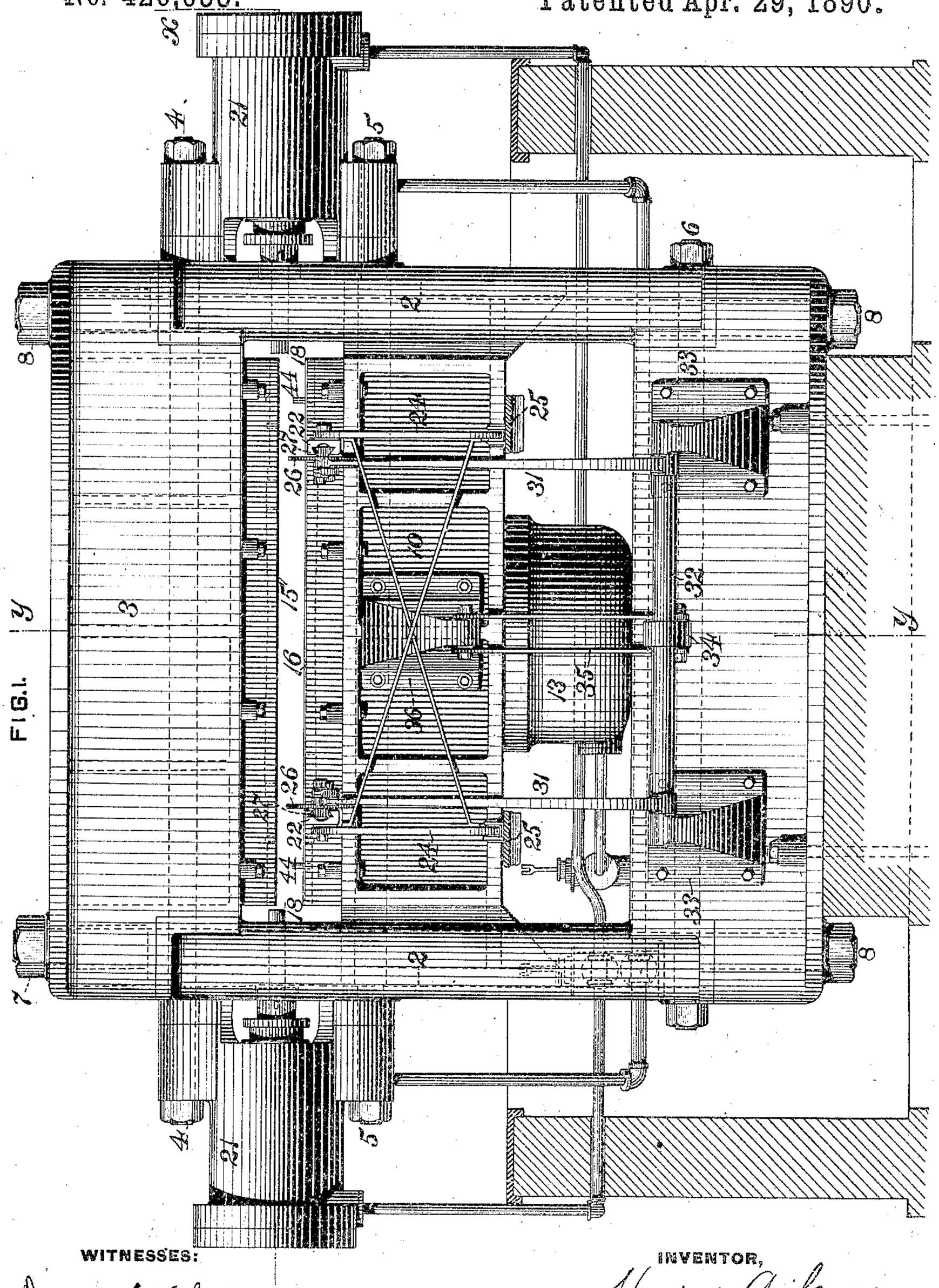
(No Model.) 7 Sheets—Sheet 1.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.



WITNESSES:

Daniel S. Wolcott Jr.

F. E. Gaither.

INVENTOR,

Henry Aiken

by George H. Christy

Att'y.

