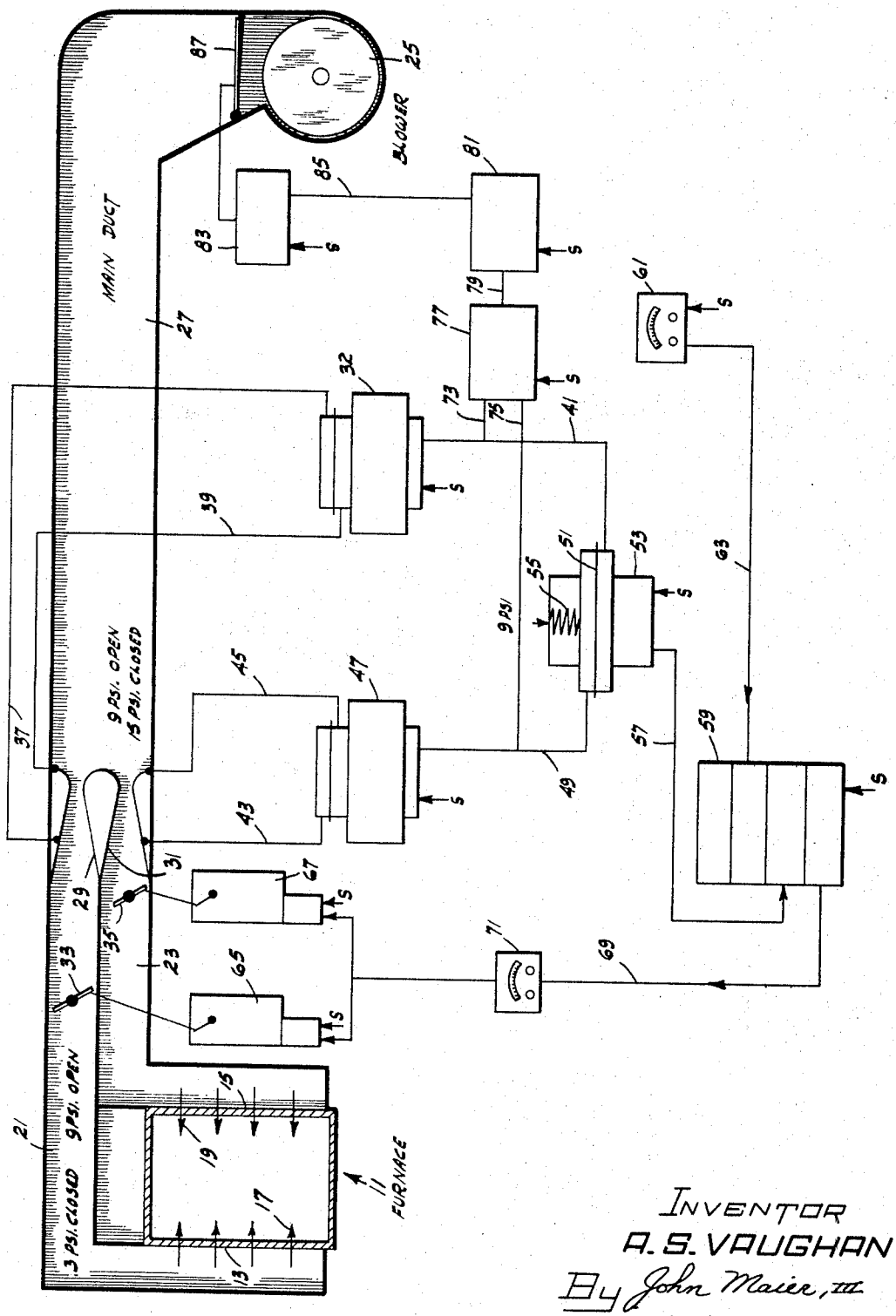
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AIR FLOW PROPORTIONING APPARATUS

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AIR FLOW PROPORTIONING APPARATUS

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ABSTRACT OF THE DISCLOSURE

An air flow proportioning apparatus utilizing two venturis with throats of substantially equal cross-sectional area and means actuated by the pressure drops across said venturis for opening and closing dampers in accordance with a predetermined rate of flow.

As the trend toward larger and larger steam generators continues, it is essential to resort to opposed firing of the steam generators with opposed burner banks. With opposed firing, it is often essential to proportion the flow of air to the two separate banks.

Therefore, it is an object of this invention to provide an apparatus for proportioning any given total air flow into two separate flows.

