

No. 710,171.

Patented Sept. 30, 1902.

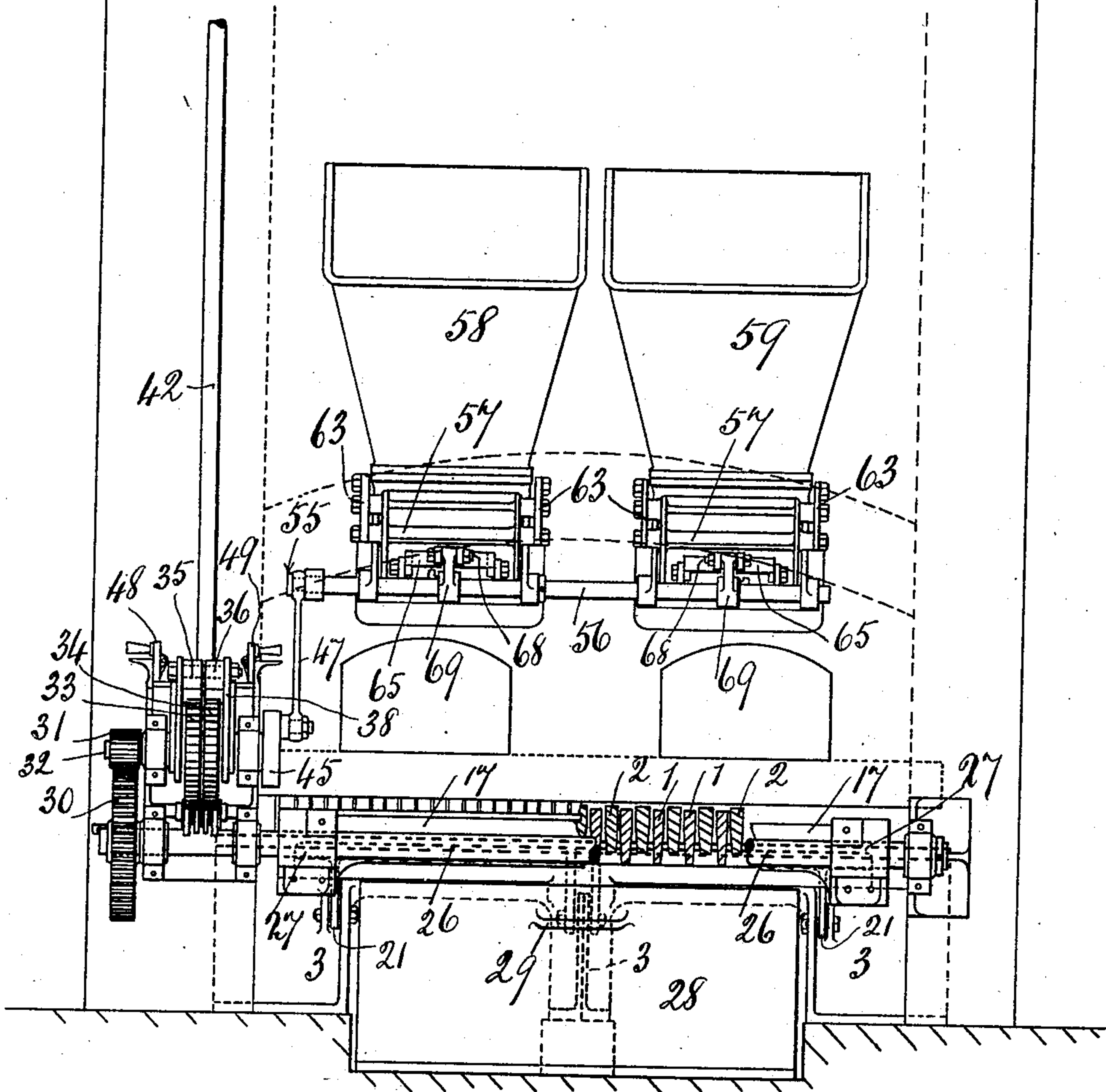
N. S. ARTHUR & J. S. BINNIE.  
MECHANICAL STOKER.

(Application filed Aug. 20, 1901.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1.



Witnesses:  
L. H. Grote.  
C. Sedgwick

Inventors:  
N. S. Arthur and  
J. S. Binnie.  
By *Agood & Co.*  
Attorneys.

No. 710,171.

Patented Sept. 30, 1902.

