No. 656,815. Patented Aug. 28, 1900.

S. FOREMAN.

HYDRAULIC RIVETING APPARATUS.

(Application filed Feb. 23, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 2.

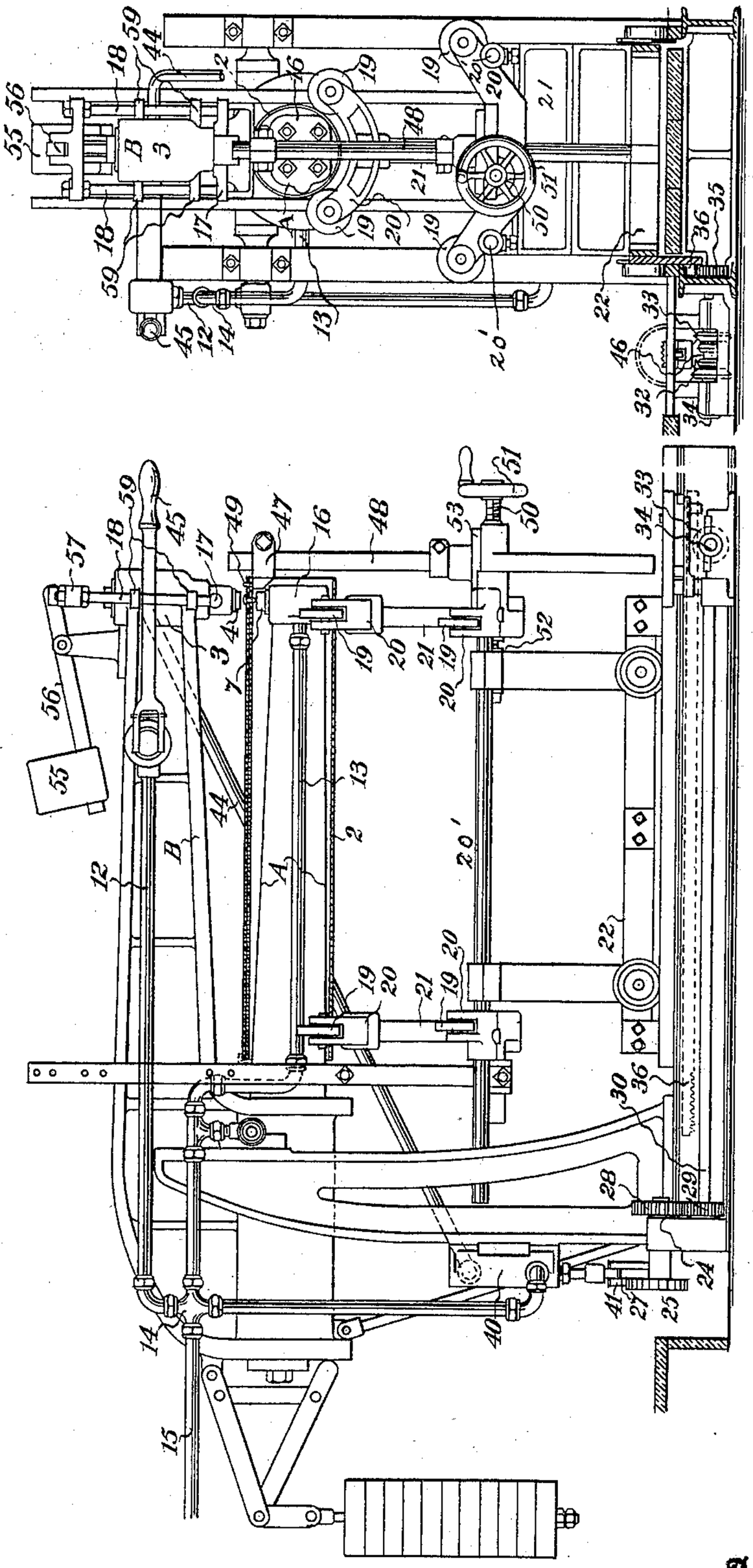


Fig. 1.

Witnesses,
F. L. Howe.
E. A. Brandau.

Inventor,
Stanton Foreman
By Dewey Strong & Co.
Attys

No. 656,815. Patented Aug. 28, 1900.

