C. ERITH.

MECHANICAL UNDERFEED STOKER.

APPLICATION FILED JAN. 13, 1915.

1,298,189.

Patented Mar. 25, 1919.

6 SHEETS—SHEET 1.

Fig. 1.

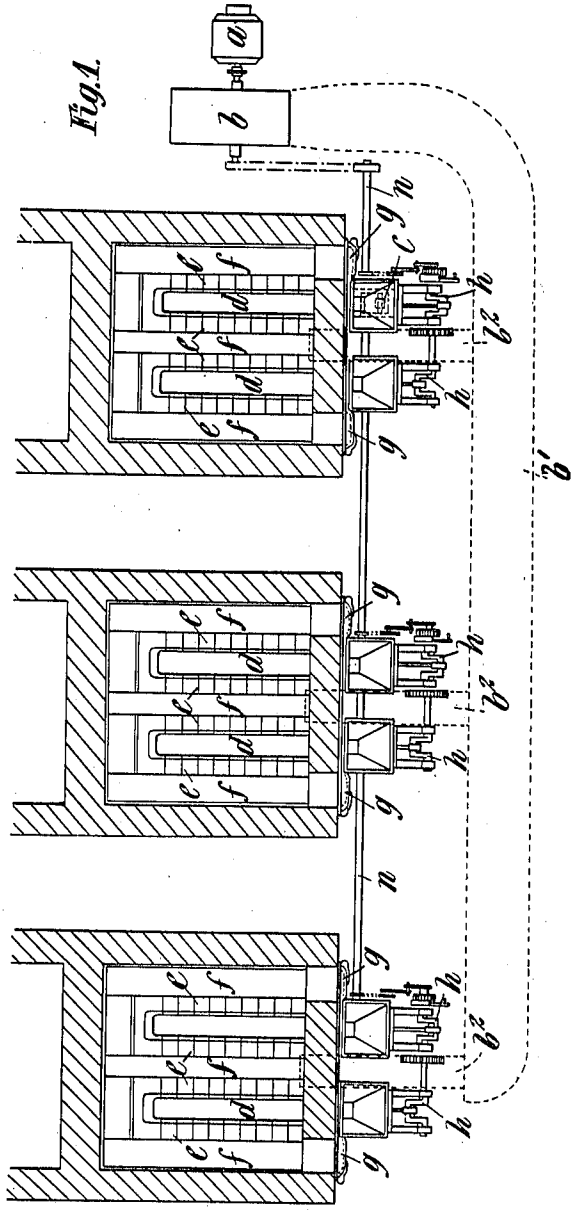
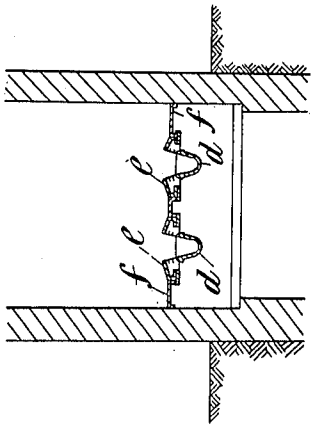


Fig. 2.



Witnesses:

M. Auer

E. Nathan

Inventor:

Charles Erith

By Fennemore & Craven

Attys.

C. ERITH.

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6 SHEETS--SHEET 2.

