

No. 653,639.

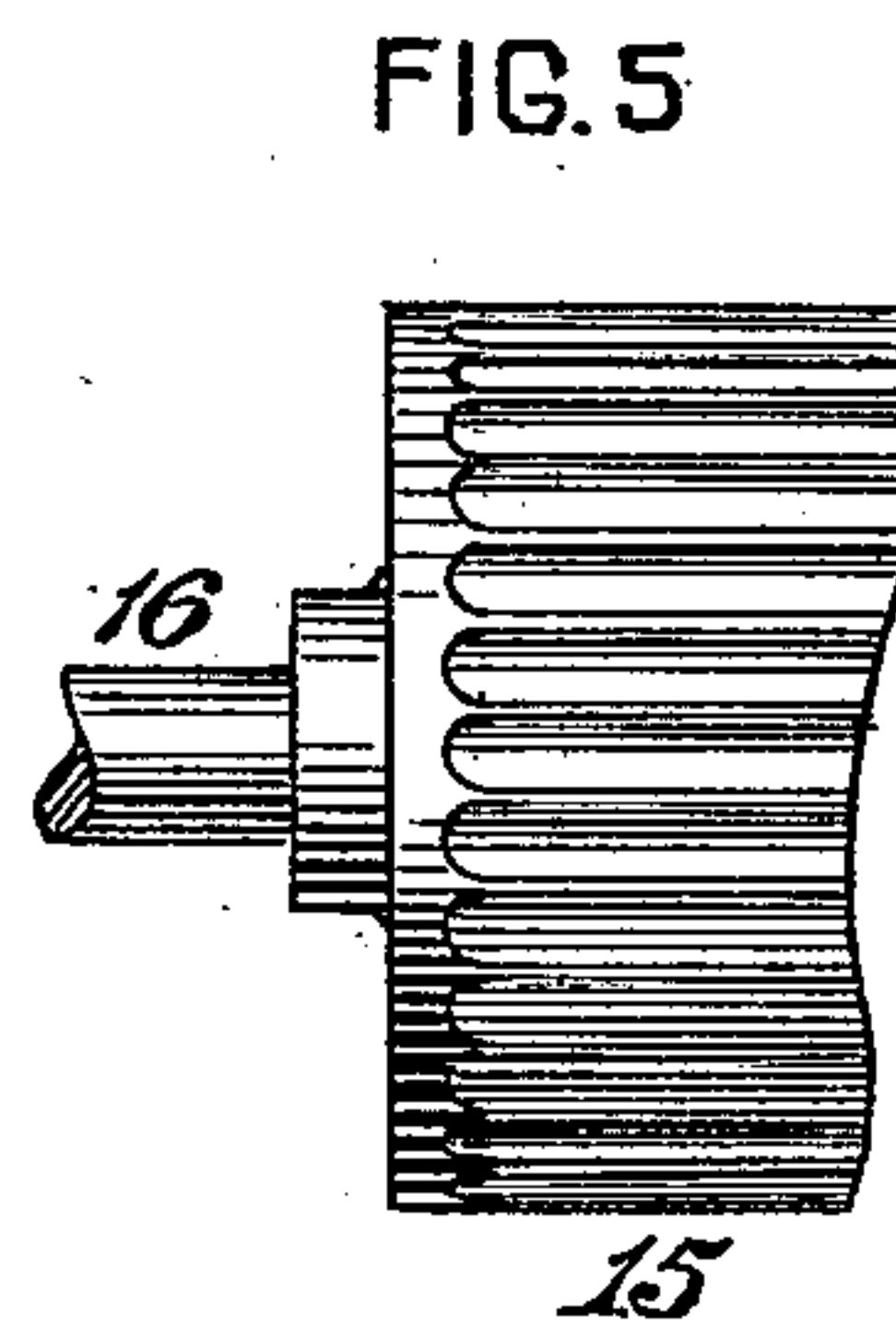