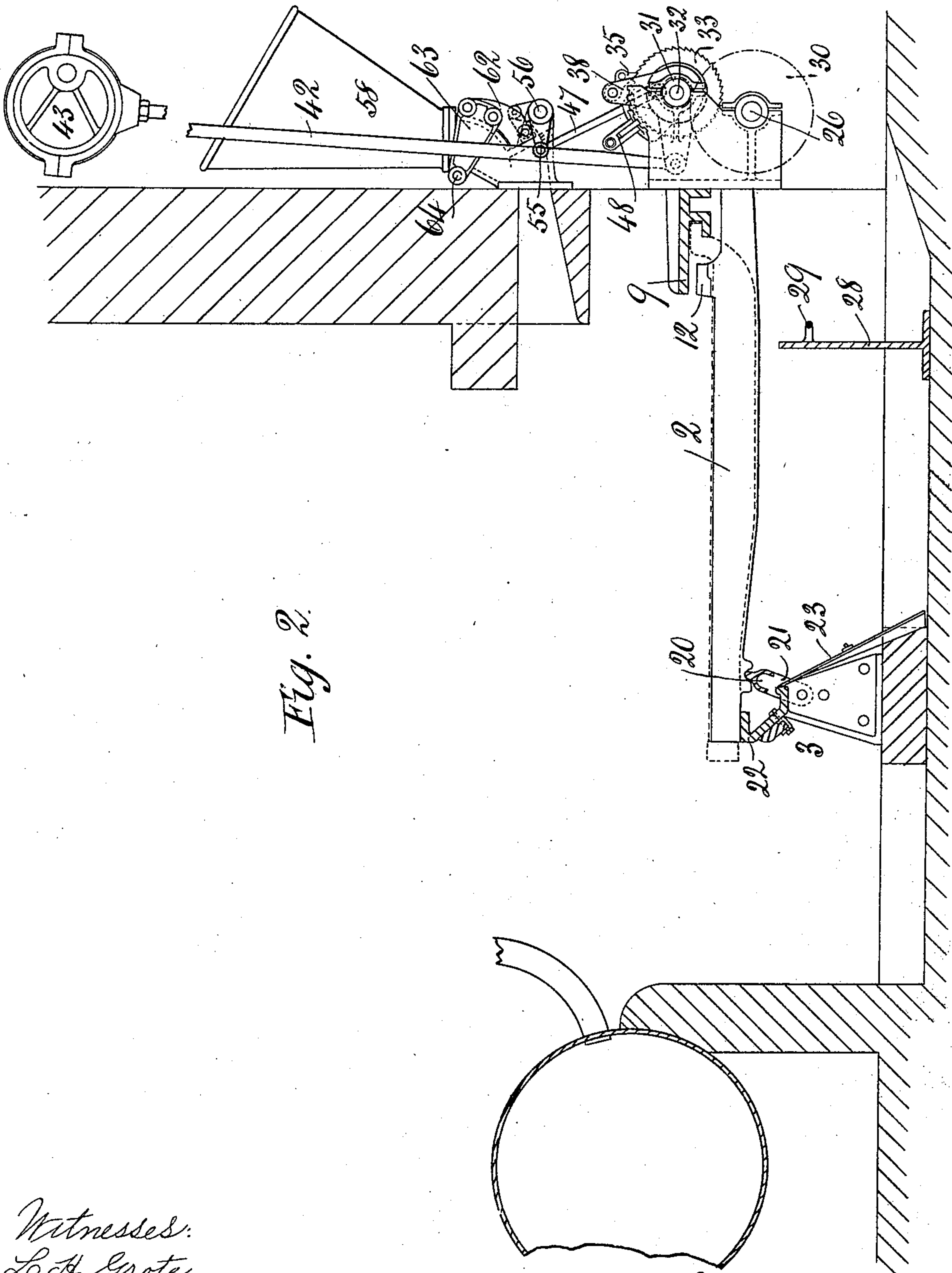
N. S. ARTHUR & J. S. BINNIE.

MECHANICAL STOKER.

(Application filed Aug. 20, 1901.)

(No Model.)

4 Sheets—Sheet 2.



Witnesses:  
L. H. Grote  
C. Sedgwick

Inventors:  
N. S. Arthur & J. S. Binnie,  
By *Asplund & Co.*  
Attorneys.

No. 710,171.

Patented Sept. 30, 1902.

N. S. ARTHUR & J. S. BINNIE.

MECHANICAL STOKER.

(Application filed Aug. 20, 1901.)

(No Model.)

4 Sheets—Sheet 3.

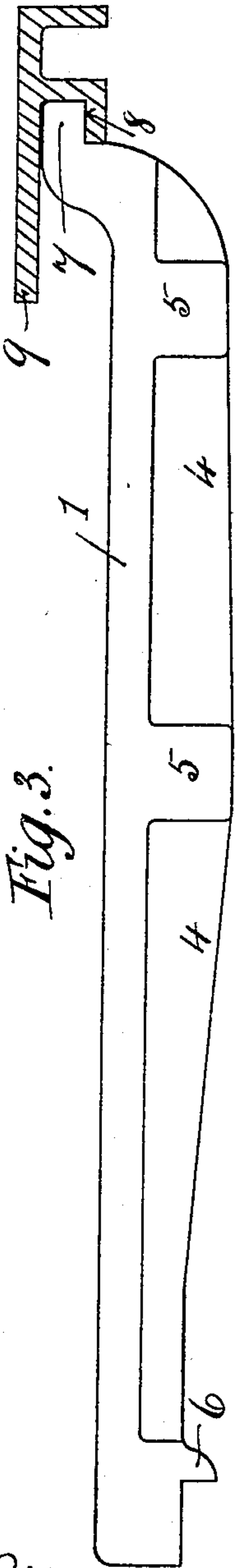


Fig. 3.

