

March 1, 1938.

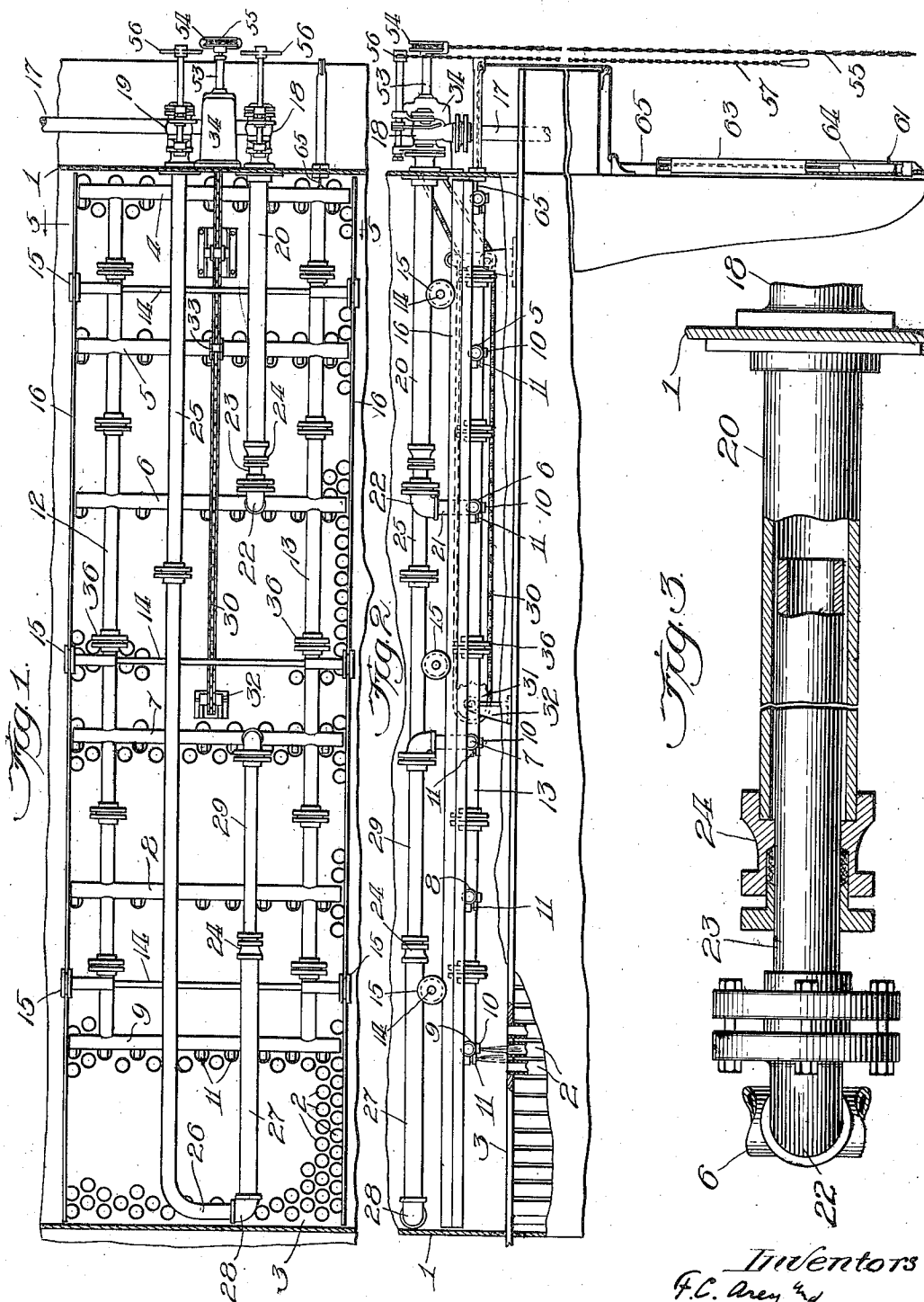
F. C. AREY ET AL

2,109,855

SOOT BLOWING APPARATUS FOR AIR PREHEATERS

Filed March 16, 1936

5 Sheets-Sheet 1



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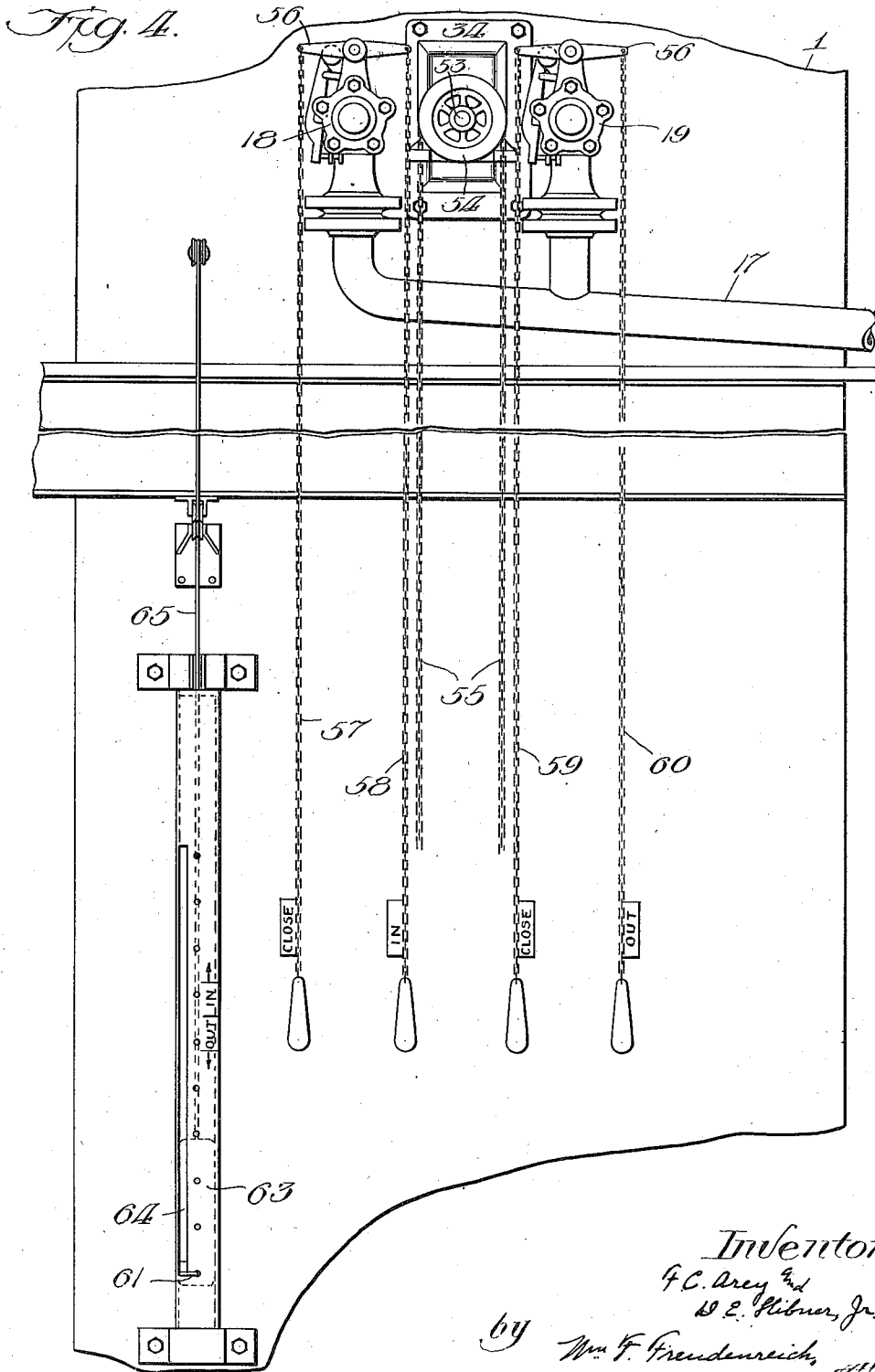
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SOOT BLOWING APPARATUS FOR AIR PREHEATERS