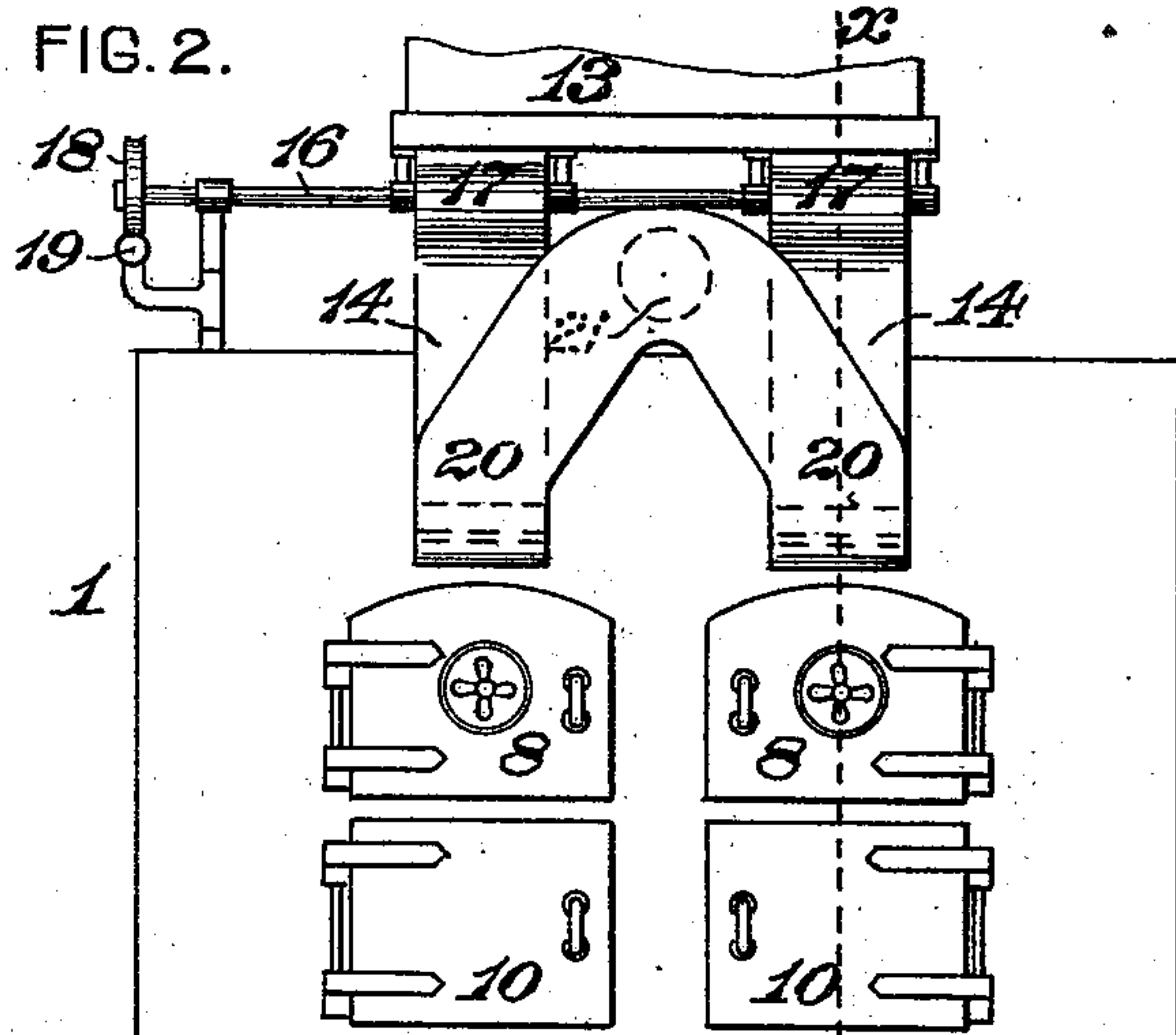
