

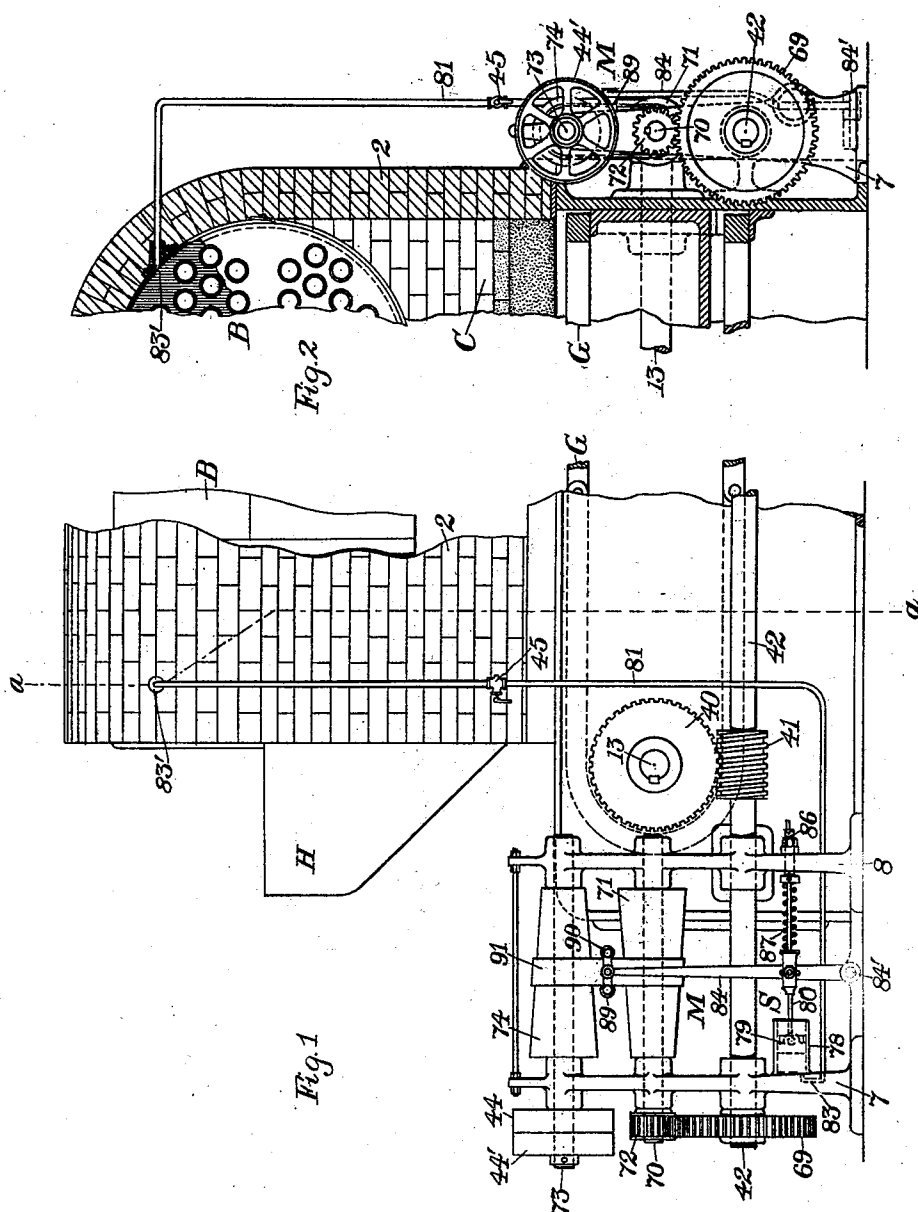
(No Model.)

3 Sheets—Sheet 1.

E. B. COXE.  
STEAM PLANT.

No. 510,582.

Patented Dec. 12, 1893.



