No. 789,796. PATENTED MAY 16, 1905.

W. H. COOKE.

AUTOMATIC FUEL FEEDING DEVICE.

APPLICATION FILED APR. 23, 1903.

3 SHEETS—SHEET 1.

Fig. 1.

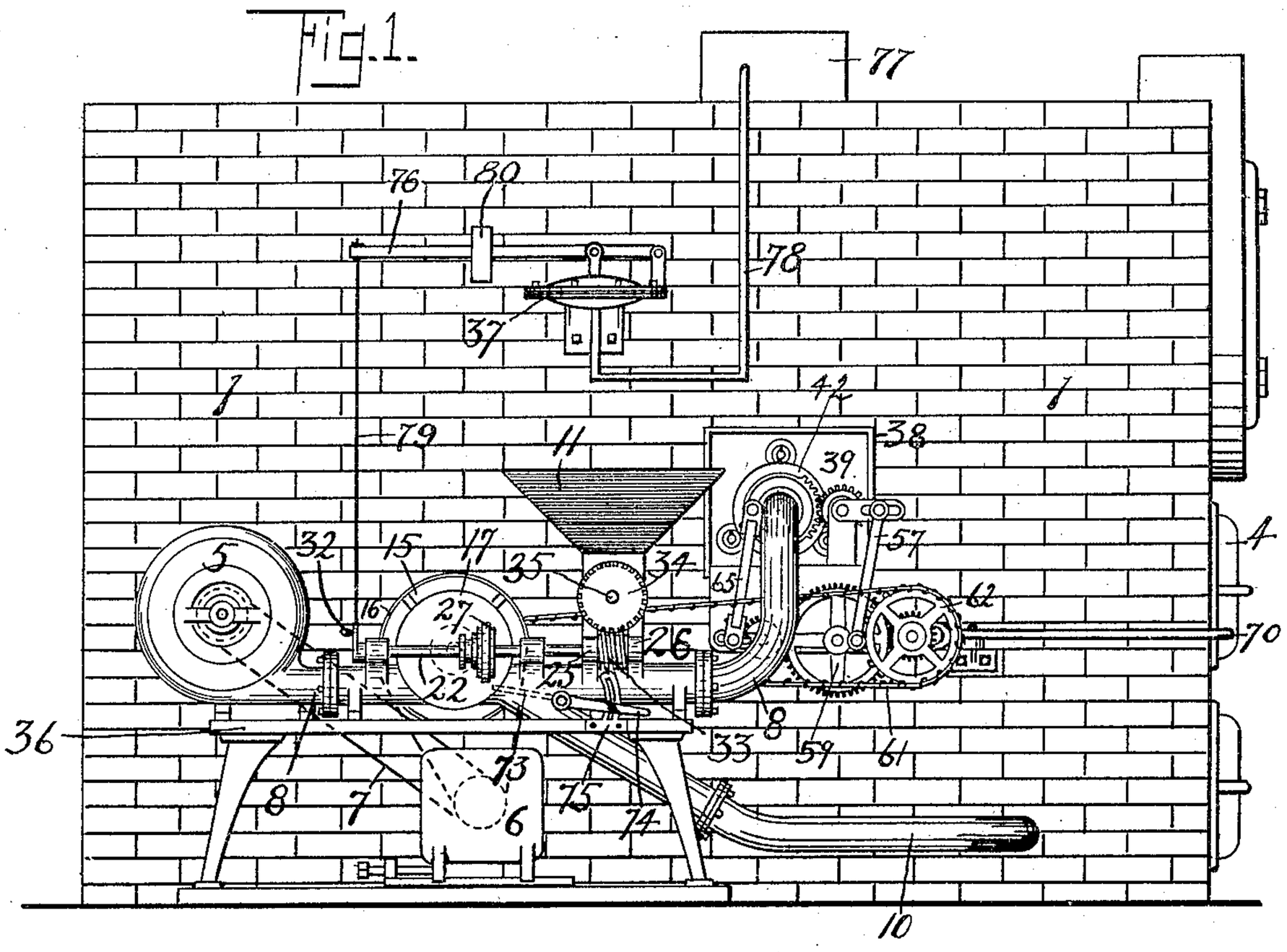
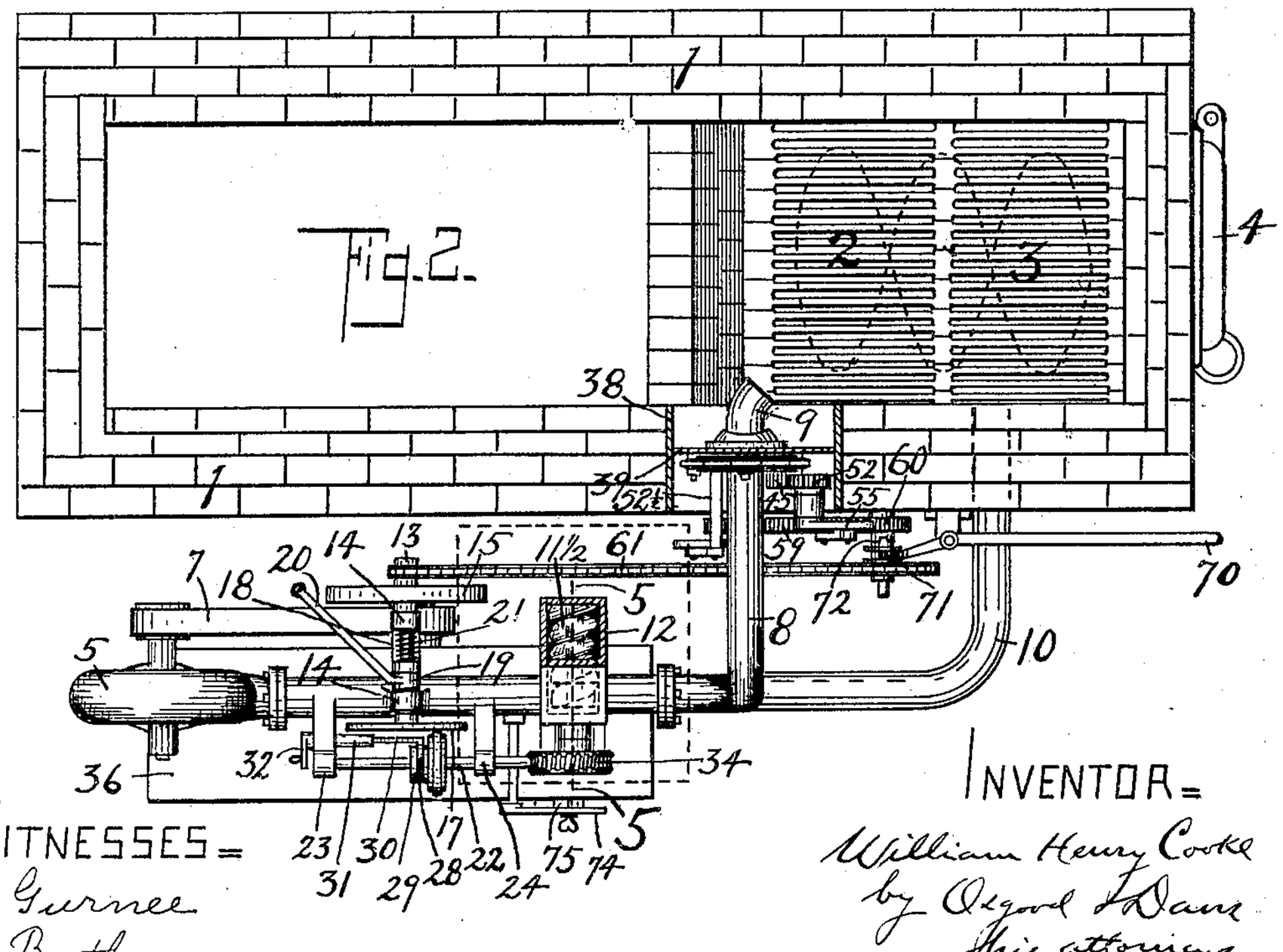