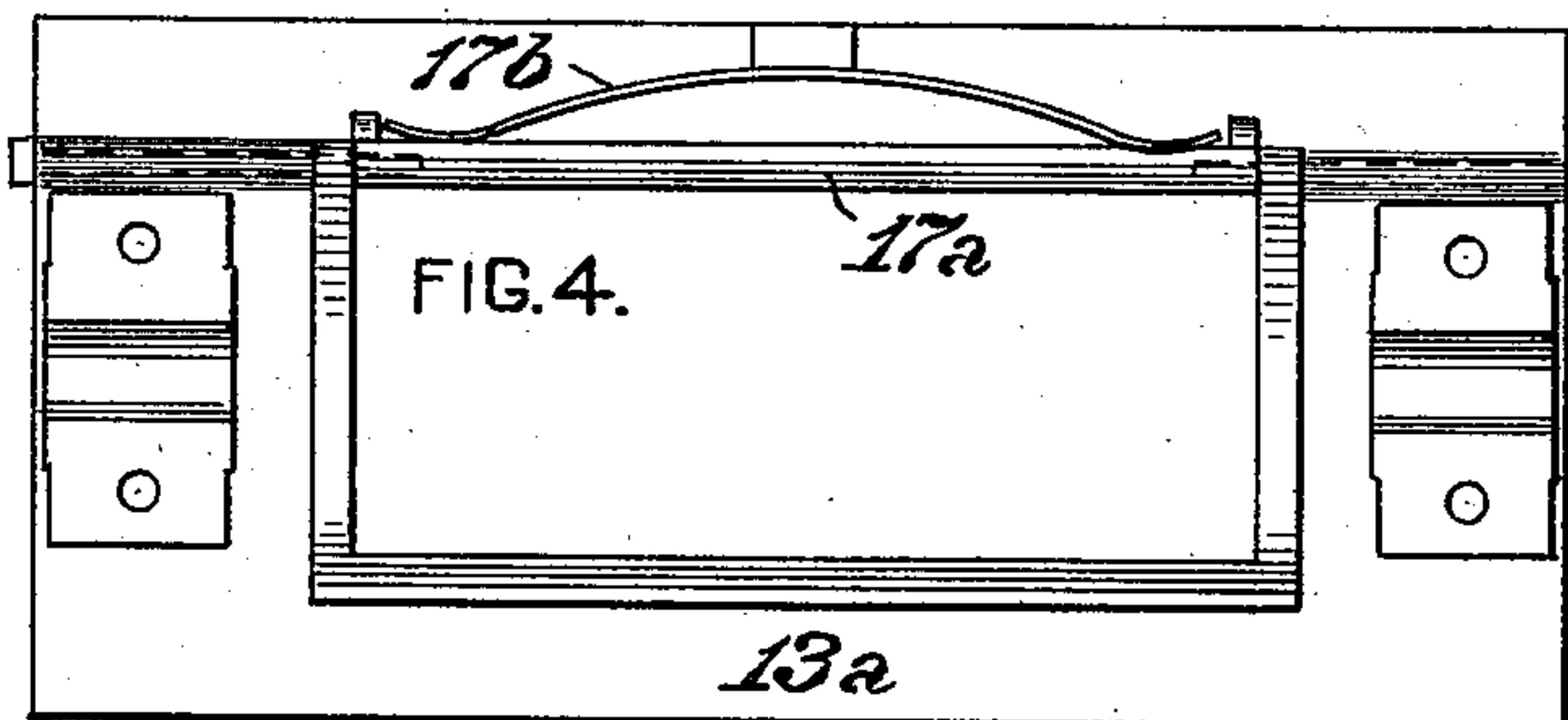
