaft 35. This sheath with the container-shaft 35 is passed through the slide N, (detail in Figs. 16 and 17,) and thus the arm carrying the motor is moved in the path of predetermined curve of the mechanism and friction between the shaft 35 and slide N avoided. On the top of the shaft 35 is fixed an arm 37, which carries slide 38. This arm is perpendicular to the axis of the cutter-head and may be more properly termed the "adjusting-arm." As will be apparent, by means of the said arm the motor can be rotated on its axis.

On the plate Q^5 is a mechanism which is an exact duplicate of that supported on plate P, except that the gear-wheels are on the upper side of Q^5, while these are on the under side of P, and the cranks or transverse slotted arms are on the under side of Q^5, while these are on the upper side of P. B^7 is likewise a duplicate of the arm B. The crank C^5 reciprocates the arm B^6 in slides which are duplicates of F, F′, and F^2, the arm B^6 being likewise a duplicate of B′. At the intersection of the slots of the double transverse slotted arm A^7 A^8 and the slots of the transverse slotted arms B^6 and B^7 there are carried the slides F^9 and F^8, respectively. (Detailed in Figs. 18 and 19.) This slide consists of a framework 47, the longer of whose sides are guided by the slotted arm moving transversely, in consequence of which it is parallel with the direction in which the board is moved under the cutter. The shorter side of

this slide is guided in the slot of the arm which is reciprocated in a direction parallel with the board and has a washer 48 clamped on its upper side by means of the nut 51. A screw 49, whose axis is parallel with the direction in which the board is fed, passes through a slide 52. By means of the former the latter's position is adjusted. The pin 51 is fitted in the slide 52 by means of two projections, which straddle the screw 49. The pin 50 is thus allowed to move in and out.

Referring to Fig. 1, we find that the plate Q^5 supports a mechanism which is an exact duplicate of that supported on plate P, Fig. 6, except that in the former case the gear-wheels are on top and the cranks and transverse slotted arms which are reciprocated by the cranks are on the under side of the plate Q^5. There are scales L^7 L^8 L^9 marked on the plate Q^5, which correspond to the scales L, L′, and L^2 on the plate P, and thus easily enable the one to set the cranks C^5, C^6, and C^9 in any relative positions with accuracy. It has already been stated that the gear-wheel U′ rotates U, which carries on its axle the crank C^5, and that the gear-wheel U^3 rotates U^2, which carries on its axle the crank C^6, and that the gear-wheel U^5 rotates U^4, which carries on its axle the crank C^9. Now the crank C^9 by its rotation reciprocates the double arm A^7 A^8 (which is an exact duplicate of the arm A A′ and which carries three transverse slotted heads) in the slides D^8, D^9, and D^{10}. The crank C^6 reciprocates the arm B^7 in slides corresponding to E, E′, and E^2 out on the slide 52. The object of having this latter arrangement will be explained directly.

Now when it is desired to use the horizontally-rotating cutter for carving, the motor-arms X^{12} and X^{13}, Fig. 3, carrying the motors 40 and 40ª, respectively, are attached to the uprights R^3 and R^4, respectively, and the arm 37, which is perpendicular to the cutter of motor 40, is attached to the axis of the motor, as previously described, for the purpose of adjusting the cutter along the normal to the curve carved. The shaft to which the motor 40 is attached passes through the cylindrical sheath 36, which passes through the slide N, Fig. 6. The adjustable pin 50, carried by the slide F^8 and fitting in the slide 38 of the arm 37, guides the arm 37 along the line of tangent, and consequently keeps the horizontal cutter adjusted to the normal, as previously set forth, by adjusting the transverse slotted arms A^7 and B^7 and their relative speed of rotation, so that the slide F^8, carried at their intersection, will describe exactly the same curve as the slide N, carried at the intersection of the transverse slotted arms A and B, with the difference that the slide F^8 is carried a little in advance of the slide N. When the board on which the figure is carved is stationary, the pin 50 is adjusted so as to be exactly at the center of the intersection of the slots of the arms A^7 and B^7. When the board is moving, the pin is adjusted from the center in the direction in which the board moves a distance depending on the speed of the board, the speed of the slide N, moving the motor-arm X^{12}, and the position of the slide F^8 relative to the slide N. Similarly the motor-arm X^{13}, supported in the upright R^4 and carrying on its free extremity the motor 40ª, is moved in the path of the predetermined curve by the slide N′, Fig. 6, through which the cylindrical sheath 36ª, fixed to the arm X^{13}, passes. On the top of the motor-shaft is likewise carried an arm 37ª, perpendicular to the axis of rotation of the horizontal cutter carried by the motor 40ª. The pin 50ª, carried by the slide F^9, fits in the slide 38ª of the arm 37ª and thus adjusts the cutter, as described in the case of the arm X^{12}.