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5 Sheets-Sheet 2



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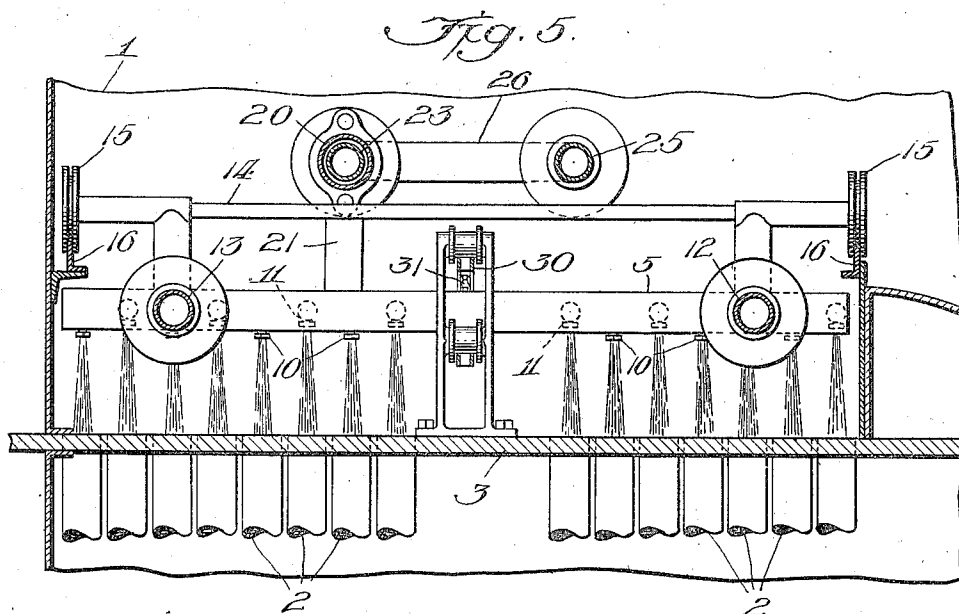
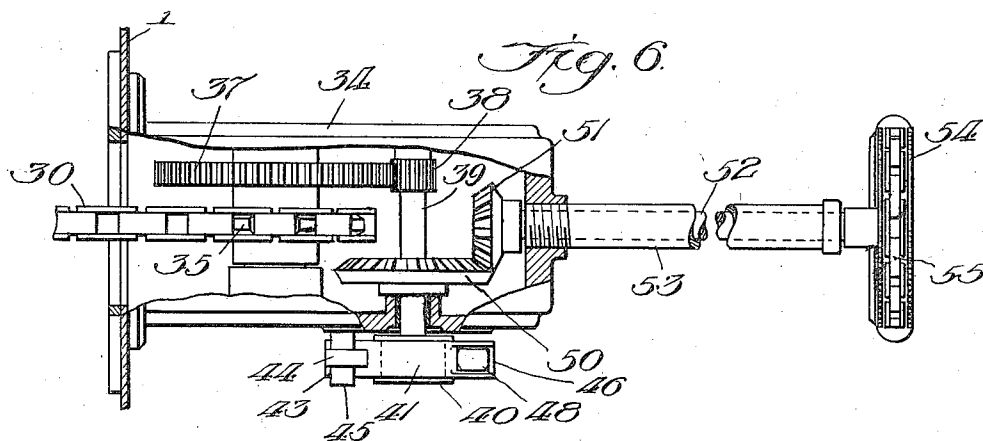
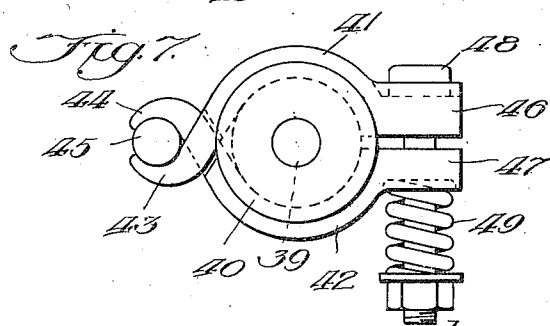
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SOOT BLOWING APPARATUS FOR AIR PREHEATERS