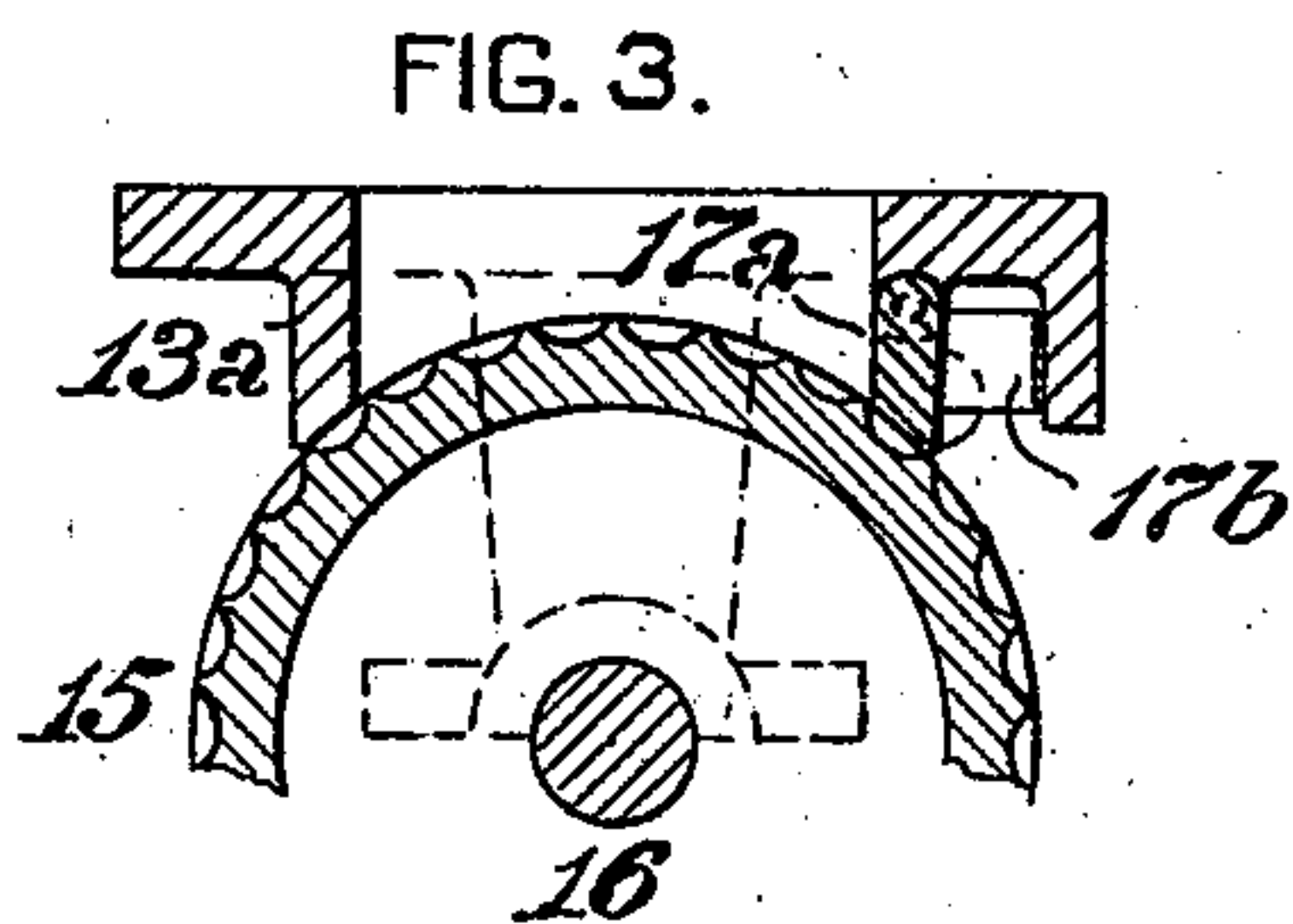
