Apr. 17, 1923. 1,452,297

H. P. HOWLAND ET AL

SAFETY DEVICE FOR HOT BLAST STOVES

Filed June 27, 1918 2 Sheets-Sheet 1

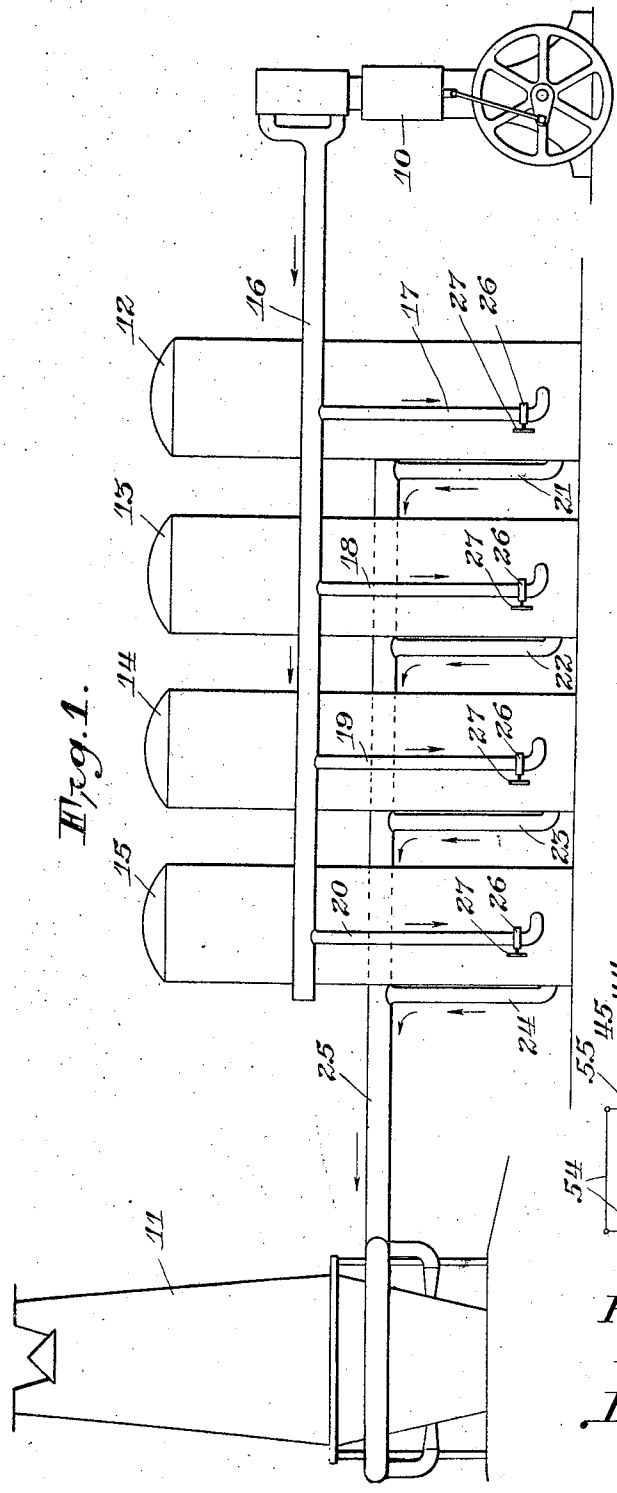


Fig. 1.

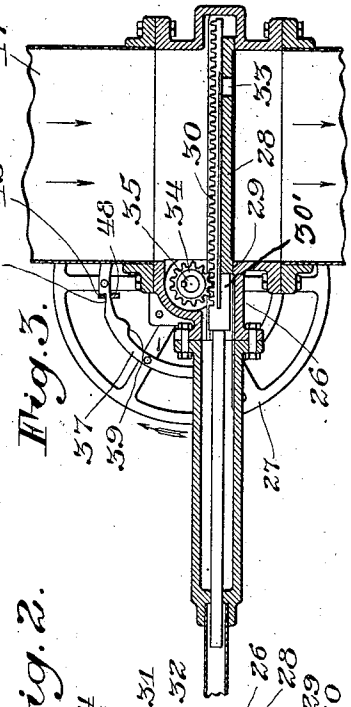


Fig. 3.

