(No Model.) 3 Sheets—Sheet 1.

E. L. FORD.

THE ART OF PUDDLING AND APPARATUS THEREFOR.

No. 564,276. Patented July 21, 1896.

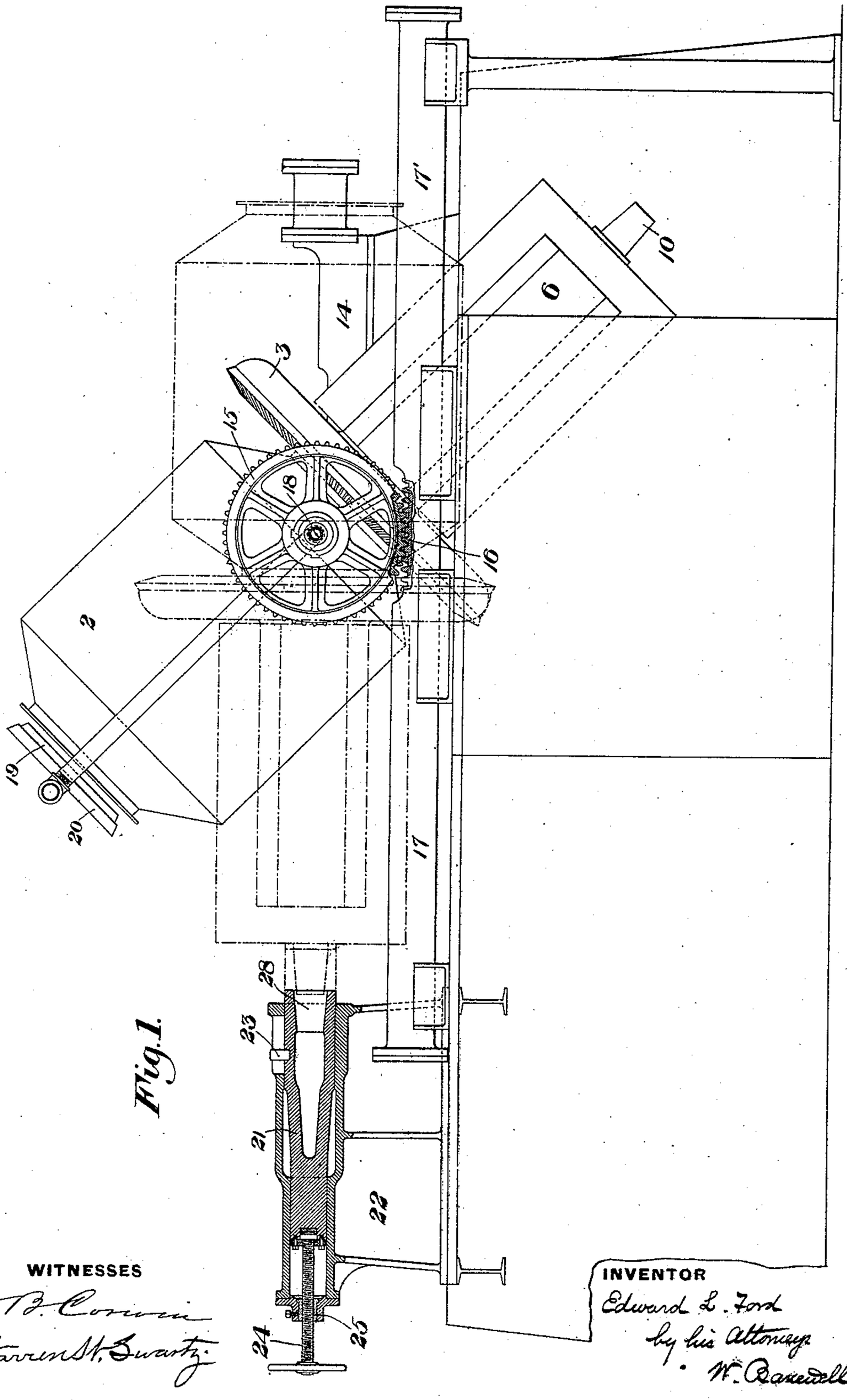

Fig. 1.