Fig. 2.



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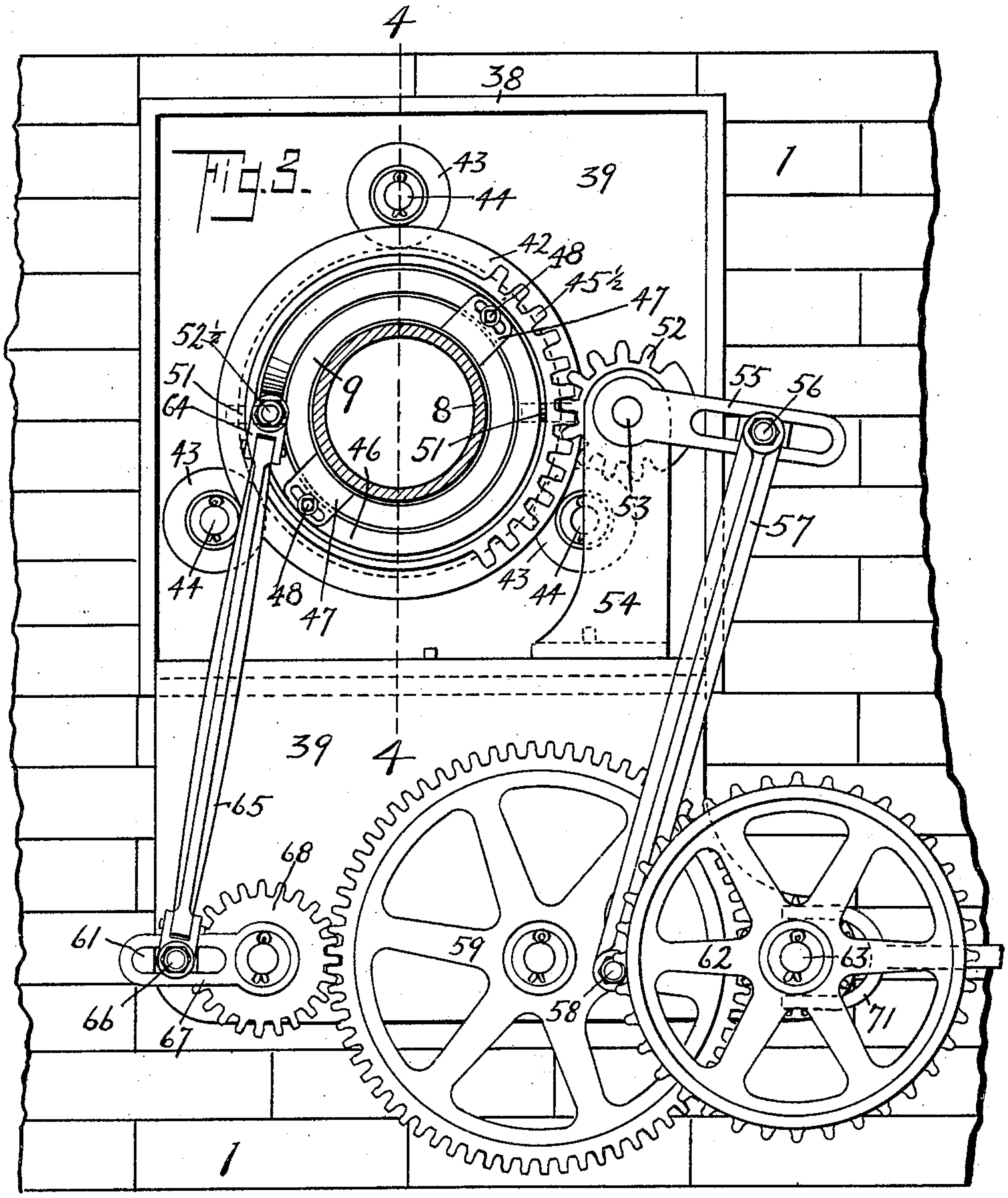

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3 SHEETS—SHEET 3.

Fig. 4.