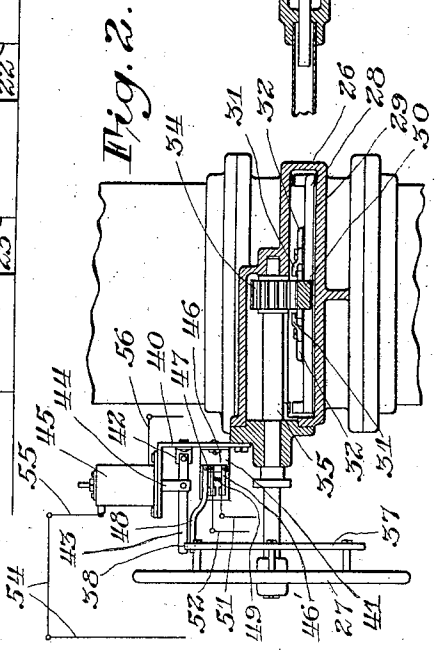


Fig. 2.

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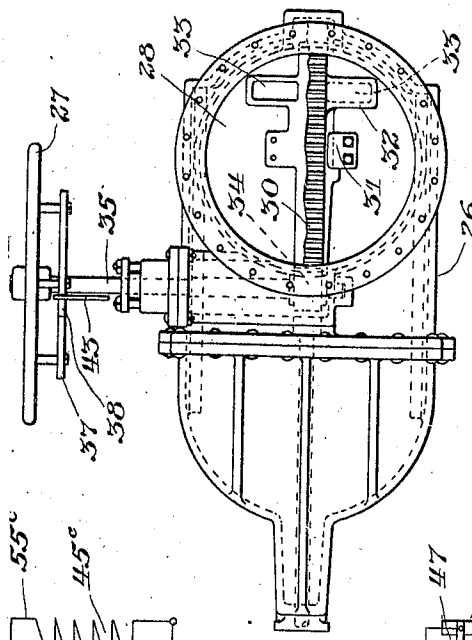


Fig. 4.

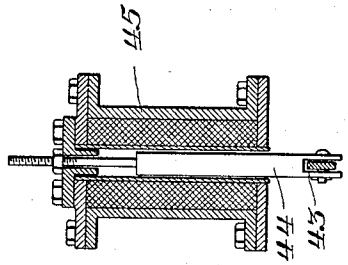


Fig. 5.