In accordance with this invention, two virtually identical venturis are each located in a separate duct. A separate damper is located downstream from each venturi. A system is provided to control the operation of the dampers which is actuated by the pressure drop across the venturis.

The invention may be better understood from the following detailed description considered in conjunction with the accompanying drawing which is a schematic diagram of the apparatus.

Referring now to the drawing, a furnace **11** has a front side **13** and a rear side **15**. Located at the front side **13** is a group of front burners **17**, and located at the rear side **15** is a group of rear burners **19**. Air is supplied to the front burners **17** by a front duct **21**. Similarly, air is supplied to the rear burners **19**, by a rear duct **23**. The air is supplied to the front duct **21** and the rear duct **23** from a fan **25** or other source of air which is most usually connected to the front duct **21** and rear duct **23** through a main duct **27**.

Located within the front duct **21** is a front venturi **29**. Similarly, a rear venturi **31** is located within the rear duct **23**. It should be also noted that it is advisable that both the front venturi **29** and the rear venturi **31**, which are virtually identical in shape and size, be approximately the same distance from the source of air **25**.

Within the front duct **21** a short distance downstream of the front venturi **29** away from the fan **25** is a front damper **33**. Downstream of the rear venturi **31** is a rear damper **35**.

A front throat tube **37** senses the pressure at the throat of the front venturi **29** while a front upstream tube **39** senses the pressure entering the front venturi **29**. These two pressure signals from the front venturi **29** are relayed to a front, low-differential pressure transmitter **32** which determines the differential in pressure between the throat and the entrance of the front venturi **29**. The front, low-differential pressure transmitter **32** transmits this differential as a front, low-differential signal through a tube **41**. Similarly, a rear throat tube **43** senses the pressure at the throat of the rear venturi **31** while a rear upstream tube **45** senses the pressure entering the rear venturi **31**. These two pressure signals from the rear venturi **31** are relayed to a rear, low-differential pressure transmitter **47** which determines the differential in pressure between the throat and the entrance to the rear venturi **31**. The rear low-differential pressure transmitter **47** determines the differential between the throat and entrance and transmits this differential as a rear, low-differential pressure signal through a tube **49**.

The front, low-differential signal is transmitted through the tube **41** to a diaphragm **51** of a computing relay **53**. The rear, low-differential signal is transmitted through the tube **49** to the opposite side of the diaphragm **51**. A permanent pressure, preferably 9 p.s.i., is applied to the diaphragm **51** by a spring **55**. Thus, when the front, low-differential signal and the rear, low-differential signal are equal, the computing relay **53** will transmit a 9 p.s.i. pneumatic signal through the tube **57** to a proportional and reset controller **59**. The predetermined extent of proportioning of flow between the front duct **21** and the rear duct **23** is manually applied through a manual loader **61**. The manual loader **61** transmits a load signal to the proportional and reset controller **59** through a tube **63**. The proportional and reset controller **59** combines the signals into a control signal which is fed to a front pneumatic actuator **65**, and a rear pneumatic actuator **67**, through a tube **69**. Located along the tube **69** is an auto-manual control station **71** which permits manual operation of the front and rear pneumatic actuators **65**, **67** without operation of the previously described pneumatic system. The front pneumatic actuator **65** is mechanically connected to the front damper **33** while the rear pneumatic actuator **67** is connected to the rear damper **35**.

One of the two pneumatic actuators **65**, **67** is adapted to close its respective damper at 3 p.s.i. and open it at 9 p.s.i. The other pneumatic actuator is adapted to close its respective damper at 15 p.s.i. and open it at 9 p.s.i. Thus, only one damper can be partially or totally closed and the other damper must be open to limit the amount of pressure drop that can be caused by the dampers.

The symbol S is used on the drawing to indicate that supply air is being fed to the respective piece of equipment.