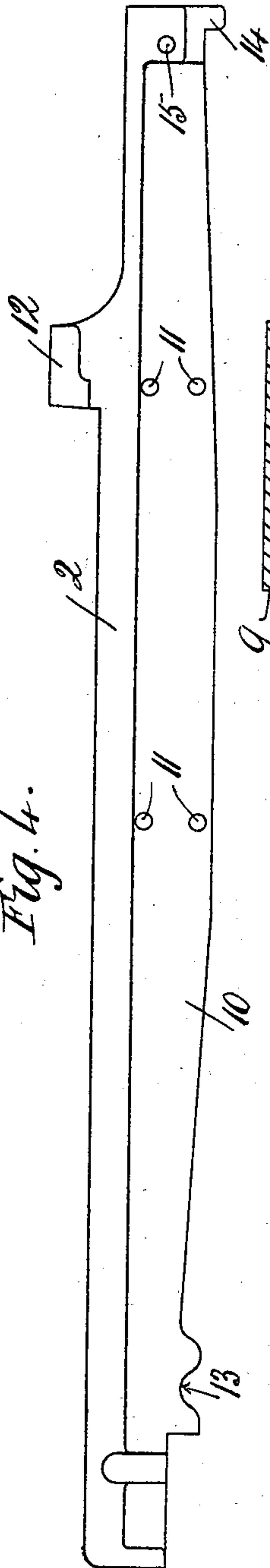


Fig. 4.

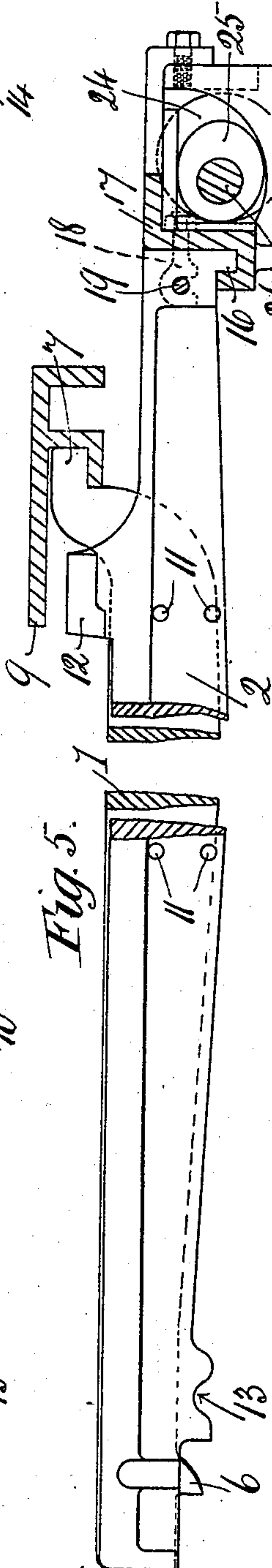


Fig. 5.

