C. F. HARRIS.

SMOKE CONSUMER.

APPLICATION FILED JAN. 6, 1909.

961,072.

Patented June 7, 1910.

2 SHEETS—SHEET 1.

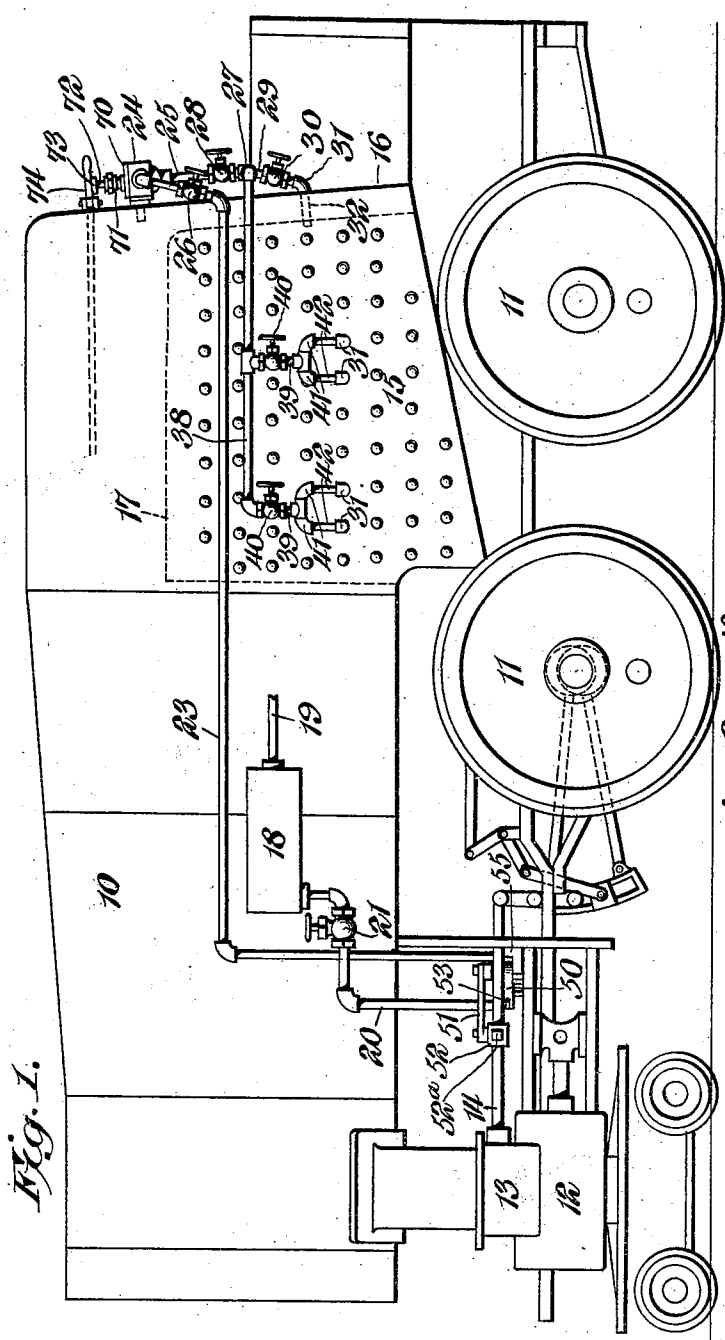

Fig. 1.