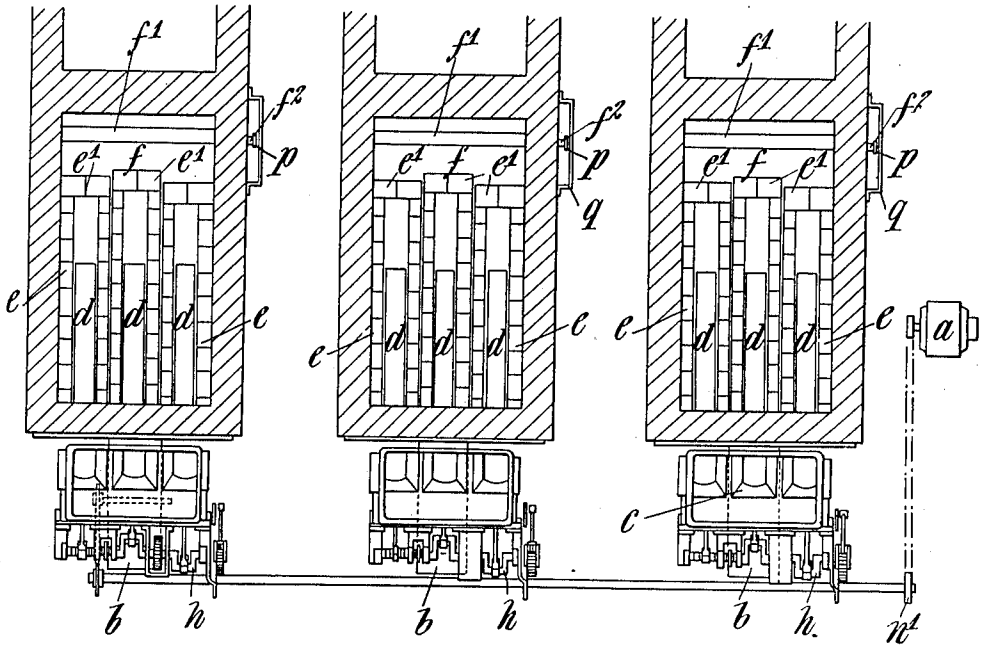

Fig.3.

Witnesses:
M. Ames
E. Hartland

Inventor:
Charles Erith
By Lemmi & Lewis & Marvin
Attys.

C. ERITH.

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6 SHEETS—SHEET 3.

Fig. 4.

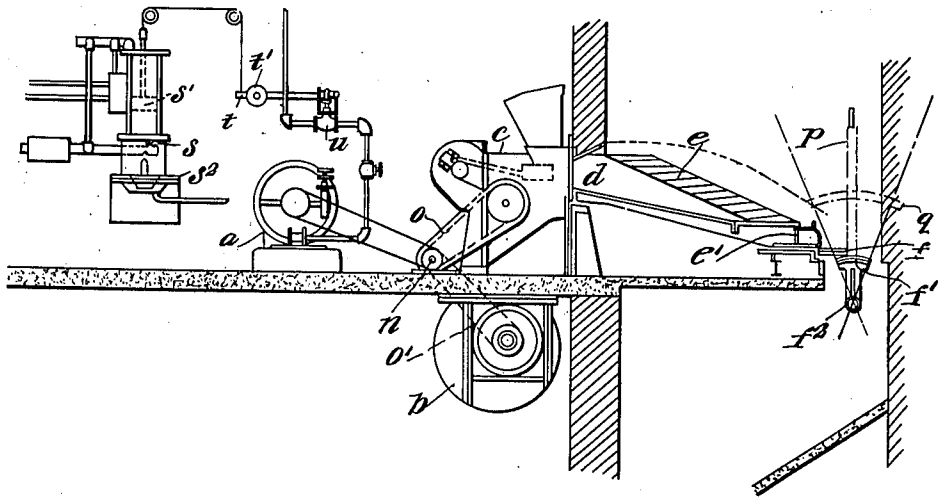
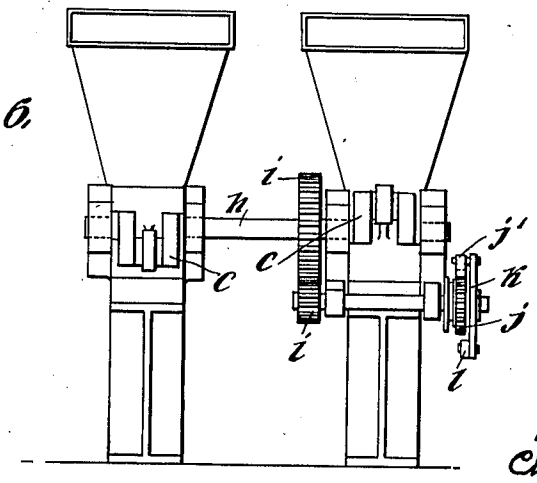


Fig. 6.



Inventor:
Charles Erith.

Pennie, Davis & Marvin,
attorneys.

C. ERITH.

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6 SHEETS—SHEET 4.

Fig.5.