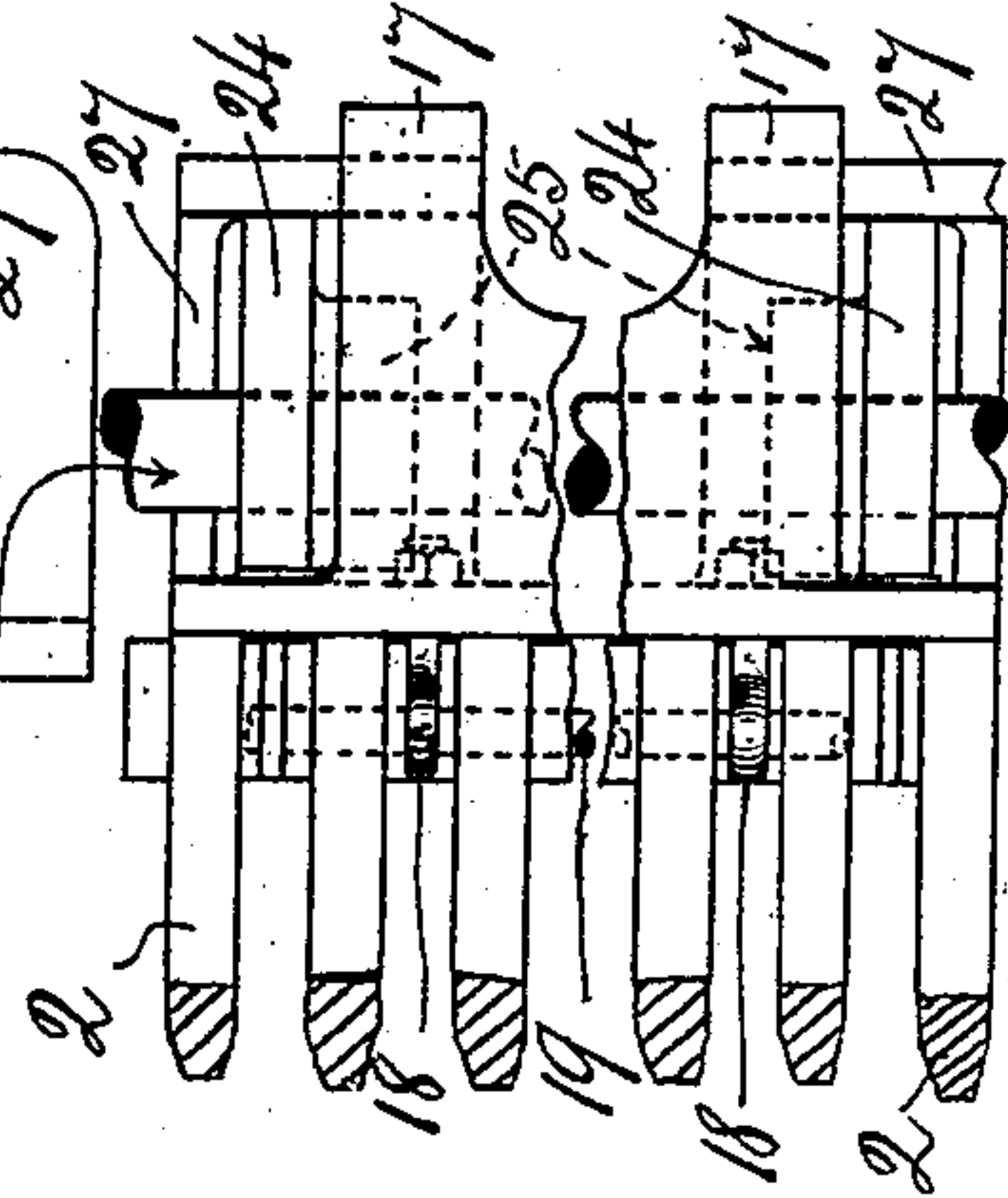


Fig. 6.

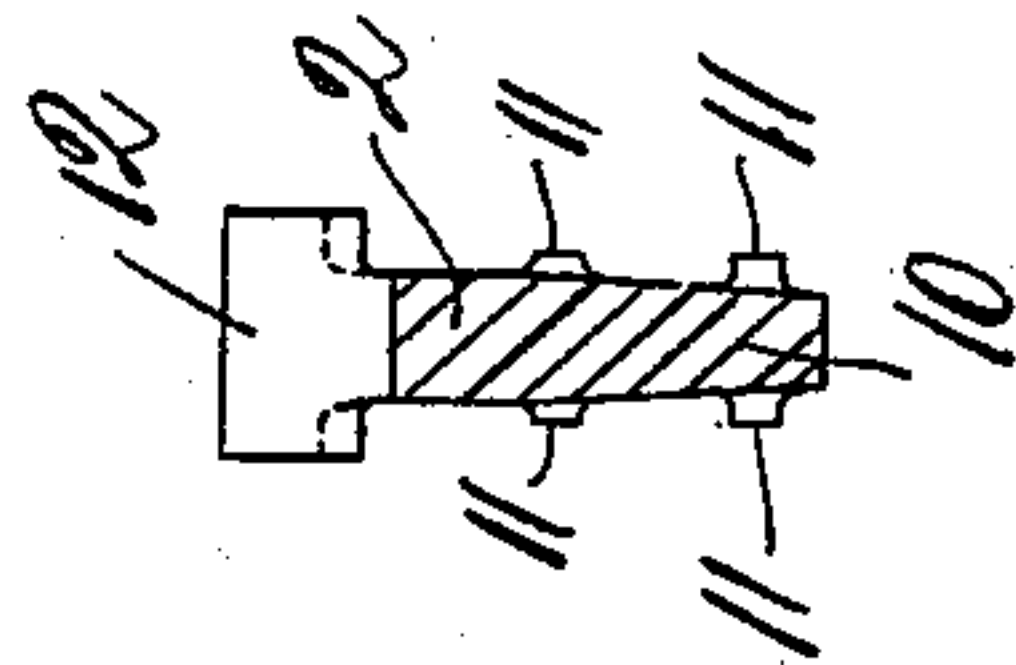


Fig. 7.

Witnesses:  
L. H. Grote  
A. Sedgwick

Inventors:  
N. S. Arthur and  
J. S. Binnie.  
By C. Good & Co.  
Attorneys



No. 710,171.

Patented Sept. 30, 1902.

N. S. ARTHUR & J. S. BINNIE.

MECHANICAL STOKER.

(Application filed Aug. 20, 1901.)

(No Model.)