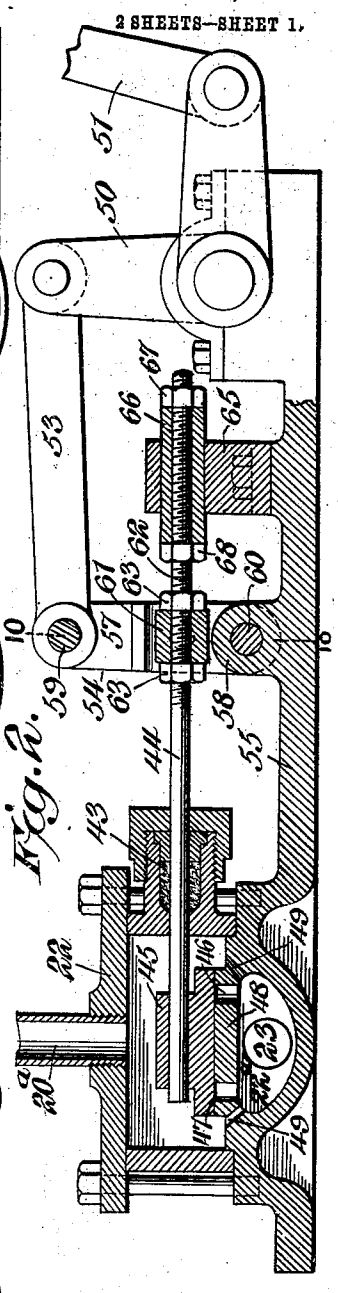

Fig. 2.

Witnesses

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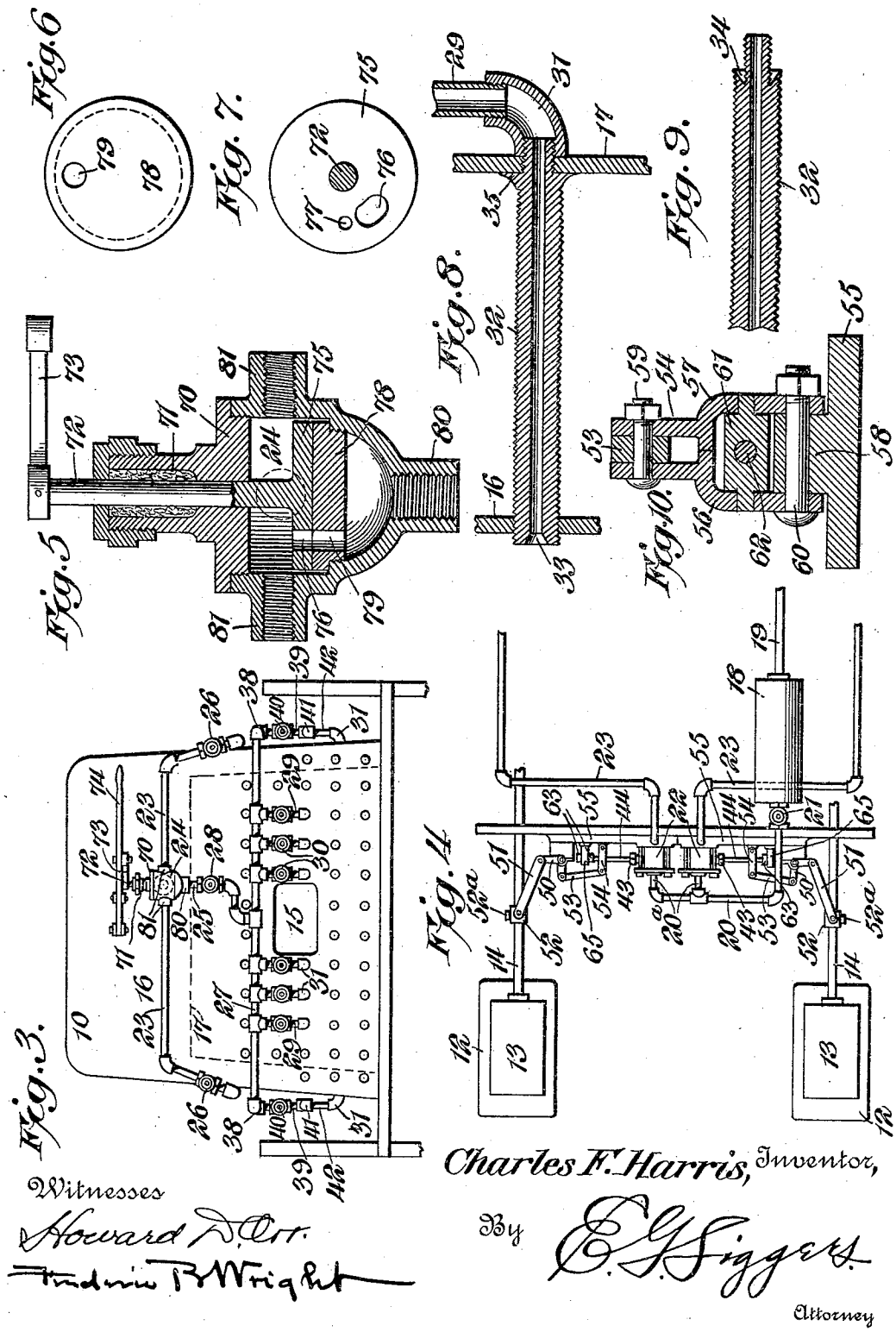