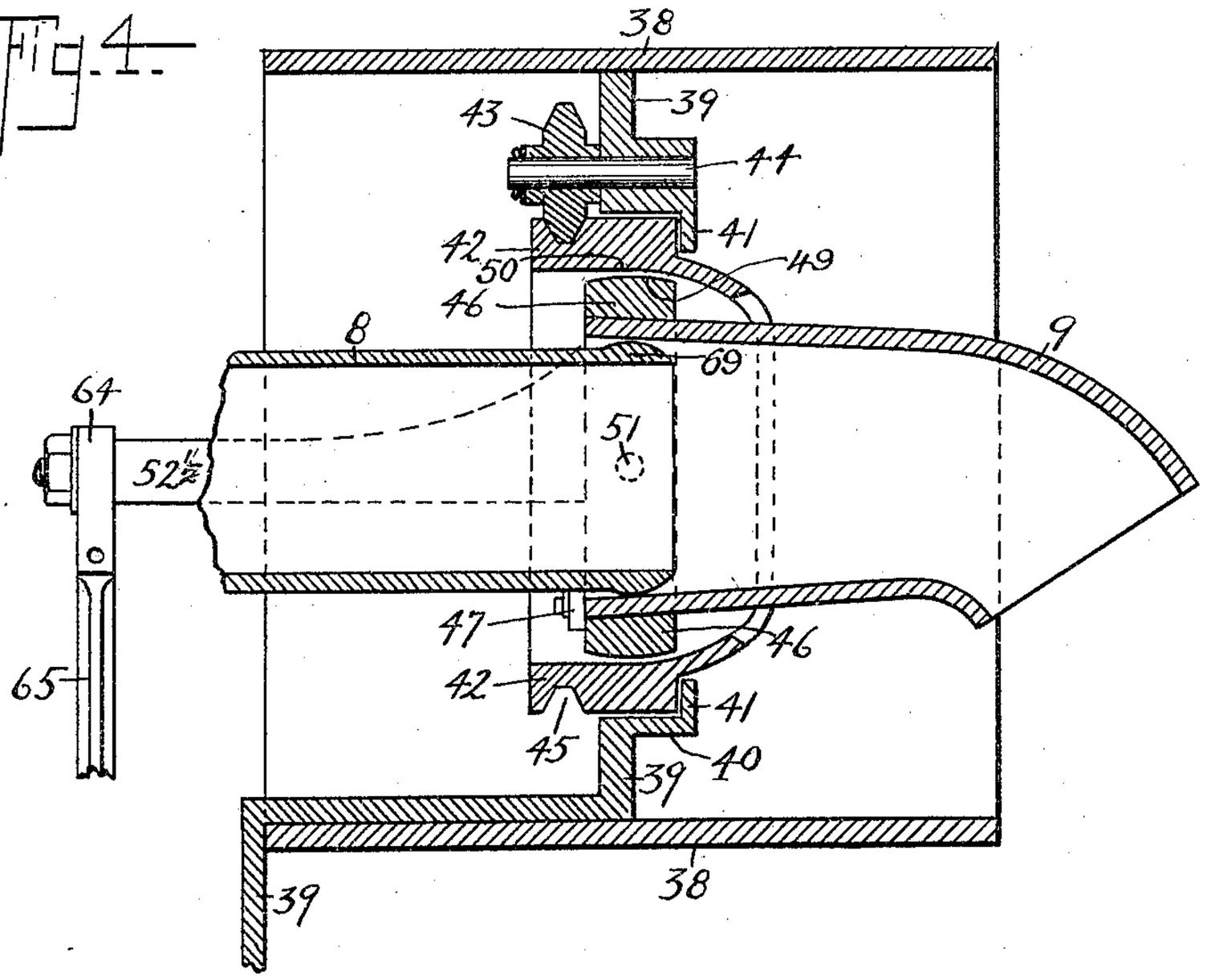
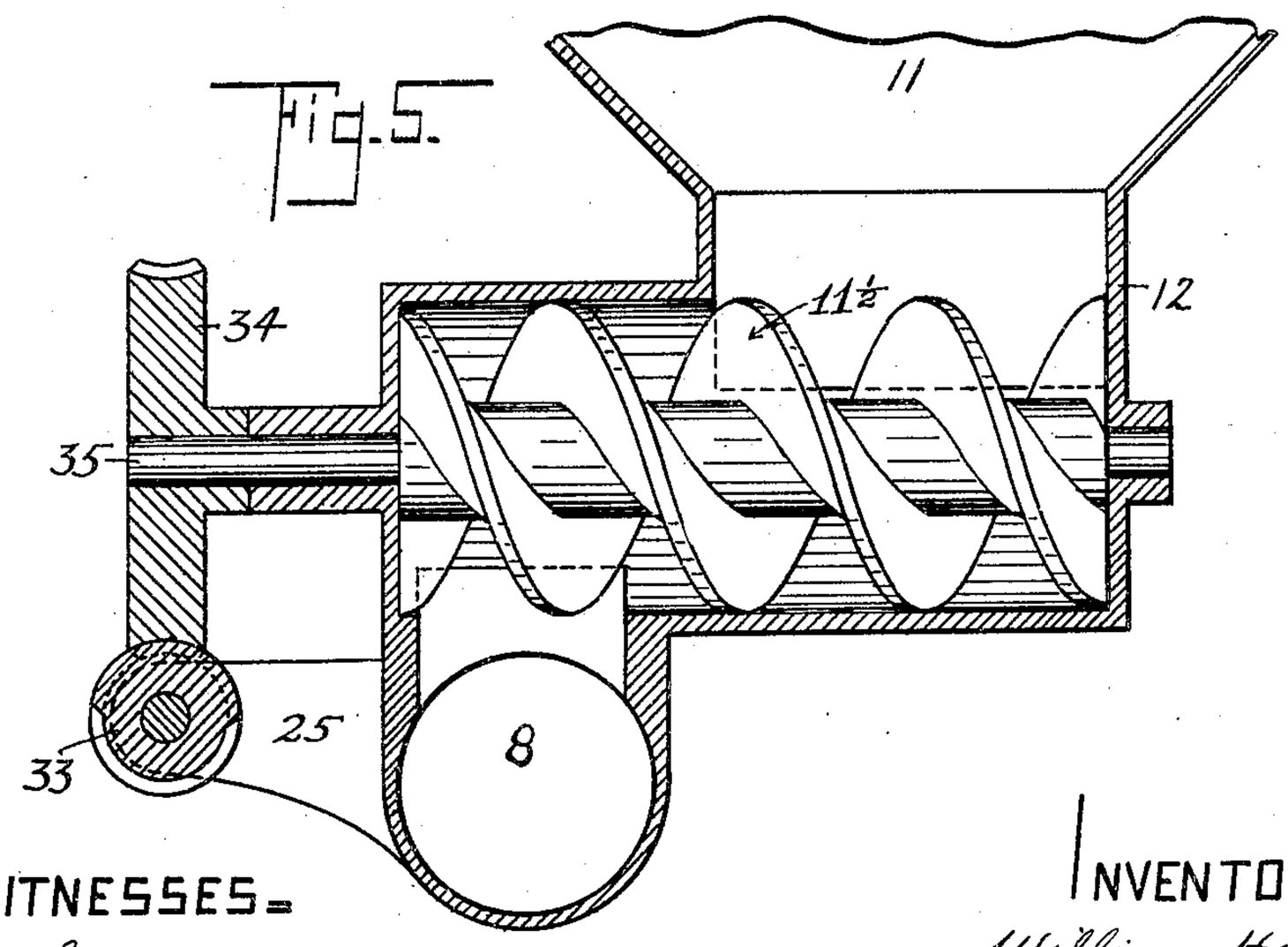