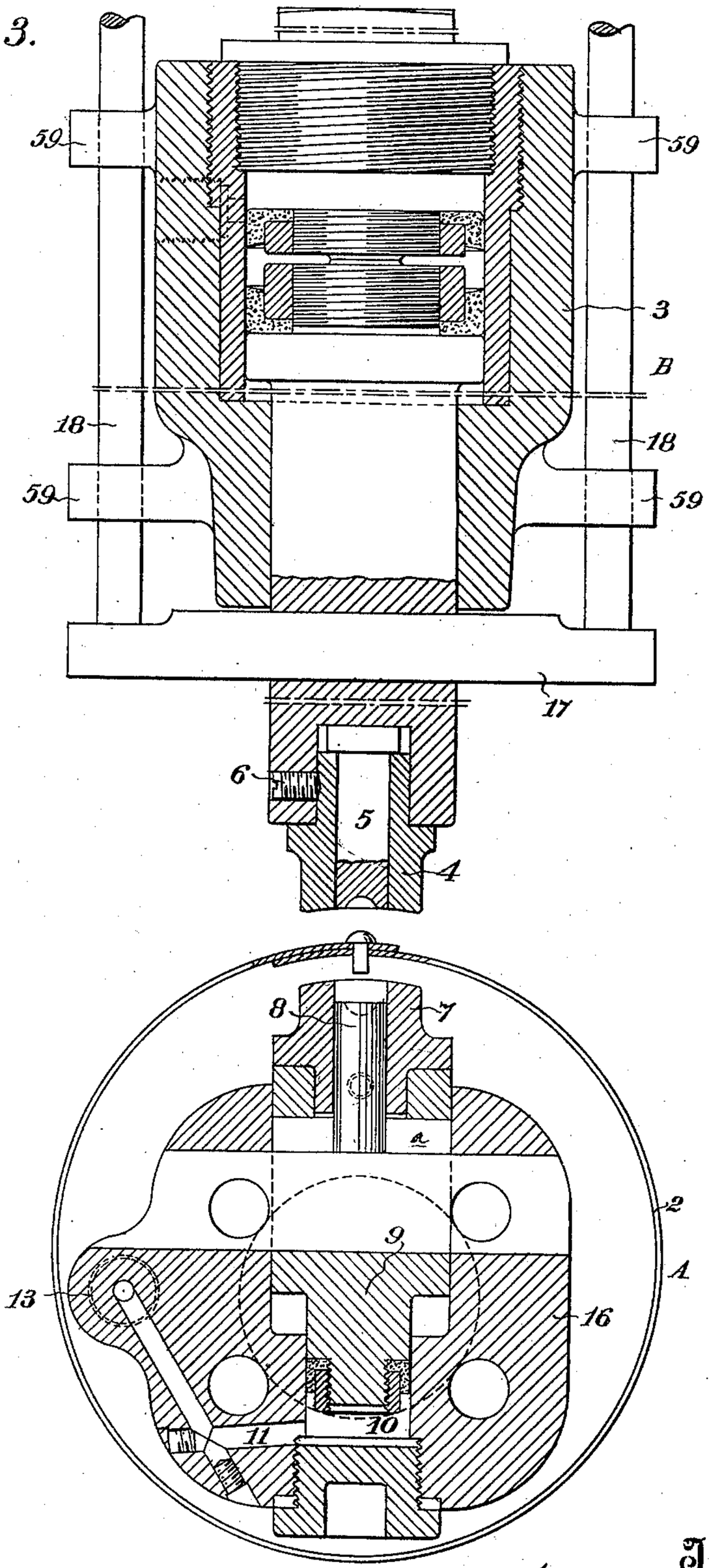
S. FOREMAN.

HYDRAULIC RIVETING APPARATUS.

(Application filed Feb. 23, 1900.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 3.



Witnesses,
J. L. Snee
E. A. Brandau,

Inventor,
Stanton Foreman
By Dewey Stong & Co.
Attys

No. 656,815. Patented Aug. 28, 1900.

S. FOREMAN.

HYDRAULIC RIVETING APPARATUS.

(Application filed Feb. 23, 1900.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 4.