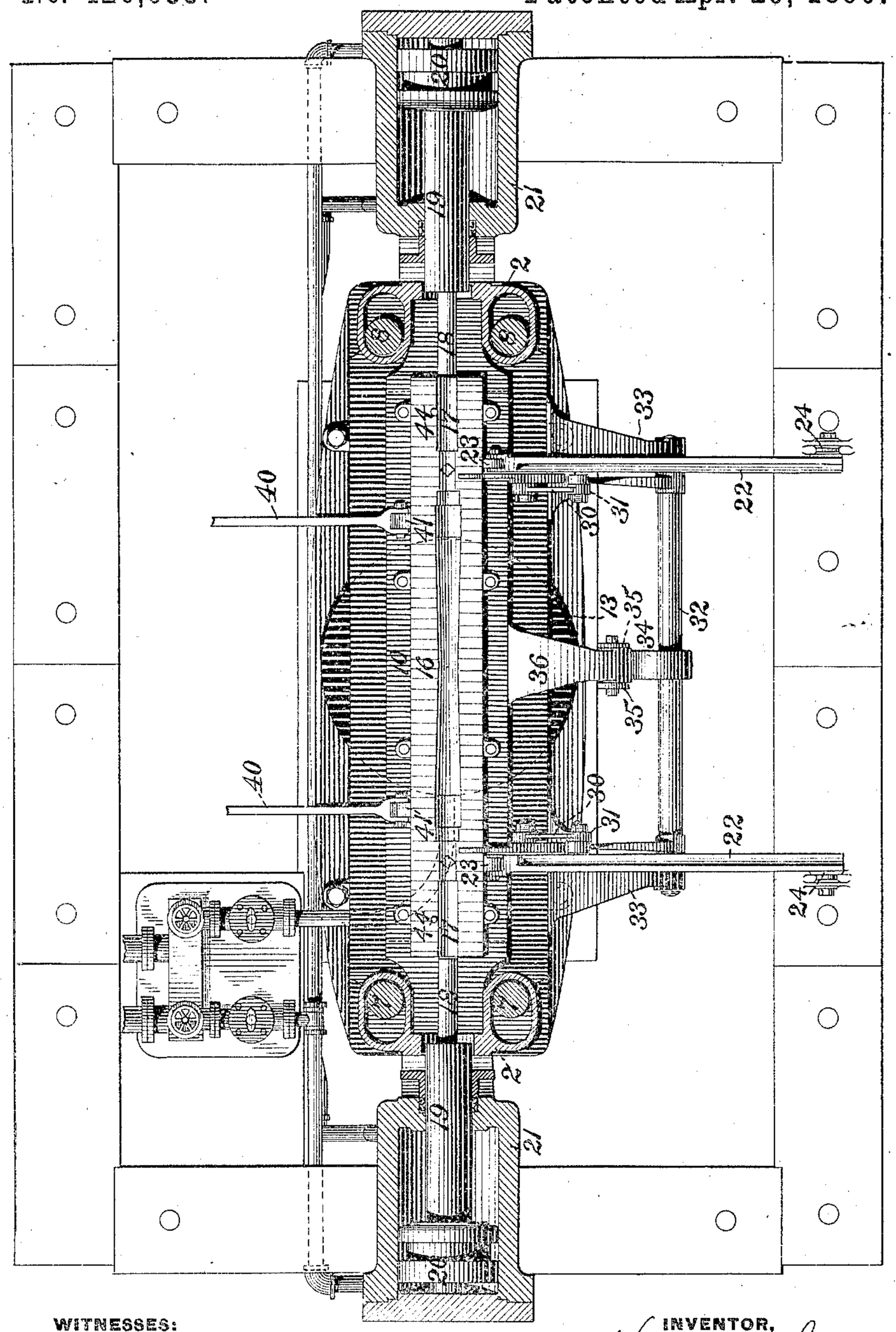
(No Model.) 7 Sheets—Sheet 2.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.

FIG. 2.



WITNESSES:

Dannie B. Wolcott

F. E. Gaither

INVENTOR,

Henry Aiken

by George W. Christy

Att'y.

(No Model.) 7 Sheets—Sheet 3.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.