Fig. 5.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC FUEL-FEEDING DEVICE.

SPECIFICATION forming part of Letters Patent No. 789,796, dated May 16, 1905.

Application filed April 23, 1903. Serial No. 153,959.

To all whom it may concern:

Be it known that I, WILLIAM HENRY COOKE, a citizen of the United States, and a resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Automatic Fuel-Feeding Devices, of which the following is a specification.

This invention relates to devices for automatically feeding fuel to furnaces and boilers and for promoting combustion therein.

The object of the invention is to provide means for accomplishing these results and others that will be disclosed hereinafter in the course of the description of the invention in an efficient manner and by simple and easily-operated mechanism that can be attached to furnaces and boilers of ordinary construction.

By means of this invention the coal or other fuel for the furnace or boiler is introduced automatically into its fire-box in a constant stream, the direction and inclination of which changes also automatically, so that the fuel is distributed evenly over the entire surface of the grate in thin layers that cannot cake or choke the grate to impede the draft and in a manner in which the fuel is best adapted to be rapidly and completely consumed. This automatic feed is represented in connection with means for introducing into the fire-box a blast of external air for the purpose of effecting complete oxidation of the products of combustion, and a form of construction is represented in which the blast of fresh air itself is the means of conveying the fuel to the furnace from a chute or hopper within which a supply is stored and from which it is automatically fed into the tube through which the blast passes; but as the construction and operation of the automatic feed is explained it will become obvious that any other suitable means may be employed to carry the fuel from the source of supply to the furnace if it is not desired to use the air-blast as the conveying means.

In the drawings, Figure 1 represents a side elevation of a furnace and shows the improved feeder attached thereto. Fig. 2 is a top elevation, the fire-box being shown in cross-section and the course of the stream of fuel being indicated by dotted lines. Fig. 3 is a side view, enlarged, of a part of the device. Fig. 4 is a cross-section on the line 4 4 of Fig. 3, and Fig. 5 is a cross-section on the line 5 5 of Fig. 2 enlarged.

The furnace is represented as bricked in by the walls 1. At the right (see Fig. 2) are shown grates 2 3, that are located in the fire-box, to which access is had by the door 4. The blast of air is supplied by a blower 5 of any suitable construction. The blower is operated by some suitable motive power, as by a motor 6, to which it is connected by a belt 7. A tube 8 carries the air-blast from the blower to the spout 9, from which it is discharged into the fire-box above the grates. A branch tube 10 may be employed, if desired, to carry a current of air beneath the grates in order to provide a forced draft. A hopper or chute 11 is shown for holding a supply of coal or other fuel, from which it is fed into the tube 8, through which it is then carried by the blast of air to the spout 9. The means shown for feeding automatically the fuel from the hopper to the pipe 8 consists of a rotary spiral screw-feeder 11½ within a box 12. One end of said feeder is located beneath the chute, which opens into the box 12, so that the fuel falls by gravity directly upon the feeder, by which it is carried to the other end of said box, where it falls into the tube 8. The spiral feeder is rotated by connection with some motive power. The drawings show it driven by the same motor 6 that operates the blower 5. Means are shown for connecting said parts, by which the speed of the feeder can be regulated, and the feeder can be stopped without stopping the driving-engine. The said connection between the motor and feeder comprises the following parts: A transverse shaft 13 is journaled in lugs 14 on the tube 8. The inner end of said shaft carries a wheel 15, by which it is driven by the motor through the belt 16. Upon the other end of said shaft a friction-disk 17 is rigidly attached. Upon said shaft, between the lugs 14, there is also a sleeve 18 and ring 19. The sleeve is splined to the shaft, so that it can