Witnesses:  
*John L. Edwards Jr.*  
*Fred. J. Dole.*

Inventor:  
*Eckley B. Cox,*  
By his Attorney,  
*F. H. Richards*

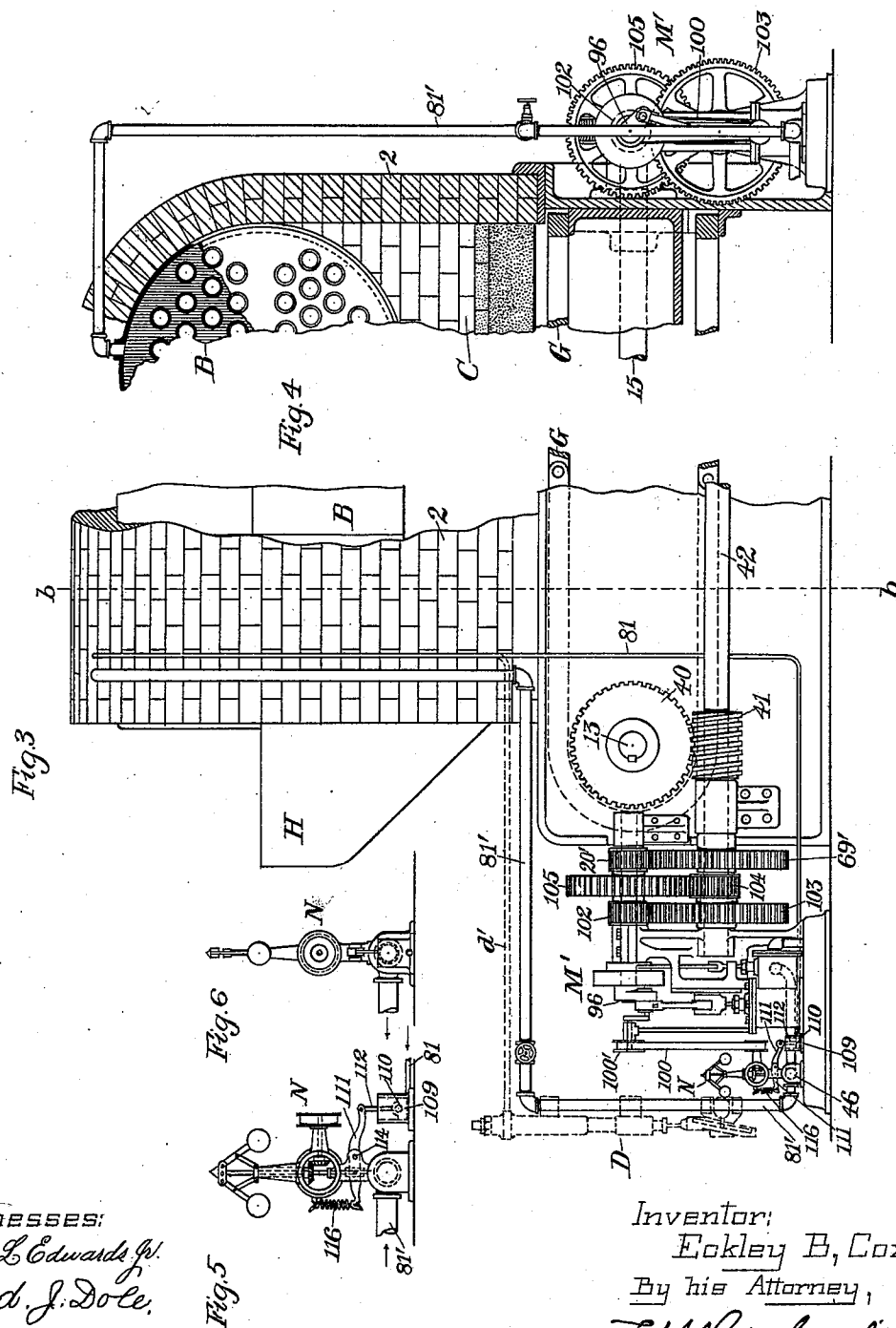
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3 Sheets—Sheet 2.

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3 Sheets—Sheet 3.

