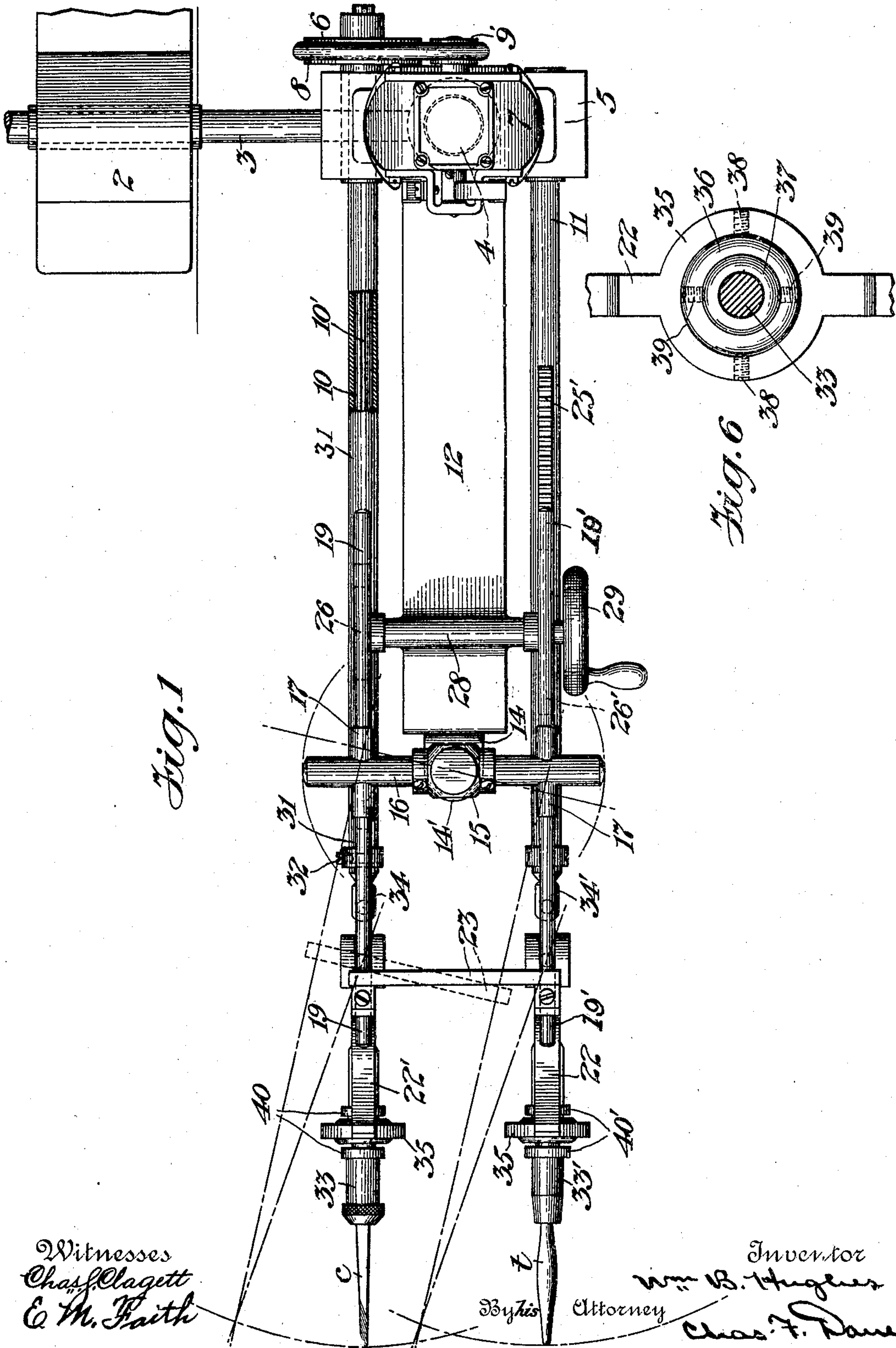


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PATENTED JULY 11, 1905.