move longitudinally therein, and the ring which fits the shaft loosely has a cam-face next the outer lug 14. The ring 19 is rotated by means of the handle-bar 20, and when said handle-bar is turned to the right in Fig. 2 the cam-face of the ring is caused to ride up upon the inner face of the lug 14, thereby forcing said sleeve 18, and with it the shaft 13, wheel 15, and disk 17, inwardly against the resistance of a spring 21 upon the shaft 13 between said sleeve and the inner lug 14. In this last position the said driven shaft 13 is disconnected from the feeder, as will presently appear. When the handle-bar 20 is turned back into the position shown in Fig. 2, the spring 21 returns the shaft and the said parts attached to it to their former position. A second rotary shaft, 22, at right angles to said shaft 13, is journaled in lugs 23 and 24 upon the side of the tube 8 and lugs 25 and 26 on the feeder-box 12. A friction-wheel 27 is splined to said shaft so as to rotate with it, but capable of moving longitudinally upon it. Said friction-wheel is moved along said shaft by means of a yoke 28, which lies in a groove in a collar 29 on the side of said wheel, said yoke having a threaded shank 30, that enters a socket in a key 31, which lies in the lug 23 and which is rotated by the handle 32. The said friction-wheel 27 engages the face of the disk 17, and its speed is regulated by changing the radial point of its engagement with the disk 17 by means of the said key 31. Upon the other end of the shaft 22 a worm 33 (see Fig. 1) is attached that meshes with a worm-gear 34, which latter is attached to the shaft 35 of the feeder-spiral $11\frac{1}{2}$. Thus the feeder is driven by the motor 6, and its speed can be regulated by adjusting the key 31 and stopped, if desired, without stopping the motor itself or the blower by throwing the handle-bar 20.

All of the parts so far described are supported above the motor on a frame 36.

An automatic device may be employed, if desired, for throwing the handle-bar 20, and thereby stopping the feeder. In Fig. 1 a flexible diaphragm 37 of ordinary construction is shown, with a rock-lever 76 and a connection with the steam-dome 77 of the boiler through the pipe 78. The end of the lever is connected by a rod 79 with the handle-bar 20.

The regulator may be set for any desired boiler-pressure by adjusting the sliding weight 80 upon the lever 76.

The spout 9, through which the fuel is discharged into the fire-box, is a separate piece in itself from the rest of the feeder-tube and may be introduced into the fire-box at any convenient point. Thus an aperture may be made for it in either the side or end walls of the fire-box, or it may be introduced through a door or other opening into said chamber. In the drawings the spout 9 is shown as entering the fire-box through its side walls at a point some little distance above the grates 2 and 3. A section of the wall 1 having been removed, the casing 38 is placed in it. Within the casing 38 and rigidly attached thereto is a supporting-frame 39, having a ring-like portion 40 and inwardly-projecting flange 41. A rotary supporting-ring 42 lies within the frame 41 and is revolubly supported therein by the three rollers 43 upon pins 44, respectively fastened to the frame 39, said rollers lying in a circumferential groove 45 in said ring 42. Upon the rotary frame 42 is a segment-gear $45\frac{1}{2}$. (See Fig. 3.) The spout 9 has a bearing-ring 46 firmly secured to its outer end, as by ears 47 on said spout, that are locked to bolts 48, respectively, on the ring 46. The ring 46 has a convex bearing-surface 49 to correspond with the concave bearing-surface 50 on the inside of the rotative ring 42. By sliding the ears 47 upon the bolts 48, respectively, the inclination of the spout 9 may be changed. The spout and its bearing-ring 46 are pivotally attached to the rotative ring 42, as by pins 51, so that the free end of said spout that projects into the fire-box is adapted to tilt; but said spout is rotative with said ring 42. The spout is rotated by means of a pinion 52 upon a shaft 53, supported in turn by the standard 54. A crank 55, wrist-pin 56, pitman 57, and wrist-pin 58 connect said pinion with the driven spur-wheel 59 to reciprocate it. The wheel 59 is driven by the spur-wheel 60, and that in turn is driven by a connection with the motor 6 through a chain 61, that drives a wheel 62 on the same rotative shaft 63 that carries the spur-wheel 60. The arc through which the spout rotates back and forth can be adjusted by changing the location of the pin 56 in the slot in the crank 55. The spout is reciprocated by means of a lever-arm $52\frac{1}{2}$, one end of which is rigidly attached to the ring 46. The driving-wheel 59 is connected with said lever to tilt it by means of the link 64, pitman 65, wrist-pin 66, crank 67, and spur-gear 68. The throw of the pitman 65, and consequently the dip or angle of inclination of the spout, can be regulated by adjusting the pin 66 in the slot in the crank 61. A shoulder 69 on the end of the tube 8 affords a bearing for the nozzle 9, and allowance is made in the ring 42 for its vertical movement. Thus the direction of the stream of fuel is constantly changed by operating the spout 9 so that the fuel as it flows from it is laid across the grates in zig-zag course throughout their length, as the mouth of the spout is oscillated by suitable means, as by those described above. To accomplish this result, two distinct operations of the spout must be effected—one by which the angle of the stream with the horizontal plane is constantly changed and another by which its angle with the vertical plane is at the same time constantly changed. The spout may have a mouth that is at an angle with its axis, as represented in the drawings, in which