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UNITED STATES PATENT OFFICE.

CHARLES F. HARRIS, OF ALTOONA, PENNSYLVANIA.

SMOKE-CONSUMER.

961,072. Specification of Letters Patent. Patented June 7, 1910.

Application filed January 6, 1909. Serial No. 470,986.

To all whom it may concern:

Be it known that I, CHARLES F. HARRIS, a citizen of the United States, residing at Altoona, in the county of Blair and State of Pennsylvania, have invented a new and useful Smoke-Consumer, of which the following is a specification.

My invention relates to steam engines and particularly to means whereby air may be forced into the fire-box of an engine above the fire and thereby produce such a heat therein as will consume the smoke and other products of combustion which would otherwise be carried up the stack.

A further object in this connection is to improve the form of my device shown and described in my application for patent, Serial No. 438,341, filed June 13, 1908, this improvement consisting in providing means whereby the valve controlling the admission of air to the fire-box shall be actuated from and by the valve rod of the steam chest and whereby the air passing from the reservoir shall be cut off or reduced without failure upon the throttle lever of the engine being operated to cut off the supply of steam to the same.

In the drawings I have shown my mechanism as applied to a locomotive engine, and therein—

Figure 1 is a side elevation of a locomotive engine, showing the air conducting pipes; Fig. 2 is an enlarged longitudinal section of one of the air controlling valves, the bell crank for operating this valve being in plan; Fig. 3 is an end elevation of the boiler and fire-box, the other portions of the engine being omitted for the sake of clearness; Fig. 4 is a diagrammatic plan view of the front portion of an engine, showing the opposed steam chests and valve connections and particularly showing the connections between the air regulating valves and the steam valves; Fig. 5 is a diametrical section of the air controlling valve connected to the throttle lever; Figs. 6 and 7 are plan views of the rigid and movable disks of this valve; Fig. 8 is a longitudinal diametrical section of one of the stay bolts; Fig. 9 is a fragmentary section of the stay bolt before the flange thereof has been overturned against the boiler sheet; Fig. 10 is a transverse section on the line 10—10 of Fig. 2.

Like reference numerals throughout the several views, designate like parts.

In the drawings, 10 denotes the boiler of a locomotive engine, mounted as usual upon the driving wheels 11, and provided with the cylinders 12 and steam chests 13 containing the usual steam valves controlling inlet of steam to the cylinders 12 and actuated by the oppositely-reciprocating valve rods 14, which are driven in any suitable manner as is usual in the art. The rear end of the boiler is provided with a fire-box 15 having inner and outer walls 16 and 17. All these parts are as usual in locomotive engines and require no further description.

As before stated, my general object is to produce a more complete combustion within the fire-box of an engine and thereby reduce or entirely eliminate smoke. In general I attain this end by providing an air reservoir connected to a source of compressed air and connect this reservoir with the fire box. Between the reservoir and fire-box I interpose a controlling valve which is reciprocated by a connection to the valve rod 14 so that the air controlling valve shall be opened and closed in accordance with the movement of the valve rod, so that as the stroke of the steam valve is changed, the stroke of the air valve shall be also changed.