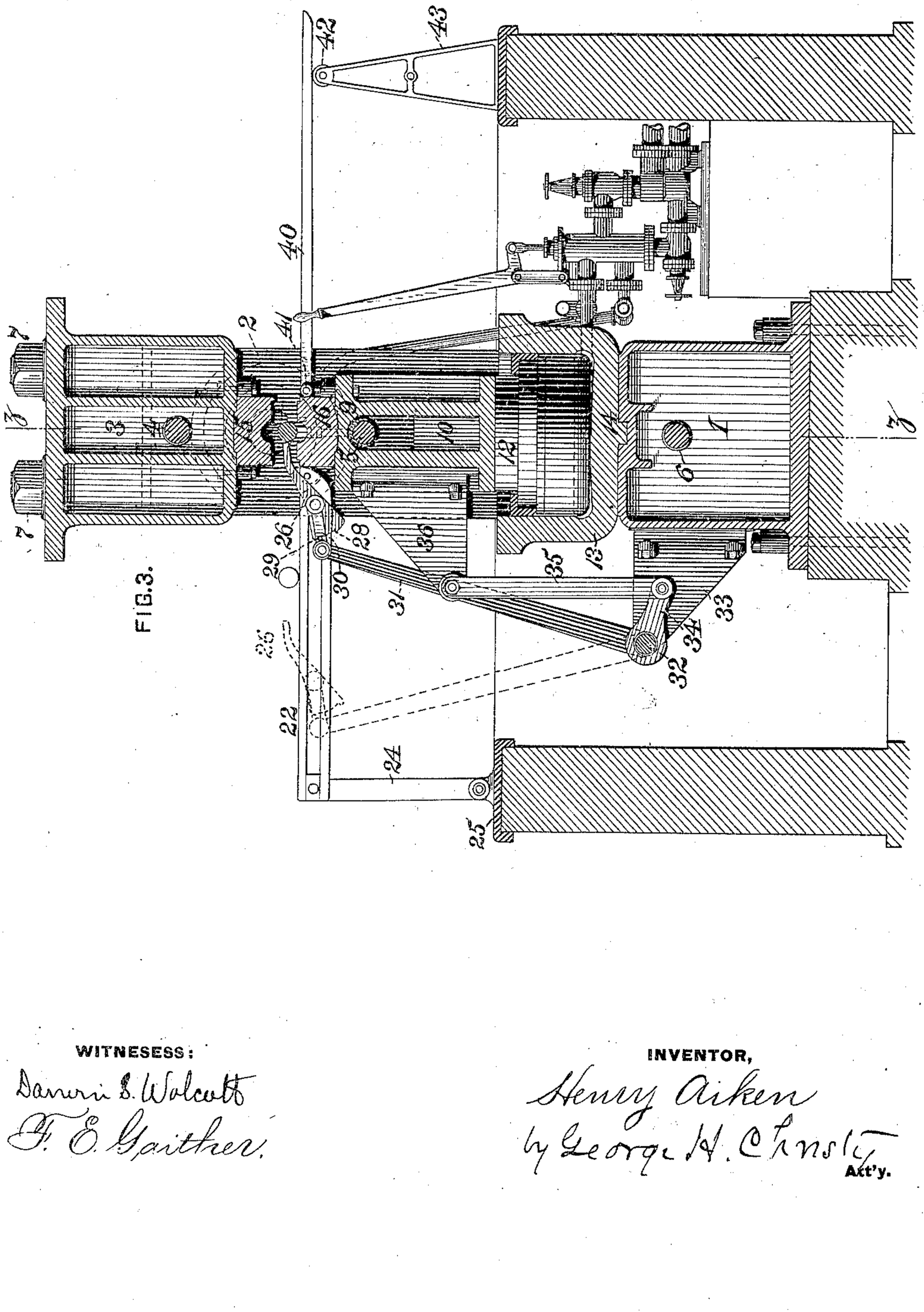


FIG.3.

WITNESSES:

Daniel S. Wolcott

F. E. Gaither.

INVENTOR,

Henry Aiken

by George H. Christy

Att'y.

(No Model.) 7 Sheets—Sheet 4.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.

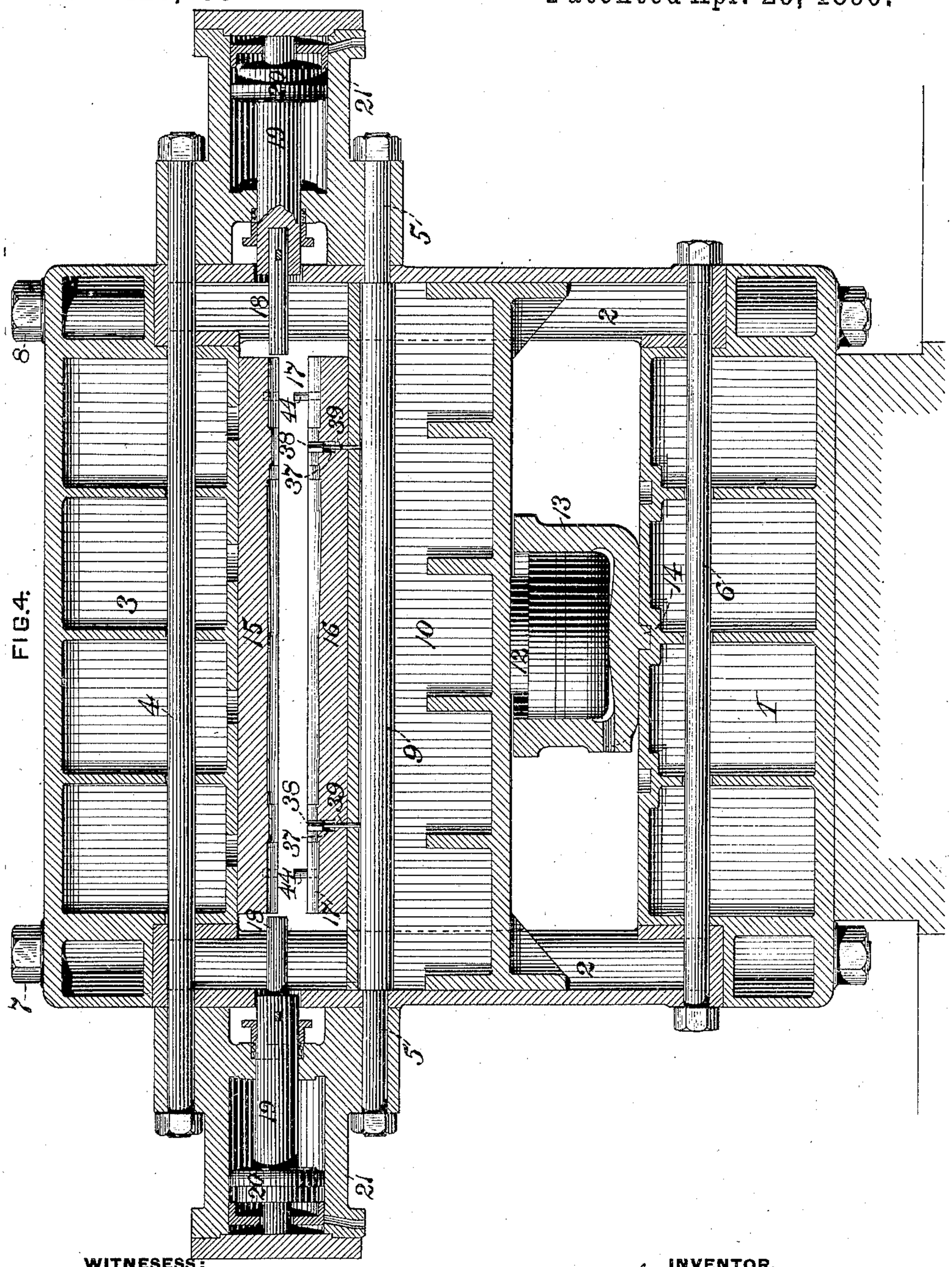


FIG. 4.