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5 Sheets-Sheet 3



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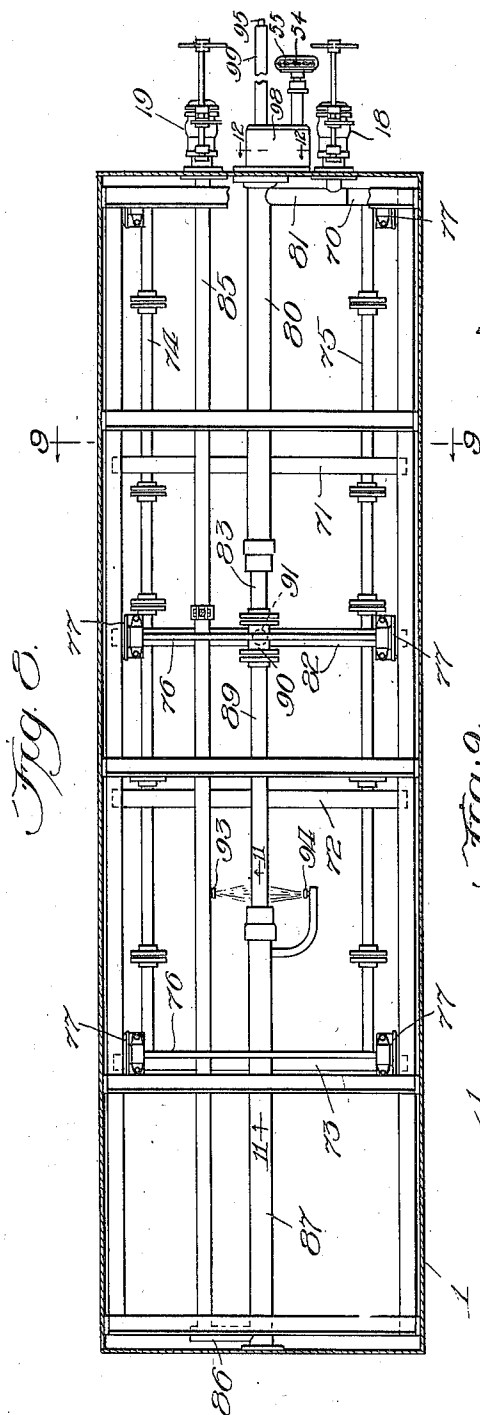
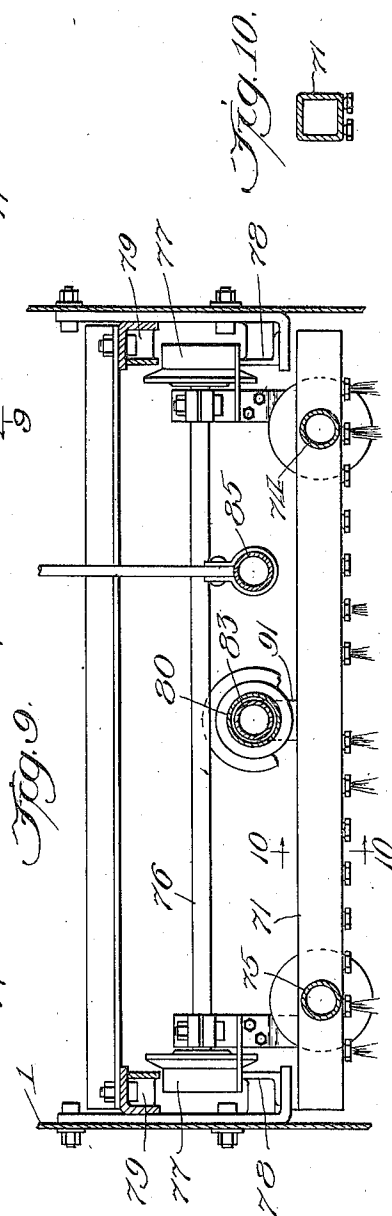
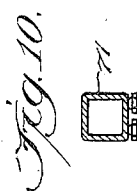
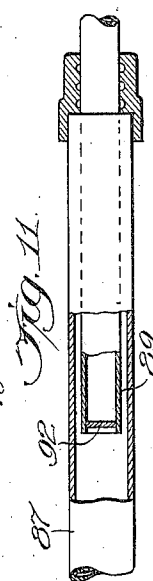
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SOOT BLOWING APPARATUS FOR AIR PREHEATERS.