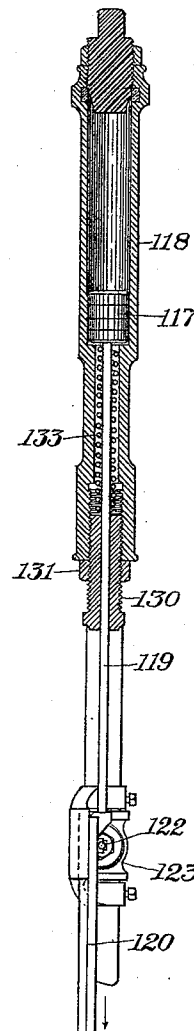
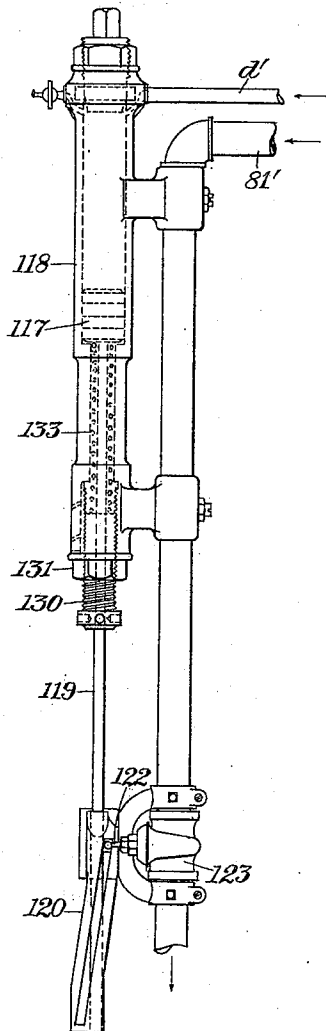
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Fig. 7

Fig. 8



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# UNITED STATES PATENT OFFICE.

ECKLEY B. COXE, OF DRIFTON, PENNSYLVANIA.

## STEAM PLANT.

SPECIFICATION forming part of Letters Patent No. 510,582, dated December 12, 1893.

Application filed October 16, 1893. Serial No. 488,272. (No model.)

*To all whom it may concern:*

Be it known that I, ECKLEY B. COXE, a citizen of the United States, residing at Drifton, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Steam Plants, of which the following is a specification.

This invention relates to that class of steam-plants in which the furnaces are provided with traveling grates; the object being to provide means for regulating the traveling-movement of the grate according to the variation in the pressure of the steam.

My present improvements being especially applicable to that class of traveling-grate furnaces described in Letters Patent No. 499,716, granted to me June 20, 1893, I have herein shown my present invention applied to a furnace of that kind, only a small portion of the furnace, however, being shown in this application.

In the drawings accompanying and forming a part of this specification, Figure 1 is a side elevation (as seen from the right-hand in Fig. 2) of a portion of a steam-plant of the class specified, furnished with my present improvements. Fig. 2 is an end elevation of the apparatus as seen from the left-hand in Fig. 1, the steam-plant proper being here shown in section on the line *a-a*, Fig. 1. Figs. 3 and 4 are two views corresponding to Figs. 1 and 2, showing a modification of the improvement having a different changeable-speed driving-mechanism for actuating the traveling-grate of the furnace. Figs. 5 and 6 are side and end elevations upon an enlarged scale, of the regulator device shown in Figs. 3 and 4. Figs. 7 and 8 are enlarged side elevation and sectional views of another kind of regulator-device applicable to the speed-changing apparatus shown in Figs. 3 and 4.

Similar characters designate like parts in all of the figures.

The improved steam-plant herein described comprises a steam-generator, a furnace therefor having a traveling-grate, and a changeable-speed driving-apparatus for the grate, controlled by variation of pressure of the steam in the generator.

Referring to Figs. 1 and 2, B designates any well-known type of steam-generator or "boiler," which is shown set over the fur-

nace-chamber, C, and inclosed by suitable walls, as 2.

Under the chamber C, is a traveling grate, G, which may (as herein shown), together with its actuating wheels and shafts, be of the kind described in my aforesaid Letters Patent. One of said shafts, 13, is shown herein as furnished with the worm-wheel, 40, whereby the grate-mechanism is actuated from the worm, 41, on a driving-shaft, 42, at the side of the furnace structure.

The fuel-hopper usually provided for supplying the endless-grate is shown in Figs. 1 and 3 set at the forward (left-hand) end of the furnace, being designated by H.

