

June 11, 1929.

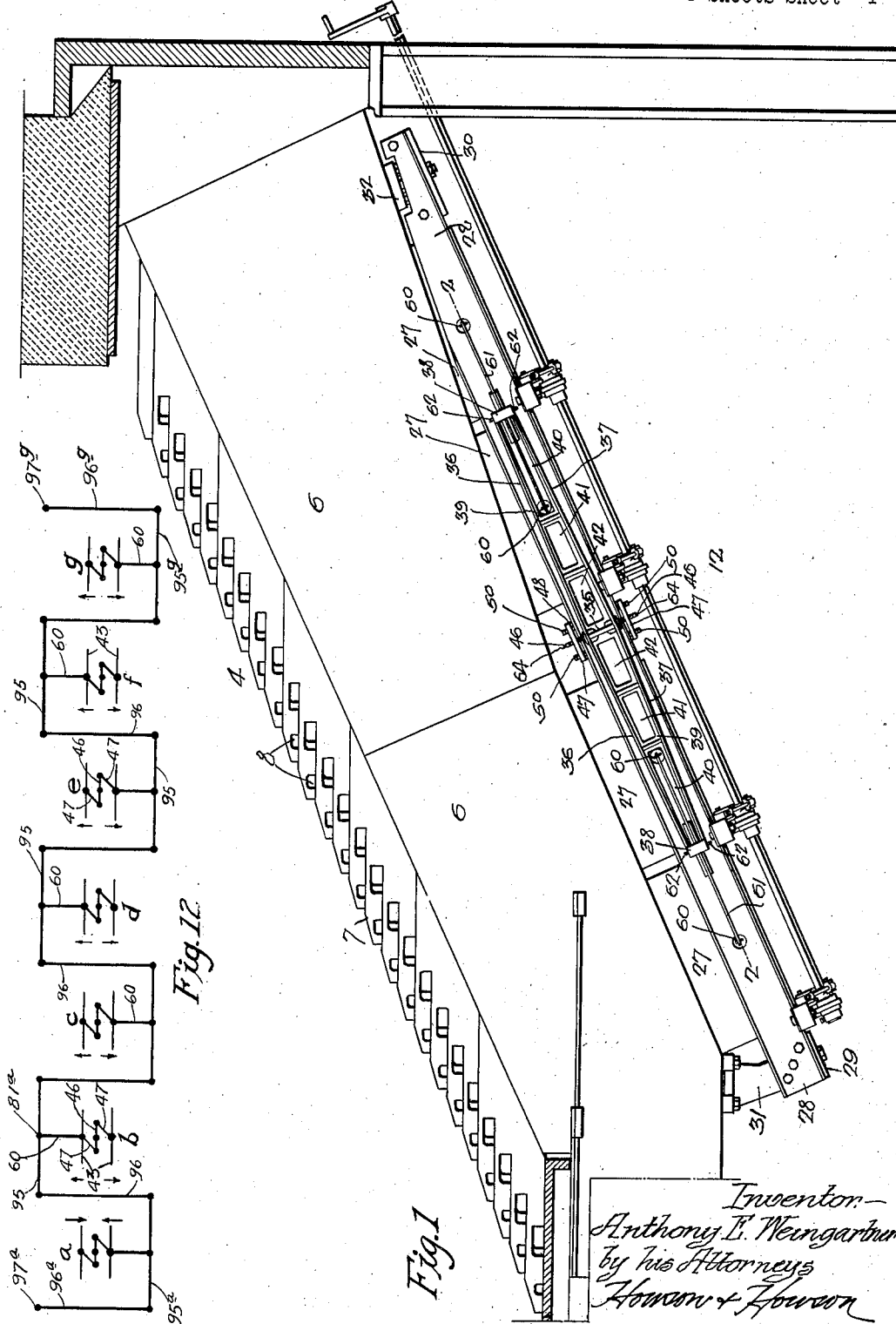
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BALANCED LEVER MECHANISM FOR AUTOMATIC FLUID CONTROL SYSTEMS