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Fig. 2.

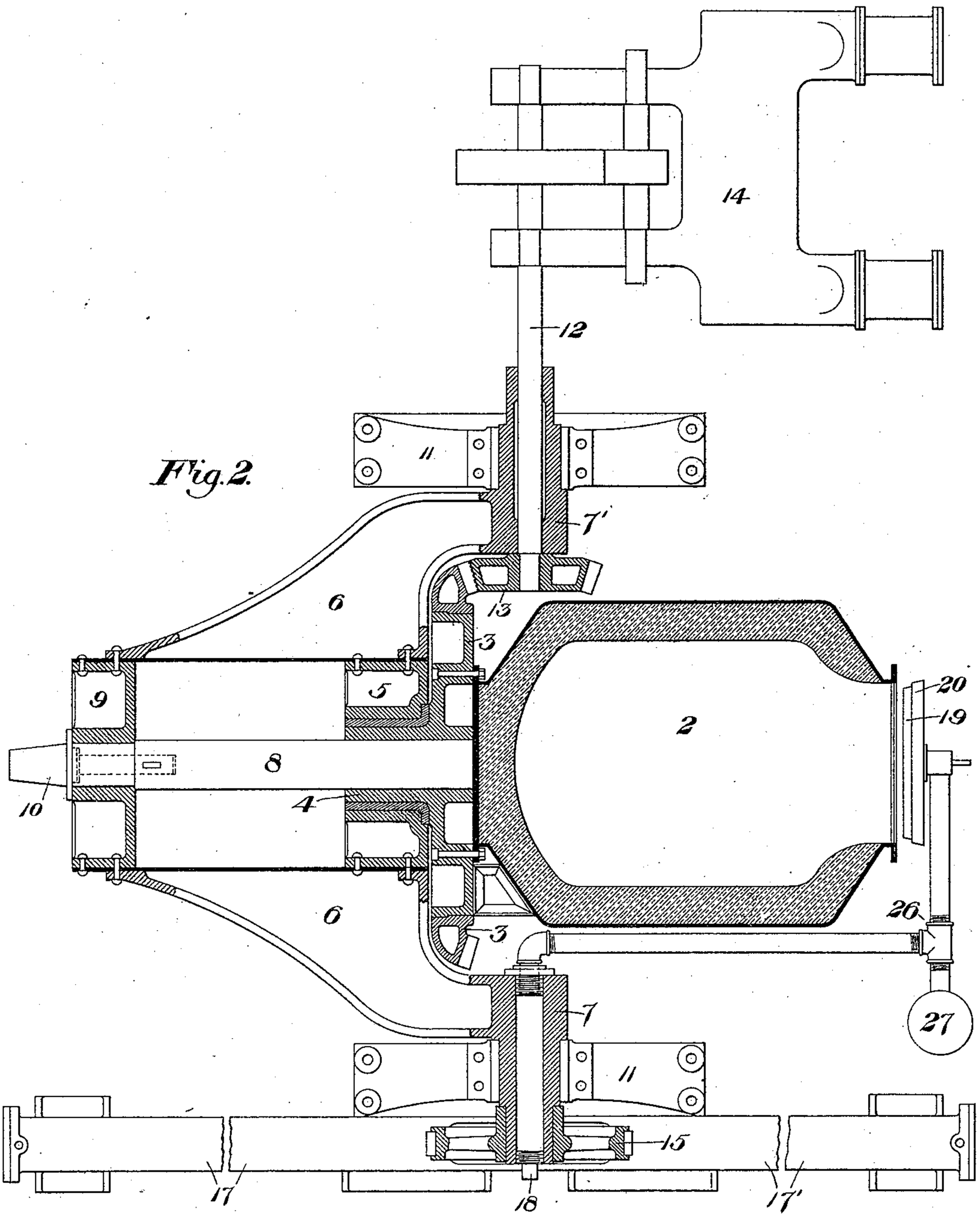

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Fig. 3.