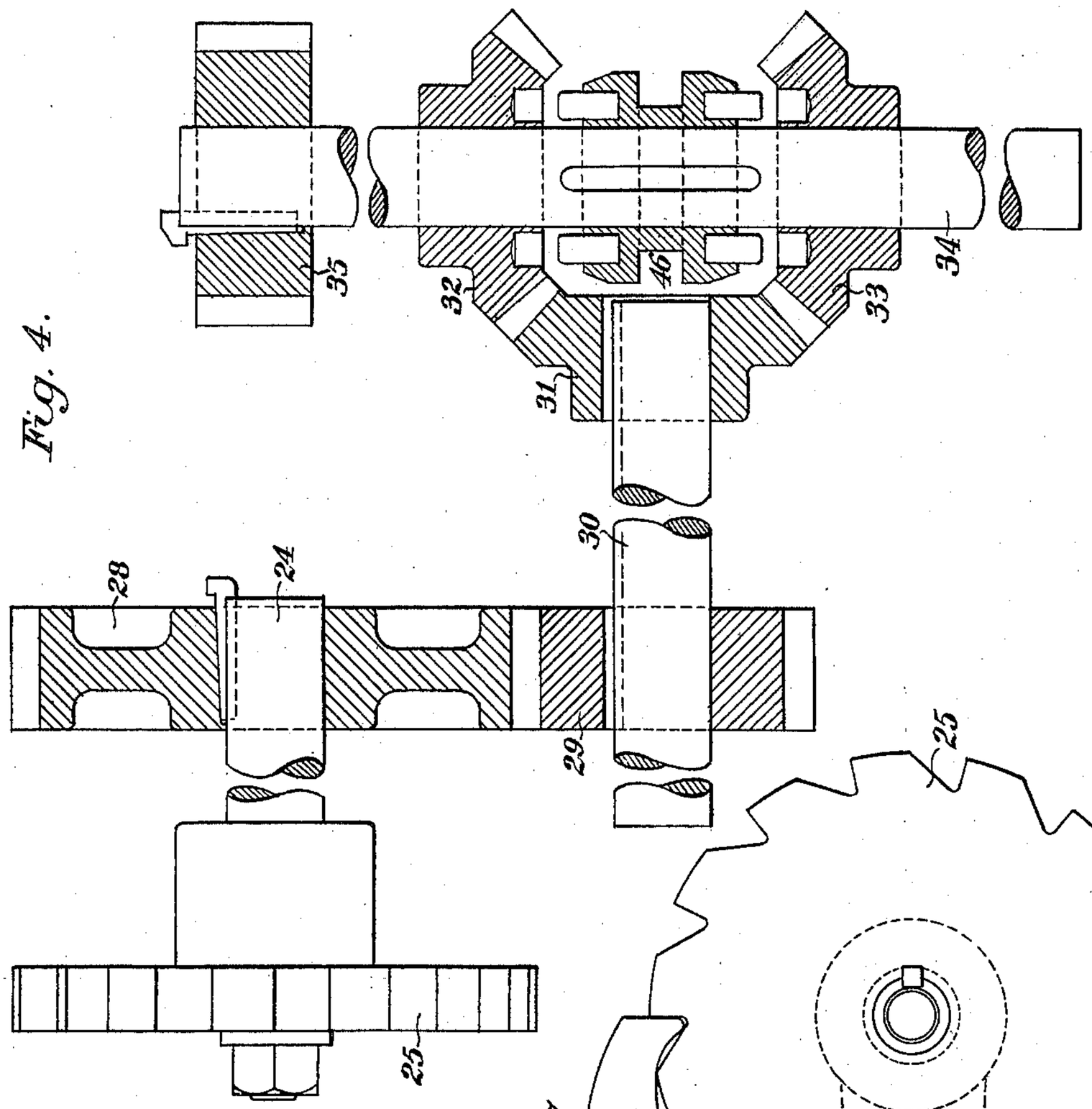
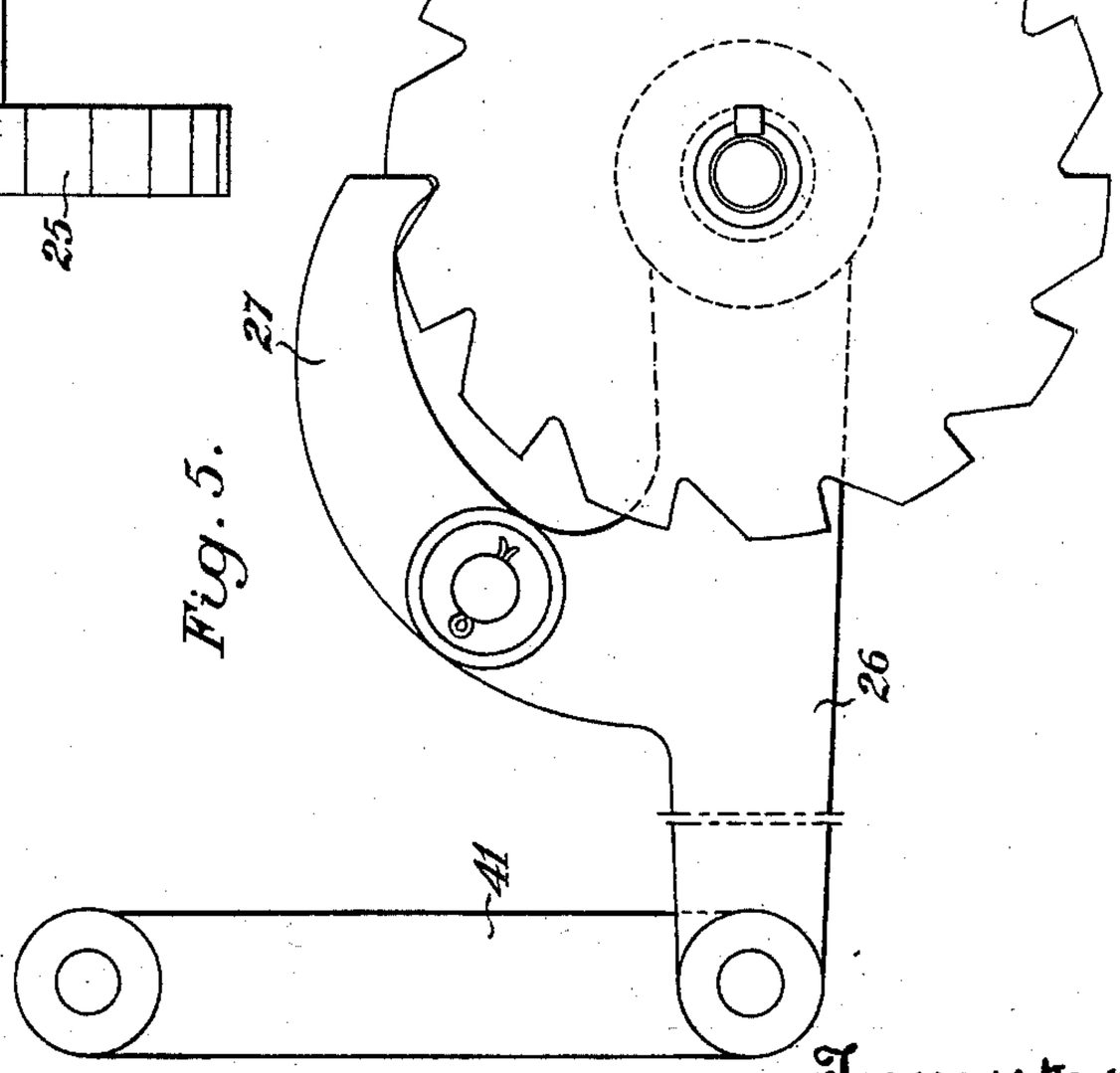


Fig. 5.



Witnesses,
C. L. Thorne
E. A. Brandau

Inventor,
Stanton Foreman
by Duvey Strong & Co.
Attys.

No. 656,815. Patented Aug. 28, 1900.

S. FOREMAN.

HYDRAULIC RIVETING APPARATUS.

(Application filed Feb. 23, 1900.)

(No Model.) 4 Sheets—Sheet 4.