WITNESSES:

Danvin S. Wolcott

F. E. Gaither

INVENTOR,

Henry Aiken

by George H. Christy

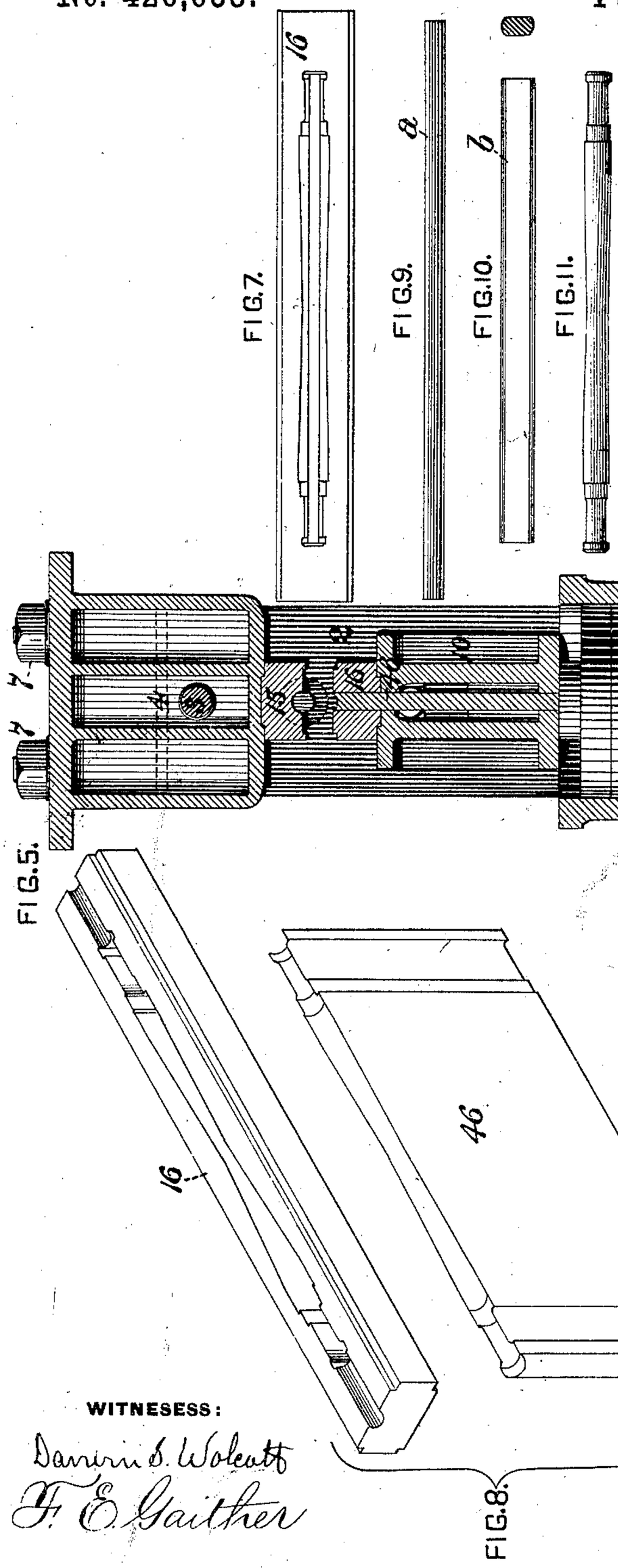
Att'y.

(No Model.) 7 Sheets—Sheet 5.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.



WITNESSES:

Damon S. Wolcott

F. E. Gaither

INVENTOR,

Henry Aiken

by George H. Christy

Att'y.