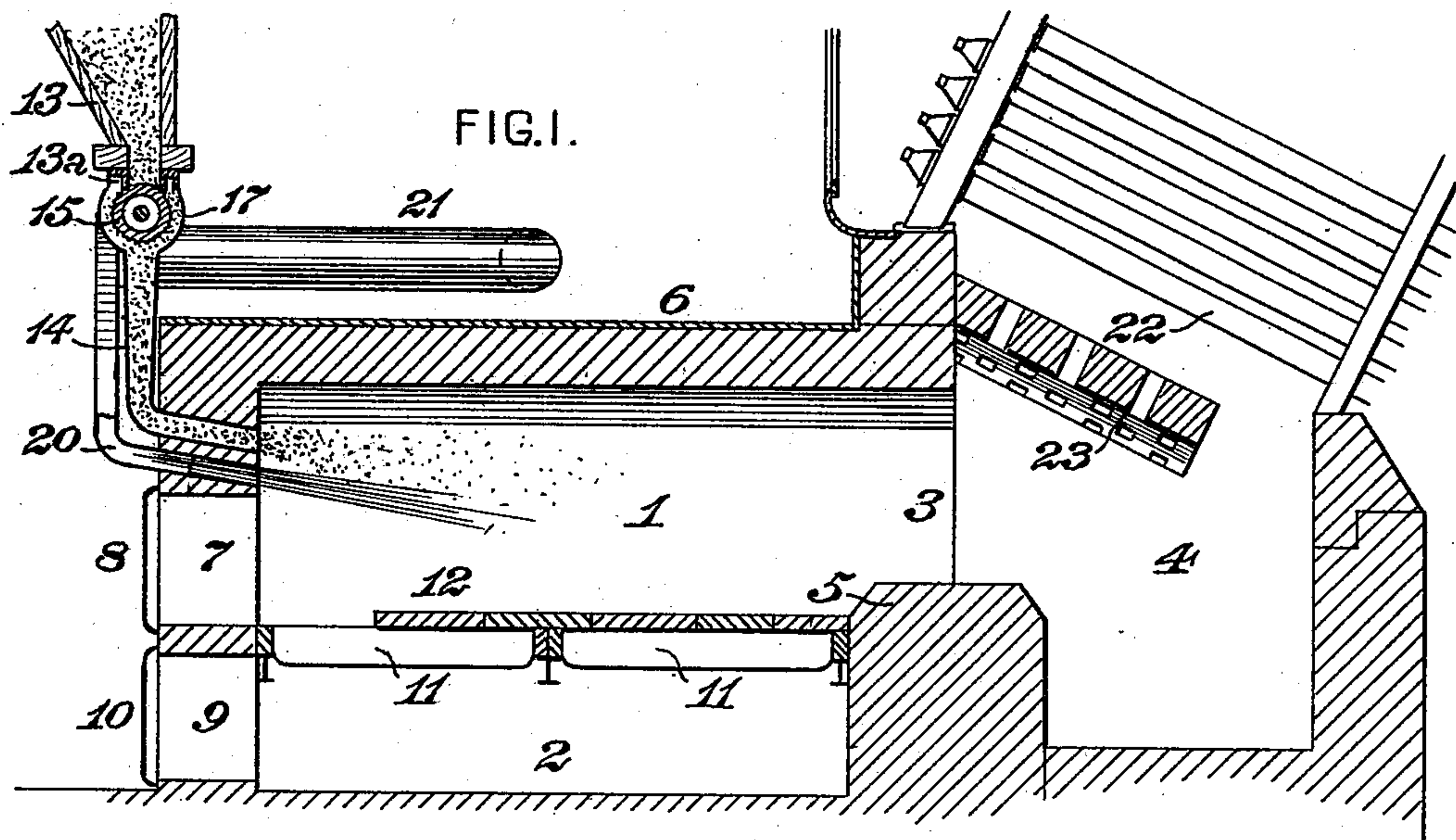
Patented July 10, 1900.