4 Sheets—Sheet 4.

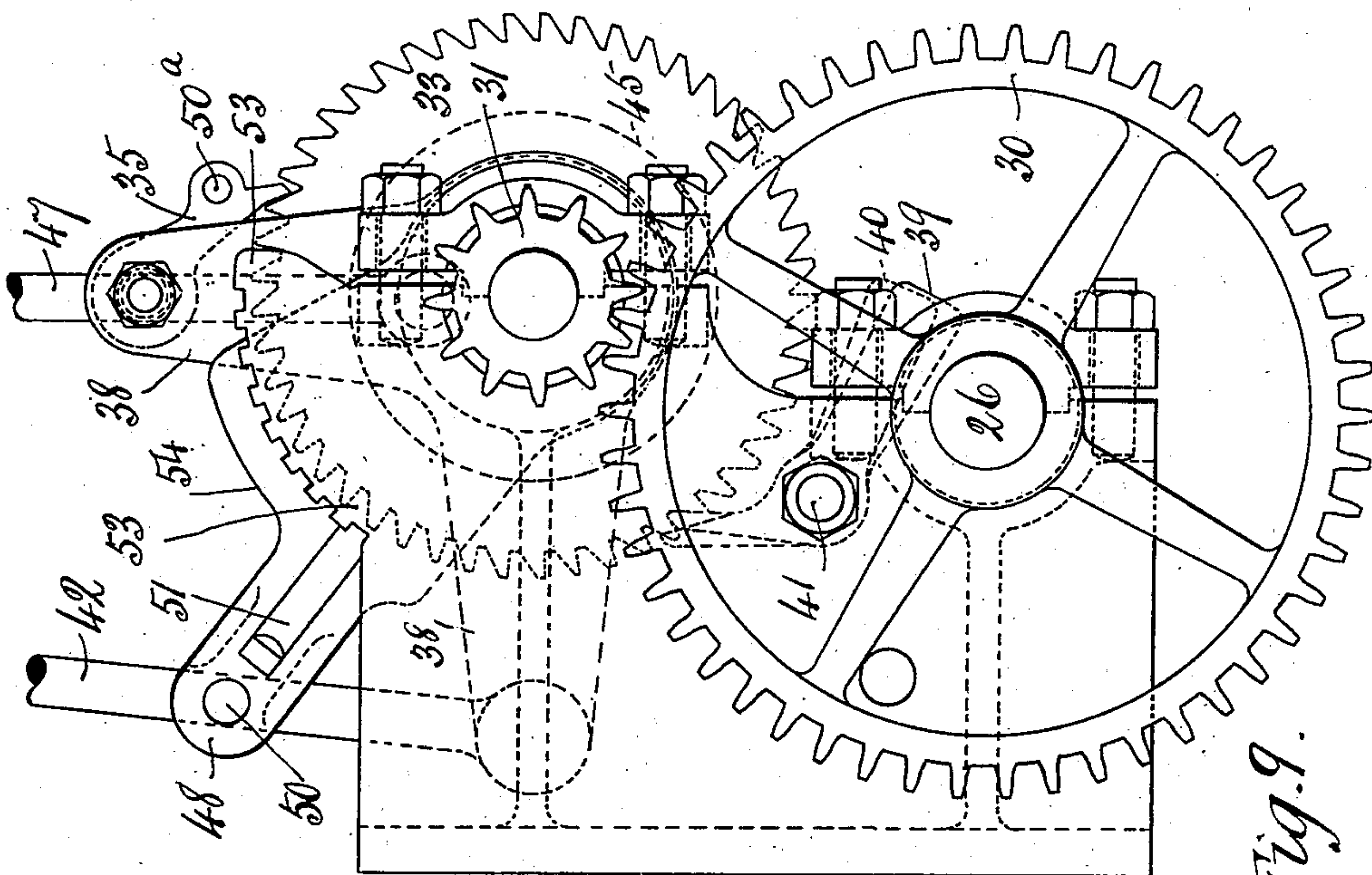


Fig. 9.