The grate-actuating shaft 42 is operated by a changeable-speed driving-mechanism, designated in a general way in Figs. 1 and 2, by M, and comprises ordinary driving-gearing or apparatus, combined with a pressure-actuated speed-changer, designated by S. Said driving-mechanism comprises some suitable framework, as for instance, the uprights 7 and 8, in which the shaft 42 is also journaled. This shaft, 42, is shown provided with a gear, 69, meshing with a pinion, 72, on a shaft, 70, supported by bearings in said uprights; another shaft, 73, is similarly supported in said uprights, and is shown provided with the ordinary tight-and-loose pulleys 44 and 44', whereby it may be actuated from any source of power not shown. The two shafts 70 and 73 are provided with the oppositely-disposed conical pulleys, 71 and 74, respectively, over which runs the ordinary driving-belt, 91. When the driving shaft 73 is revolved at a uniform rate of speed, the speed of the driven shaft 70 will, of course, be increased or reduced accordingly as the belt 91 shall be moved toward the larger or smaller end of said conical pulley 74. By this means, the endless grate being connected as set forth with said shaft 70, the speed of the grate may be increased or reduced as required, within limits depending upon the proportions of the several parts. For the purpose of effecting such variation in the speed of the grate-mechanism, the changeable-speed apparatus M is provided with the speed-changing pressure-device hereinbefore referred to. This device, designated in a general way by S, consists, in the preferred form thereof shown in Figs. 1

and 2, of an ordinary steam-cylinder, 78, in which is a piston, 79, that is connected by a rod, 80, with a lever, 84, that is pivoted at 84' to the framework of the apparatus M, and carries at its upper end the belt-engaging fingers, 89 and 90, between and by which the belt 91 is controlled. Steam, or water under the same pressure, is supplied to the cylinder 78, by means of the pipe, 81, which connects with one end of the cylinder at 83, and at its opposite end, as, for instance, at 83', connects with the boiler B. A valve, at 45, in said pipe 81 furnishes a means for shutting-off the connection between the boiler and the pressure-device S whenever this may be required. For resisting the action of the piston 79, the rod, 80, is shown continued beyond the lever 84, and is provided with a resistance-spring, 87, which bears against a collar on said rod and is adjusted to the required pressure by means of an adjusting-screw, 86, fixed in the upright 8 of the framework.

When the apparatus is in operation, any increase of pressure in the cylinder 78 forces the same toward the right-hand in Fig. 1, until the force thereof is counter-balanced by the increased resistance of the spring 87; at the same time, the lever 84, being carried by its connection with the piston in the same direction, shifts the belt 91 toward the smaller end of the driving-cone 74, thereby reducing the speed of the opposite driving-cone 71, and through this and the connecting gearing, reducing the speed of the traveling grate G. By a reversal of the same operation, a reduction of the pressure within the boiler, and consequently within the cylinder 78, permits the spring 87 to force the piston and the belt-shifter 84 toward the larger end of the conical pulley 74, and thereby driving the opposite conical pulley and its connecting mechanism actuating the endless grate G with an increased velocity. In this manner, when the pressure within the boiler increases, the grate-mechanism of the furnace is operated more slowly, so as to carry less fuel into the furnace and thereby reduce the amount of heat generated thereby; on the contrary, when the boiler-pressure increases, the driving-apparatus, operated as described, increases the speed of the traveling grate and thereby brings a greater quantity of fuel into the furnace, and so increases the quantity of heat produced in the furnace, for raising the boiler-pressure to the normal point. By adjusting the pressure of the spring 87 (the speed of the driving-shaft 73 being unchanged), the limits of the grate-speed, as compared with the boiler-pressure, may be regulated.

In the modification shown in Figs. 3 and 4, the principal features described in connection with Figs. 1 and 2 are retained; but the belt-driven driving-apparatus is replaced by a steam-actuated driving-apparatus, designated by M', and consists of an ordinary steam-engine (as will be understood by inspection of Fig. 3) whose crank-shaft, 96, carries a pin-

ion, 102, meshing with an intermediate gear, 103, whose pinion, 104, meshes with another intermediate gear, 105, that connects, through the pinion, 20' and the gear, 69', with the aforesaid driving-shaft 42 of the furnace-mechanism. Any well-known kind of engine of the class specified may be used for the purpose here described. Steam for driving said engine is or may be brought therefor from the boiler B, through the pipe, 81', which is shown provided at 46, with an ordinary throttle-valve for the usual purpose.