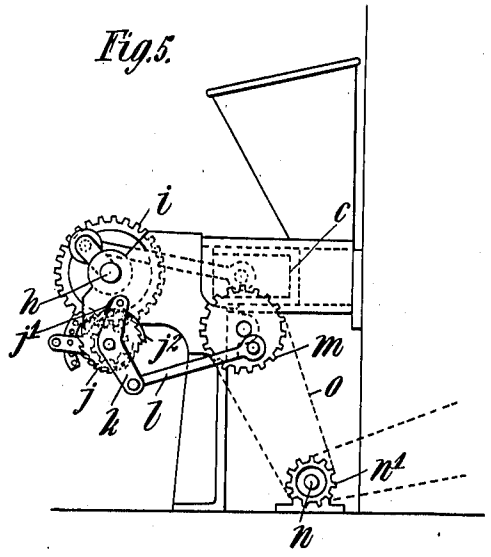
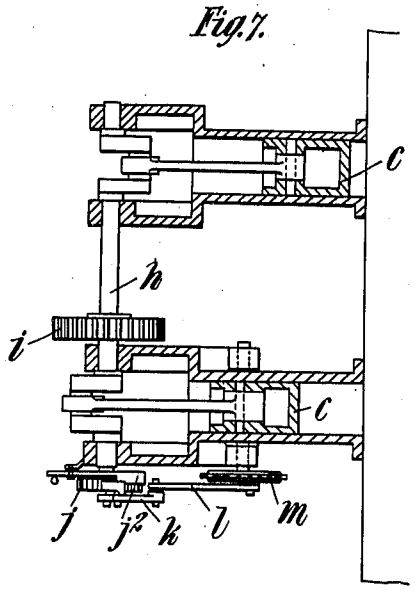


Fig.7.



Witnesses:
M. Auer
E. Nathan

Inventor:
Charles Erith
By Cunningham & Mann
Attys

C. ERITH.

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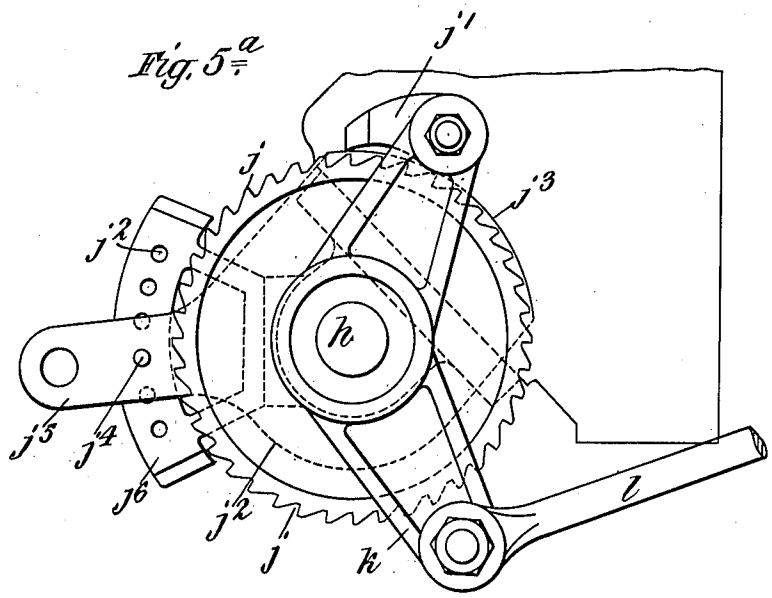
6 SHEETS—SHEET 5.

Fig. 5a



Inventor:
Charles Erith
By Lemuel Davis & Marvin
Attys.

C. ERITH.

MECHANICAL UNDERFEED STOKER.

APPLICATION FILED JAN. 13, 1915.

1,298,189.

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6 SHEETS—SHEET 6.