W. B. HUGHES.  
CARVING MACHINE.  
APPLICATION FILED JAN. 19, 1904.

4 SHEETS—SHEET 1.



Witnesses  
Chas. Claggett  
E. M. Faith

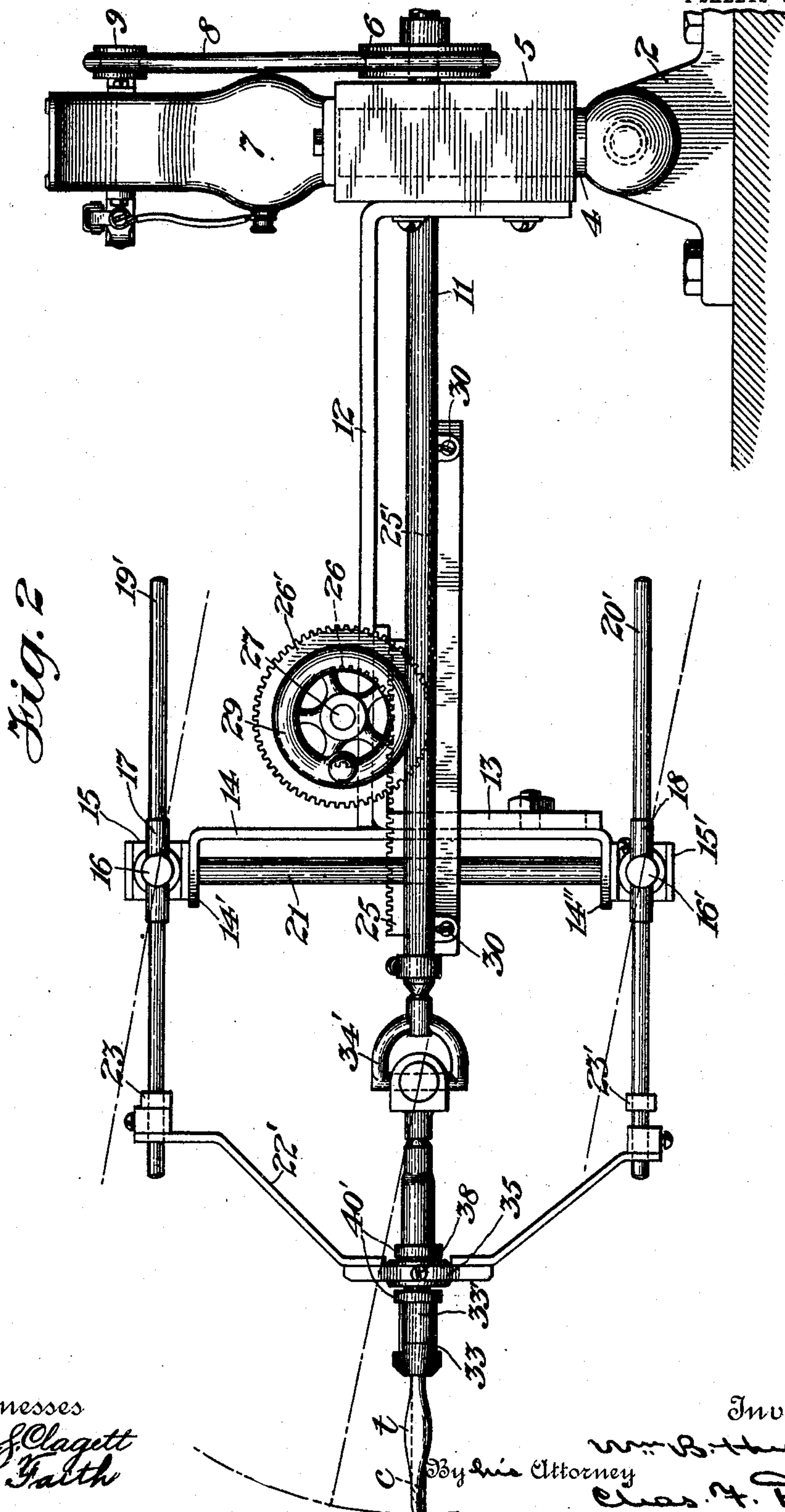
Inventor  
W. B. Hughes  
Chas. F. Dore  
By his Attorney

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APPLICATION FILED JAN. 19, 1904.