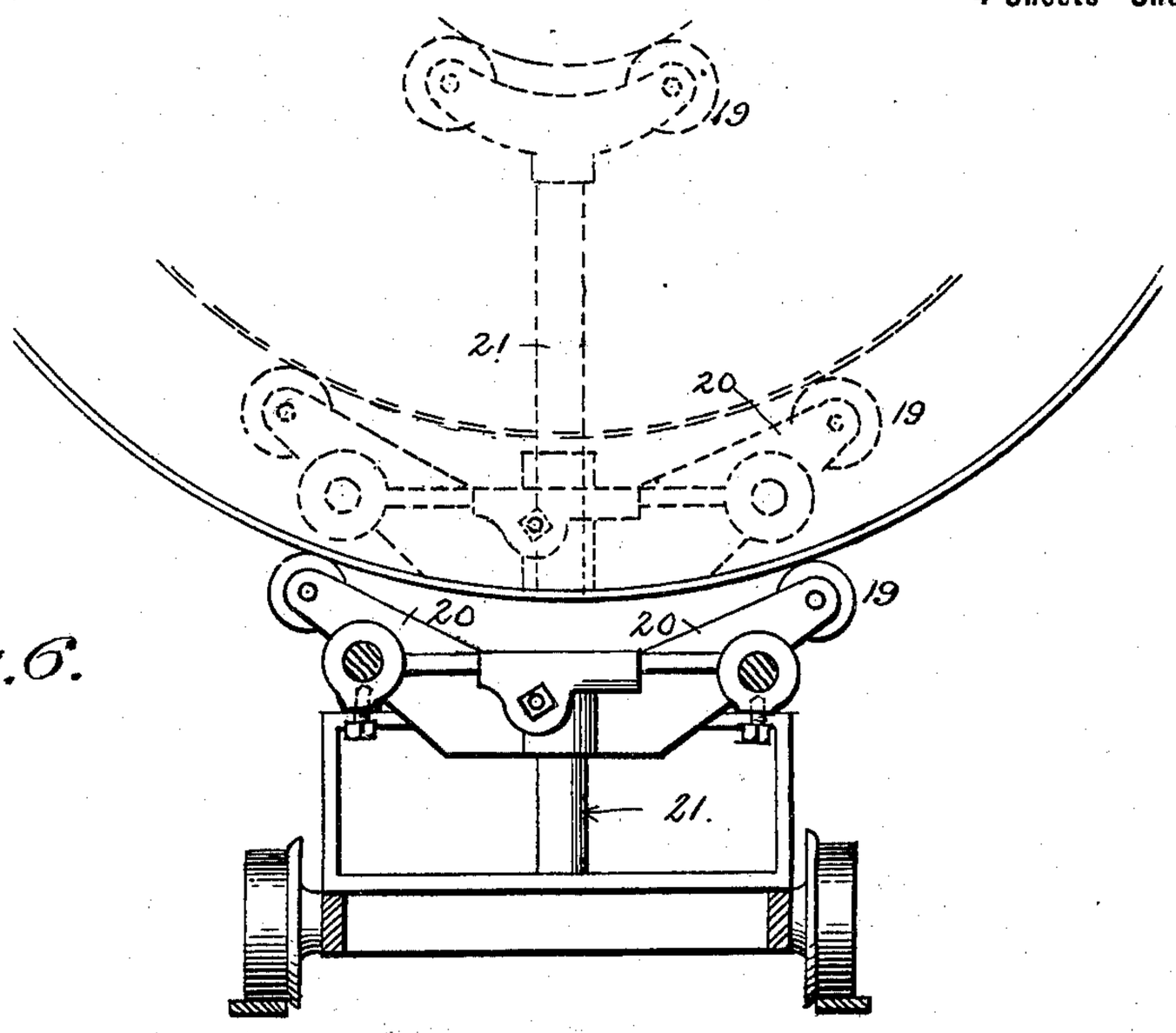


Fig. 6.

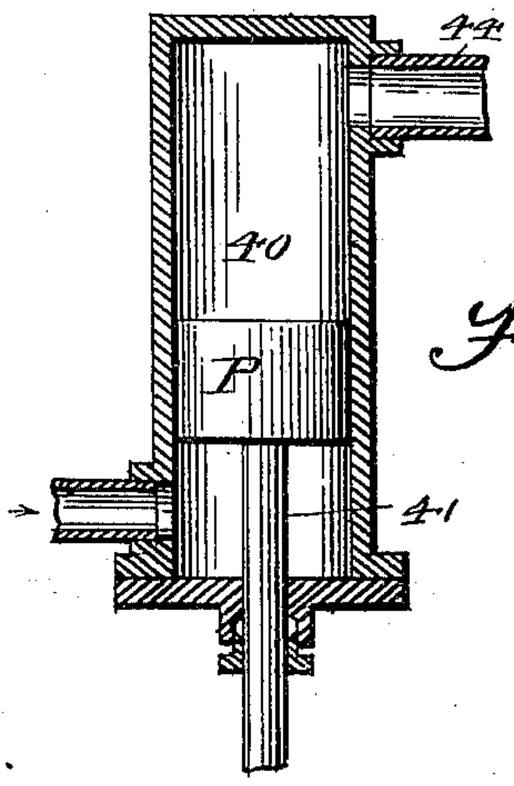


Fig. 7.

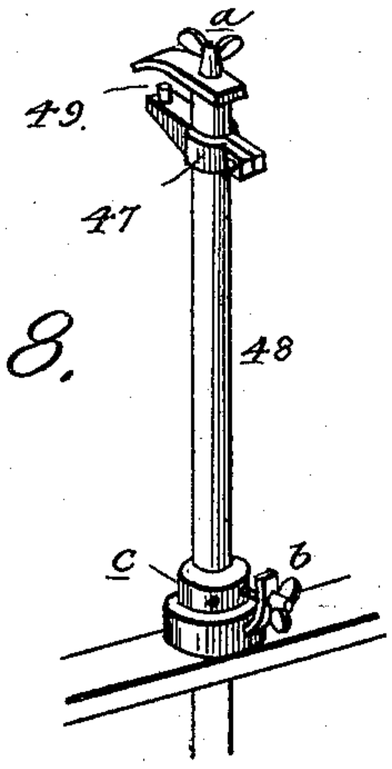


Fig. 8.