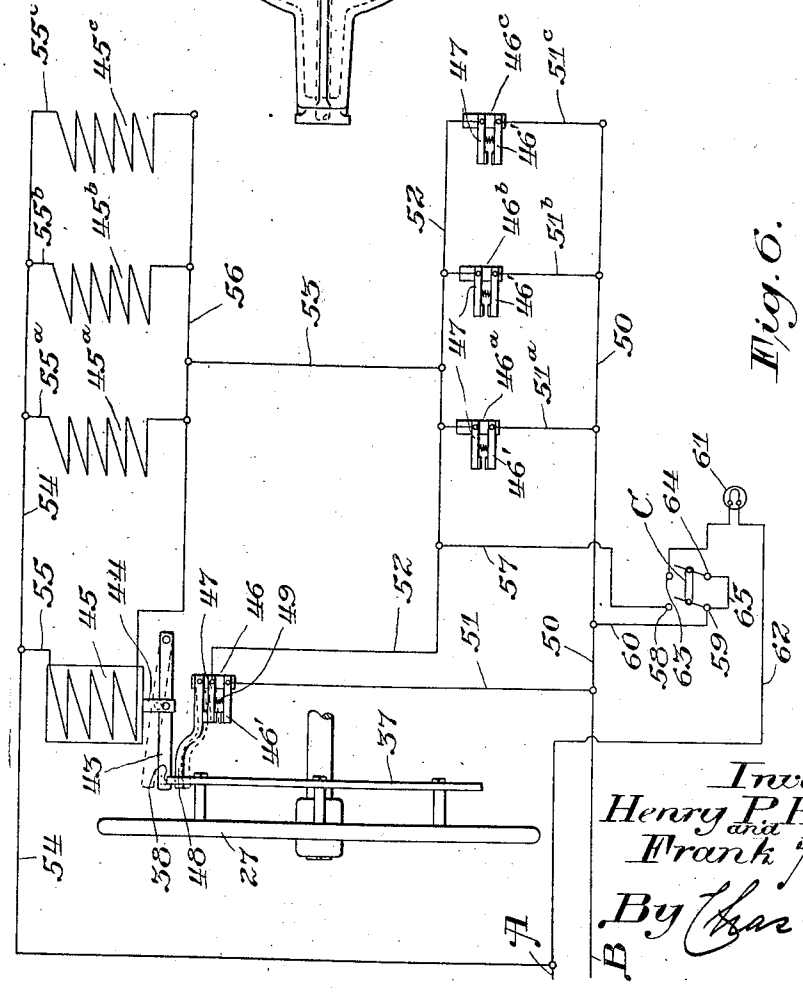


Fig. 6.

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UNITED STATES PATENT OFFICE.

HENRY PHELPS HOWLAND AND FRANK ALBERT WILEY, OF CHICAGO, ILLINOIS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO INTERNATIONAL HARVESTER COMPANY, A CORPORATION OF NEW JERSEY.

SAFETY DEVICE FOR HOT-BLAST STOVES.

Application filed June 27, 1918. Serial No. 242,325.

To all whom it may concern:

Be it known that we, HENRY P. HOWLAND and FRANK A. WILEY, citizens of the United States, and residents of Chicago, in the county of Cook and State of Illinois, and of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Safety Devices for Hot-Blast Stoves, of which the following is a full, clear, and exact specification.

This invention relates to safety devices for air blast furnaces and more particularly to safety devices used in connection with hot blast stoves which are employed to heat the air for the blast in operating blast furnaces.

All blast furnaces require air blasts for their operation; the air is forced into the furnace at the bottom against the resistance caused by the materials to be melted with which the furnace is filled. This air after performing its function of burning the coke in the furnace, passes out at the top in the form of gas. Since the materials in the furnaces offer considerable resistance to the passage of air, blowing engines are required to force the air through the furnace at a considerable pressure, the pressure often reaching thirty pounds per square inch.

In the air circuit between the blowing engine and the blast furnace a set of hot blast stoves is interposed in order to heat the air before it reaches the furnace. These stoves usually consist of a cylindrical steel shell filled with brick checker-work and passages. The brick work in the interior of the hot blast stove is brought to an intense heat by means of the gas which passes out of the blast furnace and when the stove has been heated to a sufficiently high temperature, the hot gases from the blast furnace are diverted from the stove which has been heated, to one of the cold stoves, and the heated stove is used to heat the air passing from the blowing engine to the furnace. To keep the air continually hot it is necessary to change stoves whenever the one in use becomes cool, due to the cooling effect of the air passing through it. The usual practice is to employ four hot blast stoves for each blast furnace in order that one of the stoves may be always maintained at a sufficient temperature to heat the air.

From the above description it will be seen that one or more blowing engines are employed to force the air through the blast furnace, and that a plurality of hot blast stoves is interposed between the engine or engines and the furnace. Valve mechanism is provided in connection with each stove to regulate the passage of air from the engine to the stove and also the passage of the hot gases from the furnace to the stove. From actual experience it has been found that operators, through carelessness, sometimes close the inlet valve for the stove that has been in use, before opening the inlet valve for one of the other stoves that he proposes to use, thereby shutting off all the exits from the cold blast main and placing the engine in danger of being wrecked.

With the above description in mind the object of the invention now under consideration is to safeguard the process of changing stoves, by providing an apparatus in which the passage from the blowing engine to one of the stoves must be always maintained open, or in other words, by means of which the closing of all of the inlet valves from the engine to the hot blast stoves is prevented. In the embodiment of the invention illustrated in the drawings, the controlling mechanism for each of the valves in the circuit between the engine and the hot blast stove, includes an electric circuit in which there is provided a solenoid which controls the closing and opening of the valves. We have illustrated one embodiment of our invention in the accompanying drawings, and in these drawings,—

Figure 1 is an elevational view showing the blowing engine, the hot blast stoves and the blast furnace, and the air conducting pipes to and from the various parts of the apparatus;

Fig. 2 is a side elevation partly in section, showing the valve mechanism and the controlling and actuating means therefor;

Fig. 3 is a sectional view taken at right angles to Fig. 2;

Fig. 4 is a plan view on an enlarged scale showing the valve mechanism;

Fig. 5 is a sectional view showing the construction of the solenoid; and

Fig. 6 is a diagrammatic view showing the electrical connections for the controlling and valve regulating circuit.