4 SHEETS—SHEET 2.



Witnesses  
Chas. J. Clagett  
E. M. Faith

By his Attorney  
C. J. Davis

Inventor  
W. B. Hughes  
Chas. F. Daine

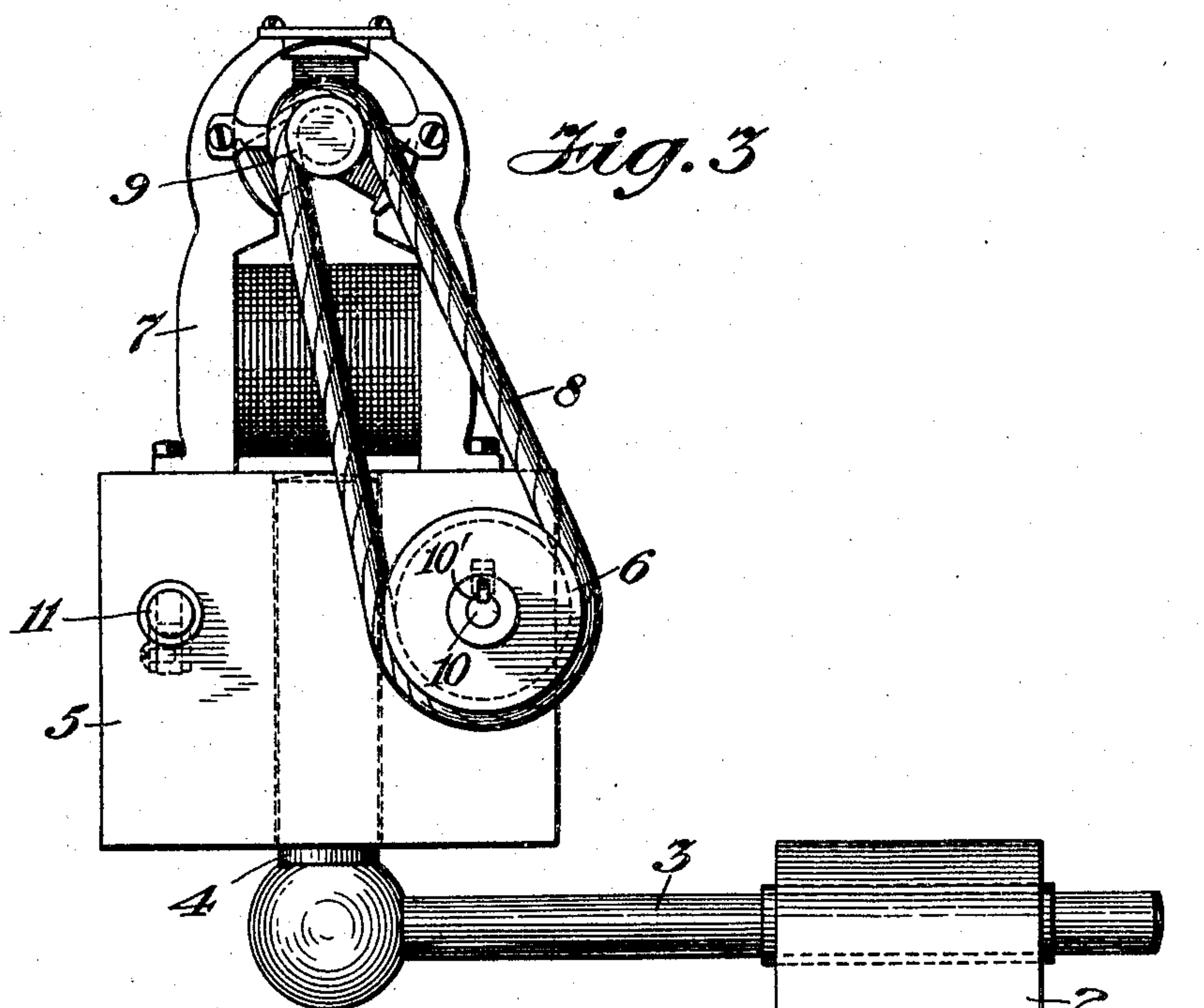


No. 794,182.

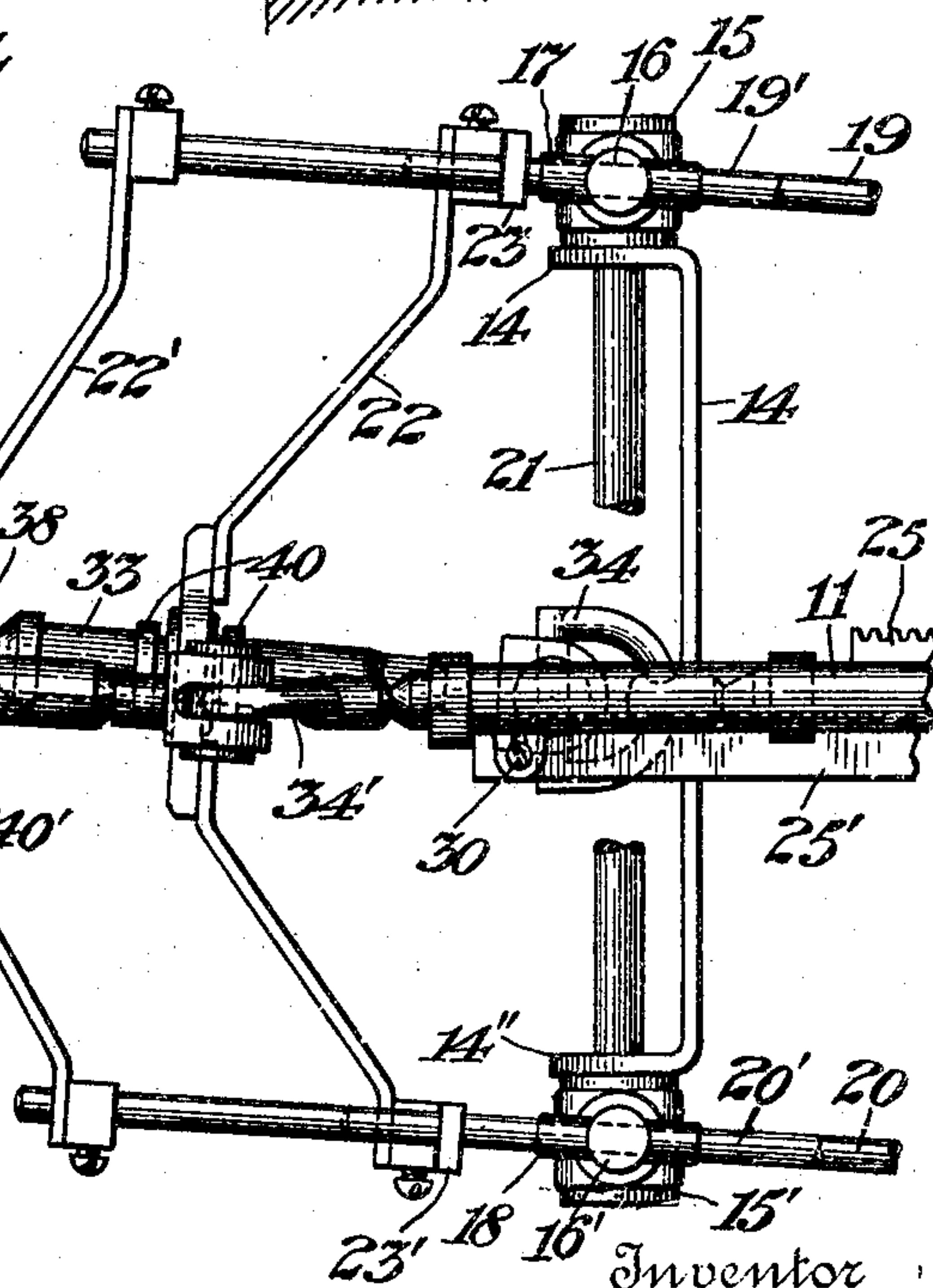
PATENTED JULY 11, 1905.

