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Patented Apr. 9, 1901.

J. H. BAKER.
PUNCHING AND FORGING APPARATUS.

(Application filed July 8, 1899.)

(No Model.)

3 Sheets—Sheet 1.

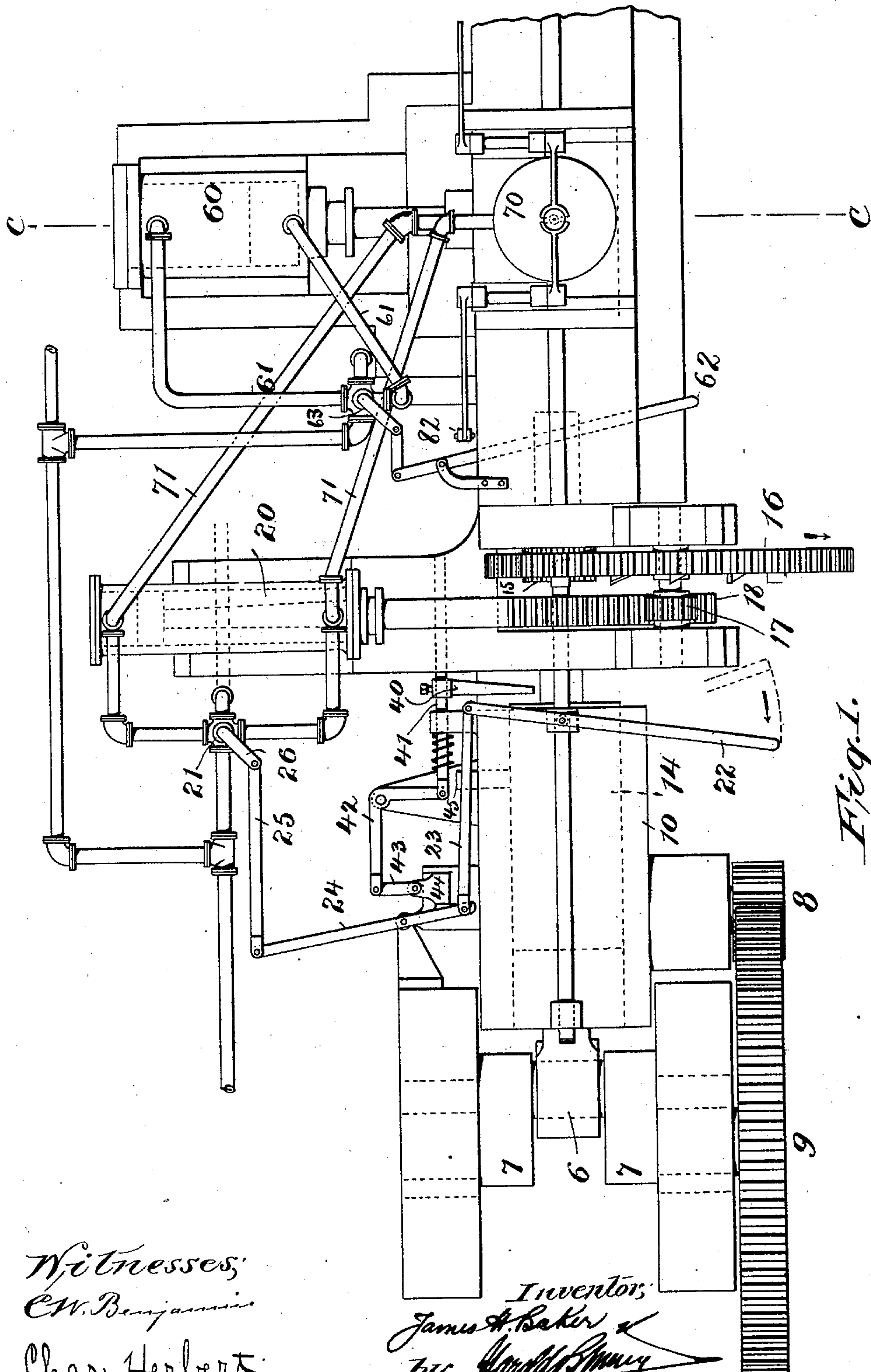


Fig. 1.