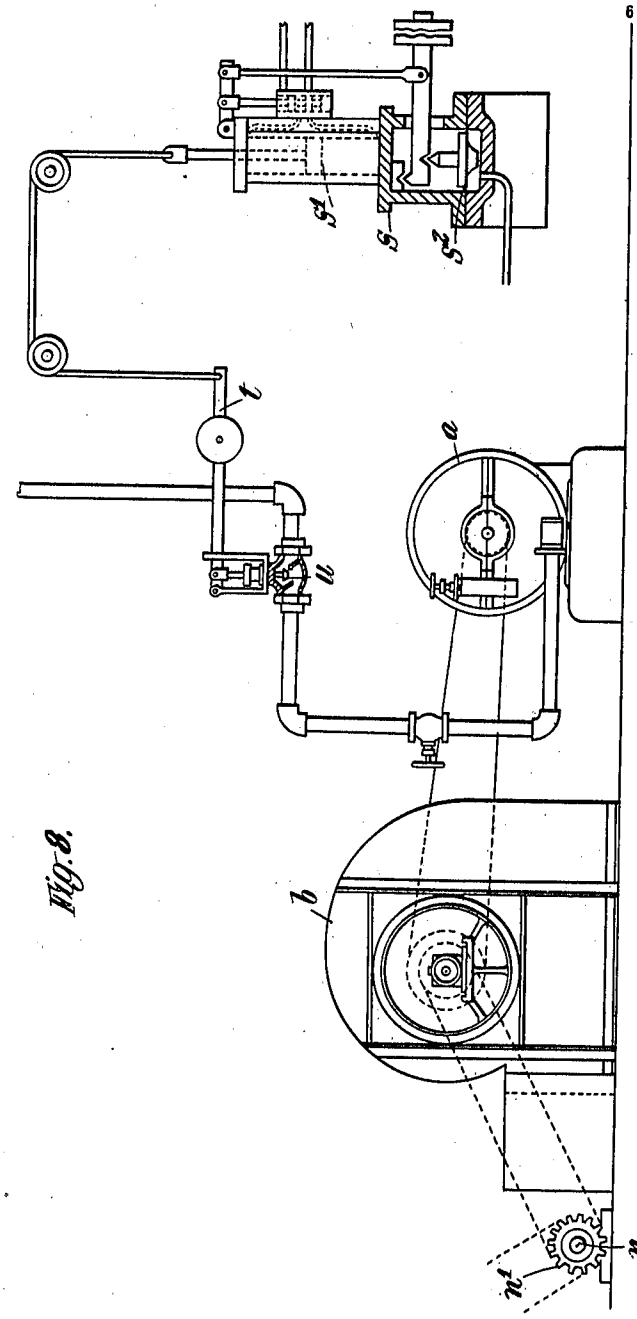

Fig. 6.

Witnesses:
M. Amer
E. Nathan

Inventor:
Charles Erith
By Dennis & Davis & Marvin
Attys.

UNITED STATES PATENT OFFICE.

CHARLES ERITH, OF LONDON, ENGLAND.

MECHANICAL UNDERFEED STOKER.

1,298,189. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed January 13, 1915. Serial No. 1,907.

To all whom it may concern:

Be it known that I, CHARLES ERITH, a subject of the King of Great Britain, residing at 70 Gracechurch street, in the city and county of London, England, have invented certain new and useful Improvements in or Relating to Mechanical Underfeed Stokers, of which the following is a specification.

This invention relates to mechanical underfeed stokers as employed in boiler and other furnaces wherein the fuel is fed by reciprocating plungers into troughs or retorts whence it rises into the zone of combustion and in which furnaces the air for combustion is delivered under pressure into the fire through twyers placed along the sides of the fuel retorts. One object of my invention is to simplify the construction and operation of such stokers, thereby reducing the working cost and upkeep charges. Another object is to provide for continuously discharging the incombustible residue to the ashpit while maintaining a seal against the inflow of excess air at the point of discharge. A further object is to enable a steady steam pressure to be maintained when working a range of boilers at varying loads.

According to the invention the fan or fans and fuel feeding plungers are actuated by a variable speed motor in such a manner that while the fan or fans are continuously rotated, the crank shaft connected to the plungers may be advanced intermittently and in uniform, but variable steps as may be required. Each stoker will preferably be provided with a separate fan thus avoiding the necessity of employing an air duct or conduit with branch pipes to each stoker. Means are also provided whereby, as the incombustible residue or ash is advanced on to the ashplate, the area of the ash-opening may be varied according to the percentage of ash in the fuel and thereby obviate the excess inflow of air into the furnace from the ashpit. The supply of fuel and air in correct proportions to the retorts is controlled so that the rate of combustion may be automatically varied in response to and in accordance with the demand on the boilers for steam.

In order that the invention may be clearly understood and readily carried into effect the same will now be more fully described by the aid of the accompanying drawings, in which:—

Figure 1 is a sectional plan of a range or series of furnaces fitted with underfeed stokers of the side-cleaning type and showing the usual arrangement of fan and air ducts.

Fig. 2 is a cross-section of one of the furnaces shown in Fig. 1.

Fig. 3 is a similar view to Fig. 1 showing a series of furnaces fitted with underfeed stokers of the rear cleaning type, each stoker being provided with a separate fan for supplying air direct, as preferred.