W. B. HUGHES.  
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APPLICATION FILED JAN. 10, 1904.

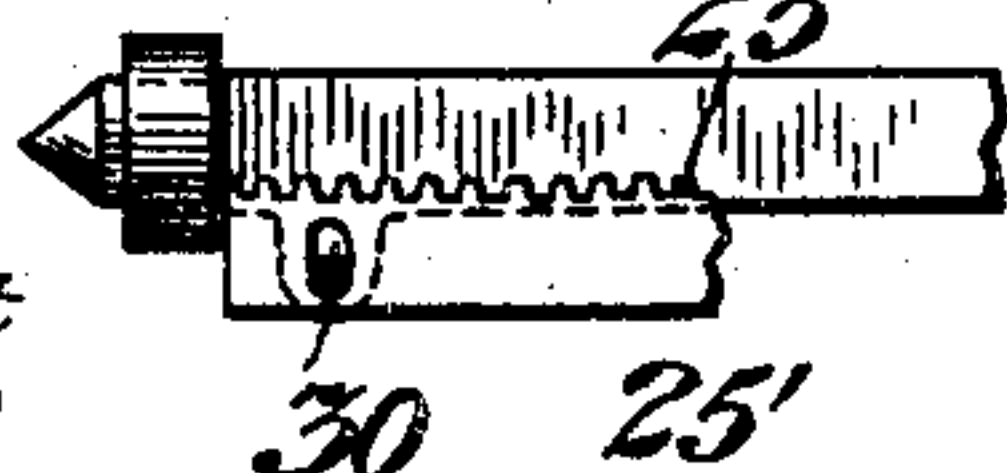
4 SHEETS—SHEET 3.