J. BOLE.

APPARATUS FOR BURNING PULVERIZED FUEL.

(Application filed Sept. 21, 1899.)

(No Model.)



WITNESSES:

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UNITED STATES PATENT OFFICE.

JOHN BOLE, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO
DAVID R. W. PATTERSON, OF SAME PLACE.

APPARATUS FOR BURNING PULVERIZED FUEL.

SPECIFICATION forming part of Letters Patent No. 653,639, dated July 10, 1900.

Application filed September 21, 1899. Serial No. 731,148. (No model.)

To all whom it may concern:

Be it known that I, JOHN BOLE, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a certain new and useful Improvement in Apparatus for Burning Pulverized Fuel, of which improvement the following is a specification.

In an application for Letters Patent filed by myself and David R. W. Patterson May 8, 1899, Serial No. 715,914, we have set forth an improved method whereby pulverized or pulverulent combustible materials, including slack and various low grades of coal, may be utilized as fuel in such manner that their thorough and complete combustion may be effected and the effective and economical application of the heat evolved thereby be attained without the production of smoke.

The object of my present invention is to provide an apparatus which shall be properly and desirably adaptable to the practice of the invention of our application aforesaid in regular service for industrial or commercial purposes.

To this end my invention, generally stated, consists in the combination of a preliminary furnace-chamber, a main or final furnace-chamber communicating therewith, a fuel-supply conduit leading into the preliminary furnace-chamber, and an air-blast conduit leading into the preliminary furnace-chamber below and adjacent to the delivery-opening of the fuel-supply conduit thereinto, the openings of the fuel-supply and air-blast conduits discharging in substantially-parallel planes into the preliminary furnace-chamber.

The improvement claimed is hereinafter fully set forth.

Prior to our invention set forth in application Serial No. 715,914 aforesaid attempts have been made from time to time to utilize fine coal and coal-dust in a raw state as fuel in furnaces of various special constructions; but so far as our knowledge and information extend none of these has attained such a degree of success in practical operation as to warrant its approval and adoption to any substantial extent. Among the difficulties which have been encountered and unsurmounted in prior efforts in this branch of the art may be

mentioned those of properly and sufficiently supplying oxygen to the fine fuel, of supporting it without waste to an ash-pit in proper relation to the surface or surfaces to be heated, and of effecting the thorough and economical application of the heat of the products of combustion to such surfaces. My present invention has been fully tested, with entirely satisfactory results, in connection with a steam-boiler furnace and has been for some time in regular operation in the generation of steam.

In the accompanying drawings, Figure 1 is a vertical longitudinal section, on the line xx of Fig. 2, through an apparatus for burning pulverized fuel, illustrating an embodiment of my invention; Fig. 2, a front view in elevation of the same; Fig. 3, a transverse section, on an enlarged scale, through a feed-roller and a base-plate of the fuel-bin; Fig. 4, an inverted plan view of a base-plate of the fuel-bin, and Fig. 5 a partial side view of a feed-roller.

In the operation of the apparatus powdered coal or slack or other pulverized or pulverulent combustible material is fed continuously during operation into a preliminary furnace-chamber of form and dimensions suitable to admit of the complete combustion of said material therein, in connection with a current of air under pressure, the application of which serves the double purpose of holding the pulverized fuel in suspension and of supplying the volume of oxygen requisite to effect its combustion. The pulverized fuel is ordinarily and preferably fed to the preliminary furnace-chamber by the action of gravity, the feed being regulated and made uniform by a proper mechanical feeding device; but other means of feeding the fuel may be employed, if preferred. The fuel enters the preliminary furnace-chamber through one or more delivery-openings, which are comparatively wide and shallow in horizontal and vertical dimensions, respectively, so as to be spread laterally into wide and thin streams or bodies, and the air-blast is delivered through a similarly-formed opening or openings, each of which is located below and adjacent to a fuel-delivery opening, so as to enable the issuing current of air to act directly and fully upon a stream or body of fuel. The fuel is ignited

and burned in suspension, and its combustion is thoroughly and completely effected in the preliminary furnace-chamber, the incom-
 5 bustible residuum or ash falling by gravity into the lower portion thereof or into a sub-
 jacent ash-pit provided to receive it. The products of combustion, which are at a high heat, are delivered from the exit end of the preliminary furnace-chamber to a main or
 10 final furnace-chamber, in which their heat is exerted upon a steam-generator or other article or material which is to be heated, and after delivering the major portion of their heat thereto are discharged in the ordinary manner
 15 through a suitable exit flue or stack. The application of the air-blast throughout the width of thin streams or bodies of pulverized fuel causes the oxygen of the air to be thoroughly and uniformly distributed to the particles of fuel, thus completing combustion
 20 while the fuel is sustained by the underlying blast, and it has been found in practice that a high degree of heat is evolved and the production of smoke is substantially completely
 25 prevented.