case the angle with the horizontal plane at which the stream of fuel is discharged from the spout is changed by rocking said spout by suitable means, as by those described above. The continuous rocking back and forth and vertical reciprocation of the spout causes the central line of the stream of fuel to follow a zigzag course, like that indicated in Fig. 2 by the dotted lines on the grates 2 and 3, from which the fuel will be sprayed out. The spout can be kept stationary without stopping the motor 6 or discontinuing the feed by means of a lever 70, that operates, through a yoke 71, a clutch 72, placed between the wheels 60 and 62.

A damper 73, operated by the lever 74, (see Fig. 1,) is shown for regulating the blast of air that passes through the pipe 10 for the purpose of creating a forced draft, and this damper may be locked in any desired position by suitable connections between said lever 74 and the guide 75.

The operation of the device is as follows: A supply of coal or other fuel is placed in the hopper 11, the motor is started, and the feeder and spout actuating mechanism is connected with the motor by throwing the lever-rod 20 back into the position shown in Fig. 2 and connecting the wheels 60 and 62 by the clutch 72, respectively. A blast of air is conducted from the blower 5 through the tubes 8 and 10 to the spout 9 and beneath the grates, respectively. Fuel is carried from the hopper through the box 12 by the spiral feeder 11 to the tube 8, through which it will be carried by the blast that passes through said tube. As the spout rocks back and forth and tilts up and down in the manner described above, the stream of mixed air and fuel that issues from its mouth will continuously change its direction, so that that portion of the fuel that falls upon the grates will be laid across it from one side to the other throughout its length in the manner already explained. As the stream of fuel leaves the mouth of the spout it spreads out, so that its separate particles are subjected to the heat of the furnace. The oxygen of the fresh air introduced into the furnace with the fuel effects a complete and rapid oxidation of the particles and many of them are consumed before they can fall upon the grates. Few, if any, of the particles will escape from the furnace with the incombustible gases, for those that do not fall upon the grates and are there consumed are consumed in the mixture of external air supplied through the spout and the combustible gases that rise from the grates. This apparatus, therefore, when attached to a furnace or boiler converts such furnace or boiler into a smoke-consumer.

By employing this apparatus pulverized or dust fuel can be used to advantage, both from the standpoint of efficiency and economy. Furnaces and boilers equipped with this improvement can use finely-pulverized fuels, which can be procured at small cost and which under ordinary conditions are not available for fuel because they choke the grates and for the reason that a large part of them are carried away with the products of combustion, occasioning loss and creating a smoke nuisance. The manner in which the fuel is laid upon the grates in thin layers insures its speedy ignition and prevents the grates from getting clogged, so that the draft is stopped. The forced draft through the pipe 10 accelerates the combustion.

An important feature of the invention lies in the introduction of the blast of fresh air above and below the grates in the manner hereinabove described. Not only is a forced draft obtained by means of the tube or pipe 10 and a supply of oxygen for the fire-box by means of the tube 9, but by introducing the air to the fire-box through these tubes respectively in the peculiar manner shown and described complete combustion is more nearly attained. In the drawings the mouth of the spout 9 is represented as directed toward the flame that rises from the grates, so that the stream of air and fuel that issue from the spout is discharged directly against the draft of the furnace or boiler. Some of the gases that are generated by heating the fuel upon the grates are unconsumed and rise from the grates with the smoke and products of combustion to pass out with them from the fire-box. The fresh air that is introduced into the fire-box through the spout 9 is discharged directly into these gases and in such a way that it is thoroughly mixed with it. A considerable proportion of the fine particles of fuel that is also discharged from the spout 9 is at once consumed by this inflammable mixture. Thus the efficiency of the furnace or boiler is both greatly increased and a double saving is effected, for the gas that would escape unconsumed with the products of combustion is consumed in the fire-box and adds to the intensity of the heat and the finer particles of fuel that are ordinarily discharged from the fire-box unconsumed are consumed also and add to the intensity of the heat.