*Fig. 4*



*Fig. 5*



Witnesses  
Chas. F. Clagett  
& M. Faith

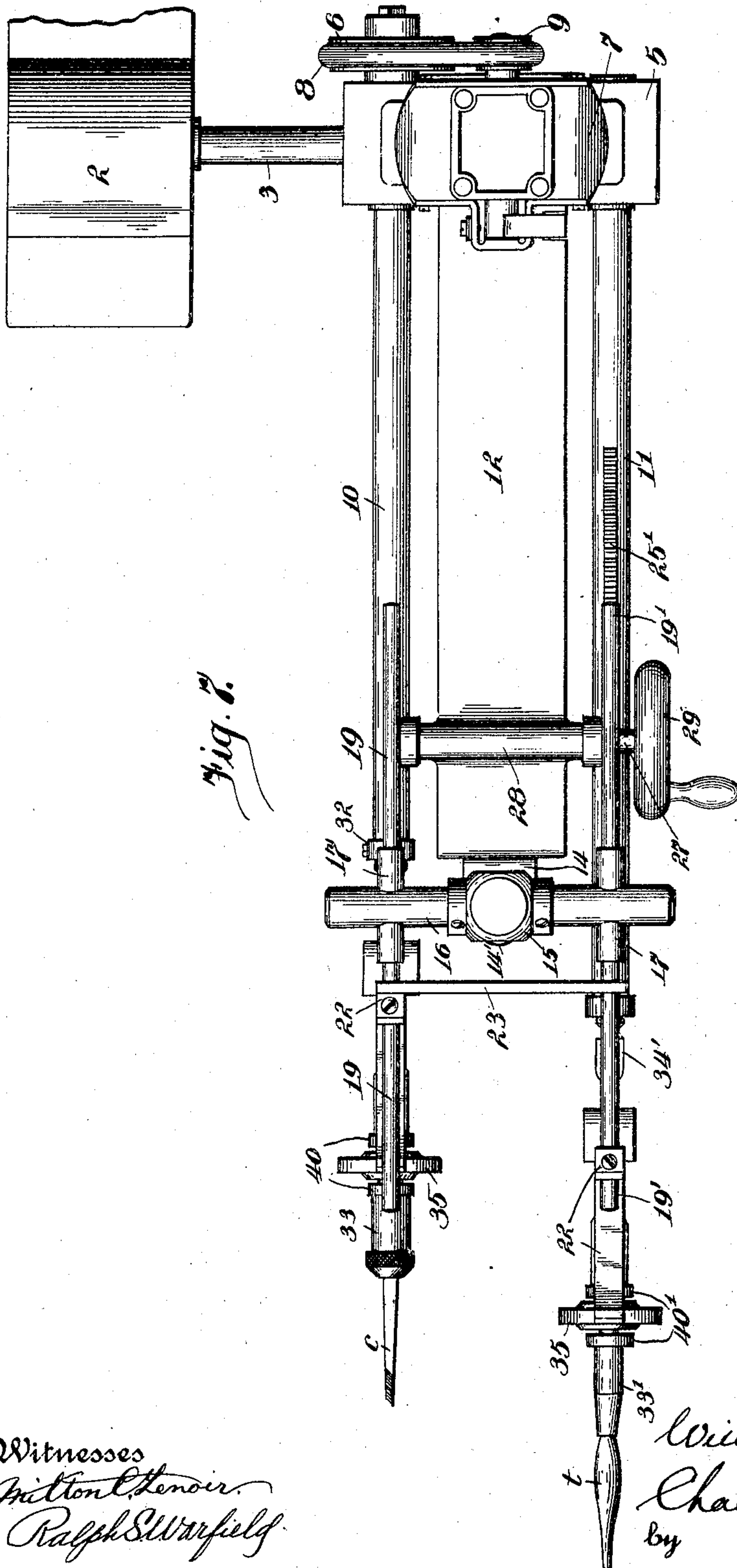
23' 10' 10' Inventor  
Wm B. Hughes  
By his Attorney  
Chas. F. Dand

No. 794,182.

PATENTED JULY 11, 1905.

W. B. HUGHES.  
CARVING MACHINE.  
APPLICATION FILED JAN. 19, 1904.

4 SHEETS—SHEET 4.



Witnesses  
Milton L. Kenoir.  
Ralph S. Warfield.

39  
Inventor  
William B. Hughes  
Chas F. Daul  
by His Attorney



# UNITED STATES PATENT OFFICE.

WILLIAM B. HUGHES, OF NEWARK, NEW JERSEY.

## CARVING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 794,182, dated July 11, 1905.

Application filed January 19, 1904. Serial No. 189,656.

*To all whom it may concern:*

Be it known that I, WILLIAM B. HUGHES, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Carving-Machines, of which the following is a specification.

This invention relates to improvements in carving-machines, and particularly pantographic carving-machines for following the lines and points of a model and reproducing the same either on a like or a different scale by cutting away corresponding portions of a block of wood or other material.

The principal object of my invention is to produce a carving-machine which will follow with exactness every feature of the model to be reproduced and will operate with precision on the block to be carved. To obtain this result, I prefer to employ a pantographic carving-machine so mounted and constructed as to be capable of moving freely in every direction and to any extent required by the work. To this end I prefer to mount the carving-machine as a whole pivotally, and preferably universally, so as to obtain an approximate or rough positioning of the machine as a whole with respect to the work, and to mount on the main universally-movable support a motor for operating the cutter or carving-tool, the weight of the machine being preferably so disposed as to facilitate the operation of the machine and so as not to have a tendency to displace either the tracer or the cutter when these are located in position. This may be accomplished by counterweighting the pivotally or universally supported machine.

In addition to mounting the carving-machine as a whole so as to be capable of moving universally for obtaining an approximate or rough positioning of the carving-machine with respect to the model and the work, the tracer and the cutter, which are the most important elements of the machine, will also be mounted in such a manner as to be movable relatively to the machine as a whole, this movement also being preferably a universal one. In the preferred construction the tracer and the cutter are connected, respectively, to a tracer-rod and a driven member or shaft mov-

able in unison lengthwise thereof with respect to the main universally-movable support, and the longitudinal movements of the tracer and the cutter toward and from the model and the work are controlled by this rod and shaft, while their other or universal movements are relative to this longitudinal movement and are controlled by a pantographic frame movable universally with respect to the main portion of the machine. The tracer-holder and the cutter-holder constitute permanent elements of the machine and are supported by universal joints in the pantographic frame and connected by universal joints with the tracer-rod and the driven shaft, so as to be capable of moving in every direction and to any extent within the limits required by the work with respect to the main frame of the carving-machine. The tracer-rod and the driven shaft for rotating the cutter-holder are connected for movement in unison in the direction of their axes or for movement in any desired ratio other than one to one, according as it may be desired to make a reproduction on the same scale as the model or on a different scale, and all of the connections from the tracer-rod and the driven shaft and from the pantographic frame to the tracer-holder and the cutter-holder are so constituted as to permit corresponding movements of the tracer and the cutter in any direction and in any desired ratio.