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5 Sheets-Sheet 4



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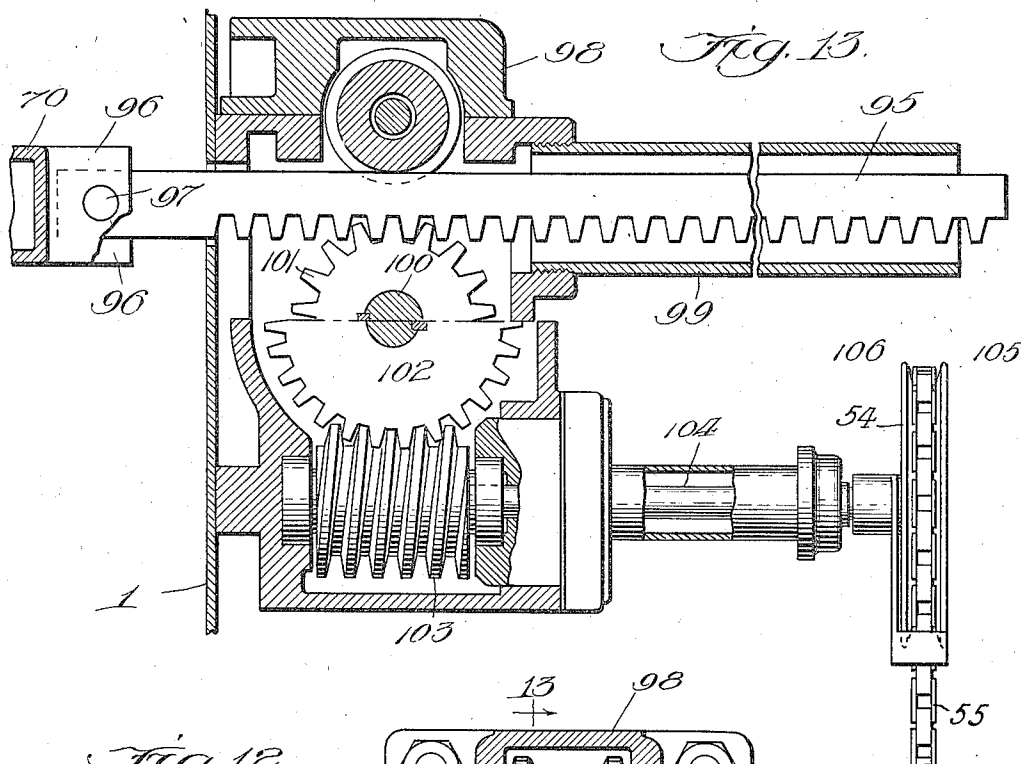
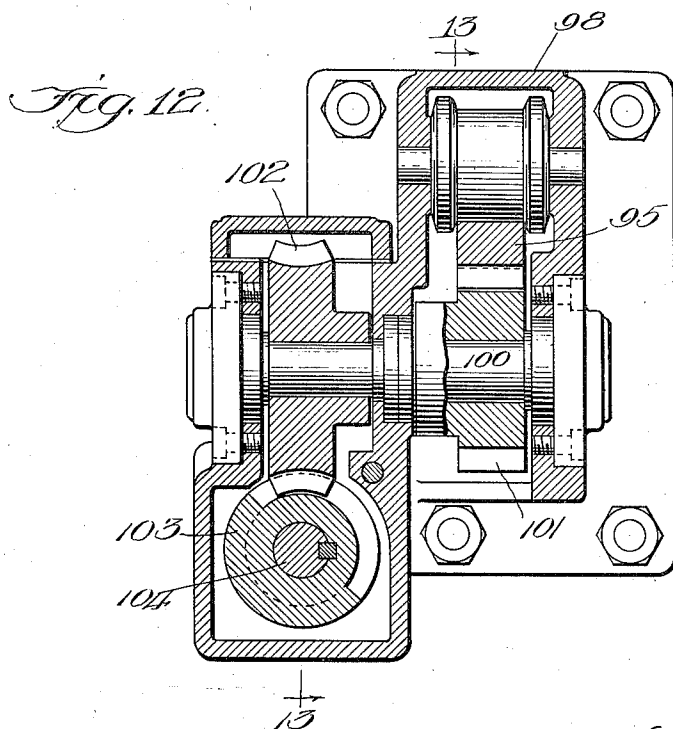
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SOOT BLOWING APPARATUS FOR AIR PREHEATERS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,109,855

SOOT BLOWING APPARATUS FOR AIR
PREHEATERS

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Application March 16, 1936, Serial No. 68,988

11 Claims. (Cl. 257—1)

In Patent No. 1,926,360, granted September 12, 1933, there is disclosed an apparatus for keeping clean the tubes of air preheaters provided with numerous tubes through which the combustion gases from a furnace or furnaces flow. The present invention may be said to have for its object to simplify and improve upon the apparatus of that patent.

