No. 782,269. PATENTED FEB. 14, 1905.

A. A. RAMSDELL.

AUTOMATIC FIRING DEVICE.

APPLICATION FILED APR. 27, 1903.

2 SHEETS—SHEET 1.

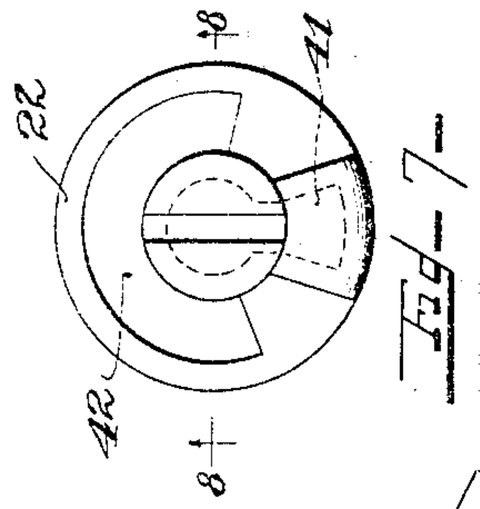

Fig. 7.

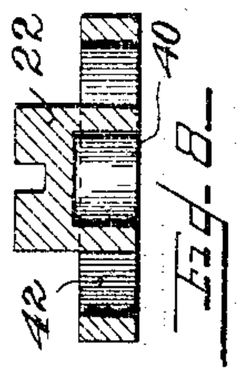

Fig. 8.