As a speed-changing pressure-device for the described engine, I have shown the same furnished with an ordinary belt-driven governor, N, operated, in the present instance, by the belt, 100, from a pulley, 100', connected with the crank-shaft 96 of the engine. Said governor is assumed to be of the well-known spring-regulated kind, it having a spring, 116, connected with the same and with a lever, 111, that is pivotally supported at 114, and is connected by a rod, 112, with a piston, 110, working in the regulator-cylinder, 109; which cylinder is connected by the pipe 81 (hereinbefore described) with the boiler B. By means of this apparatus, any increase of pressure in the boiler tends to raise the piston 109 against the force of the spring 116, thereby shifting the normal limits within which the regulator will operate. By this means, the regulator-system being connected as usual with a throttle-valve, 46, in said supply-pipe 81' of the engine, an increased pressure in the boiler operates to reduce the supply of steam to the engine M' and thus reduces the speed of the engine, and, through this and the described connections, reduces the speed of the traveling grate and thus brings less fuel into the furnace, resulting in a lessening of the heat produced therein. In like manner, but reversely, the lowering of the boiler-pressure operates, through the pressure-device described, to increase the quantity of steam supplied to the engine M' and thereby increases the speed of the grate G, to bring more fuel into the furnace, for increasing the production of heat in the same.

Instead of a governor arranged to operate as a pressure-device as hereinbefore described in connection with Figs. 3, 4, 5 and 6, I may use a direct-acting throttle-governor, of the form, for instance, illustrated in Figs. 7 and 8, and as shown by dotted lines at D, Fig. 3. This kind of pressure-device consists of a suitable cylinder, 118, provided with a piston, 117, and connected by a branch-pipe, d', with the aforesaid pipe 81' from the boiler. The cylinder 118, is, or may be carried by suitable connections (see Fig. 7) with the steam-pipe 81' of the engine; and the piston, 117, of said cylinder may be directly connected, through the piston-rod, 119, and the grooved slide, 120, with the stem, 122, of the throttle-valve, 123. By this means, any longitudinal movement of the piston within the cylinder operates to open or close the throttle-valve, ac-

cording to the direction of said piston-movement.

In the cylinder 118 is shown an adjusting-screw, 130, normally held in place by the check-nut 131; this screw is for the purpose of regulating the tension of the resistance-spring 133 which acts against said piston 117 for the purpose of co-acting with the varying steam-pressure within the cylinder for operating said throttle-valve and thereby controlling the speed of the driving-mechanism. The general operation of this pressure-device in connection with the other features of the steam-plant, is substantially the same as already set forth in connection with the preceding figures of drawings.

Having thus described my invention, I claim—

1. In a steam-plant, the combination with the steam-generator and a furnace therefor, of a traveling furnace-grate, a changeable-speed driving-apparatus for actuating the grate, and a pressure-device in communication with the generator and connecting with said driving-apparatus, whereby the speed of the grate may be regulated in accordance with the variation of pressure within the generator.

2. In a steam-plant, the combination with the steam-generator and a furnace therefor,

of a traveling furnace-grate, a changeable-speed driving-apparatus connected for actuating the grate and comprising belt-connected speed-changing pulleys substantially as described, and a pressure-device intermediate to the generator and said driving-apparatus and connected to shift the belt, whereby the speed of the grate may be regulated from the variation of pressure in the generator.

3. In a steam-plant, in combination, a steam-generator and a furnace therefor, a traveling furnace-grate, changeable-speed driving-apparatus connected for actuating the grate, a steam-cylinder having a piston connected with said driving-apparatus, a resistance-spring opposing said piston, and a pipe connecting the cylinder with the generator, substantially as described.

4. In a steam-plant, the combination with the generator and a furnace therefor having a traveling grate, of a pressure-controlled changeable-speed grate-actuating apparatus in communication with the generator, substantially as described and for the purpose specified.

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