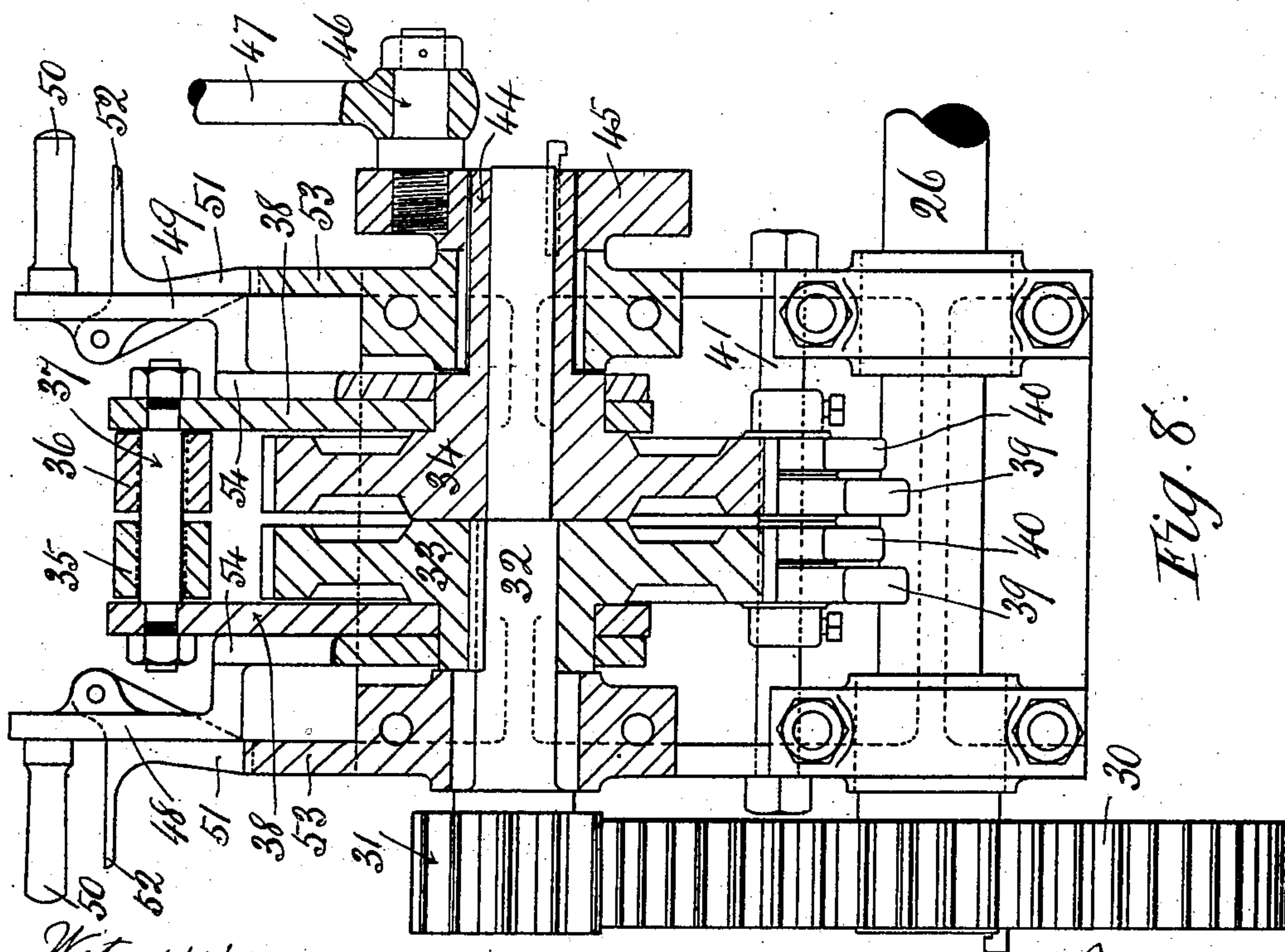


Fig. 8.

Witnesses:  
L. H. Grote  
C. Sedgwick

Inventors:  
N. S. Arthur & J. S. Binnie,  
By Caspell & Co.  
Attorneys.



# UNITED STATES PATENT OFFICE.

NICOL SINCLAIR ARTHUR, OF GLASGOW, AND JOHN SILLARS BINNIE, OF KILMALCOLM, SCOTLAND.

## MECHANICAL STOKER.

SPECIFICATION forming part of Letters Patent No. 710,171, dated September 30, 1902.

Application filed August 20, 1901. Serial No. 72,638. (No model.)

*To all whom it may concern:*

Be it known that we, NICOL SINCLAIR ARTHUR, of 64 Buchanan street, Glasgow, and JOHN SILLARS BINNIE, of Belmont, Kilmalcolm, county of Renfrew, Scotland, subjects of the King of Great Britain, have invented certain new and useful Improvements in Mechanical Stokers, of which the following is a specification.

10 This invention relates to mechanical stokers for boiler and other furnaces of that class wherein movable fire-bars are used.

Mechanical stokers having grates with movable fire-bars have not been heretofore successful owing to defects in their construction and to their failure to give a regular and steady feed of fuel combined with a properly-distributed supply of air up through the bars and among the coal.

20 Our invention does not consist in any radical departure from former practice, but in an improved construction, arrangement, and combination of the parts of the apparatus whereby a mechanical stoker which has been proved by experiment to be both reliable and efficient is obtained.

The features of novelty constituting the invention are pointed out in the claims at the end of this specification.

30 The annexed drawings illustrate our invention.

Figure 1 is a front elevation with part broken away, so as to show the fire-bars of the apparatus as applied to the furnace of a water-tube boiler. Fig. 2 is a longitudinal section taken through the furnace, but showing the driving-gear and stoker in side elevation. Figs. 3, 4, and 5 are detail views of the furnace-grate bars and parts connected therewith. Fig. 6 is a plan of part of the furnace-grate. Fig. 7 is an enlarged cross-section of a grate-bar. Fig. 8 is a section, and Fig. 9 a side elevation, of the driving-gear of the stoker.

45 On the drawings the same reference-numerals wherever repeated indicate the same parts.

The furnace-grate consists of a number of fixed bars 1 and movable bars 2, arranged alternately side by side. Each fixed bar is made, as shown at Fig. 3, with a central lon-

gitudinal depending web 4, side cheeks 5, lug 6, and catch 7, which latter enters a recess 8, formed at the under side of the dead-plate 9 of the furnace. The lug 6 bears against the top flange of the back bearer 22 on the fire-bridge 3. Each movable bar is made as shown in Figs. 4 and 7—that is, with a central longitudinal depending web 10, side pops 11, a step 12, which projects laterally over the fixed bars at each side, a recess 13 at the back end, and a hook 14 and hole 15 at the front end. The side cheeks 5 of the bars 1 and the pops 11 of the bars 2 bear against each other, and thereby keep the bars the proper distances apart, so as to allow proper passages between for air and ash.

The hook 14 engages with a groove 16, made in a cross-bearer 17 at the front of the furnace. The bars 2 are also connected to this bearer by means of hook-bolts 18 and a rod 19, passed through the holes 15 of the bars. (See Figs. 5 and 6.) The recess 13 of each movable bar rests upon a cross toggle-bar 20, having a leg 21 at each end, which is pivoted to the bridge 3 in such manner as to be capable of working freely. The bridge has a fixed back bearer 22, upon which the rear ends of the movable bars can slide.

23 is a door in the bridge.

The front bearer 17 supports all the movable bars and is itself carried upon cams 24 at each end of the shaft 26. These cams work in boxes 27, attached to the bearer, and which are partially filled with oil.

28 is an air-deflector consisting of a plate arranged vertically in the well of the ash-pit and provided with a handle 29, whereby it can be readily removed whenever desired.

The cam-shaft 26 is driven by means of the spur-wheel 30 from the pinion 31 of the short shaft 32, which latter, as shown at Fig. 10, is reduced in diameter at its right-hand side. Upon the thick part of the shaft a ratchet-wheel 33 is keyed, while upon the thin part of the shaft a second ratchet-wheel 34 is fitted loosely. The ratchet-wheel 33 has a driving-pawl 35 engaging with it, while the ratchet-wheel 34 has a driving-pawl 36 engaging with it. Both these pawls are carried on the bar 37 at the upper end of the double bell-crank 38, mounted movably on the hubs of the



ratchet-wheels. Each ratchet-wheel is provided with gravity check-pawls 39 40, carried on the fixed bar 41. The bell-crank 38 is actuated by the rod 42 from the eccentric 43 (see Fig. 2) on the main driving-shaft.