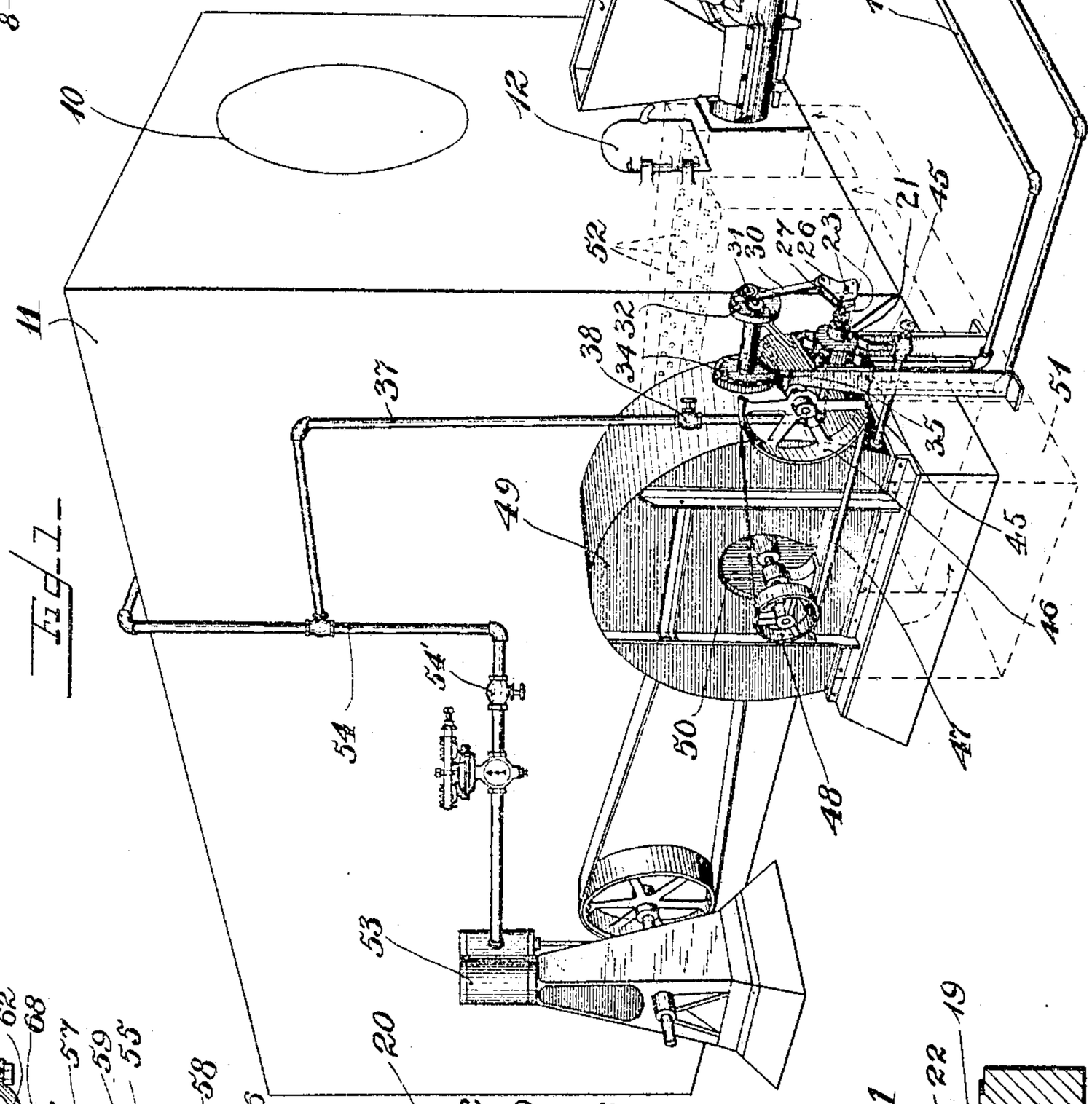

Fig. 1.

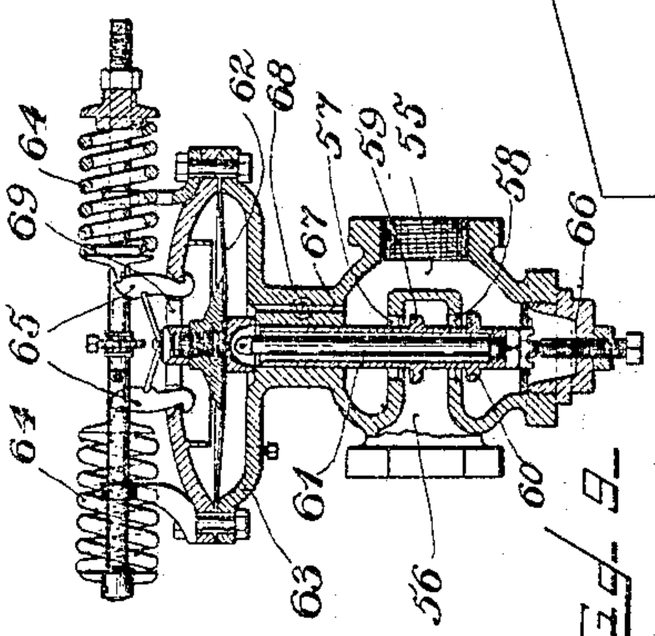

Fig. 3.

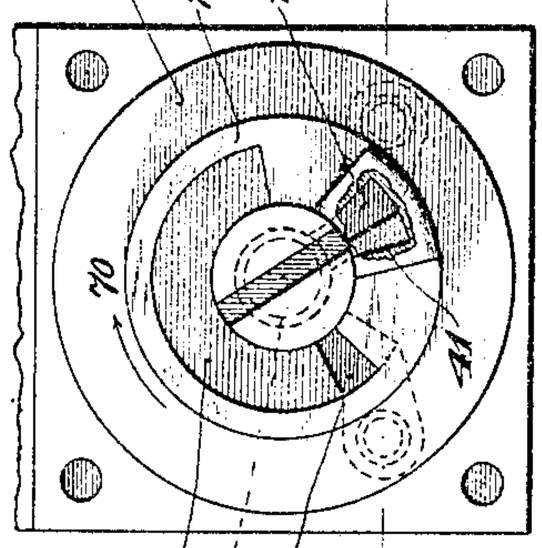

Fig. 5.

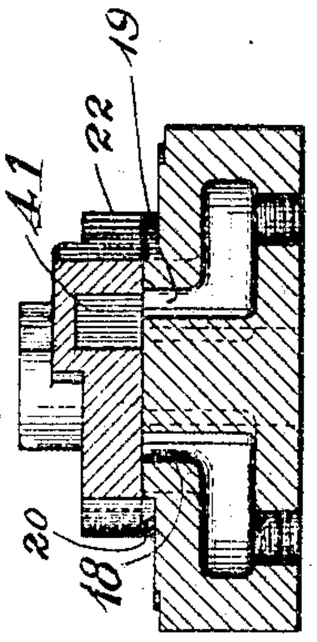

Fig. 6.

Witnesses
Charles J. Schmidt.
Lynn A. Williams

Inventor
Albert A. Ramsdell
By Charles A. Brown
Attorney

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2 SHEETS—SHEET 2.