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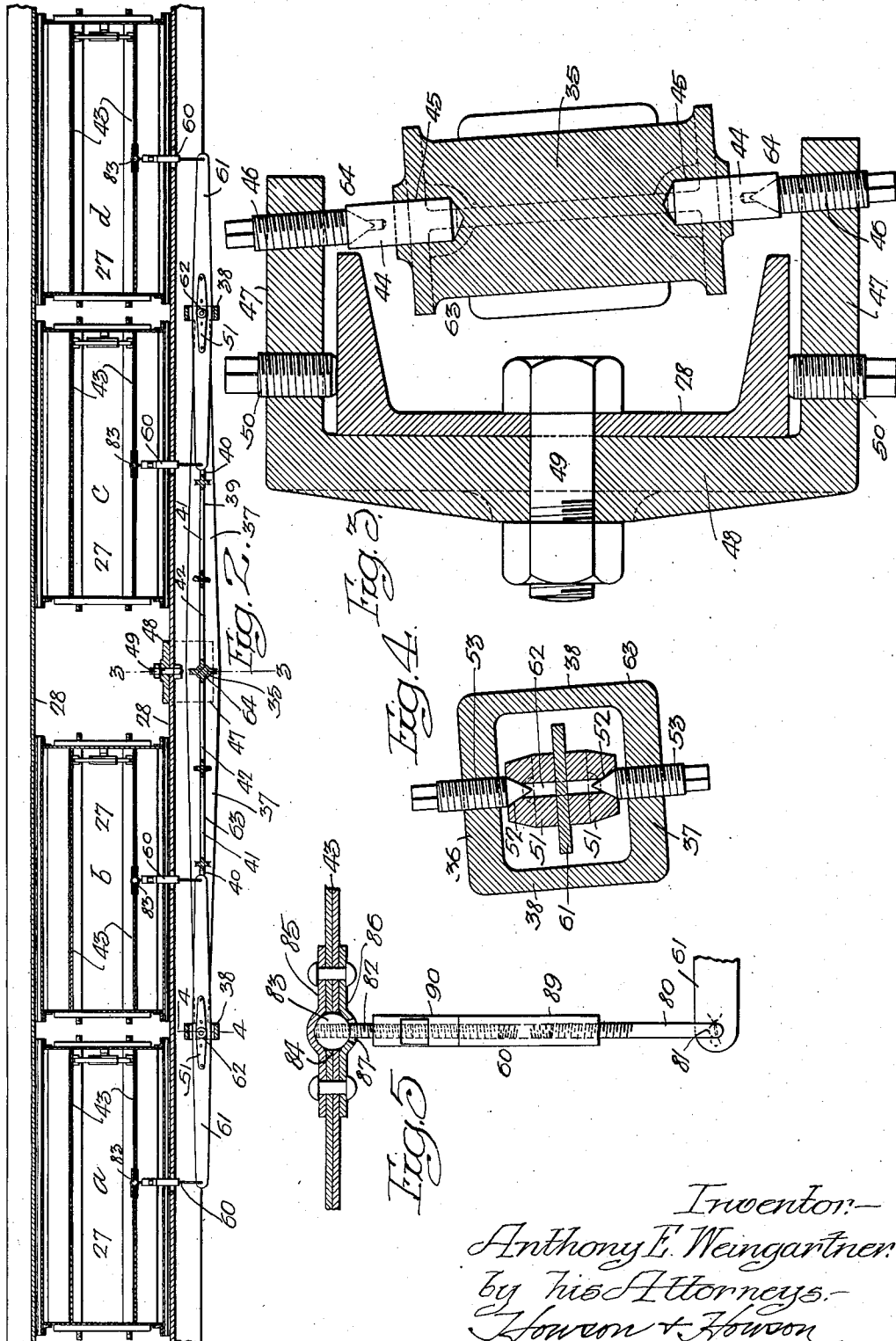
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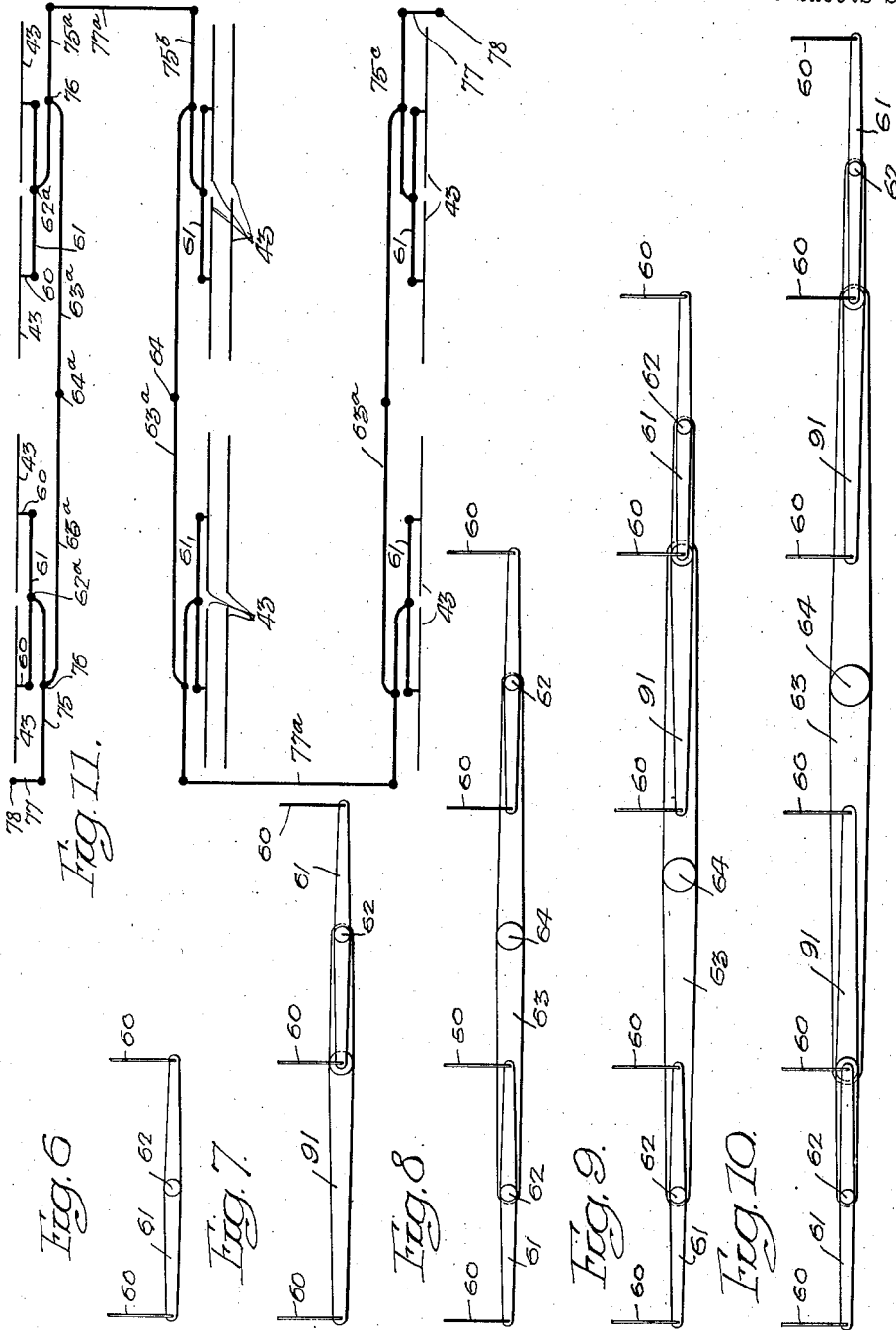
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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BALANCED-LEVER MECHANISM FOR AUTOMATIC FLUID-CONTROL SYSTEMS.