In Fig. 1 a blowing engine 10 is illustrated, which may be of any desired type,

and between this engine 10 and the blast furnace 11 a series of hot blast stoves 12, 13, 14 and 15 is interposed. A pipe 16 forms the cold blast main or header and is connected by branches 17, 18, 19 and 20 to the stoves 12 to 15 inclusive. The air after being heated passes out of the pipes 21, 22, 23 and 24 to a hot blast main 25, which leads to the tuyères of the blast furnace.

It will of course be understood that in the operation of this apparatus the stoves are not all used simultaneously, but that the cold blast is passed through one of the stoves, for instance stove 12, and passes out of its exit pipe 21 to the hot blast main 25. In connection with each of the hot blast stoves there is interposed between the cold blast main and the stove a valve 26 which is controlled by a hand wheel 27, these valves being similar for all of the stoves.

In the showing in the accompanying drawings we have illustrated the ordinary horizontal gate valve, the details of the construction being shown in Figs. 2, 3 and 4. This valve has a circular plate 28 which is slidably mounted on a circular seat 29 secured to the inlet conduit, and in its closed position the plate 28 entirely closes the passage into the hot blast stove. There is slidably mounted on the top of the plate 28 a rack 30 which is guided by overlapping retaining lugs 31. There are formed integral with the rack 30 outwardly extending lugs 32 which in the closed position of the rack are superposed over openings 33 in the valve plate. As the rack is retracted in order to open the valve, it moves independently of the valve disk 28 until the lugs 32 on the rack engage the overlapping lugs 31 carried by the valve plate, and after this engagement the rack and the plate move to valve opening position simultaneously. As the lugs 32 are moved in a direction to open the valve, they uncover the apertures 33 in the plate 28 and admit to the stoves a small portion of the air blast from the engine, the purpose of this construction being to prevent too sudden a change in the load on the engine and equalizing the pressure on the two sides of the valve. When the valve is to be closed the hand wheel 27 will be rotated counterclockwise (Fig. 3) which will first cause the rack 30 to travel to the right to close the apertures 33. When the apertures are fully closed the depending lug 30′ on the rack will engage the valve disk 28 so that continued movement of the rack will slide the disk on its seat 29 into closed position.

The rack 30 above described is operated by means of a pinion 34 secured to a shaft 35 which is operated by means of the hand wheel 27. The safety device for the prevention of the closing of all of the inlet valves for the hot blast stoves when the pumping engine is in operation, is operatively connected to the hand wheel 27 by the manipulation of which the valve 26 is operated.

Upon each hand wheel there is secured a band 37 circular in outline and having on its outer periphery a notch 38 and on its inner periphery an inwardly projecting lug 39. An L-shaped bracket 40 is secured to the casing of the valve, the vertical portion of this bracket having secured thereto a casting 41 and a supplementary bracket 42. The casting 41 carries a controlling switch for an electric circuit hereinafter described, and the supplementary bracket 42 has pivoted thereto a locking member or latch 43 which normally rests on the outer periphery of the band 37. The locking member is pivotally connected intermediate its ends to a soft iron core 44 of a solenoid 45, the latter being supported on the horizontal portion of the L-shaped bracket 40. The electric switch 46 supported on the casting 41 is made up of a fixed member 46′ and a pivoted member 47, an outwardly projecting arm 48 being also pivoted to the casting 41 and resting on member 47. A spring 49 is interposed between the fixed member 46′ and the pivoted member 47 of the switch and normally forces the pivoted member 47 and the arm 48 upwardly against the inner periphery of the band 37 in a position to be engaged by the lug 39. Each of the inlet valves used in connection with the hot blast stoves is similar to that above described and therefore one description will suffice.