In preheaters of the type under consideration, there are vertical tubes arranged in transverse and longitudinal rows; the blowing apparatus comprising a series of transverse blowing elements which are moved step by step, so that each element takes care of a predetermined number of transverse rows of tubes. The connection between the steam supply pipe and the movable blowing apparatus must be flexible and, in the arrangement shown in the aforesaid patent, this connection comprises hinge pipe sections placed outside of the preheater shell and thus taking up considerable space. One of the objects of the present invention is to provide the apparatus with means placed within the preheater shell or casing to maintain a proper connection between the blowing apparatus and the steam supply pipe in all positions of said apparatus.

When a preheater is very large, the movable blowing apparatus is heavy and has heretofore been moved back and forth by means of a suitable motor or engine. One of the objects of the present invention is to make it possible to dispense with such motor or engine, causing the steam that is used for blowing to furnish all or the greater portion of the power to move the blowing apparatus back and forth through the direct pressure of such steam against such apparatus.

The various features of novelty whereby our invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of our invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a top plan view of a preheater and an associated blowing apparatus positioned above the tubes in the preheater and adapted to blow jets of steam down through such tubes, the shell or casing being partly broken away; Fig. 2 is a side view of the upper part of the preheater, portions being broken away to disclose the blowing apparatus in elevation; Fig. 3 is a view, partly in section and partly in plan, on a much larger scale than Fig. 1, illustrating one of the tele-

scopic pipe connections between the blowing apparatus and the steam supply pipe; Fig. 4 is a front view of the preheater, on a much larger scale than Figs. 1 and 2, showing the controls and the position indicator; Fig. 5 is a section, also on a larger scale than Fig. 2, on line 5—5 of Fig. 1; Fig. 6 is a view, partly in top plan, and partly in section, of the manual driving and controlling means for the sprocket chain that moves the carriage of the blowing apparatus back and forth; Fig. 7 is an elevation, on a larger scale than Fig. 6, showing the brake that appears in Fig. 6; Fig. 8 is a view similar to Fig. 1, showing a modification; Fig. 9 is a section on a larger scale, taken on line 9—9 of Fig. 8; Fig. 10 is a section through one of the blowing elements or tubes, taken on line 10—10 of Fig. 9; Fig. 11 is a view partly in elevation and partly in section, illustrating one of the telescopic pipe connections between the steam supply pipe and the blowing apparatus in Fig. 8; Fig. 12 is a section, on a much larger scale than Fig. 8, on line 12—12 of Fig. 8; and Fig. 13 is a section taken on line 13—13 of Fig. 12.

Referring to Figs. 1-7 of the drawings, 1 represents a shell or casing containing numerous vertical tubes or small flues 2 arranged in two rows at right angles to each other; the transverse rows being comparatively short, and the longitudinal rows being long. It will be understood that the hot gaseous combustion products from a furnace travel upwardly through these tubes or flues, whereas the air to be preheated flows through the shell or casing in contact with the peripheries of the tubes; there being nothing new in this construction which may be said to represent simply an air preheater of the vertical type.

Our improved apparatus for keeping the tubes or flues clean is arranged above the upper flue sheet 3; and, as in the aforesaid patent, it comprises a series of transverse tubular blowing elements provided with nozzles to discharge steam jets into the open ends of the tubes; there being shown six of these blowing elements, 4, 5, 6, 7, 8 and 9, each of which has thereon two rows of nozzles, 10 and 11, extending throughout the length thereof and pointing downwardly. The blowing elements are connected by longitudinal pipes 12 and 13, by means of which the whole is tied into a rigid, flat framework. This tubular frame structure is suspended from three transverse axles 14, on the ends of each of which are grooved wheels 15 running on horizontal longitudinal rails 16. The blowing elements are spaced at equal distances apart except that there

is a wider space between the two center elements than between the others, for the reason that the tubular flues are arranged in two groups or banks spaced apart a short distance from each other.

5 The movable tubular framework is shorter than the length of the preheater, from front to rear, by an amount approximately equal to the spacing between adjacent blower elements of each of the two groups. Therefore, the tubular frame

10 structure need be moved lengthwise only a comparatively short distance, so that the nozzles on each blower element will travel over or scan as many flues as are located between two of the blowing elements when the blowing apparatus is

15 at rest in the position shown in Figs. 1 and 2.

Steam is supplied to the tubular frame structure through two separate connections with a supply pipe 17. Each of these connections, as best shown in Fig. 4, starts with a valve in a

20 branch of the pipe 17; these valves being indicated at 18 and 19. Connected to the valve 18 is a stationary pipe 20 extending through the front wall of the preheater shell or casing, above the blowing apparatus; the pipe 20 extending

25 parallel with the direction of travel of the movable structure. Rising from the tubular blower element 6 is a short pipe section 21 connected by an elbow 22 to a length of pipe 23 that extends into the open rear end of the pipe 20. As best

30 shown in Fig. 3, the rear end of the pipe 20 is provided with a suitable stuffing box 24 which permits the pipes 23 and 20 to move relative to each other in the lengthwise direction and yet maintain a sufficiently tight joint between the

35 same to prevent escape of steam. When the valve 18 is opened, steam flows through the pipes 20 and 23 into the tubular blowing system.