Application filed March 23, 1928. Serial No. 264,215.

My invention relates to automatic fluid control systems such as that shown and described in a co-pending application of Maxwell Alpern, Serial No. 262,935, filed Mar. 19, 1928.

As set forth in the said co-pending application, such a system is applicable to a variety of forms of utility and for the purpose of illustration I have chosen a furnace provided with a stoker of the under-feed type, generally known as the Taylor stoker, in which the coal is fed to the bed of the fire by suitable rams and pushers, and air under pressure is supplied, for the purpose of aiding combustion, through a series of tuyères arranged in banks and alternating with the rams and pushers which feed the coal to the furnace. The air is supplied by a suitable blower to a chamber underlying the pushers and the tuyères, which is commonly designated as the wind-box, the air passing from the wind-box through suitable apertures in the tuyères, and combining with the gases emanating from the heated coal for the purpose of properly effecting combustion.

In the operation of this type of stoker, there are occurrences when the coal feeding apparatus fails to uniformly cover the adjacent tuyères with a desirable amount of coal, resulting in the fire burning through at that particular starved point, permitting an excessive rush of air through the tuyère apertures and causing an extremely abnormal temperature to develop at, and adjacent to, that particular portion of the fire bed, with a consequent burning out of the tuyère units.

In the said co-pending application, a system is described for automatically controlling the amount of air supplied to all parts of the fire bed, by which the supply of air would be automatically reduced at any one or a number of particular spots, wherein the fire has a tendency to burn through the fuel bed, as above described. Should the fire burn through at any particular spot, or number of spots, the supply of air from the wind-box is immediately and automatically reduced, thereby maintaining the temperature at and adjacent the particular spot in the fire below the danger point, until such time as a fresh supply of coal is placed over the spot which has burned through, whereupon the air supply will again be increased to normal.

In the system above mentioned, mechanism is provided for effecting an increase in the supply of air to the adjacent portions of the fire surrounding the spot which has burned through with a view of increasing combustion at these points which have not burned through, and thereby maintaining the fire bed in a more uniform state.

My invention relates to the details of construction of the equalizing mechanism of the above system which will be more fully disclosed hereinafter, reference being had to the accompanying drawings, of which:

Fig. 1 is a longitudinal sectional elevation through a furnace embodying the features of my invention;

Fig. 2 is a sectional plan view taken along the line 2—2 of Fig. 1, and illustrating the preferred arrangement of balanced levers forming the subject of my invention;

Fig. 3 is a transverse sectional elevation taken along the line 3—3 of Fig. 2, illustrating the manner in which the main lever is supported;

Fig. 4 is a transverse sectional elevation taken along the line 4—4 of Fig. 2, illustrating the method of pivotally attaching the supplementary levers to the main lever;

Fig. 5 is an enlarged section plan view illustrating the method of pivotally attaching the supplementary levers to the motor elements of the control system;

Figs. 6 to 10 inclusive illustrate various combinations of balanced levers adaptable to furnaces having different numbers of tuyère units in the tuyère banks;

Fig. 11 is a diagrammatic view illustrating an arrangement of levers whereby the entire fire bed may be affected by the operation of any one single control unit; and

Fig. 12 is a diagrammatic view of an alternate system of levers for interconnecting the operating elements of the control units in any one tuyère bank.

The furnace selected for the purpose of illustrating my invention comprises a front wall and side walls, defining the fire bed space within which is suitably mounted a series of tuyère banks, the individual banks alternating with coal feeding units or retorts. Each of the tuyère banks comprises a pair of side walls suitably mounted in the furnace, and each bank comprising a series of tuyère units

of the usual construction and comprising air outlets which communicate with an air passage formed within the tuyère units.

The air passage in the tuyère bank is divided into sub-chambers by means of partitions suitably formed in or attached to the tuyère units of the desired points. Each of the air chambers communicates with the wind box of the furnace through and by means of an air nozzle, and suitable controlling mechanism is provided and contained in an air control box for each nozzle as illustrated in detail in the said copending application.

As illustrated in Fig. 1, each tuyère bank includes side plates 6 and tuyère units 7, each being provided with apertures 8, 8 from which the air passes into the fuel bed which overlies the tuyères. A series of air control boxes, as illustrated at 27, 27, are provided between the side plates 6, 6. The control boxes 27 extend between each of the air nozzles and the wind-box 12 of the furnace, by means of which the amount of air passing from the wind-box to the tuyères may be accurately and automatically controlled.

The control boxes 27, 27 of the series for each tuyère bank 4 are suitably mounted upon a pair of longitudinally extending supporting beams 28, 28 which are connected at their opposite ends by means of transverse members 29 and 30. Extending between and suitably secured to the side plates 6, 6 of each tuyère bank is a pair of transverse supporting members 31 and 32. The transverse member 29 is horizontally pivoted to the transverse member 31, and the transverse member 30 is vertically pivoted to the transverse member 32 permitting relative movement between the control box and the air nozzle with which it is associated. On furnaces employing the above described construction, warping or misalignment of the side plates 6 will not affect the alignment or operation of any of the movable elements carried by the frame which comprises the side beams 28, 28 and the transverse connecting members 29 and 30, due to the fact that the frame is supported at but two points on the side plates.