On the eccentric 44 of the hub of the ratchet-wheel 34 is a disk-wheel 45, with crank-pin 46, to which the rod 47 is connected.

The pawls 35 36 are gravity-pawls and are provided with laterally-projecting pins 50<sup>a</sup>, and they can be regulated or thrown entirely out of engagement with their ratchet-wheels whenever desired by means of the regulating-levers 48 49 turning upon the hubs of the ratchet-wheels. Each lever is provided with a handle 50 and a spring-catch 51, with projecting handle 52. The catches are adapted to engage with the teeth of the notched guards 53 on the framing. In Fig. 10 the levers 48 49 are shown in the vertical position, while in Fig. 11 they are shown as thrown back. It will be seen that each lever has a shoulder 54, which is capable of bearing against the lateral pin 50<sup>a</sup> of its corresponding driving-pawl.

The rod 47 at its upper end is connected to a wiper 55, which has a greater radial length than the crank-disk 45 and is fitted on the end of the shaft 56 which operates the rams 57 of the feeding-hoppers 58 59. Fitted outside of the hopper-body and so as to work in the throat is the curved feed-ram 57, swung by means of the arms 63 from a cross-shaft 64, fitted at the back of the body. The ram is actuated by means of a forked link 65, connected by a bolt to lugs of the ram and by the hinge-bolt 68 to the arm 69 of the shaft 56. As the shaft 56 is rocked by its driving-gear each ram reciprocates within the throat of its hopper and feeds the fuel regularly into the furnace. The ram is made in the manner shown and swung from the shaft 64 in order to give as little friction as possible in its working. The arrangement is such that presuming both the driving-pawls 35 36 are in action then the bell-crank 38 (operated from the eccentric 43) drives the pawl 35 and ratchet-wheel 33, with the result that the pinion 31 turns the spur-wheel 30 with an intermittent motion, so that the cams 24 25 act intermittently on the front bearer 17 and movable fire-bars 2. The large cams 24 move the bars in and out, while the small cams 25 lift or tilt them up along with the front bearer. The combined action of these cams causes the movable bars to rise up at their front ends, with the front bearer slightly above the level of the fixed bars, then to travel a short distance toward the back of the furnace, moving on and with the swinging toggle-bar 20, then to drop down slightly below the level of the fixed bars, and finally to travel forward again to their original positions. This agitation of the movable bars takes place at intervals and effectually stirs up the coal, allowing air to pass freely therethrough, while breaking up clinkers and the like. The other

driving-pawl 36 simultaneously actuates the ratchet-wheel 34, which turns upon the shaft 32. The movement of the ratchet-wheel 34 is communicated to the crank-disk 45 and from thence by the rod 47 to the wiper 55 and rock-shaft 56, thereby operating the link-gears 69 65 and reciprocating the rams 57, so as to feed the coal into the furnace. The coal from the hoppers falls down on the furnace-grate just in front of the steps or pushers 12, which when the moving bars travel inward push the coal forward along the grate. By moving the regulating-levers 48 49 the driving-pawls 35 36 can be caused to take one, two, or more teeth of the ratchet-wheels at a time, so that the speed of the coal-feed and of the oscillation of the grate-bars can be regulated as desired. When either of the regulating-levers is pulled forward to its full extent, the driving-pawl, in connection with the lever so pulled, is lifted up out of engagement with its ratchet-wheel, which thereupon ceases to act. It will easily be seen from the foregoing that by manipulating the regulating-levers the coal-feed can be set into operation either in conjunction with or apart from the oscillating grate. In some cases it is desirable for a time to operate the grate only and in others to operate the coal-feed only.

The deflector 28 directs the intruding air up through the fire-grate and just in advance of the pushers 12, where the most intense heat is generated. The air rushing between the bars keeps them cool and prevents them being injured by the heat.

Having now fully described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a mechanical stoker the combination of a furnace-grate consisting of movable bars each made with a longitudinal depending web, side pops and overhanging pusher, and being intercalated with fixed bars, said movable bars being connected to a bearer at their front ends and working on a toggle-bar carried by the bridge at their rear ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, ratchet-gear for driving the cam-shaft, means for operating the ratchet-gear, and means for feeding the coal upon said grate, substantially as hereinbefore described.

2. In a mechanical stoker the combination of a furnace-grate consisting of movable bars each made with a longitudinal depending web, side pops and overhanging pusher, and being intercalated with fixed bars, said movable bars being connected to a bearer at their front ends and working on a toggle-bar carried by the bridge at their rear ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, ratchet-gear for driving the shaft, a bell-crank and driving-pawl for operating



the ratchet-gear, a connecting-rod and eccentric for operating the bell-crank, means for operating the eccentric, and means for feeding the coal upon said grate, substantially as hereinbefore described.