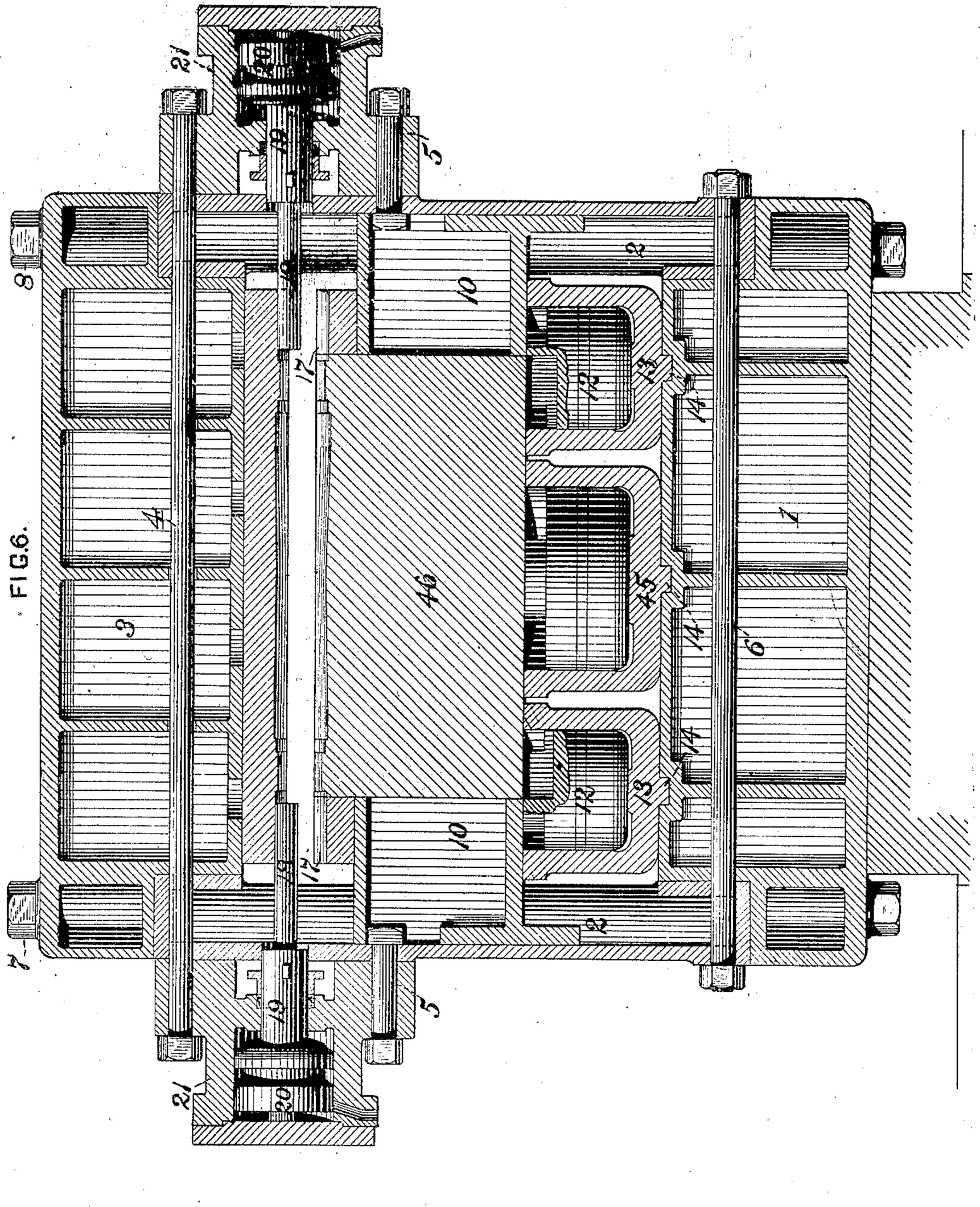
(No Model.) 7 Sheets—Sheet 6.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.

FIG.6.



WITNESSES:

Danvers S. Wolcott

F. E. Gaither

INVENTOR,

Henry Aiken

by George H. Christy

Atty.

(No Model.) 7 Sheets—Sheet 7.

H. AIKEN.

APPARATUS FOR THE MANUFACTURE OF AXLES.

No. 426,653. Patented Apr. 29, 1890.