All that was said in reference to the adjustment of the vertical carving-arms applies with equal force to the adjustment of the horizontal cutter-arms, and as large a variety of designs can be produced by means of the latter as by the former, with the exception of the designs produced by the aid of the intermittent gear-wheel.

It will be obvious from what was said concerning the vertical cutter-arms and the horizontally-rotating cutter-arms and the manner of guiding and adjusting the same that nothing would interfere with the use of a vertical cutter-arm and a horizontal cutter-arm at one and the same time, for the transverse slotted arms B and B′ and the compound transverse slotted arm A A′ act in the same manner in guiding horizontal or vertical cutter-arms; but in the use of a horizontal cutter-arm the transverse slotted arms B^7 and B^6 and the compound transverse slotted arm A^7 serve to adjust the horizontal cutter to the normal, and their operation in no way interferes with the use of a vertical cutter-arm at the same instant that a horizontal cutter-arm is in operation, both movements being independent of one another.

It will be noted that various changes may be made in the details of construction of the above-described machine without departing from the general idea involved in this invention; as, for example, the electric motor may be dispensed with and other means employed to rotate the cutter.

It will be obvious that the arm of the vertical cutters may be dispensed with and the cutter carried in a suitable slide guided by the transverse slotted arms, which slide supplies the bearings of the cutter. Power may be brought to bear on the cutter for rotating it by various means, such as keeping the belting between the driving-pulley and the driven pulley on the cutter stretched by means of a weight attached to an idle-pulley connected with the belt. Similar means may be employed to guide and rotate the horizontal cutter, thus dispensing with the double-hinged arm.

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

1. In a woodworking-machine, the combination of the two vertical cutter-arms carrying vertical cutters, an intermittent feed, and planer substantially as described.

2. In a woodworking-machine, the combination of the two vertical cutter-arms carrying vertical cutters, intermittent feed-rolls, an adjustable table, a planer, substantially as described and for the purpose set forth.

3. In a woodworking-machine, the combination of the two vertical cutter-arms guided by transverse slotted arms, continuous feed-rolls, a planer, cutters and an adjustable table substantially as described.

4. In a woodworking-machine, comprising vertical cutter-arms guided at the intersecting slots of transverse slotted arms in combination with an adjustable table, substantially as described.

5. In a woodworking-machine, comprising vertical cutter-arms, means to rotate and guide said arms in combination with continuous feed-rolls substantially as described and for the purpose set forth.

6. In a woodworking-machine, the combination of the vertical cutter-arms carrying vertical cutters, means to rotate and guide said arms, continuous feed-rolls and an adjustable table substantially as described.

7. In a woodworking-machine, comprising vertical cutter-arms carrying vertical cutters, means to independently rotate and guide said arms, in combination with continuous feed-rolls, substantially as specified and for the purpose set forth.

8. In a woodworking-machine, comprising vertical cutter-arms carrying vertical cutters, means to independently rotate and guide said arms, in combination with intermittent feed-rolls and an adjustable table substantially as described.

9. In a woodworking-machine, the combination of the vertical and horizontal cutters, the transverse slotted arms, a table, and a continuous feed of the lumber, substantially as set forth.

10. In a woodworking-machine, the combination of the two horizontal cutters, guided at the intersection of two transverse slotted arms and a lineal slotted arm and regulated by means of a duplicate set of transverse slotted arm and a lineal slotted arm, substantially as described and for the purpose set forth.

11. In a woodworking-machine, the combination of a horizontal cutter, guided at the intersection of a transverse slotted arm, and a lineal slotted arm, means to rotate said cutter and regulate the same by a duplicate set of slotted arms, substantially as described.

12. In a woodworking-machine, the combination of the cranks C, C′, C^2, having scales, and carrying crank-pins S, S′, S^2, the saip crank-pins moving the compound transverse slotted arms A, A′, and the transverse slotted arms B, B′, means for carrying vertical rotating cutters and guiding the same by means of said arms, substantially as described.

13. In a woodworking-machine, a double-hinged arm, carrying a vertical rotating cutter-head, provided with pulleys carrying oil-cups communicating with one another, substantially as described and for the purpose set forth.

14. In a woodworking-machine, a double-hinged arm, having a vertical rotating cutter-head, provided with pulleys carrying oil-cups and siphons communicating with said cups, substantially as described.

15. In a woodworking-machine, a double-hinged arm carrying on its free extremity an electric motor 40, having attached to its base portion an arm 42, carrying the horizontal cutter-head frame 45, having secured thereto the cutter 80, fixed to the pulley 46, substantially as described.