3. In a mechanical stoker the combination of a furnace-grate consisting of movable bars each made with a longitudinal depending web, side pops and overhanging pusher, and being intercalated with fixed bars, said movable bars being connected to a bearer at their front ends and working on a toggle-bar carried by the bridge at their rear ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, ratchet-gear for driving the shaft, a bell-crank and driving-pawl for operating the ratchet-gear, a regulating-lever for controlling the action of the driving-pawl, means for locking said regulating-lever in position, means for operating the bell-crank, and means for feeding the coal upon said grate, substantially as hereinbefore described.

4. In a mechanical stoker the combination of a furnace-grate consisting of movable bars each made with a longitudinal web, side pops and overhanging pusher, and being intercalated with fixed bars, said movable bars being connected to a bearer at their front ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, a spur-wheel on the shaft, a second shaft, a pinion on this shaft gearing with the spur-wheel, a ratchet-wheel on the second shaft, a bell-crank mounted on the hub of the ratchet-wheel, a driving-pawl on the bell-crank adapted to gear with the ratchet-wheel, means for operating the bell-crank, means for controlling the driving-pawl, and means for feeding the coal upon the grate while the latter is being operated, substantially as described.

5. In a mechanical stoker the combination of a furnace-grate consisting of movable bars intercalated with fixed bars said movable bars being connected to a bearer at their front ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, a second shaft, means for driving the cam-shaft from the second shaft, means for driving the second shaft, a ratchet-wheel fitted loosely on the second shaft, a bell-crank mounted on the hub of the ratchet-wheel, a driving-pawl on the bell-crank adapted to gear with the ratchet-wheel, means for operating the bell-crank, means for feeding fuel to the grate, and means for operating said fuel-feeding means from the ratchet-wheel, substantially as hereinbefore described.

6. In a mechanical stoker the combination of a furnace-grate consisting of movable bars intercalated with fixed bars said movable

bars being connected to a bearer at their front ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, a second shaft, means for driving the cam-shaft from the second shaft, means for driving the second shaft, a ratchet-wheel fixed on the second shaft, a ratchet-wheel mounted loosely on the second shaft, a bell-crank mounted on the hubs of the ratchet-wheels, driving-pawls on the bell-crank, means for operating the bell-crank, means for controlling the action of the pawls, means for feeding fuel to the grate, and means for operating said fuel-feeding means from the loose ratchet-wheel, substantially as hereinbefore described.

7. In a mechanical stoker the combination of a furnace-grate consisting of movable bars intercalated with fixed bars, said movable bars being connected to a bearer at their front ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, a spur-wheel on the shaft, a second shaft, a pinion on this shaft and gearing with the spur-wheel, a ratchet-wheel fitted loosely on the second shaft, a bell-crank mounted on the hub of the ratchet-wheel, a driving-pawl on the bell-crank adapted to gear with the ratchet-wheel, means for operating the bell-crank, means for controlling the driving-pawl, a disk on the hub of the ratchet-wheel, a crank-pin in said disk, a rod connecting the pin with a wiper on a rock-shaft, and means for feeding fuel to the grate, substantially as described.

8. In a mechanical stoker the combination of a furnace-grate consisting of movable bars intercalated with fixed bars, said movable bars being connected to a bearer at their front ends, cams arranged in connection with said bearer and adapted to give it and the movable fire-bars a combined vertical and horizontal movement, a cam-shaft, a spur-wheel on the shaft, a second shaft, a pinion on this shaft gearing with the spur-wheel, a ratchet-wheel fixed on the second shaft, a ratchet-wheel mounted loose on the second shaft, a bell-crank mounted on the hubs of the ratchet-wheels, driving-pawls on the bell-crank, means for operating the bell-crank, means for controlling the action of the pawls, check-pawls for the ratchet-wheels, a disk on the hub of the loose ratchet-wheel, a crank-pin in said disk, a rod connecting the pin with a wiper on a rock-shaft, and fuel-feeding means operated by said rock-shaft, substantially as described.

9. In a mechanical stoker provided with means for automatically feeding the coal upon the grate-surface and means for simultaneously operating the movable bars of the grate, the combination with said movable bars of fixed bars, as 1, each made with a longitudinal depending web, side cheeks, a raised



catch at the front end and a lug at the rear end, substantially as and for the purposes set forth.

10. In a mechanical stoker provided with  
5 means for automatically feeding the coal upon the grate-surface and means for simultaneously moving the movable fire-bars, the combination with the fixed bars of the movable bars each made with a longitudinal de-  
10 pending web, side pops, and overhanging pusher, a hook, as 14, at the front end, and a recess, as 13, at the other end, the whole being arranged for combined operation substantially in the manner and for the purposes  
15 set forth.

11. In a mechanical stoker having means for automatically feeding the coal upon the grate-surface and means for simultaneously

operating the movable bars of the grate, the combination with the fixed grate-bars of the 20 said movable bars each of which is provided with a hook at one end and a recess at the other, a bearer having a recess for the reception of the hooks, a toggle-bar adapted to work in the recesses of the movable fire-bars, 25 and a cross-bar and hook-bolts for connecting the movable fire-bars to the bearer, the parts being arranged for operation substantially in the manner and for the purposes set forth.

Signed at Glasgow, Scotland, this 6th day 30 day of August, 1901.

NICOL SINCLAIR ARTHUR.

JOHN SILLARS BINNIE.

Witnesses:

HUGH D. FITZPATRICK,  
WILLIAM FLEMING.