Inasmuch as at many times the engine is "drifting" the valve rod being reciprocated without, however, any steam being used, and therefore, without the necessity of a forced draft, I provide means whereby admission of compressed air to the fire-box is additionally controlled by a valve connected to the throttle lever of the engine.

18 denotes an air reservoir which is connected by the pipe 19 to any suitable source of compressed air. A pipe 20 extends from the reservoir to each valve chest 22, shown in detail in Fig. 2, to which it is connected by a branch 20^a, a globe valve 21 being interposed in the pipe 20 between the reservoir and the valve casing, 22, so that connection between the reservoir and valve casing may be entirely cut off.

Before describing the valve mechanism shown in Fig. 2 in detail it will be best to describe the connections from one casing 22 to the fire-box. From the lower portion of the casing 22 a pipe 23 extends upward as shown to a point above the reservoir 18 and then rearwardly to the rear end of the boiler, where, as shown in Fig. 3, it extends around the end of the boiler to about the center thereof and enters a valve casing 24, as shown in Fig. 5. A regulating valve 26

for closing off the passage through the pipe 23 is located on the upturned branch of the pipe 23, as shown in Fig. 3. From the valve casing 24, a pipe 25, extends downward to a header 27 by which the air is carried across the rear face of the fire-box. The globe valve 28 is located in the pipe 25 so as to cut off connection between the valve casing 24 and the header 27. Extending from the header 27 is a series of pipes 29, each provided with valves 30 and engaging at their lower ends in elbows 31, which, in turn, have screw threaded engagement with the projecting ends of tubular stay bolts 32 shown in Fig. 8, these stay bolts extending through the sheets 16 and 17 of the boiler as shown in Fig. 8. The inner ends of the stay bolts are flared as at 33 so that the air entering thereby will be directed in an expanding jet over the fire. The outer ends of the stay bolts are formed as shown in Fig. 9 with a V-shaped cut 34, extending around the central projecting portion, thus forming an outwardly extending flange 35 which is flared and expanded as shown in Fig. 8 against the inner face of the sheet 17, thus forming a tight joint for the stay bolt, entirely closing the inner end thereof against the side sheet and holding the stay bolt rigidly in place relatively to the sheet. It will be seen from this that the course of the compressed air is from reservoir 18 to the valve casing 22, through the valve ports therein into the pipe 23, from pipe 23 to the valve casing 24, and from thence to the fire-box.

While a very good effect is gotten by conducting the compressed air into the front of the fire-box, I have found in practice that to prevent the air rushing through the fire-box and into the stack it is best to provide means for creating whirling eddies or cross currents in the air thus introduced and the products of combustion with which the air is mixed. To that end I also introduce air into the sides of the fire-box by means of pipes 38 which are connected to opposite ends of the header 27, as shown in Fig. 3 and extend around the sides of the fire-box to the position shown in Fig. 1. Extending from the pipe 38 are one or more connections such as heretofore described, whereby the air from pipe 38 may be directed into the fire-box. These consist of the downwardly extending pipes 39 connected by tees or elbows to the pipe 38 and provided with valves 40. The lower ends of these pipes 39 are formed with oppositely-projecting downwardly-turned elbows 41, which in turn connect with the pipes 42 formed with the elbows 31, which connect with the tubular stay bolts 32, as previously described.

It will be obvious that air injected into the space above the fire by the lateral nozzles formed by the stay bolts 32 will meet the forwardly-directed jets of air and that eddies or whirls of air will therefore be created in the fire-box above the fire, which act to check flow of air toward the front of the engine or stack and to prevent a too rapid passage of air up the stack. This is necessary particularly as my mechanism is intended to inject air into the fire-box at the moment that the exhaust steam from the cylinders is directed into the stack.