Fig. 4 is a longitudinal section of one of the furnaces indicated in Fig. 3 and also shows the speed regulating means.

Fig. 5 is a side elevation of the gear for actuating and controlling the fuel feeding plungers.

Fig. 5^a is an enlarged detailed view of Fig. 5 hereinafter fully described.

Fig. 6 is an end elevation, and

Fig. 7 a horizontal section of Fig. 5.

Fig. 8 shows the regulator as applied for controlling the steam admission valve of a turbine which constitutes the motor for driving the fan or fans and fuel feeding plungers.

a indicates the motor or turbine which drives the fan *b* for supplying air through the main duct or conduit *b'* and branch pipes b^2 to the furnaces, and for actuating the reciprocating and intermittently operated fuel feeding plungers *c*.

In the side-cleaning type of underfeed stoker, shown by Figs. 1 and 2, the reciprocating plungers *c* feed the fuel to the retorts *d* whence it rises over the twyers *e*, the incombustible residue or ash accumulating on the side plates *f*, from which the ash is periodically withdrawn. Hitherto side cleaning underfeed stokers with reciprocating plungers have been operated by intermittently actuated steam engines, that is to say, each plunger has been driven by a piston to which steam is admitted at intervals for each charging and return stroke of the plunger. In one such arrangement valve mechanism is employed for controlling the intermittent admission of steam to a series of such stokers. Experience shows, however, that there is a tendency for steam to leak past the valves and pistons when they are at rest, and also the losses in condensation and leakage in the steam pipes are often considerable, while the valve mechanism is necessarily complicated and costly. With the improved arrangement of gear, the crank shaft *h* for transmitting motion to the plungers *c* is actuated by means of spur wheels *i* and ratchet and pawl mecha-

nism j, the pawl j' being carried by a lever k attached to a connecting rod l which in turn connects with a sprocket m driven by chain or other gearing from the motor a. As shown in the drawings the motor may drive on to a shaft n provided with another sprocket or chain wheel n' which in turn transmits motion by means of the chain o to the sprocket m (Fig. 5).

In the rear cleaning type of underfeed stoker indicated by Figs. 3 and 4 each furnace is provided with its individual fan b while I also employ my improved driving mechanism of a kind similar to that described with reference to Figs. 1 and 2 in connection with the side cleaning type of stoker. The reciprocating plungers c feed the fuel to the retorts d which are set on a considerable incline (see Fig. 4) while the twyers e occupy all the space at the sides of said retorts. The ashplate f is placed at the lower end of the inclined retorts as in this type of stoker the ash is fed to the rear end. In all forms of rear-cleaning underfeed stokers it has hitherto been usual to connect the multiple fuel feeding plungers of each unit to a crank-shaft and to drive this crank-shaft very slowly but continuously from a high-speed steam engine, employing costly double-worm reduction gearing together with a clutch for each such stoker. In large unit stokers of this class, two, three or more worm-gears and clutches are used. If more than one stoker unit is driven from the same engine then each unit requires in addition a variable speed gear. A series of small steam engines for stokers and fan or fans is very uneconomical in steam, especially when the exhaust steam is discharged to atmosphere, and the complicated arrangement of steam piping involves condensation losses, and steam leakage often arises. In accordance with my present arrangement no steam is required and a variable speed for each stoker unit is secured without any complicated or costly gearing.

Thus instead of actuating each plunger intermittently by steam, or instead of continuously operating the plungers by a high speed steam engine through speed-reduction gearing and clutch as described above, I actuate the fan or fans b and also all the plungers c by the variable speed motor a the arrangement being such that, while the fan or fans b are continuously rotated, the ratchet and spur gear previously referred to enables each stoker unit to advance the crank shaft h, to which the plungers c are connected, intermittently, in uniform, but variable, steps. That is to say, the pawl j' may engage one, two or more teeth of the ratchet wheel j at each stroke, according to the position of the shroud j^2 (Fig. 5) which may be adjusted so as to cause the pawl j' when oscillated by the rod l, to be raised clear of the teeth in the ratchet wheel. The shroud or stop j^2 consists of a flat plate fitted close behind the ratchet wheel j while the pawl j' is as wide as the ratchet wheel and stop combined. The shroud or stop has a curved portion j^3 standing slightly above the teeth of the ratchet wheel j adapted to prevent the pawl j' from engaging the ratchet teeth. The position of the shroud or stop can be varied so that it covers one or more teeth passed over by the pawl and it may be fixed in any desired position by means of a pin or bolt j^4 engaging an extension j^5 of the shroud or stop of one of the holes j^7 in a quadrant j^6 attached to the frame of the stoker gear, see Fig. 5a. Or, the pawl can be entirely held out of engagement with the ratchet teeth and thereby have an idle motion, thus each stoker unit has a range of speeds independently of the other units, and each unit can instantly be brought to rest as desired. I am aware that ratchet mechanism has been used for overfeed stokers notably for rotating through worm-gearing the continuous grates of chain-grate stokers, but it has not been used in connection with underfeed stokers having reciprocating fuel plungers (with or without reciprocating ash-pushers) and in combination with a fan or fans for delivering air under pressure to the twyers of such underfeed stokers.