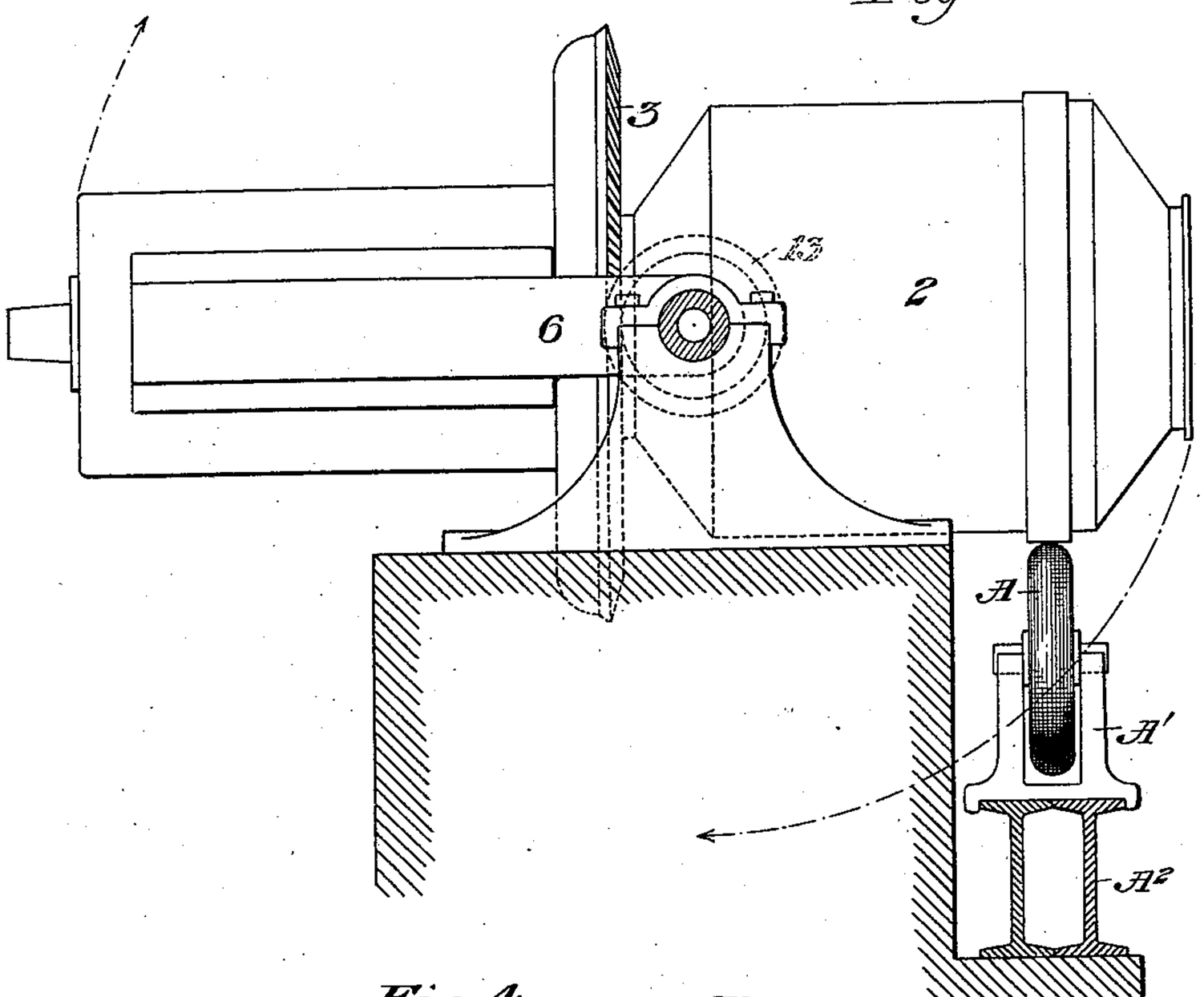