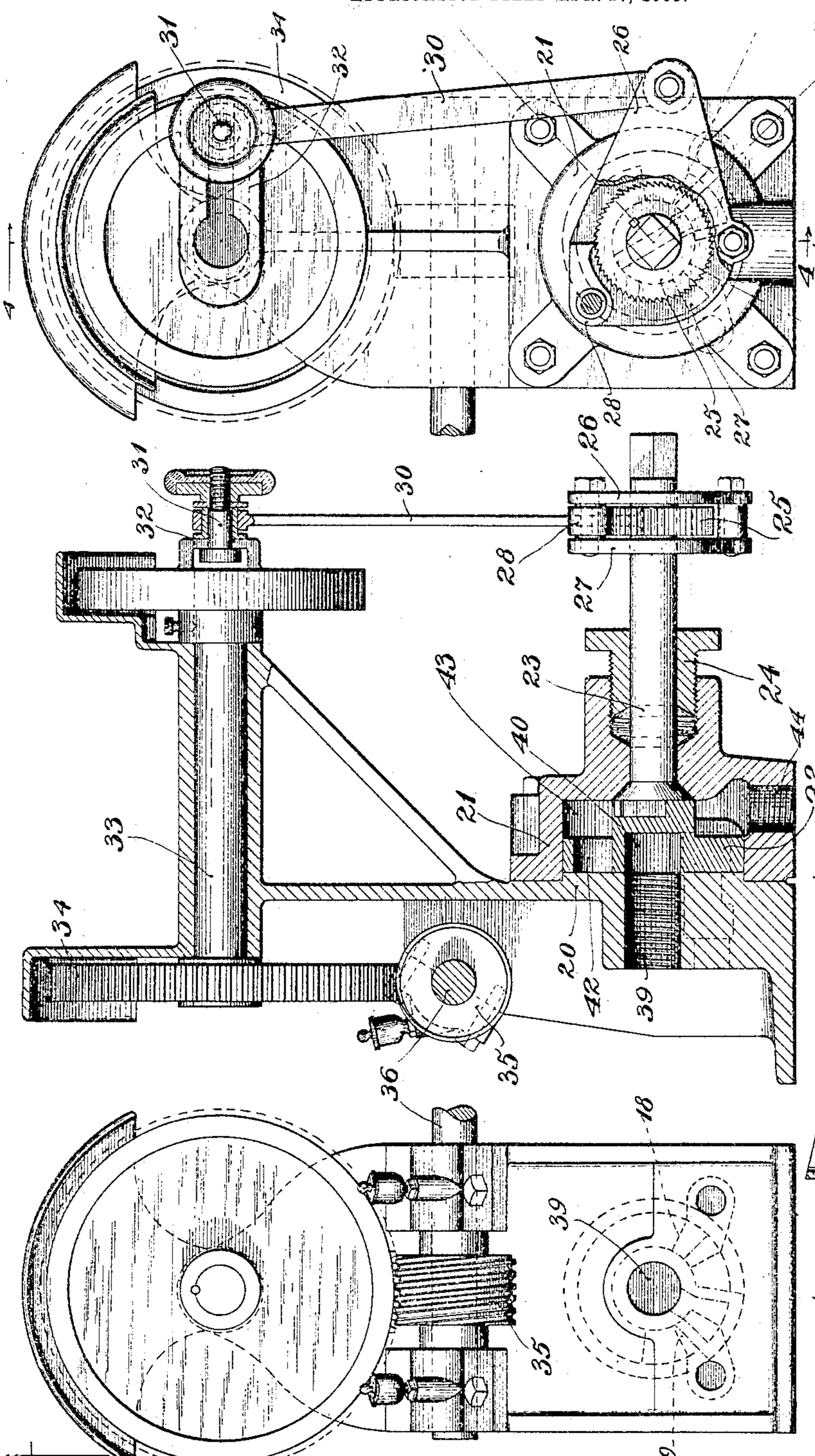

Fig. 2.

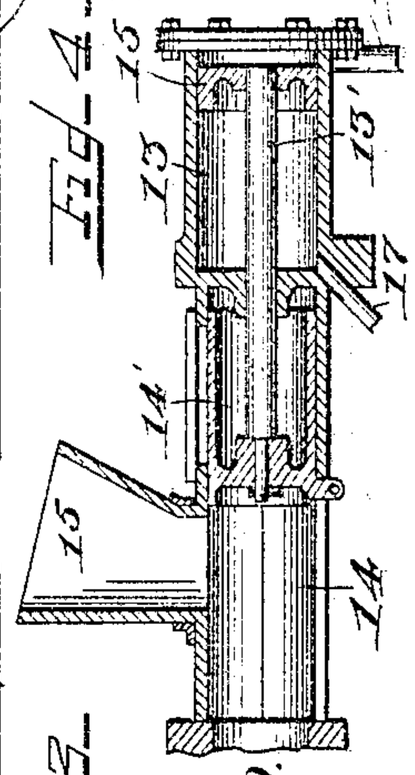

Fig. 4.