16. In a woodworking-machine, a double-hinged arm, consisting of the parts 29 and 30, the latter carrying the brushes 31 and 32, an electric motor arranged to the shaft 35, having secured thereto the contact-wheels 33 and 34, inclosed by a hollow shaft 36 carrying on its upper extremity an arm 37, said arm provided with a slotted guide for the reception of the adjusting-pin 50, the motion of said pin serving to adjust the horizontal position of said motor about its vertical axis substantially as described.

17. In a woodworking-machine, a double-hinged arm consisting of the parts 29 and 30, the latter carrying the shaft 35, having on its upper extremity the slotted guide-arm 37, and on its lower extremity the motor 40, the cutter 80 adjustably secured to the arm 42 of the said motor, substantially as described.

18. In a woodworking-machine, a double-hinged arm, consisting of the parts 29 and 30, the latter carrying the motor 40, said motor communicating motion to the cutter-head 80, suspended in a frame 45, substantially as described and for the purpose set forth.

19. In a woodworking-machine, a double-hinged arm, consisting of the parts 29 and 30, the latter carrying the brushes 31 and 32, adapted to convey electric currents to the contact-wheels 33 and 34 of the shaft 35 and connected with suitable wires passing through a bore 39, conveying electric currents to the motor 40 of the shaft 35, the latter adapted to be turned on its axis by an adjusting-arm 37, provided with a slotted guide 38, and means for revolving the same as specified.

20. In a woodworking-machine, a double-hinged arm carrying on its free end a shaft 35, having secured on its lower extremity a motor 40 and to its upper extremity the adjusting-arm 37 in combination with a horizontal rotating cutter, substantially as described.

21. In a woodworking-machine, a double-hinged arm carrying on its free end a shaft

35, having connected with it a horizontal rotating cutter-head, a slotted guide 38 of the adjusting-arm 37 and means for independently revolving the same as specified.

22. In a woodworking-machine, a double-hinged arm, carrying a vertical shaft having connected with its lower extremity the horizontal rotating cutter and with its upper extremity an adjusting-arm provided with a slotted guide and means for independently revolving the same and suitable means for rotating said cutter, substantially as described.

23. In a woodworking-machine the combination of the gear-wheels V, V′, and V^2, the feed-rolls F^3, F^4, the miter gear-wheel Z^3, of the shaft S^3, and the miter gear-wheel Y^3, of the shaft S^5, miter gear-wheels Y, Y′, Y^2, the gear-wheels Z^2, Z^4, of the shaft S^4, said gear-wheels communicating motion to the shafts S^6, S^7, S^8, of the cranks C′, C^2, and C, respectively, said cranks guiding vertical cutters by means of transverse slotted arms, substantially as described and for the purpose set forth.

24. In a woodworking-machine, the combination of the cranks C, C′, C^2, reciprocating the adjustable transverse slotted arm A, A′, the transverse slotted arms B, B′, carrying at the intersection of their slots the slides N, N′, in combination with the double-hinged vertical rotating cutter-arms, substantially as described and for the purpose specified.

25. In a woodworking-machine, the combination of a continuous gear-wheel V^3, of the feed-rolls F^3, F^4, said wheel carrying on its axis a removable gear-wheel M^5, transmitting motion to the cranks C, C′, C^2, said cranks reciprocating arms A, B, B′, the latter guiding horizontal cutters substantially as described.

26. In a woodworking-machine, the combination of a continuous gear-wheel V^3, of the feed-rolls F^3, F^4, said wheel carrying on its axis a removable intermittent gear-wheel transmitting motion to the crank C, C′, C^2, said cranks reciprocating arms A, B, B′, said arms guiding horizontal cutters substantially as described.

27. In a woodworking-machine the combination, of the continuous gear-wheel V^3, the feed-rolls F^3, F^4, means for conveying motion to the cranks C, C′, said cranks guiding a horizontal cutter by means of the arms A, B, substantially as specified.

28. In a woodworking-machine, the combination of a continuous gear-wheel V^3, the feed-rolls F^3, F^4, intermediate gearing for carrying motion from the axis of V^3, to the cranks C, C′, the arms A and B, and the vertical carving-arm X^8, substantially as described.

29. In a woodworking-machine, the combination of an intermittent gear, the feed-rolls F^3, F^4, intermediate gearing and means for conveying motion to the cranks C, C′, the arms A and B and the vertically-adjustable carving-arm X^8, substantially as set forth.

30. In a woodworking-machine, the combination of the continuous gear-wheel V^3, the feed-rolls F^3, F^4, means for conveying motion to the crank C′, the clamp 19 and vertical carving-arm X^8, substantially as specified.