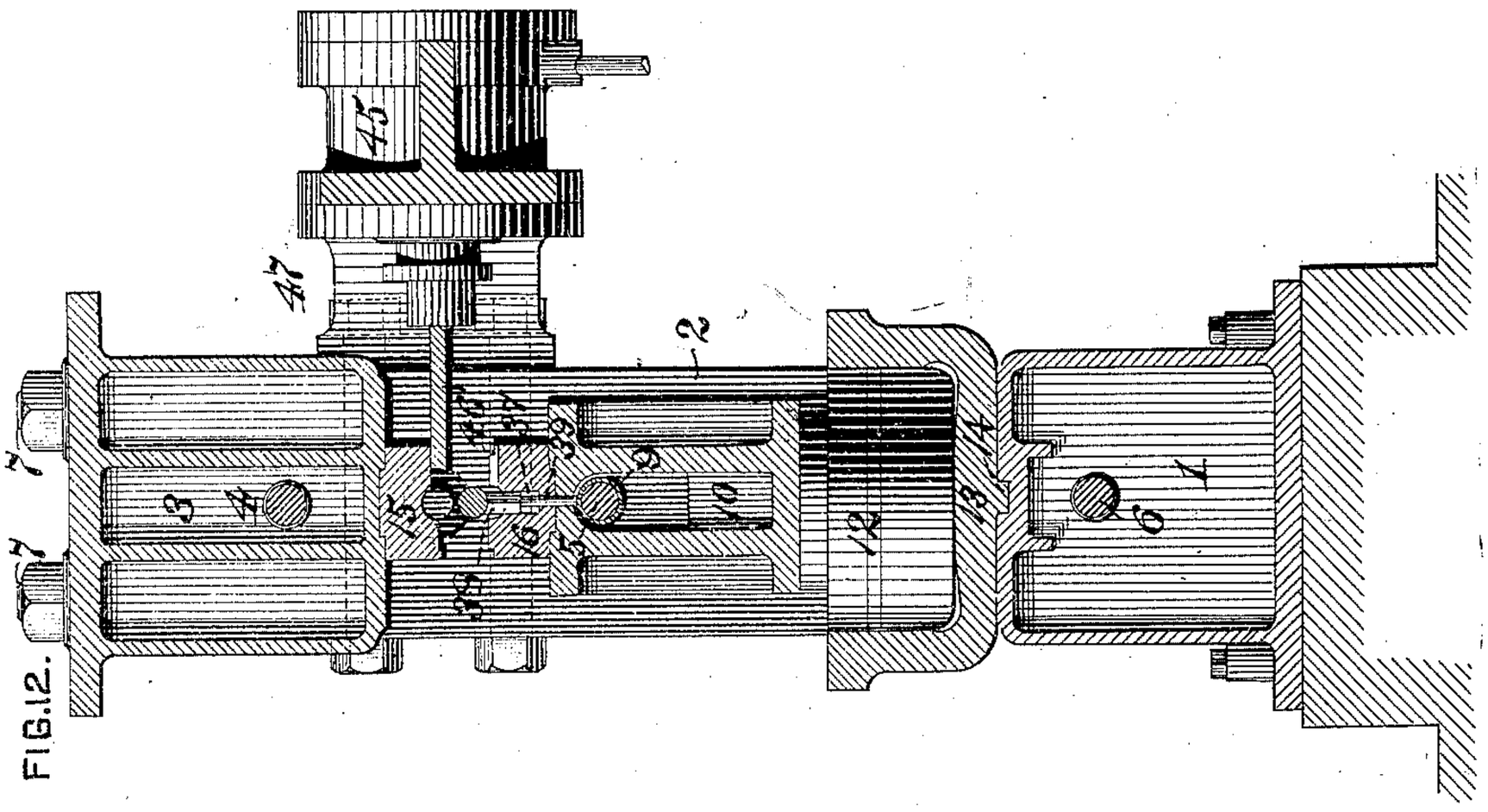


FIG. 12.

WITNESSES:

Dannii S. Wolcott
F. E. Gaither

INVENTOR,

Henry Aiken
by George N. Christy
Att'y.

UNITED STATES PATENT OFFICE.

HENRY AIKEN, OF PITTSBURG, PENNSYLVANIA.

APPARATUS FOR THE MANUFACTURE OF AXLES.

SPECIFICATION forming part of Letters Patent No. 426,653, dated April 29, 1890.

Application filed November 29, 1889. Serial No. 331,900. (No model.)

To all whom it may concern:

Be it known that I, HENRY AIKEN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Apparatus for the Manufacture of Axles, of which improvement the following is a specification.

The invention described herein relates to certain improvements in apparatus for manufacturing axles in the manner described in application, Serial No. 315,738, filed June 27, 1889, and also in an application of even date herewith. The methods described in said applications consist, generally stated, in inclosing a suitably-shaped blank or bar in dies having matrices formed therein, and then subjecting the blank to endwise or laterally-applied pressure, thereby causing the metal to conform to the matrices.

This invention has for its object a construction of apparatus whereby the above-mentioned methods may be quickly and easily carried out.

In general terms the invention consists in the construction and combination of mechanical devices or elements, all as more fully hereinafter described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a view in side elevation of my improved machine. Fig. 2 is a sectional plan view, the plane of section being indicated by the line *x x*, Fig. 1. Fig. 3 is a sectional elevation, the plane of section being indicated by the line *y y*, Figs. 1 and 2. Fig. 4 is a sectional elevation, the section being taken on the line *z z*, Fig. 3. Figs. 5 and 6 are views similar to Figs. 3 and 4 of modifications of the apparatus, the feed mechanism being omitted. Figs. 7 and 8 are plan views of lower dies used in the machine shown in Figs. 5 and 6. Figs. 9, 10, and 11 are detail views of the blanks and a finished axle, respectively; and Fig. 12 is a transverse section of a modified arrangement of the apparatus designed to form axles by lateral pressure.

The frame of the machine consists of a base 1, cheek-pieces 2, supported by the base, and a cap 3, resting upon the cheek-pieces, the said parts being firmly held together by the horizontal bolts 4, 5, and 6 and by the vertical bolts 7 and 8. The horizontal bolts 4 and 6 pass through the cap and base, respectively, as well as through the cheek-pieces; but the bolt 5 passes through the cheek-pieces only, and as said pieces serve as guides for the carrier-block 10 a section of pipe 9 is placed around the bolt 5 and bears at its ends against the cheek-pieces, so as to prevent the latter from being sprung inwardly when the nuts on the ends of the bolts 5 are tightened up. The same function can be effected by forming shoulders on the bolt 5.

Between the cheek-pieces is arranged a heavy casting, forming the carrier 10, guided at its ends by the cheek-pieces, as hereinbefore stated. This carrier is vertically slotted, as shown in Fig. 3, so as to permit of the passage of the bolt 5 without interference with its vertical movements, which are effected by the piston 12 of the fluid-pressure cylinder 13, arranged, as shown in Figs. 1, 3, and 4, upon the base 1, and held in position laterally by a stud 14, formed thereon and fitting in a socket in the base. The dies 15 and 16, having suitable matrices formed therein, are secured to the cap 3 and carrier 10, and in the adjacent faces of the dies, at the ends of the matrices, are cut grooves 17, which, when the dies are closed, form passages for the upsetting-plungers 18. These plungers are attached to the stems 19 of the pistons 20 of the fluid-pressure cylinders 21, which are preferably secured to the cheek-pieces 2 by the bolts 4 and 5, as shown in Fig. 4.

For convenience of operation the machine is so arranged in a pit, as shown in Figs. 1, 2, and 3, that the dies will be readily accessible from the floor-level, and when operating the blanks are placed upon rails 22, pivoted at their inner ends to ears 23 on one side of the lower movable die 16 and at their outer ends to posts 24, also pivoted to shoes 25, secured to the floor of the mill, as shown in Figs. 2 and 3. The posts 24 are made of such a height that when the die 16 is raised the rails 22 will be level or approximately level, so that any blanks placed upon the rails may not roll off, but will either roll or slide down toward the die 16 when it is lowered, or will remain in position until forced toward and into the die by the dogs 26. These dogs are pivoted to blocks 27, mounted in dovetailed grooves in the inner walls of the rails 22, as

shown in Fig. 1, and have their outer ends weighted, so as to hold their inner ends normally above the rails and to permit said inner ends to be depressed and pass under a blank during the outward movement of the sliding blocks.