Referring now to Figs. 2 and 4, 22 denotes opposed valve chambers of any desired character, having each the inlet pipe connection 20^a and the stuffing box 43, through which passes a valve rod 44, carrying at its end a slide valve 45. This in its movement back and forth in the casing 22 is adapted to alternately cover and uncover the ports 46 and 47, whereby air is admitted from the chamber 22 into a chamber 22^a below the ports 46 and 47, and thence into the pipe 23. In order to provide a support for the slide 45 and for the openings 46 and 47 I form the lower portion of the valve chamber 22 with a transverse septum 48, upon the upper face of which the valve 45 slides. As will be seen from Fig. 2, the opposite ends of this septum are provided with the small air passages 49, which the slide 45 never covers. These permit, therefore, a constant passage of a small amount of air from the upper portion of the chamber 22 into and through the pipe 23 to the fire box.

As shown in Fig. 2, the slide 45 is in a position to cover both of the ports 46 and 47, but it will be obvious that upon a reciprocation of the slide valve the ports will be opened alternately, and that if the full stroke of the slide valve is cut down, the ports will be only partly opened in accordance therewith.

In order to reciprocate each rod 44 in time with the valve 14 adjacent to it, I provide a bell crank lever 50, journaled in bearings upon a suitable base 55, on the engine frame and connecting by a link 51 with a sleeve 52 adjustably mounted by means of a set screw 52^a upon the valve rod 14. The other arm of the bell crank lever is connected by a link 53 to a rocking arm 54, which is pivoted at its lower end to an ear projecting from the base 55, preferably forming part of the valve casing 22. This rocking arm 54 as shown in Fig. 10 is formed in two halves 56 and 57. The lower ends of these two conjoined halves are spaced apart sufficiently to receive the end of the link 53, bolts 59 and 60 passing through the link and through the ear, respectively, provided for the pivotal connection of the arm 54 to the link and ear. Pivotally mounted between the two sections 56 and 57 just above the ear 58 is the rocking block 61 having a screw-threaded passage through it adapted to engage with the screw threaded end 62 of the rod 44. Set nuts 63 on the rod 44 are adapted to be screwed up

on either side of the block 61 so as to hold the rod 44 set in any adjusted position with regard to the block 61. In order to support the rear end of the rod 44 I provide an upwardly extending bearing 65 attached to the base 55 in any suitable manner, which carries a sliding sleeve 66, screw-threaded upon the end of the rod 44. This sleeve receives all the wear which would otherwise exist between the rod 44 and the bearing 65. The sleeve is held in place by set nuts 67 and 68, so that it may be adjusted upon the screw-threaded portion 62 of the rod in consonance with the adjustment of the rod in the rocking block 61.

It will be seen that with the mechanism above described a reciprocation of the valve rod 14 causes a reciprocation of the rod 44. This in turn reciprocates the valve 45, alternately cutting off and admitting air from the pipe 20 into the pipe 23. It will also be seen that by using the two ports 46 and 47 this supply of air will be coincident with the arrival of the engine piston at the extremity of its stroke, that is, at the point where the exhaust passes into the stack. It will be seen that by means of the adjustment of the rod 44 relatively to the arm 54, the stroke of the valve 45 may be regulated in any desired manner and so as to have any desired relation to the stroke of the piston in the engine cylinder. While I might control the supply of air entirely from one of the valve rods 14 of the engine, I prefer to control the supply from both valve rods as shown in Fig. 4, it, of course, following that the respective pistons 42 of the two valves will be oppositely moving at the same time in accordance with the opposite movement of the valve rods 14 on either side of the engine.