WITNESSES

Walter J. Buckhead.

J. Edw. Fowler

INVENTOR

Stanton Foreman,

by Dewey, Strong & Co

his Attorneys

UNITED STATES PATENT OFFICE.

STANTON FOREMAN, OF SACRAMENTO, CALIFORNIA, ASSIGNOR TO SCHAW, INGRAM, BATCHER & CO., OF SAME PLACE.

HYDRAULIC RIVETING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 656,815, dated August 28, 1900.

Application filed February 23, 1900. Serial No. 6,251. (No model.)

To all whom it may concern:

Be it known that I, STANTON FOREMAN, a citizen of the United States, residing at Sacramento, county of Sacramento, State of California, have invented an Improvement in Hydraulic Riveting Apparatus; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to an apparatus for riveting by hydraulic pressure. It is especially designed for riveting the longitudinal seams of "sections" or "joints," so called, from which lengths of pipe are afterward made up by riveting these sections together.

It consists in a mechanism by which the overlapping edges of the plates are pressed together just previous to the heading of the rivet, a mechanism by which the section is advanced a distance equal to that between the rivet-holes, means for automatically adjusting the same, and means for reversing the movements of the feed apparatus, so that one line of rivets is placed and headed through the length of the section and the apparatus then returns the pipe and the other line of rivets is fixed and headed. Means are provided for varying the feed and spacing to suit the distance between the rivet-holes of different classes of pipe and improved construction of the riveting-heads.

My invention also comprises details of construction which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal elevation of my apparatus. Fig. 2 is a front elevation of the same. Fig. 3 is an enlarged sectional view of the cylinder carrying the upper riveting-tool and through the mandrel carrying the lower riveting-tool. Fig. 4 is an enlarged sectional view of the shifting mechanism for pipe-carrying carriage. Fig. 5 is a front view of the pawl and ratchet. Fig. 6 is an enlarged detail showing the yokes 20 and adjunctive parts and showing the upper yokes in dotted lines. Fig. 7 is a sectional view of the cylinder 40. Fig. 8 is a perspective view of one of the clamps and its connections.

The apparatus consists of a yoke formed of a mandrel A and an upper section B, either one or both sections being strongly formed of forged or cast steel and bolted or otherwise united together at the rear to form a yoke, the front ends of which diverge from each other sufficiently to allow a pipe-section 2 to be introduced over the mandrel A. The length of the opening between the two is sufficient to receive any length of pipe-section which it is desired to rivet. Upon the outer end of the upper section B is the cylinder 3, within which is a reciprocating plunger, and connected with this plunger by a plunger rod or stem is a socket 4, within which is fitted the upper riveting-head 5, the lower end of which is concaved and adapted to fit over the usual form of semiglobular rivet-head. The lower face of the socket-piece 4 is slightly concaved transversely, the concavity corresponding with the convexity of the pipe to be riveted, and these socket-pieces may be changed by removing a set-screw 6, so as to use a socket having a curvature corresponding with any size and curvature of pipe. The lower socket-piece or sleeve 7 is made convex on the upper surface, and this is also interchangeable, these pieces corresponding in their convexity with that of the pipe to be riveted and the socket-piece 4 above. Both upper and lower socket-pieces are prevented from turning by suitable guides. Through the socket-piece or sleeve 7 extends the riveting-head 8, having the top recessed, so that when the rivet is forced through the overlapping edges of the pipe 2 the lower end will be upset in this socket, and thus form a head on this end. In order to properly close the plates of which the pipe is composed, so as to prevent the rivet from being expanded between these plates and thus making a leaky joint, the sleeve 7 is forced upward by a plunger 9, movable in a cylinder 10 and receiving fluid under pressure through a passage, as shown at 11. This passage and also the ram-cylinder above are both connected by pipes 12 and 13 with a T 14 at the rear end of the yoke, and this T is connected through a pipe 15 with an accumulator or source of supply, from which the fluid is brought under pressure to operate the mechanism. The pressure passing through the pipe 13 to the cylinder 10 acts upon the plunger 9 and forces the sleeve 7 up above the

riveting-head 8. This riveter 8 is carried upon a head 16, which is fixed to or formed upon the outer end of the mandrel, and the plunger 9 is movable with relation to these fixed parts. When a rivet has been inserted into the holes already made in the pipe, water is admitted to the ram-cylinder above by means of any suitable valve operated by a hand-lever within reach of the operator. This forces the head 4 and the riveter 5 down upon the overlapping edges of the pipe-section, the rivet being already in place through the rivet-holes. The pressure thus produced is counteracted by the yielding pressure of the sleeve 7; but this pressure is only sufficient to insure the absolute closing of the plates together before the lower end of the rivet comes in contact with the interior rivet-header 8. As the parts are thus moved with relation to each other the yielding of the sleeve 7 by reason of the superior pressure upon the opposite side of the yoke allows the lower end of the rivet to be upset in the cup of the header 8 and the parts firmly secured together.