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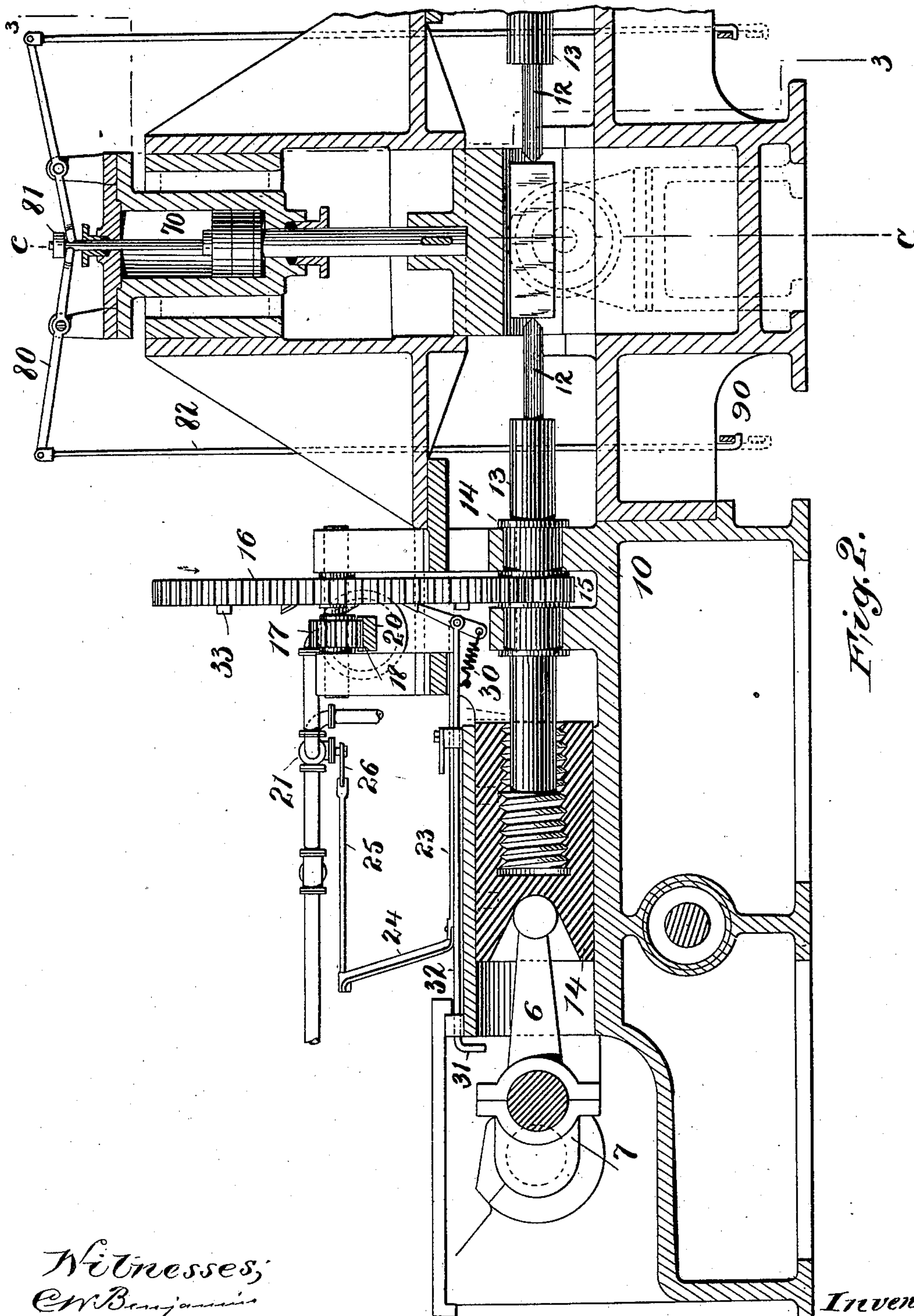
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