As shown in Figs. 3 and 4 each furnace is provided with a fan b for delivering the air directly into the air chamber below each stoker and thence through the twyers into the fire. As each ton of coal burnt requires for its combustion about 450,000 cubic feet of air weighing approximately sixteen tons, the air ducts of the known type, as indicated at Figs. 1 and 2, are bulky and costly. They are also subject to air leakage, and the diversion of air from the main duct or conduit into branch pipes also causes considerable frictional loss involving extra power cost. By providing each stoker with an individual fan b discharging directly under the stoker, all the cost, bulk and other inconveniences of air ducts and pipes hitherto used are avoided. The power to drive the series of fans b and plungers c is also preferably transmitted mechanically from the motor a by the shaft n and sprocket chains o, o', and chain o driving stokers c and the chain o' the fans b. It would however, be equally practicable in the arrangement shown at Figs. 3 and 4, to drive the fan or fans direct from the motor or turbine a and to connect the fan or fans to the stoker driving gear for its stoker, see Fig. 8.

Provision is also made in this type of stoker for continuously discharging the incombustible residue to the ashpit while main-

taining a seal against the inflow of excess air at the point of ash-discharge. The ash-pushers e' advance the incombustible residue or ash on to the ash-plate f as before described and a curved plate f' mounted on a shaft f^2 may be swung by a lever p so as to limit the ash-opening to suit the percentage of ash in the fuel, while permitting the ash to fall through to the ash-pit in a steady stream without leaving sufficient opening for excessive air to flow into the furnace from the ash-pit. A rack q allows of the lever p being set at any predetermined position to give the desired opening, and the lever enables the position of the plate to be adjusted in a single motion when required. Further, the plate f' can be set either to entirely close the opening and accumulate the ash, or to give the maximum opening when it is desired to shut down a boiler.

For controlling the supply of fuel and air in correct proportions in order that the rate of combustion may be automatically varied in response to the varying demand on the boilers for steam, an hydraulic regulator s, provided with a piston s' and a diaphragm s^2 exposed to steam pressure on its underside is employed. As the load on the boilers increases, the steam pressure drops and the diaphragm s^2 falls so that water pressure is admitted to the upper side of the piston s' to cause it to be forced down and thereby raise the lever t of the throttle valve u to speed up the turbine a, see Figs. 1 and 8. Thus, as the motor or turbine a drives the air supplying fan or fans and also the stoker mechanisms, the air and the fuel to each furnace in service is correspondingly increased so that the rate of combustion responds to the demand for steam, or load, on the boilers. Conversely, as the load falls off, the steam pressure begins to rise, pushing up the diaphragm s^2 and admitting water pressure to raise the piston s' during which a weight t' pulls back the lever t of the throttle valve u and reduces the speed of the motor or turbine so that the rate of combustion is reduced to correspond to the falling load, and steady steam pressure and efficient combustion are thus maintained at varying loads.

What I claim and desire to secure by Letters Patent of the United States is:—

A geared mechanical underfeed stoker for boiler furnaces, comprising retorts, reciprocating fuel feeding plungers, a crank shaft for actuating said plungers, twyers, an air chamber below the stoker, a fan for supplying air to said chamber and twyers, means for discharging the ash, intermittent gear associated with said crank shaft for controlling the plungers, a turbine for driving the crank shaft and fan, a valve for controlling the admission of steam to said turbine, and a regulator, including a piston positively actuated by water under pressure, connected to said valve.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES ERITH.

Witnesses:
GEORGE ERITH,
P. D. SIMMONS.