Referring now to Fig. 5, the valve casing 24 is provided with a cap 70 closing the top of the valve casing and provided with a gland 71 through which passes the rotatable valve spindle, 72, connected by a crank arm or link 73 to the usual throttle lever 74. The lower end of the valve spindle 72 is formed with a disk 75 provided with two openings 76 and 77, the opening 76 being elongated and much larger than the aperture 77. Immediately beneath the disk 75 is the fixed disk 78, which is screw-threaded into the walls of the casing 24. This disk 78 is formed with one opening 79, as shown in Fig. 6, and the openings 76 and 77 are adapted to respectively register with the opening 79 as the valve spindle 72 is turned. The lower end of the valve casing 24 is formed with the nipple 80, which is screw-threaded into the pipe 25 as before described, and interiorly screw-threaded nipples 81 project from the sides of the valve casing 24 and are adapted to engage with the pipes 23. These details, of course, may be modified in many ways as desired, without changing the essence of the invention. The crank 73 is so directed with relation to the angular position of the apertures 77 and 76 that when the throttle lever 74 is thrown so as to open the throttle to its full extent, the larger aperture 76 will coincide with the aperture 79; and that when the throttle is thrown so as to shut off steam entirely, then the small aperture 77 registers with the opening 79. By this mechanism it is impossible to shut off steam and yet be forcing air into the fire-box to the great waste of coal and air. Thus only a little air will pass into the fire-box even though the slide valves in the cylinders 12 of the engine are being reciprocated. At the same time when the valve 75 is so thrown that the opening 76 is in alinement with the opening 79, it is obvious that the supply of air will be entirely regulated by the movement of the valve rods 14, and that when the valve gear with which these valve rods are ordinarily connected is thrown so as to provide for a very small reciprocation of the valve rods that the ports 46 and 47 will either be uncovered very slightly or not at all by the reciprocation of the slide valves 45. Thus the supply of air to the fire box is entirely in proportion to the movement of the valves within the steam chest and dependent upon this movement, while, at the same time, the supply is simultaneously shut off upon the movement of the throttle valve and is thus not dependent upon the attention of the fireman or engineer and cannot be left open for the free passage of air through carelessness. It will be seen that there is always a certain amount of air passing from the reservoir 18 through the side parts 49, into the valve casing 24 and through the small ports 77, thus supplying air just sufficient to provide for a proper amount of draft when the engine is "drifting," or when the slide valve 45 is stationary.

One of the objects attained by my invention is the means whereby the stroke of the air valve 45 is reduced if the steam to the piston cylinders is cut back. Unless some means of reducing this stroke of the slide valve 45 is used, air will be admitted in full amount to the fire box at every reciprocation of the valve rods 14 without regard to the amount of such reciprocation. By connecting the valve rods 44 to the valve rods 14 it, of course, follows that a variation in the stroke of the rods 14 causes a like variation in the stroke of the rods 44 and that the slide valve 45 will therefore move in exact accordance with the movement of the usual slide valve within the steam chest 13 so that when the engine is being more lightly worked, the supply of air is cut down, and vice versa.

The importance of the cut-off mechanism shown in Fig. 5 resides in this, that, when

the engine is "drifting" though no steam be used, yet the valve rods 14 are making their full reciprocation, and, hence, a full amount of air would be admitted to the fire box, even though this air were not needed. A valve might be provided in the pipe 23 which could be closed by the fireman or engineer at this time, but this valve could be easily left open through carelessness, thus wasting the compressed air. This is obviated by connecting the valve to the throttle lever as described. By means of the various valves 21, 26, 28, 30 and 40, the air may be directed into any desired portion of the fire box or may be cut off therefrom entirely.

While I have shown two pairs of air inlet pipes, 42, upon the sides of the fire-box, it will be understood that I may use as many inlets as desired, and arrange them differently from the exact arrangement shown, and in accordance with what practice determines to be the best arrangement.

Having thus described my invention, what I claim as new and desire to secure by Letters-Patent, is:

1. The combination of a boiler, a furnace for heating the same, an engine including a valve mechanism for admitting and exhausting the steam to and from the engine, and means connected with the valve mechanism and positively actuated thereby for admitting fluid to the furnace.

2. The combination of a boiler, a furnace for heating the same, an engine including a cylinder and a valve mechanism for controlling the supply of steam from the boiler to the cylinder and the exhaust of the steam from the latter, a valve for controlling the admission of fluid to the furnace, and an operating connection between the last-mentioned valve and the said mechanism for admitting fluid to the furnace while steam is admitted to the cylinder.