In order to prevent too great movement of the dogs, lugs 28 are formed on their outer ends, so as to engage pins 29 on the sliding blocks. These blocks 27 are connected by links 30 to the upper ends of arms 31, which are attached to a rock-shaft 32, mounted in brackets 33, bolted to the base 1, as shown in Figs. 1 and 3. A crank 34, projecting from the shaft 32, is connected by a link 35 to a bracket 36, bolted to the carrier 10, so that when the carrier is raised the rock-shaft is so turned as to move the blocks and dogs outwardly, the latter passing under and behind the blank on the rails, and when the carrier is lowered, separating the dies, the dogs are moved inward, pushing a blank before them into the matrix of the lower die, thereby displacing a completed axle.

In the lower die are formed sockets 37 for the reception of the crutches 38, which fill the sockets and have a firm solid bearing in the bottoms thereof, and have their upper faces shaped to form a part of the matrix and register therewith during the blank-shaping operation. These crutches are provided with stems 39, extending down through the die and adapted to engage the bolt 5, or the pipe surrounding the same, when the carrier is lowered, thereby holding the crutches and the finished axle stationary while the die 16 continues its downward movement. The stems are so proportioned as to length that the axle will be held clear of its matrix when the die has reached the lower limit of its movement, and can therefore be readily pushed from between the dies onto the receiving-rails 40 by the incoming blank. The receiving-rails 40 are pivoted at their inner ends to ears 41, formed on the side of the lower die 16, and have their outer ends supported on a friction-roller 42, mounted in suitable bearings formed in the upper end of standards 43, secured to the floor-plate of the mill. These standards are made of such a height that the rails 40 will be level, or approximately so, when the die 16, carrying the inner ends of the rails, is at the lower limit of its movement, but will have a downward inclination toward their outer ends when the die is raised, so that the finished axle may be automatically discharged therefrom.

In order to prevent the blanks from being pushed beyond the matrices of the dies by the dogs 26, pins 44 are placed on the discharge side of the die 16, as shown in Figs. 2 and 3, and that the stop-pins may not interfere with the discharge of the finished axle they are located beyond the ends of the matrices, so as to engage the ends of the blank, which, as described in application, Serial No. 315,738, is longer than the axle to be formed, while permitting the finished axle to pass between them.

The machine thus far described is applicable to the practice of the method described and claimed in application Serial No. 315,738, hereinbefore referred to, wherein a blank of uniform cross-sectional size approximately equal to the smallest sectional size of the axle to be formed and of a length greater than that required in such axle is subjected to end compression or upsetting, thereby reducing the blank in length and enlarging its ends and intermediate portions.

In an application of even date herewith I have described and claimed another method of forming such axles, the same consisting in subjecting a blank *b*, Fig. 10, oblong or oval in cross-section, to lateral pressure while in a closed die, thereby causing the metal to flow longitudinally and laterally and fill the die-cavity.

For the manufacture of axles in accordance with this method slight changes are required in the machine hereinbefore described—as, for example, two cylinders 13 are employed for operating the carrier-block, said cylinders being arranged on the base 1, so as to engage the carrier-block at the ends thereof and afford room between them for a third fluid-pressure cylinder 45, which is employed for operating a vertically-moving plunger 46. This plunger, which is arranged in a vertical slot formed through the carrier-block 10 and through the lower die 16, is made of a width equal to the matrix in the die 16, and has its operative edge so constructed as to complete the shaping-face of the die 16, as shown in Figs. 6 and 8. The plunger 46 may be made of a thickness not greater than the smallest diameter of the matrix in the die 16, the slot having a corresponding width, in which case the plunger has a uniform width throughout and its side walls are made plain or straight, as shown in Figs. 5 and 6, or the plunger may be made to correspond in transverse dimensions to the diameters of the matrix in the die 16 or of the finished axle, the slots in the carrier and die having correspondingly-varying transverse dimensions, as shown in Fig. 8. The matrices of the dies 15 and 16 are closed at their ends when shaping the blank by lateral pressure either by the plungers 18, as shown in Fig. 6, or by solid walls, as shown in Fig. 7, so that the metal when subjected to lateral pressure by the plunger 46 may flow longitudinally against the end-closing abutments, whether formed by the plungers or solid walls, and then flow radially into and fill the collar-forming grooves adjacent to the abutments.

While the axles can be readily formed in dies having solid abutments, I prefer to employ movable abutments in the shape of the plungers 18, as by their use a compacting or condensation of the metal may be effected after the axle has been shaped by the plunger 46, and, further, in case the blank is a little

short of metal to completely fill the matrix, the plunger 18 can supplement the shaping operation of the plunger 46 and complete the axle. As these plungers 18 have only a finishing or supplemental action, their movements are very small; hence the cylinders 21 are made very much shorter than is required for the machine when shaping blanks by end pressure alone. The cylinders 13 and 45 are so constructed that a longer stroke or greater vertical movement is imparted to the carrier-block and die 16, thereby permitting of such downward movement of the die 16 along the plunger 46 that an axle will be stripped from the die-matrix and held on a level with the face of the die, or approximately so, from which position it can be readily removed by an incoming blank.