Fig. 10.

Witnesses
Charles J. Schmidt.
Lyman A. Williams

Inventor
Albert A. Ramsdell
By Charles A. Brown
Attorney

No. 782,269. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

ALBERT A. RAMSDELL, OF DETROIT, MICHIGAN, ASSIGNOR TO THE UNDER-FEED STOKER COMPANY OF AMERICA, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY.

AUTOMATIC FIRING DEVICE.

SPECIFICATION forming part of Letters Patent No. 782,269, dated February 14, 1905.

Application filed April 27, 1903. Serial No. 154,458.

To all whom it may concern:

Be it known that I, ALBERT A. RAMSDELL, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented a certain new and useful Improvement in Automatic Firing Devices, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to automatic mechanism for stoking or firing furnaces. It may be applied to furnaces of any style or type and to a furnace whose heating effect may be utilized for any one of an almost endless variety of purposes. While I do not in any manner wish to limit the use of my invention to such furnaces, I have found it particularly well suited for use in connection with furnaces employed in metallurgical processes and in furnaces used for heating steam-boilers.

The especial object of my invention is to provide means whereby the stoking or firing of furnaces may be accomplished entirely automatically and at the same time with the greatest possible economy in fuel.

My invention provides, first, for the automatic regulation of the rate of operation of any type of mechanical stoking mechanism to correspond with the demand made upon the furnace supplied thereby, and, second, to provide automatic means for regulating the supply of both air and fuel to correspond with the demand upon the furnace, whereby the proper and most economical and efficient proportion of air to fuel may be maintained at all times regardless of any and all variations in the rate of operation of the stoking mechanism or the quantity of air admitted to the furnace, either and both corresponding with the demand upon the furnace.

My invention may be adapted to almost any kind of furnace, and any type of mechanical stoking apparatus may be employed. It is adapted for use in connection with any suitable means for supplying air to the furnace, and a great variety of devices may be employed for automatically controlling the rate of operation of the stoking mechanism and the quantity of air admitted to the furnace to correspond with the demand upon the furnace.

It will be seen that my invention provides means whereby the stoking or firing of a furnace may be accomplished wholly automatically, thereby overcoming the defects in systems of the prior art hereinbefore pointed out. The use of automatic mechanism for jointly regulating the supply of fuel and air to a furnace causes the most efficient and economical consumption of fuel to correspond at all times with the useful work done by the furnace.

While my invention is thus applicable to a great variety of furnaces for a correspondingly great number of purposes, I have found my invention to be particularly advantageous when employed in connection with a furnace used for heating a steam-boiler. As applied to a steam-boiler furnace my invention may comprise any suitable mechanical stoker, either overfeed or underfeed, the power for driving which may be derived from any suitable source, such as a steam-engine or steam-cylinder having suitably-controlled valve mechanism. In case a steam-cylinder is associated with the mechanical stoker to supply the necessary power thereto a steam-engine may be employed to control the valve mechanism. In either case the steam-engine may, if desired, be driven by steam from the boiler to which the furnace is applied. A suitable regulator may be placed in the supply-pipe connecting the boiler with the engine, the regulator being such as to control the speed of the engine to correspond inversely with the boiler steam-pressure, an increase in the boiler steam-pressure causing a decrease in the speed of the engine, and a decrease in the boiler-pressure causing an increase in the speed of the engine. The rate of operation of the mechanical stoker and the quantity of fuel supplied to the furnace is thereby made to correspond inversely with the boiler steam-pressure.

I find it desirable to employ forced draft in

connection with installations embodying my invention. Such forced draft may be provided by a rotary fan or blower forcing air under pressure into the combustion-chamber of the furnace. In case an overfeed-stoker is employed the forced draft may reach the fuel through suitable grate-bars, while in case an underfeed-stoker is employed it may be desirable to supply the air to the fuel through suitable twyers. Such a rotary fan or blower may be operated from any suitable source of power, as previously mentioned—such, for instance, as a steam-engine deriving its supply of steam from the steam-boiler heated by the furnace. As in the case of the engine utilized for the purpose of operating the mechanical stoking mechanism an automatic regulator may be employed for the purpose of governing the speed of the engine inversely with the steam-boiler pressure, whereby the quantity of air supplied to the furnace may be varied inversely with the boiler steam-pressure. In this manner the quantity of fuel and the quantity of air supplied to the furnace are both varied to meet at all times the demand made upon the furnace for heat and at the same time the proportion of air to fuel is maintained constant to provide for an efficient and economical combustion of all the fuel supplied.