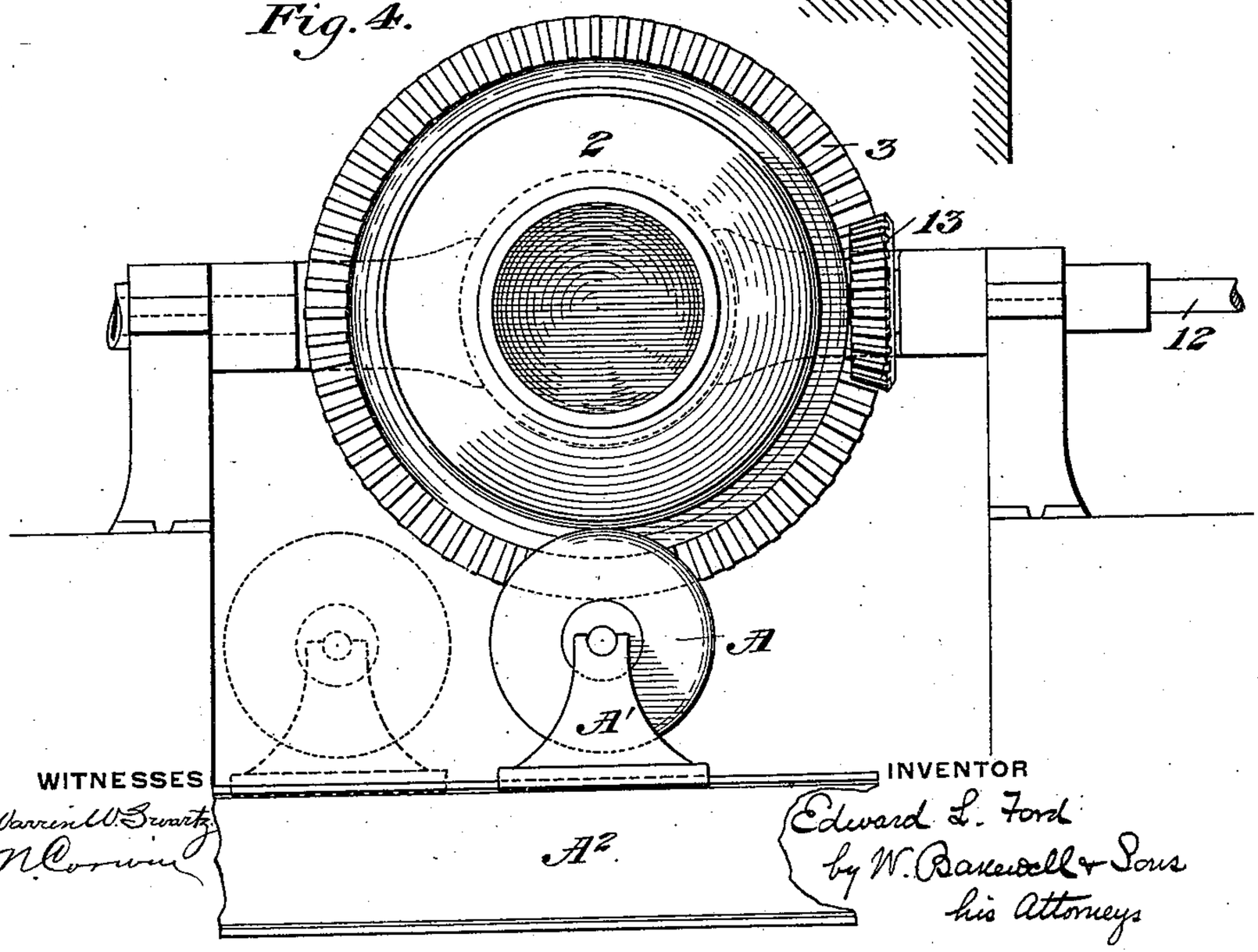