31. In a woodworking-machine, the intermittent gear-wheel V^3, and vertically-adjustable cutter-arm X^8, guided by the transverse slotted arms A and B with means for transmitting motion from said intermittent gear to said transverse slotted arms substantially as set forth.

32. In a woodworking-machine the cranks C, C′, C^2, reciprocating the compound transverse slotted arms A, A′ and the transverse slotted arms B, B′, respectively, the vertical rotating cutter-arms X^8, X^9, carried in the adjustable brackets R^2, R^3, with suitable means for rotating the said cranks C′, C^2, and for rotating the cutters of said vertical cutter-arms X^8, X^9, substantially as described.

33. In a woodworking-machine the combination of the cranks C, C′, reciprocating the transverse slotted arms A and B, guiding the vertically-adjustable carver-arm X^8, means for operating said cranks and said carver, and the adjustable table Q, substantially as set forth.

34. In a woodworking-machine, the combination of the feed-rolls F^3, F^4, the shaft 72 carrying the gear-wheels V^3 and M^5, the gear-wheel M^4 attached to an adjustable arm D^4, the gear-wheel M^3, communicating motion to the cranks C, C′ through a train of gears, the transverse slotted arms A, and B and the adjustable vertical rotating cutter X^8, substantially as described.

35. In a woodworking-machine, the combination of the pulleys R^4, R^5, transmitting motion to the pulleys 9, 9′, rotating the vertical cutters of the arms X^8, and X^9, the cranks C, C′, C^2, the compound transverse slotted arm A, A′, the transverse slotted arms B, B′ and suitable means to operate said mechanism, substantially as described.

36. In a woodworking-machine, the combination of the continuous gear-wheels V^3, the feed-rolls F^3, F^4, the cranks C, C′, C^2, the compound transverse slotted arm, A, A′, the transverse slotted arms B, B′, said arms guiding at the intersection of their slots a vertical cutter, and suitable means to operate said mechanism, substantially as described and for the purpose set forth.

37. In a woodworking-machine, the combination of the intermittent gear-wheel V^3, the feed-rolls F^3, F^4, means for transmitting motion from the axis of said intermittent gear-wheel V^3, to the cranks C, C′, C^2, the double transverse slotted arm A, A′, the transverse slotted arms B, B′, guiding at the intersection of their slots a vertical rotating cutter, substantially as described.

38. In a woodworking-machine, the combination of the cranks C, C′, the transverse slotted arms A and B, guiding at the intersection of their slots a vertical rotating cutter, and suitable means for operating the same, substantially as described.

39. In a woodworking-machine the combination of the feed-rolls F^3, F^4, the cranks C', C^2, reciprocating the transverse slotted arms B, B', said arms guiding vertical rotating cutters, means to operate said feed-rolls and said cranks, substantially as described.

40. In a woodworking-machine, the combination of the continuous gear-wheel V^3, the feed-rolls F^3, F^4, means for transmitting motion from the axis of gear-wheel V^3, to the crank C, the arm B, guiding a vertical cutter and suitable means for operating the same, substantially as described.

41. In a woodworking-machine, the combination of the feed-rolls F^3, F^4, the cranks C, C', C^2, the transverse slotted arms, B, B', the adjustable transverse slotted arm A, A', guiding the intersection of their slots the horizontal cutter-arms X^{12}, X^{13}, and a duplicate set of cranks and transverse slotted arms guiding at the intersection of their slots the adjusting-pins 50 and 50^a substantially as described.

42. In a woodworking-machine, the combination of the cranks C, C', C^2, the compound transverse slotted arm A, A', the transverse slotted arm B, B', guiding the horizontal rotating cutter-arms, X^{12}, X^{13}, cutters of said arms adjusted by pins 50, 50^a, said pins guided at the intersections of a duplicate set of transverse slotted arms, operated by a duplicate set of cranks, and suitable means for operating the same, substantially as described.

43. In a woodworking-machine the combination of the cranks C', C^2, guiding horizontal rotating cutter-arms X^{12}, X^{13}, a set of duplicate cranks and arms guiding adjusting-pins 50 and 50^a substantially as described.

44. In a woodworking-machine, the cranks C, C', slotted arms A, B, guiding a horizontal cutter, said cutter adjusted by a pin 50 guided by the arms A^7, B^7, a duplicate set of cranks, substantially as described.

45. In a woodworking-machine, the combination of the crank C, C', reciprocating transverse slotted arms A and B, said arms guiding at the intersection of their slots a horizontal cutter a duplicate set of transverse slotted arms to adjust said cutters, means for operating said crank and said cutters, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY HARRER.

Witnesses:
H. C. EVERT,
H. E. SEIBERT.