As both the mechanical stoking apparatus and the apparatus for supplying air to the furnace are operated or may be operated by a steam-engine, I have found it desirable to provide a single engine for this purpose, to which are connected both the stoking mechanism or valve mechanism controlling the operation of the stoking mechanism and the blower or devices controlling the quantity of air admitted to the furnace. The speed of this single engine may be controlled by a single automatic regulator to vary inversely with the boiler steam-pressure. In this manner I provide means whereby the firing of the furnace of a steam-boiler is accomplished wholly automatically without any attention whatsoever from an attendant, while at the same time the boiler-pressure is maintained under almost absolutely uniform pressure even under great variations in the demand for steam which may be made upon it, and, furthermore, the greatest possible economy in the use of fuel is attained. These advantages are all attained by the provision of mechanism which is at once simple, efficient, durable, and reliable in operation.

My invention will be more clearly understood by reference to the accompanying drawings, in which—

Figure 1 is a perspective view illustrating somewhat diagrammatically a steam-boiler associated with a mechanical stoker, its valve mechanism, a pressure-blower, and a steam-engine and regulator for controlling the operation of these devices. Fig. 2 is a detached view, in front elevation, of valve mechanism adapted to be employed in connection with the stoker. Fig. 3 is a rear elevation of the same. Fig. 4 is a cross-sectional view of the detached valve mechanism, taken on line 4 4 of Fig. 2. Fig. 5 is a detached view, in front elevation, of the valve and its seat, the wall of the admission-port of the valve being broken away in part to reveal the port-opening, the valve-cover and the remainder of the valve mechanism being removed. Fig. 6 is a cross-sectional view taken on line 6 6 of Fig. 5. Fig. 7 is a view in front elevation of the valve alone. Fig. 8 is a cross-section of the valve, taken on line 8 8 of Fig. 7. Fig. 9 is a cross-sectional view illustrating a form of regulator which may be employed. Fig. 10 is a longitudinal sectional view of the stoking device.

In Fig. 1 I have shown a boiler 10 mounted in its setting of masonry 11, the door 12 in the front of the setting opening into the boiler-furnace, the details of which are immaterial and need not be particularly described herein. At the front of the furnace is located a mechanical stoker comprising a steam-cylinder 13, which upon the supply of steam to the alternate ends thereof causes the reciprocation of a plunger 14′ within a plunger-tube 14 to force charges of fuel from the hopper 15 into the furnace-retort, the plunger being connected to the piston 15′ by a piston-rod 13′. The pipes 16 and 17 lead, respectively, from either end of the cylinder 13 to the ports 18 and 19 in the valve-seat 20. Within a valve-cover 21 is placed a rotary valve 22, the rotation of this valve being caused by means of the rotary-valve stem 23, which leads through the stuffing-gland 24 to the ratchet-wheel 25, securely mounted thereon. The ratchet mechanism comprises the side plates 26 and 27, rotatably mounted upon the stem 23, and a pawl 28, which is in engagement with the ratchet-wheel 25. The oscillation of the ratchet mechanism is caused by means of a connecting-rod connected with an adjustable crank-pin 31 upon the slotted crank-disk 32. A slow rotation of the crank-disk 32 is caused by means of the shaft 33, upon which the worm-gear 34 is mounted and which in turn is driven by the worm 35, mounted upon the worm-shaft 36, the rotation of the worm-shaft being caused by a pulley-and-belt connection, the details of which will be hereinafter more fully explained. Steam is supplied from the boiler 10, through a pipe 37 and a throttle-valve 38, to an opening 39 in the valve-seat 20. There is an opening 40 in the under side of the valve 22, which registers with the opening 39 in the valve-seat, this opening 40 being connected with an admission-port 41, having an opening through the lower side of the valve. An exhaust port or passage-way 42 is cut through the valve, as best shown in Fig. 7. The valve-cover 21 provides a chamber 43 to the front of the ro-

tary valve 22, which chamber is at all times in open communication with the exhaust-port of the valve 42. This chamber is also connected, through the opening 44, with the exhaust-pipe 45. In the embodiment of my invention which I have herein shown the worm-shaft 36 is rigidly secured to a driving-pulley 46, by which it is driven by the belt 47, running about the pulley 48 on the shaft of the blower 49. The revolution of the fans of the blower causes air to be drawn in through the opening 50 and discharged through an air-flue 51, (shown in dotted lines in Fig. 1,) leading to the twyers or other openings 52, which supply the air necessary for combustion to the furnace of the boiler.