What I claim is—

1. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; and means for automatically oscillating the discharge end of the spout at angles with both the horizontal and vertical planes.

2. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; means for automatically oscillating the discharge end of the spout at angles with both

the horizontal and vertical planes; and an automatic feeding device, whereby fuel is fed to said conveyer from said supply.

3. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying said fuel from said supply to said spout; means for automatically oscillating the discharge end of the spout at angles with both the horizontal and vertical planes; an automatic feeding device, whereby fuel is fed to said conveyer from said supply; and means for regulating the feed.

4. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; means for automatically oscillating the discharge end of the spout at angles with both the horizontal and vertical planes; an automatic feeding device; a driven wheel; and driving connections between said driven wheel and both said conveying means and said means for oscillating said spout.

5. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel into the fire-box, and having its mouth at an angle with its axis; means for conveying fuel from said supply to said spout; and means for automatically both rocking said spout and oscillating its mouth, vertically.

6. In an automatic feeder the combination with a fuel-supply of a spout adapted to discharge fuel into the fire-box, and having its mouth at an angle with its axis; means for conveying fuel from said supply to said spout; means for automatically both rocking and vertically oscillating said spout, a driven wheel; and driving connections between said wheel and both the said means for rocking said spout and those for oscillating it vertically.

7. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout having a pivotal connection therewith; means for independently oscillating said spout and its support, whereby fuel is discharged from the spout upon the grates in zigzag course.

8. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout, having a pivotal connection therewith; a driven wheel; and connections between said driven wheel and said spout and its said support, respectively, whereby said spout and its said support are independently oscillated to discharge fuel upon the grates in zigzag course.

9. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout, having a segmental gear and a pivotal connection with said spout; a driven wheel; and connections between said driven wheel and said spout and said segmental gear, respectively, whereby said spout and its said support are independently oscillated to discharge fuel upon the grates in zigzag course.

10. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout having a pivotal connection therewith; a lever-arm attached to said spout; a driven wheel; and connections between said driven wheel and said lever-arm and said support, respectively, whereby said spout is reciprocated and its said support is rocked.

11. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout; a ring pivotally supported within said support; means for detachably securing said spout to said ring; and means for rocking said support and reciprocating said spout.

12. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; a rotative support for said spout; a ring pivotally supported within said support; adjustable means for attaching said spout to said ring, whereby the direction in which fuel is discharged therefrom is determined; and means for rocking said support and reciprocating said spout.

13. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; the rotative ring-support 42, having the segmental gear 45; and a pivotal connection with said spout; a bearing for said ring; the lever-arm 52 attached to said spout; and means operating upon said segmental gear and said lever-arm, respectively, for oscillating said spout.

14. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; the rotative ring-support 42, having the segmental gear 45; a support for said rotary ring; the ring 46 pivotally supported within said ring 42; means for attaching said spout to the ring 46; means for reciprocating said spout; and means for rocking the ring 42.

15. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; the rotative ring 42, having the segmental

gear 45, and a pivotal connection with said spout; a support for said ring; the lever-arm 52 attached to said spout; the driven wheel 62; and operating connections between said wheel 62 and the segmental gear 45, and said lever, respectively, whereby said spout is both reciprocated vertically and rocked.

16. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; the rotative ring 42, having the segmental gear 45 and a pivotal connection with said spout; a support for said ring; the lever-arm 52 attached to said spout; the driven wheel 62; and operating connections between said wheel 62 and the segmental gear 45, and said lever, respectively, whereby said spout is both reciprocated vertically and rocked; and means for adjusting the rotation of said ring 42.

17. In an automatic fuel-feeder the combination with a fuel-supply, of a spout adapted to discharge fuel upon the grates; means for conveying fuel from said supply to said spout; the rotative ring 42, having the segmental gear 45 and a pivotal connection with said spout; a support for said ring; the lever-arm 52 attached to said spout; the driven wheel 62; and operating connections between said wheel 62 and the segmental gear 45, and said lever, respectively, whereby said spout is both reciprocated vertically and rocked; and means for adjusting the throw of said lever-arm 52.

18. In an automatic fuel-feeder the combination with a fuel-supply of means for conveying fuel from said supply to the fire-box of a furnace, or boiler; a separate spout as a part of said conveying means through which the fuel is discharged; means for pivotally supporting said spout at one end, and means for automatically oscillating the discharge end of said spout at angles with both the horizontal and vertical planes, so that the fuel is discharged therefrom upon the grates in zigzag course.

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Witnesses:
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