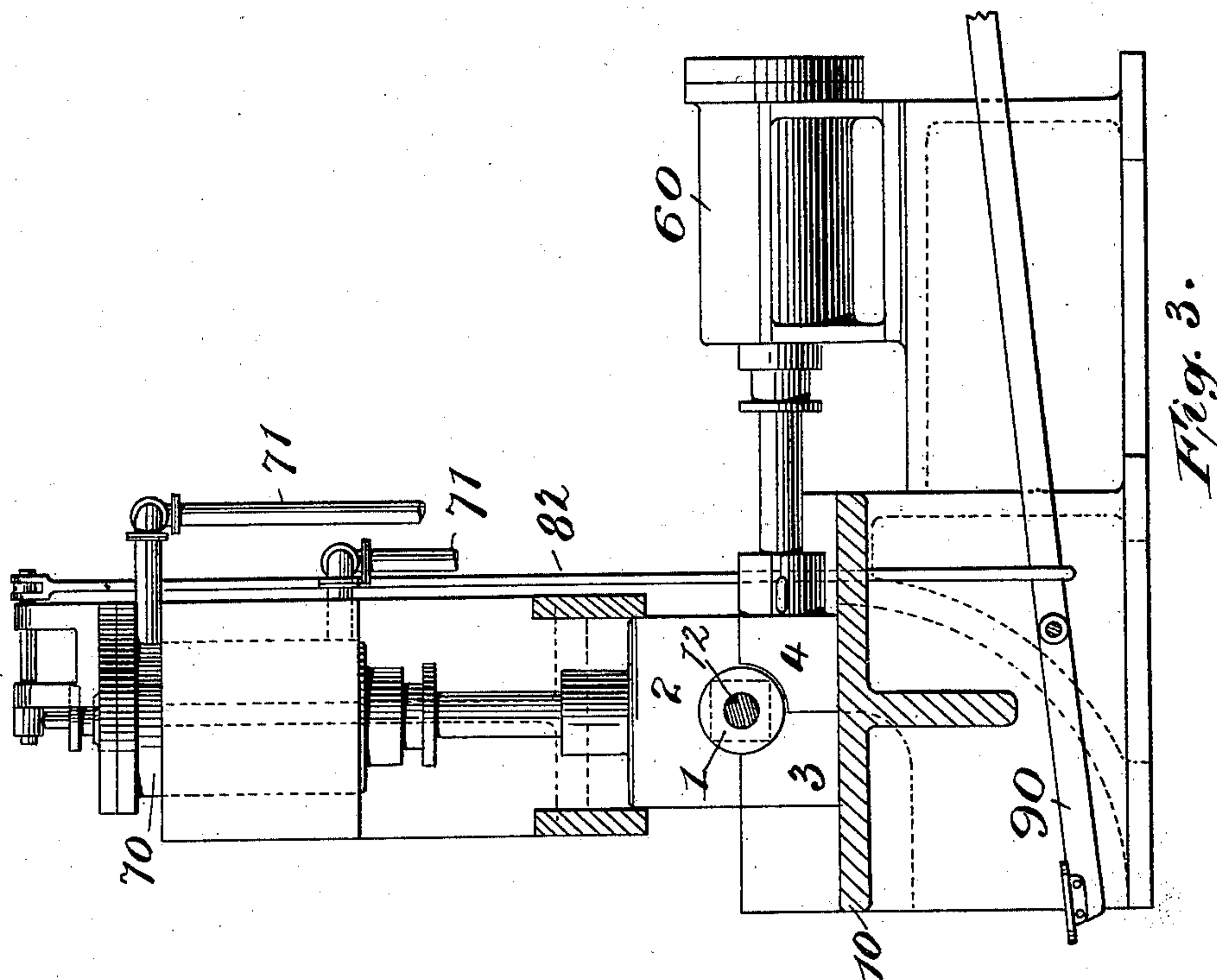
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3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