The blower 49 is desirably belted to a steam-engine 53, as illustrated. This engine 53 is supplied, through the pipe 54 and throttle-valve 54', with steam from the boiler 10, there being also connected in this pipe a Foster regulator, the details and operation of which will be clear from an inspection of Fig. 9, in which the essential features are shown to comprise two chambers 55 and 56, there being connected with the chamber 55 the pipe 54, leading from the boiler 10, and with the chamber 56 there being connected a pipe leading to the steam-chest of the engine 53. Between the chambers 55 and 56 are openings 57 and 58, a passage-way through which is controlled by the movement of the valves 59 and 60, both mounted upon a valve-stem 61, mechanically connected with the flexible diaphragm 62, the periphery of which is clamped between the upper and lower halves of a diaphragm-chamber 63. Adjustable spring mechanism 64 serves, through the interposition of lever mechanism 65, to exert a downward pressure upon the diaphragm and valve-stem connected therewith, the downward movement of the valves and valve-stem being limited by a set-screw stop 66. A small opening 67 leads from the chamber 55 to the lower part of the diaphragm-chamber 63, the passage through this opening 67 being controlled by a valve 68. The upper side of the diaphragm is subject to atmospheric pressure through the opening 69 in the upper half of the diaphragm-chamber. The under side of the diaphragm 62 is directly subject to the steam-boiler pressure by means of the communicating passage-way through the opening 67, the chamber 55, and the pipe 54. The spring mechanism 64 is so adjusted in tension that upon an increase in the boiler-pressure above the normal operating pressure an upward movement of the valve-stem and its associated valves is caused by an increase of the pressure on the lower side of the diaphragm 62. It will thus be seen that an increase in the steam-boiler pressure causes a decrease in the amount of steam supplied to the engine 53 on account of the decrease in the size of the opening between the chambers 55 and 56. Upon a decrease in the boiler-pressure below the normal operating-pressure there is a decrease in the upward pressure against the lower side of the diaphragm 62, whereupon the expansion of the spring mechanism causes a downward movement of the valve-stem 61 and the valves 59 and 60, connected therewith, thus increasing the size of the opening between the chambers 55 and 56 and permitting an increased supply of steam to the engine 53. This arrangement provides, therefore, that an increase in the steam-boiler pressure shall be accompanied by a decrease in the speed of the engine 53 and the blower 49, connected therewith, while a decrease in the boiler-pressure below the normal operating pressure causes an increase in the speed of the engine 53 and a corresponding increase in the speed of the blower 49.

The operation of the valve mechanism controlling the supply of steam to the cylinder 13 of the stoker is as follows: The valve when in the position shown in Fig. 5 provides an opening through the passage-ways 40 and 41 of the valve 22, whereby steam is admitted from the supply-pipe 37 through the valve mechanism to the port 19, and thence through the pipe 17 to the plunger end of the cylinder 13 of the automatic stoker. The head end of the cylinder 13 is at the same time provided with an exhaust-opening by way of the pipe 16 and the port 18, from which there is communication to the chamber 43 and exhaust-pipe 45 by means of the exhaust-port 42 of the valve 22. A forward rotation of the valve 22 in the direction indicated by the arrow 70 causes first a closure of both the ports 18 and 19 and at a short time thereafter the simultaneous communication of the port 18 with the passage-ways 40 and 41 and of the port 19 with the exhaust-valve port 42 and the exhaust-chamber 43. Upon the establishment of these communicating passage-ways live steam is admitted to the head end of the cylinder 13, while the plunger end of the cylinder is connected with the exhaust-pipe 45. In the present embodiment of my invention I have shown the exhaust-pipe 45 as leading into the housing of the blower 49, whereby the exhaust-steam is carried into the boiler-furnace with the draft of air. A further continued rotation of the valve 22 causes the opening of a passage-way through the exhaust-port 42 of the valve 22 between the head end of the cylinder 13 and the exhaust-pipe 45. Both head and plunger ends of the cylinder are then maintained for a considerable length of time in open communication with the exhaust-pipe 45. Upon again reaching a point slightly in advance of that illustrated in Fig. 5 the live-steam communication with the plunger end of the cylinder 13 is again established, whereupon the above-described cycle of operations is repeated.