Referring to the drawings, I provide a preliminary furnace-chamber 1, the lower portion of which forms an ash-pit 2, which may be located above or adjoining a separate ash-
 30 pit, if preferred. The furnace-chamber 1, which is built of brick or masonry and lined with suitable refractory material, is preferably of substantially-rectangular section both longitudinally and transversely and is closed
 35 at top by an arched roof 6. An opening 7, (one or more,) controlled by a door 8, is formed in the outer end wall of the preliminary furnace-chamber for the purpose of affording access thereto, and a lower opening 9 (one
 40 or more) is formed in the same wall for the removal of residuum from the ash-pit. Two upper and two lower openings 7 are indicated as provided in the instance shown, and the preliminary furnace-chamber is also shown
 45 as provided with grate-bars 11 in order to adapt it for use with lump or solid fuel, if desired, in the event of a temporary failure of supply of pulverized fuel or during renewal or repair of the fuel or air feeding devices. In the
 50 normal operation of the apparatus the major portion of the grate should be covered with a protecting layer of fire-brick or tile 12 to prevent the destruction of the grate-bars by the high heat evolved in the combustion of
 55 the fuel.

A bridge-wall 5 may be formed at the inner end of the preliminary furnace-chamber, which communicates by a delivery passage or throat 3 with a main or final furnace-cham-
 60 ber 4, in which the heat of the products of combustion escaping from the preliminary furnace-chamber 1 is exerted for the purpose for which the apparatus is designed. A water-tube steam-generator 22 is in this in-
 65 stance shown as set in the main or final furnace-chamber; but it will be obvious that said furnace-chamber may be employed for

any other heating purpose desired without departure from the spirit or essential features of my invention. In order to attain a more
 70 effective application and distribution of the heat of the products of combustion in the final furnace-chamber, the latter is preferably, as shown, provided with a perforated arch or checker-work partition 23, of fire-brick, ex-
 75 tending transversely above the delivery-passage 3 for the major portion of the depth of the furnace-chamber 4. The arch-bricks are laid so as to provide openings or spaces be-
 80 tween their ends for the passage of the products of combustion, as indicated in Fig. 1.

A fuel-bin 13 for the reception of a charge of pulverized fuel is supported above the preliminary furnace-chamber 1 adjacent to the
 85 outer end thereof, and a fuel-supply conduit 14 (one or more) leads from the fuel-bin into the furnace-chamber 1 above the opening 7 in the front wall thereof. Two fuel-supply conduits are employed in the instance shown, and the number thereof may be more or less, in the
 90 discretion of the constructor. The fuel-supply conduits 14 pass through the front wall of the furnace-chamber 1, preferably on a slight incline, as shown, and the delivery-openings of their inner ends are substantially rectangular
 95 and are comparatively wide and shallow, so as to discharge the fuel in a stream or body of corresponding transverse section, as indicated by dotted lines in Fig. 2. The fuel is fed by gravity from the fuel-bin to the fur-
 100 nace-chamber 1, and its delivery is regulated and rendered uniform by a suitable mechanical feeding device, consisting in this instance of a pair of peripherally-grooved rollers 15, mounted on and rotating with a shaft
 105 16 in casings 17, which constitute the upper portions of the feed-supply conduits 14. The feed-rollers 15 are rotated at a slow rate of speed through a worm-wheel 18, engaging a worm 19, fixed upon a shaft, to which rotation
 110 is imparted from any suitable prime mover. The peripheral grooves of the feed-rollers 15 terminate a short distance from their ends, thus leaving unbroken cylindrical end portions, which fit freely against the correspond-
 115 ingly-recessed ends of the base-plates 13^a of the fuel-bin 13, as shown in Figs. 3 and 5, so as to prevent the outward passage of the pulverized material except through the grooves of the rollers. In order to obviate the liabil-
 120 ity to clogging or breakage of the feed mechanism by fragments of fuel or foreign matter which are too large to pass through the grooves, the base-plates 13^a may be provided with yielding release-plates 17^a, pivoted at top
 125 to the base-plates and fitting on their lower sides against the feed-roller, said relief-plates being held in position by springs 17^b. When subjected to pressure greater than that due to the normal feed of the fuel, the spring 17^b will
 130 yield thereto and permit the relief-plate to swing outwardly upon its pivots and discharge the lumps or foreign matter from the space above the feed-roller.