The electrical connections for the solenoids will now be described, and attention is directed to Fig. 6 wherein the valve actuating wheel 27 is shown in connection with one of the solenoids in order to illustrate the construction, and it should be understood that this mechanism is also used in connection with the other solenoids, a single showing in this figure of the valve actuating wheel being sufficient.

In the embodiment of the invention illustrated four solenoids 45, 45^a, 45^b, and 45^c and four switches 46, 46^a, 46^b, and 46^c are shown, although of course, this number can be varied if a larger or smaller battery of hot stoves is used. The electric circuits which are utilized in carrying out my invention may be traced in detail by reference to Fig. 6 wherein a line wire 50 leads from the main line terminal B to one side of a parallel circuit including branch wires 51, 51^a, 51^b, and 51^c. These branch wires are connected in parallel with each other and include switches 46, 46^a, 46^b and 46^c. The other side of this parallel circuit is formed by a wire 52 which in turn is connected to a wire 53. A line wire 54 leads from the opposite main line terminal A and is connected through branch wires 55, 55^a, 55^b, and 55^c, to solenoids 45, 45^a, 45^b, and 45^c, these solenoids and branch wires being connected

in parallel with each other between the line wire 54 and a wire 56, the latter being connected through the wire 53 to the wire 52 which as above stated forms one side of the parallel circuit containing the switches.

Thus the solenoids are all connected in parallel and the switches are also connected in parallel, the two parallel circuits being connected in series in the main circuit. Thus it will be seen that the closing of any one of the switches energizes all of the solenoids, thereby lifting the latch members 43 and permitting the closing of the valves for the stoves not in use.

From the above description and the showing in Fig. 6 it will be seen that the circuit from A passes through each of the solenoids and then through the switches and back to the source of electric power. The circuit will be closed when any one of the switches is closed. In each case the position of the hand wheel 27 controls the position of the bar 48 which in turn controls the opening and closing of the switch and the opening and closing of the electric circuit. Thus, referring to Fig. 3, when the hand wheel 27 is turned in a clockwise direction to open the valve, the projection or lug 39 comes into contact with the arm 48 secured to the movable member of the switch, forcing this arm downwardly, thereby making a contact between the movable and fixed members of the switch and closing the electric circuit. As the circuit is closed the solenoids will all be energized, thereby drawing the soft iron core pieces 44 upwardly and lifting the latch members 43. When the latches 43 are lifted out of engagement with the notches 38 in the plates 37 secured to the hand wheels 27, these hand wheels may be rotated in a direction to close the valves of the stoves not in operation.

Suppose, for instance, switch 46 is closed by the operation of its hand wheel in the direction to open the valve; the electric circuit may then be followed from B through the wire 50, branch wire 51, and switch 46 to the wire 52, and thence through the wire 53 and through each of the solenoids 45, 45^a, 45^b, and 45^c, to the wire 54 and back to the terminal A, completing the circuit.

From this description it will be seen that it is necessary for one valve to be opened, thereby closing the electric circuit, energizing the solenoids and lifting the latches 43 before any of the remaining valves which are open can be closed. In other words, the controlling device operates in such a manner that it is impossible to shut all the valves at once, and also in such a way that any of the valves can be closed if one of the valves is open.

There are times, however, when it is desirable to close all the valves at once, as for example, when the furnace is shut down for any reason. To provide for this contingency a switch has been included in the electric circuit for closing the circuit through solenoids, thus operating all of the solenoids and throwing the entire controlling mechanism out of operation. In order to clearly indicate to the operator when the controlling mechanism is out of operation, a safety lamp is also included in the circuit with the switch, it being understood by the operator that the mechanism is out of commission when the lamp is burning. This circuit is shown at the bottom of Fig. 6 and a double pole switch C is shown interposed between the two main branches of the electric circuit, one pole of the circuit being connected to one side of the parallel solenoid circuit and the other pole being connected through the switch to the other side of the parallel solenoid.