Other features of my invention not hereinbefore described will be hereinafter referred to and are illustrated in the accompanying drawings, in which—

Figure 1 is a plan of a carving-machine constructed in accordance with my invention with the counterweight removed. Fig. 2 is a side elevation of the same. Fig. 3 is a rear elevation of the same. Fig. 4 is a side elevation similar to Fig. 2 of the pantographic frame at the forward end of the machine and illustrates the positions of the parts when the frame is tipped and the tracer-rod and the driven shaft move at different rates for reproducing a model on a reduced scale. Fig. 5 is a detail illustrating an adjustment for controlling the position of a tracer-rod-actuating rack for different ratios of movement.



Fig. 6 is a detail illustrating the construction of the universal or gimbal joint for supporting the tracer-holder and the cutter-holder, and Fig. 7 is a plan view showing the parts in the relation indicated in Fig. 4.

Similar characters designate like parts in all the figures of the drawings.

My improved carving-machine as a whole is preferably mounted on a suitable fixed support in such a manner as to be capable of turning both in a vertical and in a horizontal plane for bringing the machine as a whole to an approximate working position. In this case I have shown at 2 a bearing, which constitutes a fixed support for the carving-machine. In this bearing, which may be bushed, as shown, a short shaft 3 is mounted in such a manner as to be capable of rotating and also reciprocating in the bearing. This shaft constitutes in the construction illustrated one element of an angular support, the other element of which is a vertical post or short shaft 4 on which the main movable support for the operating parts of the machine is mounted so as to turn in a horizontal plane. This support is designated by 5. On it is mounted a rotary driving member, which in this case is a driving wheel or pulley 6, held from movement in the direction of its axis with respect to such support, and upon said support may be mounted a motor, such as an electric motor 7, for driving the wheel 6, the motor-shaft and the driving-wheel being connected by a belt 8, passing around the wheel 6 and a corresponding pulley 9 on the motor-shaft. The pulley 6 is intended to rotate the driven member or shaft by means of which the cutter-holder is operated. This driven member or shaft is designated by 10 and is mounted in a bearing in the support 5 and connected with the pulley 6 in such a manner as to be movable through said support and pulley to provide for advancing the cutter toward or withdrawing it from the work. This movement of the driven member in the direction of its axis with respect to the driving member or pulley 6, while at the same time permitting it to rotate in unison with said pulley, is accomplished by splining these two parts together, the shaft 10 having a long keyway 10' therein for this purpose.

The tracer of this carving-machine is preferably connected with a tracer-rod parallel with the driven shaft 10 and mounted to slide in unison or in correspondence therewith through the support 5. This tracer-rod is shown at 11. Both the driven shaft 10 and the tracer-rod 11 may also be supported at their forward ends by the pantographic frame proper, connected with the main support 5. In the construction shown a long bracket-arm 12 extends from the support 5 and at its forward end has secured to the under side thereof a bracket 13, which constitutes a support for the pantographic frame proper. At the

forward end of the bracket 12 a vertical frame-piece is also secured, this vertical frame-piece or bar being designated by 14 and being bolted or otherwise secured to the bracket 13. From this frame-piece or bar 14 is supported what I designate as my "pantographic" frame, which will now be described. At its ends the bar 14 has transverse ears 14' and 14'', at the upper and lower sides, respectively, of which are oscillatory bearing-blocks 15 and 15', in which are mounted to turn in a vertical plane horizontal shafts, such as 16 and 16', provided near their ends with parallel transverse guides or sleeves, such as 17 and 18, for the reception of horizontally-movable guide-rods 19, 19', 20, and 20', the tool being provided with the guide-rods 19 and 20, while the tracer is provided with the rods 19' and 20', respectively.

All of the parts just described constitute portions of the pantographic frame proper, and in addition to the sliding movements of the guide-rods and the turning movements of the shafts 16 and 16' in a vertical plane these parts are also mounted to turn in unison in a horizontal plane about a vertical axis. This last-named movement is provided for by a vertical shaft 21, mounted in bearings in the ears 14' and 14'' and having the bearing-blocks 15 and 15' secured to opposite ends thereof.

At their forward ends the guide-rods 19 and 19', 20 and 20' are connected by frame-pieces or cross-bars, (designated generally by 22 and 22',) which are vertically disposed, and by cross-bars 23 and 23', which are horizontally disposed. These frame-pieces or cross-bars constitute a braced rectangular frame for maintaining the proper relative positions of the cutter and tracer at the forward end of the pantographic frame. The cross-bars 22 and 22' are fixed to the forward ends of the slide-rods; but the cross-bars 23 and 23' are loosely secured thereto to permit one or the other vertical pair of slide-rods to slide there-through when the ratio of movement of the tracer and cutter is not one to one.