3. The combination of a boiler, a furnace for heating the same, an engine including a cylinder and a valve for controlling the admission of steam from the boiler to the cylinder, a draft appliance for supplying fluid to the furnace, said appliance including a valve operatively connected with the valve of the engine to move simultaneously therewith for maintaining a pulsating draft in the furnace while the engine is consuming steam, separate valves movable simultaneously for controlling the flow of steam to the engine and of air through the said appliance to the furnace independently of the movement of the other valves for reducing or increasing the amount of fluid supplied to the furnace as the demand for steam decreases or increases, and a controller for the last-mentioned valves.

4. The combination of a boiler, a furnace for heating the same, an engine including a cylinder and a valve for controlling the admission of steam from the boiler to the cylinder, means for supplying fluid to the furnace including a controlling valve, a common operating mechanism for the steam and fluid valves, a throttle for controlling the supply of steam from the boiler to the engine, and a valve located in the said means and connected with the throttle to open and close with the opening and closing of the latter to control the supply of fluid to the furnace through the said means.

5. The combination with a boiler, a furnace, a cylinder, a steam valve controlling the supply of steam thereto, of an air reservoir, a conducting pipe connecting the reservoir and the furnace, a valve located in the pipe, and means connected to the steam valve actuating means for periodically opening and closing the valve with each stroke of the steam valve to permit or cut off the passage of air through said pipe.

6. The combination with a locomotive engine including a boiler having a furnace, cylinders, and steam valve mechanism actuated only during the travel of the locomotive for controlling the admission of steam to the cylinders, of an air reservoir carried by the locomotive, air supply pipes connecting the reservoir with the furnace, valves located in the pipes, said mechanism including a reciprocatory member and means driven by the reciprocatory member of the steam valve mechanism to effect the operation of the air supply valves.

7. The combination with a fire-box, a cylinder, and a steam valve controlling the supply of steam thereto, of a conducting pipe leading from a source of compressed air and entering the fire-box, a reciprocating valve in said pipe for regulating the passage of air through the pipe, and means for operating said reciprocating valve from the steam valve to admit and cut off the air from said reservoir in time with the movements of the steam valve.

8. The combination with a fire-box, a steam cylinder, and a reciprocating steam valve controlling the admission of steam thereto, of a conducting pipe leading from a source of compressed air and entering the fire-box, a valve casing in said pipe, and a reciprocating valve in said casing connected to the steam valve and constructed to cover and uncover the ports in said casing at opposite portions of the stroke of the valve, to permit the intermediate passage of air through the pipe from the reservoir to the fire-box.

9. The combination with a fire-box, a steam cylinder, and a reciprocating steam valve controlling the admission of steam thereto, of a conducting pipe leading from a source of compressed air and entering the fire-box, a reciprocating valve located in said conducting pipe and adapted to alter-

nately cut off and permit the passage of air through the pipe, a bell crank lever connected to said valve for operating it, and a connection between said bell crank lever and said steam valve.

10. The combination with a fire-box, a steam cylinder, and a reciprocating steam valve controlling the admission of steam thereto, of a conducting pipe leading from a source of compressed air and entering the fire-box, a valve casing located in said pipe, a slide valve operating in the casing and having an exposed stem and adapted to alternately open and close the passage through said pipe, a lever connected to the stem, a bell crank connected to said lever, and connections between said bell crank and said reciprocating steam valve.

11. The combination with a fire-box, cylinders having steam chests, reciprocating steam valves located one in each steam chest controlling the admission of steam to the cylinders and having projecting valve rods, of opposed conducting pipes leading from a source of compressed air and entering the fire-box, a valve casing in each of said pipes, a reciprocating valve in each casing having a projecting stem and alternately cutting off and permitting the passage of air through said pipe, a lever to which said stem is pivotally connected, a bell crank having one arm connected to the lever, and a pitman connecting the other arm of the bell crank to the adjacent valve rod.