It will be apparent that the speed of rotation of the valve 22 depends directly upon the

speed of rotation of the engine 53, and thus directly upon the pressure of the steam in the boiler 10. The rotation of the valve 22 is, furthermore, an intermittent one, the amount of angular advance of each step being dependent upon the amount of oscillation of the ratchet mechanism, which in turn is directly dependent upon the distance between the crank-pin 31 and the center of the crank-disk 32. This distance may be varied at will to cause a greater or less angular advance of the valve 22 for each revolution of the worm-wheel 34. The speed of revolution of the valve 22 is preferably so adjusted by means of the position of the crank-pin 31 that the rate of reciprocation of the stoker-plunger shall be such as to supply substantially enough and no more fuel to the boiler-furnace than is necessary to maintain the desired normal steam-pressure when such fuel is burned under proper conditions of combustion. The Foster regulator is so adjusted that the speed of the engine and the blower connected directly therewith shall be such as to cause the supply of substantially the proper quantity of air to the boiler-furnace under all conditions of operation. It will thus be seen that my invention provides mechanism for a fuel-supply such that the operation of a steam-boiler furnace may be entirely automatic and whereby the greatest possible efficiency and economy in the use of fuel may be secured. It is evident that a battery of connected boilers may be similarly operated through the agency of a single engine connected to the main supply-pipe leading from all of the boilers in the battery.

Many modifications will at once occur to those skilled in the art, and as these modifications may be employed without departing from the spirit of my invention I do not wish to limit myself to the precise disclosures herein set forth; but,

Having described my invention, I claim as new and desire to secure by Letters Patent—

1. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, valve mechanism for controlling the supply of steam to said mechanical stoker, a blower for supplying air to said furnace, a steam-engine for driving both said blower and said valve mechanism, said engine and said valve mechanism being supplied with steam from said boiler, and a diaphragm-controlled valve interposed in the supply-pipe to said steam-engine, increase in said boiler-pressure causing said valve to limit the amount of steam to said engine whereby said blower and said valve mechanism are driven at a lower speed, and decrease of boiler-pressure causing said valve to admit more steam to said engine whereby both the blower and the valve mechanism are driven at an increased rate, the supply of air fed by said blower and the amount of fuel fed to said furnace being thus proportionate to each other and to the boiler-pressure.

2. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, rotary valve mechanism for controlling the supply of steam to said mechanical stoker, a blower for supplying air to said furnace, a steam-engine for driving said blower and said valve mechanism said valve mechanism being supplied with steam from said boiler, a diaphragm-controlled valve for governing the steam-supply to said engine, and means for adjusting the ratio between the rate of revolution of said blower and the rate of revolution of said rotary valve mechanism whereby the ratio between air-supply and fuel-supply may be varied.

3. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, a rotary valve for said steam-operated stoking mechanism, one revolution of said rotary valve causing one complete actuation of said stoking mechanism, a blower to supply air to said furnace, a steam-engine for driving said blower and said rotary valve, said engine and said valve being supplied with steam from said boiler, controlling means for causing the speed of the engine to vary inversely as the boiler-pressure, and adjusting means for varying the ratio between the rate of revolution of said blower and the rate of revolution of said rotary valve whereby the ratio between air-supply and fuel-supply may be regulated independently of the boiler-pressure.

4. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, a rotary valve for controlling the supply of steam to said stoking mechanism, one charge of fuel being deposited in the furnace by said stoker for each complete revolution of the rotary valve, a blower for supplying air to said furnace, a steam-engine for driving both said blower and said rotary valve, said engine and said valve being fed with steam from said boiler, and means for varying the ratio between the rate of revolution of said blower and the rate of revolution of said rotary valve whereby the proportion of air to fuel may be varied independently of the boiler-pressure.

5. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, a rotary valve for controlling the supply of steam to said mechanical stoker, one charge of fuel being deposited in said furnace by said stoker for each complete revolution of the rotary valve, a steam-engine, a blower driven by said engine, means also driven by said engine for causing angular advancements of said rotary valve, and adjusting means for varying the

distance of said advancements whereby the ratio of the rate of revolution of the blower and the rate of revolution of the rotary valve may be varied and consequently vary the proportion between the air-supply and the fuel-supply of said furnace.

6. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, a rotary valve for controlling the steam-supply to said mechanical stoker, a steam-engine fed by steam from said boiler, a blower driven by said engine, a crank-arm also driven by said engine and having connection with said rotary valve, each revolution of said crank-arm causing an angular advancement of said rotary valve, and means for adjusting the length of said crank-arm to vary the angular advancement of said rotary valve whereby the ratio between the rate of revolution of said blower and the rate of revolution of said rotary valve may be varied, consequently to vary the proportion between the air-supply and fuel-supply to said furnace.

7. In combination, a steam-boiler, a furnace therefor, a mechanical stoker having a reciprocating plunger and a steam-cylinder adapted to cause the operation of said plunger to supply fuel to said furnace, a rotary valve for controlling the steam-supply to said cylinder, a complete revolution of said valve causing a complete stroke of the reciprocating plunger, a steam-engine, said engine and said valve being supplied with steam from said boiler, means for causing the quantity of steam supplied to said engine to vary inversely as the boiler-pressure, a blower driven by said engine, a crank-arm also driven by said engine and connecting with said rotary valve, each revolution of said crank-arm causing an angular advancement of said rotary valve, and adjusting means for varying the length of said crank-arm to vary the angular advancement of said rotary valve whereby the proportion between air and fuel supply to said furnace may be varied.