For the purpose of operating the driven shaft 10 and the tracer-rod 11 back and forth with any desired ratio of movement I prefer to connect them positively by rack-and-spur gearing, these two members 10 and 11 having connected therewith racks, such as 25 and 25', the former of which is connected to the shaft and the latter to the tracer-rod. With these racks mesh, respectively, the pinion 26 and the gear 26', secured to a shaft 27, journaled in a long bearing 28 on the bracket 12 near the forward end of said bracket. At one end of said shaft means, such as the hand-wheel 29, may be provided for turning the same, and thereby feeding the tracer-rod and the driven shaft for the cutter gradually and positively toward or from the model and the work. The ratio of movement shown between the tracer-



rod and the shaft 10 is about two to one, but may be varied as desired by changing the gears and the elevation of the racks. For this reason the rack 25' will preferably be adjustable vertically, as by means of screw-and-slot connections, such as 30, with respect to its supporting tracer-rod. The rack 25 is secured to a sleeve 31, in which the shaft 10 turns, and which moves longitudinally with that shaft, but does not turn therewith, the usual connection, such as 32, being employed to permit simultaneous reciprocation of these parts with the rack 25 while preventing turning of the rack.

From the forward ends of the shaft 10 and the tracer-rod 11 connection may be made with suitable holders, such as a rotary reciprocating cutter-holder 33 and a reciprocating tracer-holder 33'. The connection is a pivotal one in each case and is preferably formed by universal joints, such as 34 and 34'. These joints permit the tracer-holder to reciprocate and also to be shifted to any desired vertical or lateral angular position and permit the cutter-holder to move in the same manner and also to rotate about its own axis. The tracer may be a device or tool substantially such as shown at *t*, and the cutter a tool or drill such as shown at *c*. This cutter will usually be held in place by a suitable chuck, which the cutter-holder 33 constitutes in the construction illustrated.

Both the cutter-holder and the tracer-holder have, in addition to their connections with the shaft 10 and the rod 11, connections with fixed points of support at the forward end of the pantographic frame. These points of support in the present case are in the vertical frame-pieces 22 and 22' of the two sides of the frame, which are capable of moving differentially, as shown in Fig. 4, when the ratio of movement of the tracer to the cutter is not one to one. In Fig. 6 I have illustrated in detail the connection between each holder and its support. Here it will be seen that the frame-piece 22, for example, has at the center thereof an enlarged portion forming an annular support 35, with a large opening to receive a pair of annular bearing members 36 and 37 and the shaft or body portion of the cutter-holder 33. The annular bearing member 36 is mounted in the annular support 35 on horizontal pivots, so as to move about its axis—that is, the pivots 38 in a vertical plane—and the annular bearing member 37 is mounted to turn in a horizontal plane about a vertical axis in the pivots 39. The chuck 33 is journaled directly in the bearing member 37, and hence is free to turn both in a horizontal and in a vertical plane by reason of the universal connection or gimbal-joint formed by these parts. Stop-collars, such as 40 and 40', on the cutter-holder and the tracer-holder, respectively, serve to limit the vertical pitch and the lateral angular movement of the pantographic

frame by confining the movement of the gimbal-joints between them. It will be noted that all of the bearing-rings just described have rounded surfaces parti-spherical in form to facilitate the universal movements of the connected parts.

From the foregoing description it will be seen that my improved carving-machine is an accurate pantographic mechanism for carving on any desired scale by simply following the points of a model with the tracer *t*, as indicated in Figs. 1 and 4. The rough adjustment of the machine to the model and the work by turning the machine as a whole about the shaft 3 and the post 4 and also by reciprocating the shaft 3, if desired, has been hereinbefore described. The fine adjustment of the parts is effected, as will be evident, by turning the pantographic frame proper about the vertical axis 21 and the horizontal axes 16 and 16' and by advancing or withdrawing the tracer and cutter by turning the hand-wheel 29. Various angular positions and movements of the parts are clearly indicated by dotted and dot-and-dash lines and need no further description.

What I claim is—

1. The combination with a support, of rotary driving and driven members carried by said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is operatively connected with said driven member.

2. The combination with a pivoted support, of rotary driving and driven members carried by said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is operatively connected with said driven member.

3. The combination with a support mounted to have a universal movement, of rotary driving and driven members carried by said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is operatively connected with said driven member.

4. The combination with a support mounted to have a universal movement, of rotary driving and driven members carried by said support and one of which is movable relatively to the other in the direction of the axis of rotation, a motor mounted on said support and operatively connected with said driving member, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is operatively connected with said driven member.

5. The combination with a support, of a rotary driving-wheel carried by said support



and held from movement in the direction of its axis, a driven shaft splined to and movable through said driving-wheel, and a pantographic mechanism embodying a tracer-holder  
5 and a cutter-holder the latter of which is operatively connected with said driven shaft.