From the valve 19 there extends through the front wall of the preheater shell or casing a second stationary pipe 25 lying in the same plane

40 as the pipe 20 and extending back to the rear end of the preheater. At the rear end of the preheater the pipe 25 is bent laterally, as indicated at 26, and the free end of the laterally-extending section is connected to a pipe 27 by

45 means of an elbow 28. The pipe 27 is quite similar to the pipe 20, extending forwardly from the rear end of the preheater, however, instead of rearwardly from the forward end. In tele-

50 scopic relation to the pipe 27 is a pipe 29 corresponding to the pipe 23; the pipe 29 being connected at its forward end to the tubular blowing element 7 in the same way that the pipe 23 is connected to the element 6. Also, the pipe 27

55 has a stuffing box 24 to preserve a steam-tight joint between the same and the pipe 29.

Normally the blowing apparatus stands at rest in its forward position, namely at the right-hand limit of its movement as viewed in Figs. 1

60 and 2. At this time the pipe 23 projects only slightly from the stationary pipe 20, whereas the pipe 29 projects only a short distance into the pipe 27. When the movable structure is shifted into its rearmost position, the greater part of

65 the length of pipe 23 will project beyond the pipe 20, whereas the pipe 29 will lie almost completely within the pipe 27.

The movable blowing apparatus may be moved in any suitable way. In the arrangement shown,

70 there is an endless sprocket chain 30 extending around a sprocket wheel 31 rotatably mounted on the upper end of a stationary bracket or pedestal 32, rising from the flue sheet 3 in the intermediate part thereof that contains no flues.

75 One run of the sprocket chain is anchored to

the blowing element 5 by being attached to the free end of a finger or bracket 33 fixed to and rising from this element. The sprocket chain continues forward through an opening in the front wall of the preheater and there enters a

5 housing 34 in which there is a second sprocket wheel 35, as best shown in Fig. 6, adapted to be driven in any suitable manner, as will hereinafter be explained.

The construction just described lends itself to

10 operation in various ways. It is obvious that the blower apparatus may be moved back and forth solely through forces applied to the external sprocket wheel 35 or by steam entering through one or the other of the valves 18 and 19, or

15 through both power applied to the sprocket wheel and steam power. Also, in the case of a very large installation, it may be advisable to blow only one half of the flues during movement of the apparatus in one direction, and the other half

20 during the return movement. If this last mentioned expedient is to be carried out, then the pipes 12 and 13 should be closed off at points between the blowing elements 6 and 7. This

25 may easily be accomplished by placing a diaphragm in each of the couplings 36 that are located in these two pipes between the blowing elements 6 and 7.

In the arrangement shown, as best seen in Figs. 6 and 7, the shaft which carries the sprocket

30 wheel 35 is provided with a large gear wheel 37 which meshes with a pinion 38 on a shaft 39 rotatably mounted in the housing 34. One end of the shaft 39 is carried out through one of the side walls of the housing, and is there provided

35 with a brake drum 40. Suitable brake shoes are associated with this drum. The shoes may conveniently comprise substantially curved bands 41 and 42 crossing each other at one end and there provided with fingers 43 and 44 respectively;

40 these fingers embracing a stationary pin or lug 45 on the housing. The shoes have ears 46 and 47 at their other ends. A bolt 48 passes through these ears and, between one of the ears and the head or nut on the bolt is a compression spring

45 49. By adjusting the nut and thus varying the compression of the spring, the brake shoes may be caused to grip the drum under any desired pressure.

On the shaft 39 is a bevel gear 50, meshing with

50 a complementary pinion 51 on the inner end of an operating shaft 52 which is mounted in a long stationary bearing sleeve 53 projecting forwardly from the front wall of the housing 54; the shaft 52 being continued inwardly from the

55 inner end of the bearing sleeve, into the housing. On the outer or front end of the shaft 52 is a sprocket wheel 54 around which extends a sprocket chain 55 which hangs down so as to be brought within reach of a workman on the floor

60 below.

Each of the valves 18 and 19 also has actuating means hanging down within reach of such workman. In the arrangement shown, each of these

65 valves has a compound rocker arm 56, consisting of two opposed radial arms. From the free end of each individual arm hangs a chain or cable, indicated at 57, 58, 59 and 60, respectively. When the rocker arms stand horizontal as shown in

70 Fig. 4, the valves are closed and no steam is flowing into the blowing apparatus. By pulling down on the cable 58, the valve 18 is opened and, by pulling down on the cable 60, steam is turned on at the valve 19.

It is necessary to provide means to apprise the

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workman of the position which the movable blowing apparatus occupies to any given time. To this end we have provided an indicator placed near the depending cables heretofore described, and low enough down to be readily seen by a workman manipulating the cables. This indicator may be a little pointer 61 movable over a stationary vertical graduated scale 63 fixed to the front wall of the shell or casing 1, each graduation representing a stopping point for the blowing apparatus. The pointer is attached to a weight 64 suspended from a cable 65 that runs over a suitable arrangement of guide pulleys, passes through the front wall of the shell or casing, and is attached to the front end of the movable blowing unit.