Fig. 4.



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UNITED STATES PATENT OFFICE.

EDWARD L. FORD, OF YOUNGSTOWN, OHIO.

ART OF PUDDLING AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 564,276, dated July 21, 1896.

Application filed April 5, 1895. Serial No. 544,586. (No model.)

To all whom it may concern:

Be it known that I, EDWARD L. FORD, of Youngstown, in the county of Mahoning and State of Ohio, have invented a new and useful Improvement in the Art of Puddling and Apparatus Therefor, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of my improvement; and Fig. 2 is a plan view of the same, partly in section. Fig. 3 is a side elevation, and Fig. 4 is a front elevation, of a modified construction of the apparatus.

In the operation of mechanical puddling-furnaces, such as the puddling-furnace of Danks, so many practical difficulties have been experienced as to prevent their application to general use. One of the most serious of these difficulties results from the fact that as the furnace is in the form of a horizontal cylinder, open at both ends for the inlet and exit of gases, the violent boiling of the molten charge during the early stages of the puddling operation causes the metal to foam up and to escape through these openings and rapidly to cut and destroy the bearings between the ends of the rotary furnace and the flues against which they abut. My invention is designed to overcome this and other difficulties hitherto incident to such furnaces.

I have discovered that if the puddling operation be conducted in a rotary tipping furnace open at one end for the admission and discharge of the gases, and if the vessel be rotated in an upwardly-inclined position during the early stages of the operation, and turned into a horizontal position after the metal has come to nature, and during the process of balling, the metal will be prevented from foaming over and out of the vessel, for such foaming will only take place when the furnace is upwardly inclined, and that the balling, which is conducted best when the axis of the rotating vessel is horizontal, can be effected without difficulty. This discovery, whose results are of very considerable practical importance, forms the basis of my invention, which consists in an improvement in the art of puddling, wherein the charge to be puddled is treated in a revolving furnace whose axis is upwardly inclined during the preliminary stages or boiling of the iron and which is tipped into a horizontal position during the operation of balling.

It also consists in certain apparatus of improved construction, which I shall now describe and which I deem to be the best apparatus for the practice of the method above stated.

In the drawings, 2 represents the furnace proper, consisting of a vessel which may be approximately cylindrical, is open at one end and closed at the other, and is incased in a metal jacket, within which is a suitable refractory lining.

To the base or closed end of the furnace is bolted or otherwise fixed a gear-wheel 3. The hub 4 of this wheel is journaled in a bearing 5 in a frame 6, forming part of or connected with trunnions 7 7′, which project laterally on opposite sides of the furnace and constitute the axis on which it is tipped. The shaft 8, on which the gear-wheel is keyed, also has a bearing 9 in said frame, and is preferably formed with a projecting tapering end 10, whose function I shall describe hereinafter. The trunnions 7 7′ are journaled in bearings 11. The trunnion 7′ is hollow, and a shaft 12 extends axially through it. At the inner side of the trunnion the shaft is provided with a pinion 13, meshing with the gear-wheel 3, and at the other end the shaft is connected with the motor or engine 14, by which it may be rotated. Rotation of this shaft by the motor will rotate the gear-wheel 3 and will revolve the furnace on its axis. On the other trunnion 7 is a pinion 15 in gear with the rack 16, which is adapted to be reciprocated by a double-acting motor, or preferably by two single-acting cylinders 17 17′, set end to end and having their rams or pistons connected with the rack which meshes with the pinion at the gap between the ends of the cylinders. A fluid-supply pipe 18, adapted to convey liquid or gaseous fuel, extends through the trunnion 7 and terminates in a burner 19 opposite the mouth of the furnace. The gases discharged from this burner into the furnace reverberate therein, and the waste products of combustion escape at the furnace-mouth around the edges of a plate or cap 20, which is carried by the burner.

To enable the burner to be removed easily from the front of the furnace-mouth, I prefer to swivel the burner-pipe at 26 and to provide it with a counterweight 27.

It is evident from the foregoing description that the furnace may be tipped on the axis of its trunnions by means of the motors 17 17′, so as to assume either a horizontal or an upwardly or a downwardly inclined position, as desired, that by the motor 14 the furnace may be rotated on its longitudinal axis, and that by reason of the arrangement of the motor-shaft in the axis of the trunnion such rotation may be carried on in any position into which the furnace may be tipped.

For the purpose of affording an additional bearing and to take up the strains to which the furnace is subjected when it is rotated in a horizontal position, I provide opposite the end of the shaft 8, when in a horizontal position, a tail-stock 21, supported in a frame 22, in which it is capable of longitudinal adjustment, but is prevented from rotation by means of a key 23 or otherwise.