JAMES H. BAKER, OF PITTSBURG, PENNSYLVANIA.

PUNCHING AND FORGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 671,430, dated April 9, 1901.

Application filed July 8, 1899. Serial No. 723,169. (No model.)

To all whom it may concern:

Be it known that I, JAMES H. BAKER, of Pittsburgh, in the State of Pennsylvania, have invented certain new and useful Improvements in Punching and Forging Apparatus, of which the following is a description.

Primarily the object of the invention is to produce apparatus for piercing billets in a heated state as a preliminary step to the manufacture of seamless tubing. The apparatus may, however, be used for making hollow bodies of various kinds.

The process which the apparatus is designed to carry out is as follows: The billet in a heated state is held firmly and the piercing-mandrel is thrust centrally into it a short distance, then thrust in a little farther, and so on step by step, being advanced until a hole of sufficient depth has been made. If the hole extends all the way through the billet, it of course forms a tube in the billet. Preferably the billet is held by hydraulic dies, and two mandrels are used, advancing in a line with each other from opposite sides. After each withdrawal the mandrels are turned on their axes ninety degrees before being again thrust into the billet in order to counteract any bending or irregularity in the action of the mandrel. When the two mandrels have almost met at the center of the billet, one mandrel is permanently withdrawn, while the other goes on advancing step by step until it punches through the web of metal and passes into the punch-hole formed by the other mandrel, completely perforating the billet. Differently-sized mandrels may be used successively, small mandrels producing the initial introduction or perforation and larger mandrels subsequently expanding the recesses or the perforation, so as to enlarge it to the diameter desired.

A preferred form of my apparatus is shown in the accompanying drawings, wherein—

Figure 1 is a plan of part of the apparatus, duplicated parts being omitted at the right of the figure. Fig. 2 is a side view of the same, showing certain gearings and other details in full, and the rest of the figure being in section on the central plane through the mandrels. Fig. 3 is a transverse section on

the plane 3 3 of Fig. 2 as viewed from the right of Fig. 2.

Throughout the drawings like numerals of reference indicate like or similar parts.

The drawings show the machine as especially arranged for perforating billets of metal lengthwise.

The billet 1 is shown gripped in place ready to be punched. The gripping-dies are numbered, respectively, 2, 3, and 4. At either end of the billet and in line centrally therewith are punches or mandrels 12, mounted in the tool-bars 13. Each of these tool-bars is threaded into a slide 14, the thread being preferably of coarse pitch, depending on the distance which it is desired to advance the punch at each stroke. The slides 14 may be reciprocated continuously during the operation of the machine, causing each tool-bar 13 to slide longitudinally to and fro. At each reciprocation the tool-bar is rotated about one-half turn, so as to cause it to be adjusted by means of the screw-thread in the slide 14, thereby advancing the punch to a small amount—say half to three-quarters of an inch in a medium-size machine—at each stroke. This rotation of the tool-bar also serves the purpose of preventing any bending of the punch or mandrel 12, for as soon as there is any incipient bending the rotation on its axis tends to straighten the bend out in the next stroke of the tool. The rotation of the tool-bar is accomplished as follows: Surrounding the tool-bar 13 is a rotary sleeve 19, mounted in the frame 10 of the machine and splined or otherwise secured to the tool-bar, so as to permit the longitudinal motion of the bar through the sleeve, while preventing any relative rotation between the two. The sleeve 19 is geared by pinion 15, gear 16, pinion 17, and rack 18, so as to be turned by the hydraulic cylinder 20. The piston within the cylinder 20 is controlled by means of four-way valve 21, and the valve in turn is controlled by hand-lever 22, link 23, lever 24, link 25, and crank-arm 26, secured to the valve-stem. When lever 22 is thrown to the left, as seen in Fig. 1, fluid-pressure is applied to the cylinder 20 in a direction tending to turn the gear-wheel 16, as indicated by the arrows in Figs. 1 and