Air-blast conduits 20 lead from an air-supply pipe 21, communicating with a blast-fan or blower, which may be of any suitable and preferred construction and is not shown, into the preliminary furnace-chamber 1, the delivery-opening of each of the air-blast conduits being substantially similar in form to and located below and adjacent to that of one of the fuel-supply conduits 14, so that the current of air discharged therefrom completely underlies the stream or body of pulverized fuel discharged from the superposed fuel-supply conduit. The volume of air under pressure delivered from the air-blast conduits is regulated, as desired, by a suitable valve or register in the ordinary manner, and the delivery of fuel is correspondingly regulated in proper proportion by variation of the speed of the feed-rollers 15 or by a valve or gate controlling the discharge from the fuel-bin 13, or both of these well-known expedients may be employed, if deemed advisable.

In order that the underlying air-blast may be maintained intact, so that it may continue to act as a support for the fuel until combustion has been completed, it is essential that the preliminary combustion-chamber be of such dimensions as to permit the fuel and supporting air-blast to move without rebound or deflection until combustion is completed, as otherwise the underlying blast would be broken up and converted into whirls or eddies, which would materially interfere with the proper support of the fuel. For this reason I prefer to construct the preliminary combustion-chamber 1 so that the exit end 3 will be so far removed from the point of intake of the air and fuel that combustion will have been substantially completed by the time the air and fuel reach the said exit end 3.

It will be obvious to those skilled in the art to which my invention relates that the form and proportion of the apparatus above described may be modified in various particulars without departure from the operative principle of my invention, the leading and essential features of which consist in practically operative means for effecting the combustion of pulverized fuel in suspension

with an air-blast in a special furnace-chamber and utilizing the heat generated thereby in another furnace-chamber.

I claim as my invention and desire to secure by Letters Patent—

1. In a furnace the combination of a combustion-chamber, means for feeding pulverized fuel thereto and means supplying an underlying and fuel-supporting blast of oxygen-bearing fluid into said combustion-chamber, said chamber being of such dimensions that combustion of the fuel is substantially completed before the blast is interrupted or deflected.

2. In a furnace the combination of a combustion-chamber, means causing a blast of oxygen-bearing fluid to traverse said chamber in an approximately-horizontal plane, means feeding pulverized fuel to said chamber in position to be supported above and by said blast, said chamber being of such dimensions that combustion of the fuel is substantially completed before the blast is interrupted or deflected, with a main or final furnace-chamber and a passage leading from the combustion-chamber to the main or final chamber, whereby said pulverized fuel is consumed in the combustion-chamber and only the products of combustion are conducted to the main or final chamber.

3. In a furnace the combination of a combustion-chamber, means feeding pulverized fuel into said chamber in a broad thin stream or sheet, means feeding a blast of oxygen-bearing fluid into said chamber in a plane beneath and substantially parallel with said stream or sheet of fuel, whereby said fuel is supported upon an underlying blast of said fluid, a main or final furnace-chamber, a passage connecting said combustion and main chambers, the combustion-chamber being of such dimensions that combustion of the fuel is substantially completed before the blast reaches said connecting-passage.

JOHN BOLE.

Witnesses:

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CLARENCE A. WILLIAMS.