I have here shown a single cylinder 10 with a single plunger, and to prevent the parts from turning, as is the tendency in such operations, I have shown the upper part of the plunger as transversely slotted, and a bar extending through this slot keeps these parts in proper line as they move, thus maintaining the convex top of the sleeve or socket-piece 7 always in the line of curvature of the pipe. The plunger of the ram and the socket-piece 4 carried by it are correspondingly kept in line by a transverse bar 17, extending through and connected with vertically-slidable rods 18, which are movable in guides upon the side of the ram-cylinder or otherwise suitably located to keep the parts in proper line. This insures the curvature of the socket-piece 4 always coinciding with that of the part 7 and also with the curvature of the pipe.

The pipe-sections when in place are supported upon rollers 19, mounted in curved yokes 20, and these yokes are slidable upon shafts 20′ and are carried upon upright standards 21, as plainly shown in Figs. 1, 2, and 6. These standards extend upward from wheel-carriages 22, which are movable upon guiding tracks or supports, so that when the carriage is drawn out from the riveting-machine the pipe-section can be laid upon its proper supports 19 and the parts run in until the pipe fits over the mandrel in proper position for the riveting to commence. The uppermost yokes 19 are intended to support pipes, say, from eight to eighteen inches in diameter, and said yokes and their standards are adjustable upon the carriage and may be removed when larger pipes—say, from twenty to thirty inches—are to be riveted. The yokes, with their supporting-rollers 19, are so made that they are interchangeable, so that one set of yokes will be sufficient to support pipes from the smallest diameter upward to a certain larger diameter. Then the next yokes will support the next size of pipe, and so on until the largest size is supported upon the yokes having the widest arc and spread. Thus pipes from eight inches to forty-two or more inches in diameter can be readily riveted upon the same apparatus.

Previous to placing the pipe upon the mandrel the holes for riveting the longitudinal seam are punched, these holes being made at a greater or less distance apart, depending on the thickness of metal, size of pipe, and character of work, or the pressure to be sustained thereby. There are usually two parallel rows of rivet-holes, the holes in one row standing intermediate on a transverse line with the other row of holes. In this apparatus the pipe having been placed the first or outside hole of one line is presented and the rivet set. The apparatus is then advanced to bring the next hole in line, and so on until a single line of rivets have been set and headed. Then the pipe is slightly turned, bringing the first hole at the inner end in line with the riveter, and the movement of the pipe is reversed, so that the riveting through the other line of holes is completed, when the pipe is then returned to its first position in readiness to be removed.

The operation of advancing the pipe a distance equal to the space between the rivet-holes is produced as follows: Upon one end of a journal-shaft 24 at the lower rear part of the apparatus is fixed a toothed ratchet 25. The number of teeth in this ratchet correspond with the distance to which the pipe is to be moved for the setting of each rivet, and by connection with a moving part of the machine the ratchet is advanced after each rivet has been set.

The particular means here shown for turning the ratchet is as follows: 27 is a pawl, one end of which is adapted to engage the teeth of the ratchet 25, and the other end of this pawl is fulcrumed to a lever 26, this lever being fulcrumed and turnable about a common center with the ratchet-wheel 25, and it lies in such position that the pawl 27 will drop by gravitation to engage the teeth of the ratchet when the lever is moved in one direction and when moved in the other direction the pawl will act to advance the ratchet. This movement of the pawl-carrying lever 26 is effected by means of a ram or pressure-cylinder 40, (see Fig. 7,) having a plunger P, movable therein, and a rod 41, extending from the lower part of the plunger through the lower end of the cylinder and suitably connected with the lever-arm 26. Water is supplied to the lower end of this cylinder from the T or coupling 14, so that pressure upon the lower part of the plunger is received direct from the accumulator. 44 is a pipe connecting the upper part of this cylinder with the valve mechanism which admits water to the ram or cylinder, through which the upper rivet-

ing-tool is actuated, this mechanism being operated by a hand-lever 45. When the valve is opened to admit water to the ram which operates the heading-tool, there will be an equal pressure admitted through the pipe 44 to the cylinder 40, and as the area of the upper side of the piston exceeds that of the lower side by the area of the piston or plunger rod the superior pressure from above will overcome that from below derived from the same source and will thus press the plunger down and through it will move the arm 26 and the pawl 27. When the ram admission-valve is moved to allow the liquid to exhaust from above its piston, the pressure will be simultaneously relieved in the pipe 44 and the upper part of the cylinder 40, while the pressure still remaining in the lower part of 40 will act to force the plunger up, and through its connections with the pawl-carrying lever 26 the latter will be also moved and the pawl engaging the ratchet-teeth will advance the ratchet the required distance. This rotates the shaft 24, which in the present case is shown carrying a gear-wheel 28. This gear engages a pinion 29 upon the shaft 30. By varying the proportions of this gear and pinion the movement of the shaft 30 may be varied to suit requirements. The shaft 30 carries upon its outer end a pinion 31, and this pinion engages pinions 32 and 33, which turn loosely upon a shaft 34 at opposite sides of the pinion 31, so that when the shaft 30 is turned the movement of the pinion 31 will turn the pinion 32 in one direction and pinion 33 in another. When either of these pinions is locked to the shaft 34, that shaft will be correspondingly turned, and through it motion is transmitted to move a rack-bar 36, which is fixed upon the side of the pipe-carrying carriage. This is effected by means of a pinion 35, fixed upon the shaft 34 and engaging the rack-bar.