The switch circuit and the lamp circuit above referred to may be traced in Fig. 6 as follows: Starting at terminal A the circuit leads through wire 54, branches 55, 55^a, 55^b, and 55^c, and the solenoids 45, 45^a, 45^b, and 45^c, to the wire 56, and thence through wire 53 to the wire 52 which forms one side of a parallel circuit containing the switches 46, 46^a, 46^b, and 46^c. The wire 52 is connected by means of a wire 57 to one terminal 58 of the double pole switch, the opposite terminal 59 of the switch being connected through wire 60 to the line wire 50 which leads to the line terminal B. The lamp 61 is connected in series in a line 62 leading from line terminal A to switch terminal 63, the opposing terminal 64 of the switch being connected by a bridging wire 65 to the switch terminal 59 above described, the circuit leading from 59 through wire 60 to the main line wire 50 and thence to the line terminal B.

The circuits through the double pole switch therefore may be traced as follows: From line terminal B through the wire 60 to the switch and thence through the switch knife to wire 57 and through wires 52 and 53 to the solenoid circuits, and from the solenoids through wire 54 to main line terminal A. The lamp circuit leads from A through wire 62 and lamp 61 to switch terminal 63, and through the knife of the switch to terminal 64 and thence through bridging wire 65 and wire 60 to the line 50 and to the line terminal B.

From an inspection of this figure it will be seen that when the switch C is closed the circuit through the solenoids is closed and a circuit is also closed through the signal lamp 61.

From the above description it will be seen that a simple and efficient apparatus has been provided for safeguarding the operation of the hot blast stoves, the apparatus preventing the closing of all of the valves at

one time when the air compressing means is in operation. Means have also been provided for throwing the valve regulating mechanism out of commission when the air compressor is not operating and the furnace is shut down.

While we have in the above specification defined one embodiment which our invention may assume it should be understood that the invention is capable of modification and that modifications may be employed without departing from the spirit and scope of the invention as expressed by the following claims:

1. In combination, means for creating a blast of air, a plurality of means for heating said blast, valve mechanism interposed between said blast creating means and each of said blast heating means for regulating the passage of said blast to said heating means, means for controlling said valves in such a manner that one of said valves must be open before the other valves can be closed.

2. In combination, means for creating a blast of air, a plurality of means for heating said blast, valve mechanism interposed between said blast creating means and each of said blast heating means for regulating the passage of said blast to said heating means, and means including an electric circuit for controlling said valves in such a manner that one of said valves must be open before the remaining valves can be closed.

3. In combination, means for creating a blast of air, a plurality of means for heating said blast, valve mechanism interposed between said blast creating means and each of said blast heating means for regulating the passage of said blast to said heating means, actuating means for said valve mechanism including a rotatable member, and means for preventing the rotation of one of said actuating means in a predetermined direction until one or more of the remaining actuating means has been rotated in the opposite direction to a predetermined degree.

4. In combination, means for creating a blast of air, a plurality of means for heating said blast, valve mechanism interposed between said blast creating means and said blast heating means for regulating the passage of said blast to said heating means, actuating means for said valve mechanism including a rotatable member, and electrically controlled means for determining the degree of rotation of said rotatable member in a predetermined direction.

5. In valve controlling mechanism, a rotatable member having a notched portion, a pivoted member adapted to seat in said notched portion, means including an electric circuit for determining the position of said pivoted member, and means operable by said rotatable member for controlling said electric circuit.

6. In combination, a plurality of valves, independent actuating mechanisms for said valves, and controlling means for each of said actuating mechanisms for preventing the operation of one of said mechanisms to close one of said valves unless one or more of the remaining valves is open.

7. In combination, a plurality of valves, actuating mechanisms for said valves, and electrical controlling means for preventing the operation of one of said mechanisms to close one of said valves unless one or more of the remaining valves is open.

8. In combination, a plurality of valves, means for actuating each of said valves, a locking member for each of said actuating means, and means including an electric circuit for throwing said locking members out of position when one of said valves is opened.

9. In combination, a plurality of valves, means for operating each of said valves, a locking member for locking each of said valves against movement in a predetermined direction, and controlling mechanism for each of said locking means set in operation by the movement of one of said valves in a direction opposite to said first mentioned direction.

10. In combination, a plurality of valves, means for operating each of said valves, a pivoted latch for preventing the actuation of each of said operating means, means including an electric circuit for lifting said latch, and a switch in said circuit adapted to be closed upon the actuation of said valve operating means in a predetermined direction.