6. The combination with a support mounted to have a universal movement, of a rotary driving-wheel carried by said support and  
10 held from movement in the direction of its axis, a driven shaft splined to and movable through said driving-wheel, a motor mounted on said support and operatively connected with said driving-wheel, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is operatively  
15 connected with said driven shaft.

7. The combination with a support, of rotary driving and driven members carried by  
20 said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is pivotally and rotatively  
25 connected with said driven member.

8. The combination with a support, of rotary driving and driven members carried by said support and one of which is movable relatively to the other in the direction of the axis  
30 of rotation, and a pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which is rotatable by and has a universal connection with said driven member.

9. The combination with a support, of rotary driving and driven members carried by  
35 said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a vertically-oscillatory pantographic mechanism embodying a tracer-holder and a cutter-holder the latter of which  
40 is operatively connected with said driven member.

10. The combination with a support, of rotary driving and driven members carried by  
45 said support and one of which is movable relatively to the other in the direction of the axis of rotation, and a pantographic mechanism oscillatory in vertical and horizontal planes and embodying a tracer-holder and a cutter-holder the latter of which is operatively  
50 connected with said driven member.

11. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of  
55 its axis of rotation, a pantographic frame a portion of which is movable longitudinally with said driven member, a tracer-holder carried by said frame, and a cutter-holder operatively connected with said driven member  
60 and pivotally supported on said frame.

12. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable  
65 relatively to the other in the direction of

its axis of rotation, a pantographic frame a portion of which is movable longitudinally with said driven member, a tracer-holder carried by said frame, and a cutter-holder operatively connected with said driven member  
70 and having a universal connection with said frame.

13. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of  
75 its axis of rotation, a pantographic frame a portion of which is movable longitudinally with said driven member, a tracer-holder carried by said frame, an annular bearing pivotally mounted on said frame, a second annular bearing pivoted in said first annular bearing and having its axis at right angles thereto,  
80 and a cutter-holder pivotally connected with said driven member and journaled in said second annular bearing.

14. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of  
90 its axis of rotation, a pantographic frame a portion of which is movable longitudinally with said driven member, a tracer-holder carried by said frame and having a universal connection therewith, and a cutter-holder operatively connected with said driven member  
95 and also having a universal connection with said frame.

15. The combination with a support, of rotary driving and driven members carried by  
100 said support and one of said members movable relatively to the other in the direction of its axis of rotation, a pantographic frame a portion of which is movable longitudinally with said driven member and also movable  
105 universally with respect to said driven member, a tracer-holder carried by said frame, and a cutter-holder operatively connected with said driven member and having a universal connection with said frame.

16. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of  
110 its axis of rotation, a tracer-rod also carried by said support and connected with said driven member for movement in correspondence therewith, a pantographic frame a portion of which is movable longitudinally with said  
115 driven member and tracer-rod and also movable universally with respect thereto, a tracer-holder having universal connections with said tracer-rod and the frame, and a cutter-holder having universal connections with said driven  
120 member and frame.

17. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of  
125 its axis of rotation, a tracer-rod also carried by



said support and connected with said driven member for movement in correspondence therewith, a two-sided pantographic frame the two sides of which are connected respectively with the driven member and the tracer-rod and are movable differentially therewith and are also movable universally with respect thereto, a tracer-holder having universal connections with said tracer-rod and one side of said frame, and a cutter-holder having universal connections with said driven member and the other side of said frame.

18. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of its axis of rotation, a longitudinally-movable tracer-rod also carried by said support, racks secured to and movable longitudinally in unison with said driven member and tracer-rod, gearing for simultaneously reciprocating said racks, and a pantographic mechanism embodying a tracer-holder and a cutter-holder connected respectively with the tracer-rod and the driven member.

19. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of its axis of rotation, a longitudinally-movable tracer-rod also carried by said support, racks secured to and movable longitudinally in uni-

son with said driven member and tracer-rod, gearing for simultaneously reciprocating said racks differentially, and a two-sided pantographic mechanism embodying a tracer-holder and a cutter-holder the former of which is connected with the tracer-rod and one side of said mechanism and the latter of which is connected with the driven member and the other side of said mechanism.

20. The combination with a support, of rotary driving and driven members carried by said support and one of said members movable relatively to the other in the direction of its axis of its rotation, a longitudinally-movable tracer-rod also carried by said support, racks secured to and movable longitudinally in unison with said driven member and tracer-rod one of which racks is vertically adjustable for varying the ratio of movement between the driven member and the tracer-rod, gearing for simultaneously reciprocating said racks, and a pantographic mechanism embodying a tracer-holder and a cutter-holder connected respectively with the tracer-rod and the driven member.

Signed at New York, in the county of New York and State of New York, this 21st day of December, A. D. 1903.

WILLIAM B. HUGHES.

Witnesses:

CHAS. F. DANE,  
E. M. FAITH.