2. A spring-pressed pawl 30 normally prevents the rotation of the gear-wheel 16; but when the reciprocating slide 14 reaches the backward end of its stroke it strikes the toe 5 31 of rod 32, connected to pawl 30, and thereby for an instant withdraws the pawl 30, allowing the wheel 16 to turn until the next one of the ratchet-teeth 33 engages pawl 30 and brings the gear 16 again to rest. This intermittent movement of the gear 16 rotates the 10 sleeve 19, and consequently also the tool-bar 13, a fractional rotation at each reciprocating movement of the slide 14, causing the tool-bar, by means of the screw-threads, to be gradually fed forward relatively to the reciprocating slide 14 at each stroke, and thereby progressively advancing the mandrel or other tool. Provision is made for preventing the 15 mandrels 12 from meeting and interfering with each other at the center of the billet. This is accomplished by providing each of the mandrels with automatic means for causing its retraction at the proper moments, one of the mandrels being retracted just before it 20 reaches the center and the other being allowed to operate somewhat farther, so as to completely perforate the center of the billet. This automatic retraction is accomplished for each mandrel in the following manner: Movable stop 40, carried on a slide-rod 41, is so 30 placed as to be struck and actuated by the enlarged screw-threaded portion of the tool-bar when the advance of the tool-bar has caused the punch or mandrel to reach the desired limit of its progressive movement. The 35 slide-rod 41 is connected by bell-crank 42 and link 43 to actuate a movable block 44 into position to be struck by the projection 45, (see Fig. 1,) which moves with the reciprocating slide 14. When this occurs, the moving projection 45 forces block 44 to the left, as seen in Fig. 1, against the lever 24, turning the 40 valve 21 and reversing the pressure in cylinder 20, so that the gear-wheel 16 is turned in a reverse direction, and by rotating the sleeve 19 the tool-bar 13 is screwed rapidly back into the slide 14, withdrawing the punch or mandrel 12 to its backward limit. Thus it will be seen that I provide means for rotating the 45 tool at each stroke and also means for advancing it at each stroke. If the screw-threads be omitted, only the rotary action will take place.

The description up to this point applies 55 equally to both parts of the machine on either side of the center line C C of Figs. 1 and 2. The hydraulic cylinder 70, however, which works the gripping-die 2, is connected by pipes 71, as seen in Fig. 1, to but one cylinder 20, so as to operate simultaneously with 60 that cylinder. It is connected to that side of the machine that is to continue operating the punch 12 after the other punch 12 on the opposite side has been withdrawn. As the 65 result of this connection when the second punch after perforating the center of the

billet is withdrawn by the operating of movable stop 40 and the reversing of valve 21, as already described, the die 2 is withdrawn by the cylinder 70 at the same time that the 70 cylinder 20 withdraws the punch from the billet.

The cylinder 60, which operates the die 4, is controlled by the hand-lever 62 and valve 63. When the forging or punching operation has 75 been completed, as just described, the operator moves the lever 62 to the left of Fig. 1, withdrawing the gripping-die 4 and allowing the billet 1 to fall from the dies.

Preferably, though not necessarily, the reciprocation of the slide 14 will be automatically stopped when the operation of the punch is completed; but this is not essential to my invention. In any event, however, when it is desired to introduce another 85 billet the billet may be put in place, and the die 4 holds it there under control of the hand-lever 62. As soon as the billet is so gripped by the die 4 the operation of the machine may be started by means of lever 22. 90 When the die 2 descends, the head 81 operates the levers 80, as seen in Fig. 2. The connections for stopping and starting the mechanisms that reciprocate the punches are not a material part of my invention and are 95 not illustrated. I do, however, show that a lever 80 is connected at one end to be actuated by head or nut 81, which moves with the piston of cylinder 70, and at its other end is connected to rod 82, which in turn is directly 100 connected to the controlling foot-lever 90, so as to move the lever 90 automatically to control any such mechanism.