11. In combination, a plurality of valves, means for operating each of said valves and including a rotatable member, a pivoted locking member for each of said rotatable members for preventing the rotation thereof in a predetermined direction, a pivoted lock releasing member for each of said rotatable members and adapted to be actuated to release said locking member upon the actuation of one of said rotatable members in a direction opposite to that first mentioned.

12. In combination, a plurality of valves, actuating means therefor, locking mechanism for preventing the operation of said actuating means in a direction to close said valves, and means set in operation by the movement of said actuating means in a direction to open one of said valves for holding said locking mechanism in inoperative position.

13. In combination, a plurality of valves, actuating means therefor, locking mechanism for preventing the operation of said means in a direction to close said valves,

and electrically controlled means set in operation by the movement of said actuating means in a direction to open one of said valves for holding said locking mechanism in inoperative position.

14. In combination, means for creating a blast of air, a plurality of stoves for heating said blast, conduits connecting said blast creating means and said heating means, valve mechanism interposed between said blast creating means and each of said blast heating means, locking means for preventing the actuation of each of said valves in a direction to close said valves, and controlling mechanism for said locking mechanism for releasing said locking mechanism upon the actuation of one of said valves to open position.

15. In combination, a plurality of valves, actuating mechanisms for said valves, controlling means for said actuating mechanisms for preventing the operation of one of said mechanisms to close one of said valves unless one or more of the remaining valves is open, and means for rendering said controlling mechanisms inoperative.

16. In combination, a plurality of valves, actuating mechanisms for said valves, electrical controlling means for preventing the operation of one of said mechanisms to close one of said valves unless one or more of the remaining valves is open, and means for rendering said controlling means inoperative.

17. In combination, a plurality of valves, means for actuating each of said valves, a locking member for each of said actuating means, means including an electric circuit for turning said locking member out of locking position when one of said valves is opened, and means for controlling said circuit independently to render all of said locking members inoperative.

18. In combination, a plurality of valves, means for actuating each of said valves, an electric circuit, means controlled by said circuit and operative upon the closing of said circuit for regulating the operation of said actuating means and means operable by each of said valve actuating means for closing said circuit.

19. In combination, a plurality of valves, means for actuating each of said valves, means for locking each of said actuating means against movement in a direction to open said valves, an electric circuit including a plurality of solenoids, and means controlled by said solenoids and operative upon the closing of said circuit for regulating the operation of said locking means.

20. In combination, a plurality of valves, means for actuating each of said valves, an electric circuit including a plurality of solenoids and a plurality of switches, means controlled by said solenoids for regulating the operation of said actuating means, and means carried by said actuating means for operating said switches to close said circuit and energize said solenoids.

21. In combination, a plurality of valves, means for actuating each of said valves, an electric circuit, a plurality of switches in said circuit each switch being operable by one of said valve actuating means, and means included in said circuit for regulating the operation of said valve actuating means.

22. In combination, a plurality of valves, means for actuating each of said valves, an electric circuit, a plurality of solenoids connected in parallel in said circuit, a plurality of switches connected in parallel with each other and in series with said solenoid in said circuit, means controlled by said solenoids for locking said valve actuating means against movement, and means carried by each of said valve actuating means for closing said switches.

23. In combination, a plurality of valves, independent actuating means for each of said valves, said actuating means being movable in directions to open and close said valves, and means for preventing the movement of all of said actuating means at the same time in a direction to close said valves.

24. In combination, a blower, a header connected thereto, a plurality of hot blast stoves, conduits leading from the header to each stove, a valve controlling each conduit, means for opening and closing the valves, and means for preventing the closing of a valve until another valve is opened.

25. In combination, a blower, a header connected thereto, a plurality of hot blast stoves, pipes leading from the header to each stove, a valve controlling each pipe, actuating means for the valves, and means cooperating with the actuating means for preventing the closing of an open valve until another valve shall have been opened.

In testimony whereof we affix our signatures, in the presence of two witnesses.

HENRY PHELPS HOWLAND.
FRANK ALBERT WILEY.

Witnesses:
JOSEPH I. DOOLEY,
J. H. MACKENZIE.