Assuming that the front half of the flues are to be blown during the rearward movement of the blowing unit and that the rear half or group of flues are to be cleaned during the forward or return movement of the apparatus: the workman first opens the valve 18 to admit steam into the blower elements 4, 5 and 6 which are in position to discharge steam jets into the transverse rows of flues lying directly underneath their nozzles. The pressure of the steam tends to move the blowing unit rearwardly and would do so were it not restrained. The brake shoes are so adjusted that the steam pressure is not quite sufficient to overcome the resistance offered by the brake, and therefore no movement of the apparatus occurs until the workman pulls on the proper run of the chain 55 to bring about a rearward movement of the blowing apparatus. Only a light pull is required in order, in cooperation with the steam pressure, to bring about a rearward movement of the apparatus. As soon as the workman stops pulling on the chain, the brake stops the apparatus, the first stop being when the pointer on the indicator reaches the first graduation above the lower end of the scale. Thus, other transverse rows of flues are brought within the field of action of the jets. The blowing apparatus may thus be caused to move rearwardly, step by step, halting long enough between steps to cause predetermined transverse rows of flues to be cleaned, until all of the flues in the front half or group have been cleaned. The valve 18 is then closed, and the valve 19 is opened. Steam is now supplied to the blowing elements 8 and 9, which, in their forward, step by step movements clean the flues in the rear half or group; the forward or return movement of the apparatus being accomplished by giving a little aid to the steam to push the apparatus forward, in the same manner as during the rearward travel of the apparatus.

If all of the tubular blowing elements are to operate at the same time, the diaphragms in the couplings 36 should be left out and the pipe 29 should be plugged as in Fig. 11 or it might even be in the form of a solid rod, if desired. Then, when the valve 18 is opened, steam is supplied not only to the elements 4, 5 and 6, but also to the elements 7, 8 and 9. Upon closing the valve 18 and opening the valve 19, the apparatus will be driven forward under the control of the operator, the pipe 29 serving simply as a plunger or piston against which steam entering the pipe 27 may react.

In Figs. 8-13, inclusive, there is illustrated an arrangement differing somewhat from that previously described. The blowing unit in these figures is shown as being smaller than the other, comprising four tubular blowing elements 70, 71, 72 and 73. These are connected together into a

tubular frame structure by longitudinal pipes 74 and 75. The tubular frame thus produced is suspended from transverse axles 76 provided at their ends with wheels 77 resting on longitudinal rails 78 and held against jumping such rails by other longitudinal rails 79 placed above the wheels. Steam is supplied to the unit through two valves 18 and 19, as in the other construction. The pipe 80, corresponding to the pipe 29, is placed at the longitudinal center of and above the apparatus and is connected to the valve 18 through a branch pipe 81 projecting laterally from the same at its front end. Between the blowing elements 71 and 72 is a tubular cross member 82 which connects together the longitudinal pipes 74 and 75. To member 82 is connected a pipe 83 that is telescoped in the rear end of the stationary pipe 80. Steam from the valve 19 enters a stationary longitudinal pipe 85, corresponding to the pipe 25 in that it extends to the rear end of the pre-heater where a lateral extension 86 thereof connects it to a pipe 87 similar to and in alignment with the pipe 80. In telescoped relation with the pipe 87 is a pipe 89 which is also connected to the tubular cross member 82. In fact, the pipes 83 and 89 may both conveniently be attached to a head 90 which is in turn connected to the tubular cross member 82 by a vertical tubular neck or stem 91.

While the pipe 83 is open at its forward end to permit the entry of steam into the same, the pipe 89 is closed, as, for example, by a plug 92 in the rear end thereof, as illustrated in Fig. 11. Consequently, when the valve 19 is opened, and steam enters the pipes 85 and 87, the pipe 87 simply serves as a cylinder into which extends a plunger that takes the form of a plugged pipe. Thus, the pressure of the steam becomes available to drive the blowing unit forward through a return stroke after it has traveled to the rear limit of its movement in making a working stroke. It is evident that the pipe 29 in the other form of apparatus may be plugged in the same manner as is the pipe 89, when it is desired that the pipe 29 shall serve only as a piston or plunger and not as a conduit for delivering steam.

The pipe 85 and a branch pipe 92 on the pipe 87 are provided with nozzles, 93 and 94, respectively, for the purpose of blowing steam against the plunger member 89 to keep the latter clean. This is desirable because almost the whole length of the member 89 is exposed to the combustion gases at all times except during the short intervals of blowing the flues.

Instead of the sprocket chain which is employed in the other apparatus to move the blowing unit, I have provided the second form of apparatus with a rack and pinion actuating means. The details of this mechanism are best shown in Figs. 12 and 13. A long rack bar 95 is hinged at its rear end to ears 96, 96 on the forward tubular blowing element 70, a horizontal transverse hinge pin 97 extending through these ears and the end of the bar. The rack bar passes through an opening in the front wall of the shell or casing 1, through a housing 98 and through a long, forward tubular extension 99 of the housing. In the housing, below the rack bar is a transverse shaft 100 having thereon a pinion 101 that meshes with the rack bar. On one end of the shaft 100 is a worm wheel 102 that meshes with a worm 103 on a longitudinal shaft 104. The shaft 104 projects through and forwardly beyond the front wall of the housing 98 and, at its front end, is provided with a sprocket wheel 54 with its

sprocket chain 55 as in the other form of apparatus. The worm and worm wheel drive is self-locking so that the blowing unit cannot be moved in either direction without pulling on the sprocket chain.

The operation of this apparatus is substantially the same as that of Figs. 1-7, the unit being moved rearwardly step by step by steam power as the worm is turned to permit such movement; whereas, on the return stroke, the movement of the unit may be practically continuous because no blowing of the flues during the return stroke occurs.

It will be noted that substantially the entire rack bar lies outside of the preheater except at times when a cleaning operation is being performed and therefore is subjected to the heat and the gases in the preheater during only short, widely-spaced intervals of time. It is true that the rack bar constitutes a projection beyond the preheater, but the length of the bar is not great and therefore the presence of the bar outside of the preheater is not objectionable.