In order to reverse the movement of the carriage through the opposite movements of pinions 32 or 33, a clutch 46 is slidable upon a feather on the shaft 34 and intermediate between the pinions 32 and 33. This clutch is movable by any usual or suitable clutch-lever or special device, if preferred, so as to stand intermediate between and disengaged from both pinions 32 and 33, in which case the revolution of the shaft 30 and pinion 31 simply revolve these pinions without affecting the shaft 34. By moving the clutch so as to engage one of the pinions, as 32, motion in one direction will be transmitted to the shaft 34 and through the pinion 35 will advance the rack-bar and pipe-carriage correspondingly. By engaging the clutch with the other pinion a reverse operation will take place. Thus the carriage and pipe will be advanced after the setting of each rivet a distance approximately equal to the distance between the rivet-holes until one of the two lines of rivets have been set, the carriage having been meantime advanced intermittently until the full length of the pipe has been brought beneath the riveting-tool. The pipe is then turned so as to bring the other line of rivet-holes in line with the riveting-tools, and by reversing the movement of the carriage the pipe will be in the same manner advanced until the second line of rivets has been set.

Various devices may be employed to secure the pipe upon its supports when in position with the rivet-holes in proper line. In Fig. 8 I illustrate a means adapted for securing the pipe upon its supports when in position with the rivet-holes in proper line. In said figure, 48 is an upright standard upon which the clamp is carried. A wing-nut *a* serves to hold the jaws of the clamp together and a pin 49 enters one of the rows of holes in the pipe. The adjustment may be made by means of a fixed collar *c* at the lower part of the standard 48, which collar has holes in it. A wing-nut or screw *b* is supported by an arm, so that its point may enter one of the holes in the collar *c* to hold the standard 48 and the clamp in position for the pin 49 to enter one of the parallel rows of holes of the overlapping edges of the pipe to be riveted. By loosening the screw *b* the standard 48 and the clamp may be turned sufficiently sidewise to engage the next hole in the collar *c*, and this will bring the second row of holes in the pipe into position for riveting. If desired, I may use for the above purpose a mechanism including an independent screw 50 and a hand-wheel 51, by which it is turnable. This screw turns through a suitable standard or nut 52 on the carriage and acts to advance an independent slidable block or carriage 53, movable on the main carriage, and by this the pipe can be brought to accurate adjustment.

The setting of each rivet will be effected by the fluid-pressure operating upon the plunger within the ram-cylinder 3, and the return of the plunger and the riveting-tool actuated thereby is here shown as being effected by a counterweight 55, attached to a fulcrumed lever 56, said lever having its opposite end connected with a yoke 57, having rods 18, slidable in guides 59. The lower ends of these rods are connected by the bar 17 or equivalent connection with the lower end of the plunger, this bar or connection serving, as previously described, to insure a vertical reciprocation of the parts without allowing them to turn. In this manner the pipe is automatically advanced with the setting of each rivet, as before described, and accurately placed for the next one.

The formation of the sockets or sleeves 4 and 7 with corresponding concave and convex faces insures their fitting perfectly to the curvature of the pipe, and thus closing the plates together in a true curve without danger of irregularity or indentation, and if the plate should happen to be slightly irregular these devices will correct such irregu-

larity. As these sockets and pressure-plates are of sufficient size to cover a considerable area, they might project beyond the adjacent line of rivets when working upon the second line. I therefore cut away the angles, which would otherwise fall in line with the rivets already set, and thus allow these parts to be pressed against the pipe without contacting with the rivets.

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

1. In a hydraulic riveting-machine, the combination of a mandrel and an upper section united at the rear said mandrel adapted to receive pipe-sections, a fluid-pressure ram carried by the upper part of the yoke, a plate-closing pressure device carried by the mandrel and rivet-heading tools acting in unison therewith for first closing the plates together and afterward heading the rivet therethrough, passages through which fluid is supplied to the ram and pressure devices from a common source, a feed-carriage and a pawl-and-ratchet mechanism actuated by the movement of the riveting mechanism for operating the carriage.

2. In a hydraulic riveting-machine, the combination with means for supporting the pipe-sections, means for riveting said sections, fluid-pressure connections for operating the riveting mechanism, a feed-carriage, and a pawl-and-ratchet mechanism actuated by the fluid-pressure connections for operating the carriage step by step.

3. In a hydraulic riveting apparatus, the upper section and pipe-carrying mandrel, a fluid-pressure ram carried upon one section, a plate-closing device carried upon the other section and having pressure applied thereto in opposition to that of the ram, means through which fluid is supplied to the ram and opposing plungers from a common source, a socket-piece carried by the ram-plunger and carrying the upper riveter, said socket-piece having its face transversely concaved and having a radius corresponding to that of the pipe, an inner socket-piece or sleeve through which the inner riveter is movable, said socket-piece having its face correspondingly convex transversely whereby the pipe is compressed between said two faces previous to the rivet being headed, a feed-carriage for advancing the pipe and a pawl-and-ratchet-mechanism connection with the carriage and actuated by the fluid-pressure devices, for operating said carriage.

4. In a hydraulic riveting-machine, a mandrel and upper section united at their rear, a fluid-pressure ram carried by one part, a yielding pressure device carried by the other and operating in opposition to the pressure of the ram and in a less degree whereby the plates are closed together before the rivet is headed, passages through which fluid is supplied to the ram and opposing plungers from a common source, concave and convex socket-pieces carried respectively by the ram and the interior plate-closer, guides whereby the parts are retained in their line of reciprocation when in operation, a feed-carriage for advancing the pipe and a pawl-and-ratchet mechanism connected with the carriage and with the fluid-pressure devices for operating the carriage step by step.