Since partial closing of one damper increases the flow resistance to the total flow, the fan output must be increased under these circumstances. Therefore, the above-described pneumatic system must be interconnected with the air-flow control system. Accordingly, a tube **73** is connected to the tube **41** and a tube **75** is connected to the tube **49**. In this way, the front, low-differential signal and the rear, low-differential signal are transmitted to an air-flow totalizer **77** which in turn sends a total air-flow signal through a tube **79** to the combustion control system **81**. Generally, the combustion control system operates a pneumatic fan actuator **83** through a tube **85** which opens and closes a shutter **87** of the fan **25**.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An apparatus for proportioning the air flow to a furnace between the front burner bank and the rear burner bank, comprising:

a source of pressurized air;

a front duct connected to said source of pressurized air;

a rear duct connected to said source of pressurized air, said front duct and said rear duct being of equal cross-sectional area;

a front venturi located in said front duct;

a rear venturi located in said rear duct, said front and rear venturis having throats with equal cross-sectional areas;

a front damper located downstream of said front venturi in said front duct and adapted to be opened and closed to control the flow of air through said front duct;

a rear damper located downstream of said rear venturi in said rear duct and adapted to be opened and closed to control the flow of air through said rear duct; and

means actuated by the pressure drops across said venturis for opening and closing said dampers in accordance with a predetermined proportional rate of flow between the front and rear ducts, said means for opening and closing said dampers opening and closing said front and rear dampers such that one of said dampers is wide open at all times.

2. An apparatus according to claim **1** wherein said means for opening and closing said dampers is pneumatic.

3. An apparatus according to claim **1** wherein said means for opening and closing said dampers includes:

means for determining the difference in pressure drop across the front venturi and the rear venturi and converting the difference into a first signal;

means for comparing the first signal with a predetermined signal and forming a second signal; and

actuating means mechanically connected to said front and rear dampers and adapted to be operated by said second signal.

4. An apparatus according to claim **1** wherein said means for opening and closing said dampers includes:

a front, pneumatically-operated, low-differential pressure transmitter connected to said front venturi and adapted to transmit as a pneumatic signal the pressure differential across said front venturi;

a rear, pneumatically-operated, low-differential pressure transmitter connected to said rear venturi and adapted to transmit as a pneumatic signal the pressure differential across said rear venturi;

a pneumatically-operated differential computing relay connected to both said front, pneumatically-operated, low-differential pressure transmitter and said rear, pneumatically-operated, low-differential pressure transmitter and adapted to compare the pneumatic signal from the front, pneumatically-operated, low-differential pressure transmitter and the pneumatic signal from the rear, pneumatically-operated, low-differential pressure transmitter and to transmit a pneumatic signal representing that comparison;

a pneumatically-operated proportional and reset controller connected to said pneumatically-operated differential computing relay and adapted to receive the signal from said pneumatically-operated differential computing relay;

a manual loader adapted to transmit a pneumatic signal in accordance with said predetermined proportioning, said pneumatically-operated proportional and reset controller being connected with said manual loader and adapted to receive the pneumatic signal from said manual loader and transmit a signal representing the signals from said pneumatically-operated differential computing relay and said manual loader; and

a pair of pneumatically-operated actuators, one of which is mechanically connected to said front damper and the other of which is mechanically connected to said rear damper and both of which are pneumatically connected to said pneumatically-operated proportional and reset controller to receive the signal from the pneumatically-operated proportional and reset controller, one of the pneumatically-operated actuators being adapted to close its respective damper when the signal to it is at a low pressure and open the same damper when the signal is at a medium pressure, the other of the pneumatically-operated actuators being adapted to open its respective damper at the same medium pressure and close the same damper at a high pressure.

5. An apparatus for proportioning air flow to a furnace between the front burner bank and the rear burner bank comprising:

a source of pressurized air;

a front duct connected to said source of pressurized air;

a rear duct connected to said source of pressurized air, said front duct and said rear duct being of substantially equal cross-sectional area;

a front venturi located in said front duct;

a rear venturi located in said rear duct, said front and rear venturis having throats with equal cross-sectional areas;

a front damper located downstream of said front venturi in said front duct and adapted to be opened and closed to control the flow of air through said front duct;

a rear damper located downstream of said rear venturi in said rear duct and adapted to be opened and closed to control the flow of air through said rear duct;

a front means connected to said front venturi to transmit the pressure differential across said front venturi;

a rear means connected to said rear venturi to transmit the pressure different acoss said rear venturi;

a computing relay means connected to both said front means and said rear means to compare the signal from the front means and the signal from the rear means and to transmit a signal representing that comparison;

a proportional and reset controller means to receive the signal from said computing relay means;

a loader means to transmit a signal in accordance with a predetermined proportioning of the air flow to said proportional and reset controller means, said proportional and reset controller means being adapted to transmit a signal representing the signals from said computing relays and said loader means; and

means to actuate in accordance with the signal from the proportional and reset controller means the front damper and the rear damper such that at least one damper is maintained wide open at all times.

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