While we have illustrated and described with particularity only a single preferred form of our invention, with a single modification, we do not desire to be limited to the exact structural details thus illustrated and described; but intend to cover all forms and arrangements which come within the definitions of our invention constituting the appended claims.

We also wish to have it understood that where we refer to steam we intend also to include compressed air or other fluids under pressure.

We claim:

1. In combination, a forwardly and rearwardly reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one section of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, the two aforesaid pipe sections connected to said unit overlying and being positioned between the forward and rear ends of said unit, a mechanical drive for said unit, manual operating means for said drive, and means to cause steam to be delivered first into one and then into the other of said supply pipes to cause the steam to exert forces tending to drive the unit first in one direction and then in the other.

2. In combination, a reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one section of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, one of the said pipe sections movable with said unit being plugged to cause the same to serve as a piston adapted to be driven in one direction by steam in the co-

operating section, a mechanical drive for said unit, and manual operating means for said drive.

3. In combination, a reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one section of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, and steam entering the unit through one of said pipes tends to drive said unit in one direction while steam entering the other pipe tends to drive the unit in the opposite direction, means to admit steam first into one supply pipe and then into the other, a mechanical drive serving both as an actuator for said unit and to hold said unit against being driven by the steam, and manual operating means for said drive.

4. In combination, a reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one section of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, and steam entering said unit through one of said pipes tends to drive said unit in one direction while steam in the other of said pipes tends to drive the unit in the opposite direction, a sprocket chain drive for said unit, a brake acting on said drive to hold the unit against movement through steam pressure alone, and a manually-operable actuator for said drive.

5. In combination, a reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one section of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, and steam entering said unit through one of said pipes tends to drive said unit in one direction while steam in the other of said pipes tends to drive the unit in the opposite direction, means to admit steam first into one supply pipe and then into the other, a rack bar connected to said unit and extending parallel with the direction of movement of said unit, a pinion meshing with the rack bar, a worm wheel fixed to the pinion, a worm meshing with the worm wheel, and a manually-operable means to turn said worm.

6. In combination, a reciprocable blowing unit, a telescoped steam supply pipe extending in the direction of reciprocation of said unit, one sec-

tion of said pipe being stationary and the other being connected to and movable with said unit, a second telescoped two-section steam pipe paralleling and similar to the aforesaid pipe, the pipe section which is at the forward end in one pipe corresponding to the section which is at the rear end in the other pipe, whereby the sections in one pipe are moved relatively to each other in a direction to separate them while those in the other pipe are being further telescoped during a stroke of said unit, and steam entering the unit through one of said pipes tends to drive said unit in one direction while steam entering the other pipe tends to drive the unit in the opposite direction, a mechanical drive serving both as an actuator for said unit and to hold said unit against being driven by the steam, valves controlling admission of steam to said pipes, and separate manual operating means for each valve and for said drive extending to a point within reach of a workman.

7. In combination, a casing containing elements to be cleaned, a reciprocable blowing unit in said casing, two steam supply pipes each comprising two telescoped sections arranged in the casing beside and extending in the direction of reciprocation of said unit, one section of each pipe being stationary and the other being connected to and movable with said unit, the positions of the two sections being reversed end for end in the two pipes, means to admit steam first into one supply pipe and then into the other, mechanical drive for said unit, and a manual actuator for said drive.

8. In combination, a casing containing elements to be cleaned, a reciprocable blowing unit in said casing, two steam supply pipes each comprising two telescoped sections arranged in the casing beside and extending in the direction of reciprocation of said unit, one section of each pipe being stationary and the other being connected to and movable with said unit, the positions of the two sections being reversed end for end in the two pipes, means to admit steam first into one supply pipe and then into the other, an endless sprocket chain in the casing beside the said unit, said chain being connected to the said unit and extending through a wall of the cas-

ing to the exterior of the latter, and means outside of the casing to drive the sprocket chain.

9. In combination, a casing containing elements to be cleaned, a reciprocable blowing unit in said casing, two steam supply pipes each comprising two telescoped sections arranged in the casing beside and extending in the direction of reciprocation of said unit, one section of each pipe being stationary and the other being connected to and movable with said unit, the positions of the two sections being reversed end for end in the two pipes, means to admit steam first into one supply pipe and then into the other, a rack bar connected at one end to one end of said unit and extending through the adjacent wall of the casing, and means in the outside of the casing to drive said rack bar.

10. In combination, a casing containing elements to be cleaned, a reciprocable blowing unit in said casing, two steam supply pipes each comprising two telescoped sections arranged in the casing beside and extending in the direction of reciprocation of said unit, one section of each pipe being stationary and the other being connected to and movable with said unit, the positions of the two sections being reversed end for end in the two pipes, one of the pipe sections connected to said unit being plugged so that it serves as a piston or plunger, means to discharge jets of steam against the latter pipe section when steam is admitted to the section in telescoped relation thereto, mechanical drive for said unit, and a manual actuator for said drive.

11. In combination, a casing containing elements to be cleaned, a blowing unit mounted within said casing for reciprocable movements from front to rear, a source of supply of cleaning fluid under pressure, means within said casing for causing cleaning fluid from said source to be delivered to said unit and exert sufficient power to move said unit back and forth, controlling means to determine the direction in which the steam tends to move said unit, and additional actuating means for said unit serving also to hold said unit against movement.

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