12. The combination with a fire-box, cylinders having steam chests, and reciprocating valves one in each chest controlling the admision of steam to the cylinders, each having a projecting stem, of an air reservoir, a conducting pipe leading from the same, corresponding valve casings into which said conducting pipe leads, opposed pipes leading one from each of said casings, and entering opposed portions of the fire-box, a slide valve in each of said casings for intermittently cutting off and permitting the passage of air from the reservoir to the fire-box, a valve stem projecting through each of the valve casings, and an adjustable connection between the valve stem and the adjacent steam valve rod whereby the extent and time of movement of the steam valve and air valve may be relatively adjusted.

13. The combination with a fire-box, a cylinder, and a steam valve controlling the admission of steam thereto, of an air conducting pipe leading from a source of compressed air, a valve casing into which the conducting pipe opens, a septum dividing said casing into two portions and having ports, a conducting pipe leading from beneath said septum to the furnace, a valve operating on said septum to cover and uncover the said ports, and mechanism for reciprocating the air valve in time with and in proportion to the movement of the steam valve, said septum in the valve casing having a permanently open port disposed out of the range of the sliding air valve in any position thereof.

14. In a traveling vehicle, the combination of a propelling engine including a cylinder and a valve mechanism controlling the admission and exhaust of steam to and from the cylinder, a boiler, a furnace therefor, a throttle controlling the supply of steam from the boiler to the engine, a smoke-consuming appliance including means for supplying fluid to the furnace, an automatically operated valve mechanism operating continuously with the first-mentioned valve mechanism during the travel of the vehicle for supplying fluid for producing a pulsating draft in the furnace, and means for controlling the supply of fluid through the said appliance independently of the second mechanism by the movement of the throttle.

15. In a traveling vehicle, the combination of a propelling engine including a valve mechanism operating continuously with the movement of the vehicle, a boiler, a furnace therefor, a throttle controlling the supply of steam from the boiler to the engine, a smoke-consuming device including means for supplying air to the furnace, a valve device operatively connected to and moving with the valve mechanism to control the supply of air to the furnace for producing a variable draft therein, and means connected with the throttle for reducing the supply of air through the said device to the furnace when the throttle is closed during coasting of the vehicle.

16. In an apparatus of the class described, a fire-box, an engine valve-operating mechanism, a throttle operating mechanism, an air conducting pipe leading into the fire-box, a valve for intermittently cutting off the passage of air through the air pipe, means for operatively connecting the valve with the first-mentioned mechanism, in combination with a controlling valve in said pipe independent of said first-named valve having a connection with the throttle operating mechanism to move therewith to regulate the supply of air in accordance with the movement of the throttle.

17. In an apparatus of the class described, a fire-box, a cylinder, a valve controlling the admission of steam thereto, a throttle-operating mechanism, an air conducting pipe leading into the fire-box, a valve connected to and operated by the throttle operating mechanism for intermittently cutting off the passage of air through the air pipe, in combination with an independent controlling valve in said pipe having two ports, one larger than the other, and means for connecting said controlling valve to the

throttle-operating mechanism so that when the throttle is closed, the larger port shall be closed and the smaller opened to permit the passage of air.

18. The combination with a fire-box, opposed steam cylinders having valves controlling the admission of steam thereto, and a throttle operating mechanism, of an air reservoir, pipes leading from the air reservoir, independent air valve casings into which said pipes are conducted, a reciprocating air valve in each casing acting to intermittently cut off the passage of air through the casing, mechanism connecting each of said valves to said steam valves arranged to operate said air valves in accordance with the operation of said steam valves, a controlling valve casing into which the pipes from the air valve casing lead, pipes leading from the controlling valve casing to opposite portions of the interior of the fire-box, a valve in the controlling valve casing, and mechanism connecting the controlling valve with the throttle mechanism whereby said valve shall move in accordance with the movement of the throttle mechanism.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

CHARLES F. HARRIS.

Witnesses:
A. H. SLAYMUN,
J. B. BOYER.