24 is a screw connected with the end of the tail-stock and passing through a nut 25. By turning this screw the tail-stock may be projected so that a socket 28 at its end shall engage and fit around the tapered end of the shaft 8 and shall serve as a bearing therefor when the shaft and furnace are in horizontal position. As a substitute for the use of this tail-stock I may employ a supporting wheel or wheels journaled under the furnace and adapted to support the frame when the furnace is horizontal. Said wheel or wheels may be adapted to be removed when it is desired to tip the furnace into a downwardly-inclined position, or the furnace may be tipped backward in the other direction. This is illustrated in Figs. 3 and 4, in which A represents a supporting-roller journaled in bearings A′, which are movable laterally on a track A^2 from its supporting position (shown in full lines) to a position shown in dotted lines, where it is out of the path of tipping of the furnace.

The operation is as follows: The furnace is charged with molten pig metal, and having been tipped into an upwardly-inclined position burning gas is delivered thereinto and the furnace is rotated on its axis. This is continued during the boiling of the metal, suitable additions of oxids, &c., being made to the charge either from the lining or otherwise, as is usual in puddling, and as the metal boils and foams it is prevented from escaping by reason of the elevation of the furnace-mouth. When the metal comes to nature, the furnace is tipped into a horizontal position, the tail-stock is connected with the shaft 8, or the furnace is caused to rest upon the supporting-wheels, as above described, and the rotation of the furnace is continued until the metal has been balled up, the burner, which moves with the furnace in its tipping, continuously discharging the flame into the open furnace-mouth. By thus turning the furnace into a horizontal position during the last stages of the process the balling is performed most effectively, and by means of the additional bearing afforded by the tail-stock or the supporting-wheels the strains caused by the dropping of the heavy balls within the revolving furnace are taken up and rendered harmless. At the conclusion of the balling the furnace may be tipped into a downwardly-inclined position and its charge of slag and puddled iron dumped from the mouth.

The advantages of my invention will be appreciated by those skilled in the art.

The apparatus and method above described are simple, and they remove most effectively many difficulties heretofore regarded as necessary incidents to revolving puddling-furnaces.

Within the scope of my invention as defined in the claims many modifications in the form and construction of the parts may be made by the skilled mechanic.

I am aware that tipping rotary puddling-furnaces have been described, but I believe I am the first to invent and practice the method above described, and the first to invent the apparatus defined in the following claims.

I therefore claim—

1. In the art of puddling, the improvement which consists in puddling the metal in a rotary puddling-furnace, putting such furnace in an upwardly-inclined position during the boiling operation, and putting it in a substantially horizontal position during the operation of balling.

2. A puddling-furnace carried by supports which permit it to rotate and tip respectively on different axes, and having a fuel-supply pipe connected with the furnace and traveling therewith when the furnace is tipped; substantially as described.

3. A rotary tipping puddling-furnace carried by supports which permit it to rotate and tip respectively on different axes, and having a fuel-supply pipe which extends through the axis of tipping of the furnace; substantially as described.

4. A puddling-furnace carried by supports which permit it to rotate and tip respectively on different axes, and having a supplemental bearing which assists in supporting the furnace when horizontal; substantially as described.

5. A puddling-furnace carried by supports which permit it to rotate and tip respectively on different axes, and having a tail-stock movable to engage a projection on the furnace and to act as a supporting-bearing when the furnace is horizontal; substantially as described.

6. A rotary tipping puddling-furnace carried by supports which permit it to rotate and tip on different axes, and having a swiveled fuel-supply pipe which travels with the furnace when the latter is tipped; substantially as described.

7. In the art of puddling, the improvement which consists in puddling the metal in a rotary puddling-furnace, putting such furnace in an upwardly-inclined position during the boiling operation, and putting it in a substantially horizontal position during the operation of balling, and putting it in a downwardly-inclined position for discharging the puddled iron and slag; substantially as described.

In testimony whereof I have hereunto set my hand.

EDWARD L. FORD.

Witnesses:
W. R. MERRICK,
F. D. JONES.