5. In a hydraulic riveting apparatus, a mandrel over which the pipe-sections are fitted, an upper part forming a yoke therewith, one part carrying a fluid-pressure ram with socket-piece and riveting-head, the other part carrying a yielding plate-closer and a correspondingly-curved socket-piece with the other riveting-head, supports for pipe consisting of adjustable yokes, a longitudinally-movable carriage upon which said yokes are supported so that a pipe can be moved along the mandrel during the process of riveting, and a pawl-and-ratchet mechanism connected with the carriage and with the fluid-pressure devices for operating the carriage.

6. A hydraulic riveting-machine consisting of a mandrel and upper section, a fluid-pressure ram and a yielding plate-closing device with rivet-forming heads carried respectively by the ram and mandrel, and a pawl-and-ratchet mechanism connected therewith and with the fluid-pressure devices whereby the pipe is automatically advanced a distance equal to that between the rivet-holes after the setting of each rivet.

7. In a hydraulic pipe-riveting machine, a mandrel, a carriage upon which the pipe is supported and movable with relation to the mandrel, a fluid-pressure ram and heads whereby the rivets are set, a ratchet-wheel mounted upon a shaft, a pawl actuated by the movements of the riveting mechanism to rotate said shaft, gears connected with the shaft and a rack and pinion through which motion is transmitted to advance the pipe-supporting carriage the required distance at each movement.

8. The combination with a hydraulic riveting-machine of a pawl-and-ratchet mechanism, rack-pinion and intermediate gearing whereby the pipe-supporting carriage is advanced a distance equal to that between the rivet-holes after the setting of each rivet, and mechanism by which the movement of the carriage is reversed after one line of rivets has been set and the pipe returned beneath the riveter to set the second line of rivets.

9. In a hydraulic riveting-machine, a supporting-standard including an upper section, a mandrel carried thereby, a fluid-pressure ram fixed to the outer end of the section, a socket-piece and riveting-tool carried thereby, an opposing plate-closer and riveting-tool against which the rivet is set, and a counterweighted lever and connections between it and the plunger of the ram whereby the latter is raised when the fluid-pressure above its plunger is relieved.

10. In a hydraulic riveting-machine, a

standard including an upper section, a mandrel, a fluid-pressure cylinder at the outer end of the section, a plunger movable therein, a socket-piece and riveting-tool having the lower ends concaved coincident with the curvature of the pipe, a pipe and valve connections through which fluid-pressure is admitted above the plunger of the ram to force the riveting-tool downward, a counterweighted lever by which the plunger is returned, and a transverse bar or rod connecting the plunger-rod and socket-piece with guided slidable rods whereby the parts are prevented from turning in their reciprocations.

11. In a hydraulic riveting-machine, a fluid-pressure cylinder with a plunger movable therein, a socket-piece and riveting-tool carried by the plunger-rod having the lower face curved to coincide with the curvature of the pipe, means for supplying fluid-pressure above the plunger to depress it and the riveting-tool, a counterweighted lever fulcrumed with relation to the cylinder, rods slidable through guides upon each side of the cylinder having a yoke connection with the weighted lever and a transverse connection between the lower ends of said rods and the plunger-rod or socket-piece whereby the latter is prevented from turning during its reciprocations.

12. In a hydraulic riveting-machine, the standard including the upper section, the mandrel, a fluid-pressure cylinder fixed to the outer end of the section having the plunger and plunger-rod, a socket-piece and riveting-tool carried thereby and shaped to fit the exterior of the pipe with guides to prevent their turning, a yielding plate-closer and a riveting-tool carried by the outer end of the mandrel, curved to fit the interior of the pipe, a plunger and means for applying fluid-pressure in unison with the pressure upon the upper riveting-tool whereby the plate-closing socket-piece is forced upward to close the plates between itself and the upper socket-piece, said inner socket-piece yielding to the superior pressure from above to allow the closed plates to descend and the rivet to be headed, and a guide-bar extending transversely through a slot in the movable plunger whereby the parts are prevented from turning.

13. In a hydraulic riveting-machine, a supporting-standard including an upper section, a mandrel, a fluid-pressure cylinder with piston or plunger movable therein, a socket-piece and riveting-tool carried by the plunger-rod, a second riveting-tool mounted upon the outer end of the mandrel and a yielding fluid-pressure plunger and plate-closing socket-piece carried thereby, a carriage upon which the pipe is supported, and means for moving it in the line of the rivet-holes consisting of a rack fixed to the carriage, gear and reversible mechanism by which it may be moved in either direction, a ratchet fixed upon the shaft through which motion is transmitted to the gear and rack, a pawl engaging the teeth of the ratchet, a fluid-pressure cylinder having a plunger and connections with the source of pressure-supply whereby pressure is alternately applied to the upper and lower surfaces of the plunger and connections between the plunger-rod and the pawl-carrying mechanism whereby the latter is reciprocated to turn the ratchet.

14. In a hydraulic riveting-machine, mechanism adapted to set the rivets along the line of holes in the overlapping plates of a pipe, a carriage upon which the pipe is supported, mechanism by which the carriage is advanced a distance equal to that between the rivet-holes, and clamps by which the ends of the pipe are locked to the carriage during the setting of each line of rivets.

15. In a hydraulic riveting-machine, mechanism by which the overlapping plates of the pipe are closed and lines of rivets are set in holes therethrough, a carriage and clamping mechanism by which the pipe-sections are fixed thereto, mechanism by which the carriage is advanced a distance approximately equal to the distance between the rivet-holes in the interval between the setting of each rivet and the next, and a supplemental adjusting mechanism connected with the carriage whereby the pipe is movable independently thereof for slight adjustments.

In witness whereof I have hereunto set my hand.

STANTON FOREMAN.

Witnesses:
F. H. KIEFER,
S. E. POPE.