I will now describe the mechanism for reciprocating the slides 14 longitudinally in 105 their bearings on the frame 10. I prefer to accomplish this by actuating them synchronously by means of a pitman 6 for each slide operated by cranks 7 and reduction-gearing 8 9, driven from any suitably strong source 110 of power. This being a familiar detail of heading and forging machines need not be further described.

By the foregoing it will be seen that I have produced an apparatus for punching or forging 115 which comprises means for gripping and for releasing a heated billet, means for forcing a punch, mandrel, or other tool against the billet by successive strokes, means for rotating the tool between strokes, and means 120 for advancing or feeding the tool a little at each stroke, also a hydraulic gripping mechanism which may be regulated so as to yield, if desirable, to allow the lateral expansion of the metal under the action of the tool, or it 125 may, on the other hand, be so regulated as not to permit of any such expansion, according to whether it is desired to form the metal externally by means of the dies or merely to grip it. In the broader aspects of my invention 130 I do not mean to limit myself in this respect, since my invention contemplates,

broadly, the action of dies externally upon the metal.

The features which I claim as characteristic of the invention and which I desire to protect by Letters Patent are the following:

1. In combination in apparatus for punching and forging, power-controlled gripping-jaws or gripping-dies for firmly holding a heated billet, a tool-bar mounted to reciprocate, power-actuated means for giving a reciprocating movement to the bar, and means for progressively advancing the said bar without interference with its reciprocating movement, substantially as set forth.

2. In combination in apparatus for punching and forging, power-controlled gripping-jaws or gripping-dies for firmly holding a heated billet, a tool-bar mounted to reciprocate, power-actuated means for giving a reciprocating movement to the bar, means for progressively advancing the said bar without interference with its reciprocating movement, and cooperating means for turning the tool-bar upon its axis and presenting it at a different angular position at each stroke, substantially as set forth.

3. In combination in apparatus for punching billets in a heated state, jaws or dies for gripping and holding the billet, a tool-bar mounted to reciprocate in line with the billet, a piercing-tool carried thereby, and power-actuated means for advancing the said tool and tool-bar by progressively farther thrusts, substantially as set forth.

4. In combination in apparatus for punching or forging, means for holding a billet, a tool-bar mounted to reciprocate, power-actuated means for reciprocating the tool-bar, power-actuated means for progressively advancing it at each stroke, and means controlled by such advance for retracting the said tool-bar, at a predetermined limit of such reciprocating and progressive movement, substantially as set forth.

5. In combination in apparatus for punching or forging, means for gripping and hold-

ing a billet, two oppositely-disposed coacting tools, a tool-bar for each mounted to reciprocate, power-actuated means for reciprocating the tool-bars, means for progressively advancing both tool-bars without interference with their reciprocation, and means for stopping such progressive advance and retracting one of the tools before the other, substantially for the purposes set forth.

6. In combination in apparatus for punching and forging, one or more cylinders, one or more movable die or dies actuated thereby for gripping and holding a billet, one or more reciprocating power-actuated tool or tools for operating upon such billet when gripped by said die or dies, and power-actuated means for advancing the tool or tools by progressively farther thrusts, substantially as set forth.

7. In punching and forging apparatus and for the purposes described, the following elements in combination: a slide mounted to reciprocate, power-actuated means for reciprocating it, a tool-bar mounted to move in said slide in a line parallel with the reciprocating movement, and power-actuated means for moving the said tool-bar relative to said slide to give successively farther thrusts of said bar at each reciprocation, substantially as set forth.

8. In punching and forging apparatus and for the purposes described, the following elements in combination: a slide mounted to reciprocate, power-actuated means for reciprocating it, a tool-bar mounted to move in said slide in a line parallel with the reciprocating movement, and power-actuated means for simultaneously turning and advancing the said tool-bar relatively to the said slide without affecting the reciprocation, substantially as set forth.

Signed this 23d day of April, 1899.

JAMES H. BAKER.

Witnesses:

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JOHN RICHARDSON.