The blanks *b*, Fig. 10, which are oval or oblong in cross-section, are fed into position between the die by the feed mechanism hereinbefore described, the movements of the dogs 26 being so regulated that the forward edge of the blank will project over the matrix of the die 16 by an amount a little greater than half its longer diameter, as shown in Fig. 5, in order that such forward edge, which is supported when the blank is fed in by the projecting plunger 46, may drop down by reason of its overbalancing weight when the die 16 is raised toward the die 15. When the blank has been placed in the position described, the die 16 is raised up against the die 15, the plunger 46 remaining stationary. During this upward movement of the die 16 the rear edge of the blank is raised, its forward edge resting on the plunger, and enters the slot in the die with the plunger. As the die 16 continues its upward movement the blank will gradually turn until its longer diameter is vertical, the lower edge of the blank resting on the plunger in the slot in the die. After the dies have been closed the plunger 46 is forced up, subjecting the blank to lateral pressure throughout its entire length, causing the metal to flow longitudinally and laterally, filling the die-cavity. As soon as the plunger 46 has completed its movement the plungers 18 are forced inward, subjecting the axle to end compression, as hereinbefore stated.

In Fig. 12 is shown a form of apparatus wherein the slot through which the plunger 46 operates is formed by recesses cut in the adjacent or meeting faces of the dies 15 and 16, the plunger 46 and its operating-cylinder 45 being supported in a horizontal position by brackets 47, secured to the cap or top piece of the machine. In this construction of machine there will not be any rotation of the blank as the lower die is raised, and said die has sufficient movement to afford space when the die is at the lower limit of its movement to permit of the insertion of the blank or the removal of the finished axle under the plunger 46. As the plunger does not in this arrangement afford means for the removal of the axle, the crutches or strippers 38 are employed, as hereinbefore described.

It will be observed that the blank is entirely inclosed in the die-matrix and slot leading therefrom before any flow of the metal occurs, and also that the operative face of the plunger 46 is so constructed that its edges are merged into the walls of the die-matrix, and that therefore there will not be any liability of forming a fin or other projection on the axle. The meeting faces of the dies being held in close contact, no metal can be forced between them, and the plunger fitting snugly in the slot in the die 16, and the edges of its operative faces being made like a knife and merging its walls into the wall of the matrix, no projection or excrescence can be formed on the axle.

It will be observed that the plunger 46 operates as regards the lifting of the finished axle from the matrix of the die 16 exactly the same as the crutches 38, the movement of the plunger being arrested by its lower end coming in contact with the cylinders 13, while the carrier and die 16 continue their downward movement.

I claim herein as my invention—

1. In an apparatus for the manufacture of axles, the combination of a stationary die, a movable die, said dies having in their adjacent faces recesses suitably shaped for the formation of an axle, a fluid-pressure cylinder for operating the movable die, and plungers operative in opposite directions between the adjacent faces of said dies, substantially as set forth.

2. In an apparatus for the manufacture of axles, the combination of a stationary die, a movable die, said dies having in their adjacent faces recesses suitably shaped for the formation of an axle, a carrier block mounted in suitable guides and having the movable die secured thereto, a fluid-pressure cylinder for moving said carrier, and plungers operative in opposite directions between the adjacent faces of said dies, substantially as set forth.

3. In an apparatus for the manufacture of axles, the combination of a stationary die, a movable die, said dies having in their adjacent faces recesses suitably shaped for the formation of an axle and provided with a longitudinal slot, and a plunger operative through said slot for exerting a lateral pressure in a blank inclosed by said dies, substantially as set forth.

4. In an apparatus for the manufacture of axles, the combination of a stationary die, a die movable toward and from the stationary die, said dies having in their adjacent faces recesses suitably shaped for the formation of an axle, one of said dies having a longitudinal slot formed therethrough, and a plunger operative through said slot for exerting a lateral pressure on a blank held in the recesses in the dies, substantially as set forth.

5. In an apparatus for the manufacture of

axles, the combination of separable dies having in their adjacent faces recesses suitably shaped for the formation of an axle, one of said dies being longitudinally slotted, a plunger operative through said slot for exerting a lateral pressure on a blank inclosed in said dies, and plungers operative in opposite directions against the ends of the blank, substantially as set forth.

6. In an apparatus for the manufacture of axles, the combination of an upper stationary die, a movable die, said dies having suitable shaping recesses formed in their adjacent faces, rails having their inner ends arranged on a level with the face of the movable die when at the lower limit of its movement, and reciprocating dogs for moving a blank along said rails between the dies, substantially as set forth.

7. In an apparatus for the manufacture of axles, the combination of an upper stationary die, a lower movable die, said dies having their adjacent faces suitably recessed, rails having their inner ends on a level with the face of the movable die when at the lower limit of its movement, movable dogs mounted on said rails, and interposed mechanism whereby the die in its movements may reciprocate the dogs, substantially as set forth.

8. In an apparatus for the manufacture of axles, the combination of a stationary upper die, a movable lower die, crutches or strippers arranged in recesses or slots in the lower die and capable of vertical movement, and a stop for arresting the downward movement of the crutches before the lower die reaches the lower limit of its movement, substantially as set forth.

In testimony whereof I have hereunto set my hand.

HENRY AIKEN.

Witnesses:
DARWIN S. WOLCOTT,
R. H. WHITTLESEY.