8. In combination, a furnace, a mechanical stoker having a reciprocating plunger and a steam-cylinder adapted to cause the operation of said plunger to supply fuel to said furnace, a rotary valve for controlling the supply of steam to said cylinder, valve-controlling means for causing said valve to intermittently admit steam to said cylinder whereby said stoker is intermittently actuated to supply fuel to said furnace, a blower for supplying air to said furnace, a steam-engine for driving both said blower and said valve mechanism, said engine and said valve being supplied with steam from said boiler, a valve for causing the supply of steam to said engine to vary inversely as the boiler-pressure whereby the speed of said blower and said valve-controlling mechanism vary inversely as the boiler-pressure, and adjusting means for said valve-controlling means for varying the length of intermission between the successive supplies of steam to said steam-cylinder.

9. In combination, a steam-boiler, a furnace therefor, a mechanical stoker having a reciprocating plunger and a steam-cylinder adapted to cause the operation of said plunger to supply fuel to said furnace, a rotary valve for controlling the steam-supply to said cylinder, valve-controlling means for causing said valve to intermittently supply steam to said cylinder whereby fuel is intermittently charged into said furnace from said stoker, a blower for supplying air to said furnace, a steam-engine for driving said blower and said valve-controlling mechanism, said engine and valve being supplied with steam from said boiler, a diaphragm-controlled valve for causing the steam-supply to said engine to vary inversely as the boiler-pressure whereby the speed of said blower and said valve-controlling mechanism varies inversely as the boiler-pressure, and adjusting means for varying the length of the intermission between the successive supplies of steam to said steam-cylinder.

10. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, a rotary valve for said steam-operated stoking mechanism, a blower for supplying air to said furnace, a steam-engine for driving said blower and said valve mechanism, said valve mechanism being supplied with steam from said boiler, a valve automatically controlled by the pressure of the steam supplied to said engine for governing the steam-supply to said engine, and means for adjusting the ratio between the rate of revolution of said blower and the rate of revolution of said rotary valve mechanism, whereby the ratio between air-supply and fuel-supply may be varied.

11. In combination, a steam-boiler, a furnace therefor, a steam-operated mechanical stoker for feeding fuel to said furnace, said mechanical stoker having a reciprocating plunger and a steam-cylinder adapted to cause the operation of said plunger to supply fuel to said furnace, a rotary valve for controlling the supply of steam to said cylinder, a valve-chamber for said valve connected with the ends of the cylinder of the mechanical stoker, a valve-stem extending from said rotary valve, a ratchet-wheel on said valve-stem, a pawl-arm having a pawl engaging said ratchet-wheel, a crank-arm, a connecting-rod connecting said crank-arm with said pawl-arm, a blower for feeding air to said furnace, driving connection between said blower and said crank-arm, a steam-engine for driving said blower, a valve for automatically controlling the steam-supply to said engine, said valve causing the quantity of steam supplied to said engine to vary inversely as the boiler-pressure, and

means for adjusting the length of said crank-arm, whereby the rate of rotation of said rotary valve is governed.

12. In combination, a furnace, a mechanical stoker having a reciprocating plunger and a steam-cylinder adapted to cause operation of said plunger to supply fuel to said furnace, a rotary valve for controlling the supply of steam to said cylinder, a valve-chamber for said valve having ports connected with the ends of said cylinder, a valve-stem extending from said valve, a ratchet-wheel on said stem, a pawl-arm having a pawl engaging said ratchet-wheel, a crank-arm, a connecting-rod connecting said crank-arm with said pawl-arm, each revolution of said crank-arm causing a partial rotation of said valve-stem, a worm-wheel connected with said crank-arm and a worm meshing with said worm-wheel, a blower for supplying air to said furnace, driving means connecting the shaft of the blower with the worm-shaft, a steam-engine for driving said blower, a valve for automatically controlling the supply of steam to said engine, the quantity of steam supplied to the engine being caused to vary inversely as the boiler-pressure, and means for adjusting the length of said crank-arm, whereby the rate of revolution of said rotary valve is controlled.

In witness whereof I hereunto subscribe my name this 22d day of April, A. D. 1903.

ALBERT A. RAMSDELL.

Witnesses:
LYNN A. WILLIAMS,
FRED A. DALEY.