Each control box comprises side and end walls, and is divided into an upper or damper chamber and a lower or motor chamber, a throat being formed between the upper and lower chambers. Within the lower chamber is a pair of motor blades 43, 43 which are pivoted in each of the end walls of the chamber. The blades 43, 43 of each pair are connected in a manner to provide for synchronous operation of the blades of each pair.

In the upper or damper chamber is provided a pair of balanced dampers pivoted in each of the end walls of the chamber. Each damper is operatively connected to the motor blade 43 underlying the particular damper with which it cooperates.

Under normal operating conditions and

with the proper amount of fuel overlying the tuyère units 7, uniformly throughout the bed of the fire, the elements of each of the control boxes 27 occupy positions wherein a uniform amount of air passes from the wind-box 12 through the motor chamber between the motor blades 43, 43, the throat between the upper and lower chambers, between the dampers in the damper chamber, through the air nozzle, into the air chamber of the tuyère units, thence through the openings 8 in the tuyère units 7 and through the body of fuel overlying the tuyères, whereby proper combustion is obtained over the entire fire bed, the body of fuel offering a certain amount of resistance to the air passing therethrough.

Should the fire bed burn through at any point, the resistance to the passage of air is thereby reduced, which causes an increase in the flow of air at this particular point, and a consequent abnormal temperature to obtain. By employing the above mentioned control system, such flow of air, at increased velocity, is checked immediately after the burning out of any particular spot of the fire bed, at which time the increased flow of air begins, the damper mechanism automatically operating to reduce the flow of air to this particular spot in the fire bed, such operation being effected in the following manner:—

Between the side walls and each motor blade a supplemental chamber is formed. Under normal operating conditions, the air pressure in the motor chamber and the two supplemental chambers is substantially uniform, therefore, the motor blades 43, 43 assume a neutral position, and the dampers being directly connected to the motor blades likewise assume a neutral position. When a spot in the fire bed burns through, the above mentioned increased flow of air begins, between the wind-box and the tuyère air chamber and the throat in the control box 27, causing the air to be drawn from each of the supplemental chambers, thereby reducing the air pressure therein to such an extent that the normal air pressure at the opposite side of each of the blades causes the said blades to turn on their pivotes, thereby causing the dampers to turn on their pivots, and the passage of air from the damper chamber to the air nozzle to be effectively reduced.

When the flow of air to any one of the nozzles is reduced, it is desirable to increase the flow of air to the remaining nozzles of the particular tuyère bank to which said nozzle belongs, and for this purpose I have provided means whereby the checking of one nozzle of the series contained in the tuyère bank will automatically increase the flow of air to the remaining nozzles thereof by means of the following mechanism.

Upon references to Fig. 2, it will be noted that one of the motor blades 43, of each pair, is operatively connected by means of a link

60 to one end of a lever 61. Each of the levers 61 is pivoted intermediate its ends, at a point 62, to one end of a main lever 63 which in turn is pivoted intermediate its ends, at a point 64, to one of the supporting beams 28.

For the purpose of illustration, I have designated the control units 27 in Fig. 2 as *a*, *b*, *c* and *d*. Should the fire burn out in the spot overlying the unit *b* with a consequent operation of the motor blades 43 thereof, as described above, the outward movement of the motor blades 43 would have a tendency to rock the lever 61, and thereby cause the motor blades of the control unit *a* to move toward each other. It will be understood that the flow of air through the unit *a*, *c* and *d* would be substantially uniform and a substantially uniform pressure upon the blades 43 thereof would obtain. Therefore, the outward movement of the blades of the unit *b* would cause the blades of the units *a*, *c* and *d* to move toward each other a substantially equal distance, one with respect to the other, by means of the lever 61 being turned on its pivot 62, the blades 43 of the unit *a* establishing a resistance to the inward movement of the end of the lever 61 connected thereto and this established resistance would cause the lever 63 to turn on its pivot 64 thereby causing the pivot 62 of the lever 61, lying intermediate the units *c* and *d*, to move inward and by means of the lever 61 and the links 60, 60 the pair of blades 43 in each of the units *c* and *d* would move toward each other, a distance equal to the movement of the blades of the unit *a*, whereby the dampers of each of the units *a*, *c* and *d* would be caused to turn on their pivots, and thereby increase the distance intermediate their upper edges, permitting an increased flow of air from the respective damper chambers to the nozzle communicating therewith.

The operation described relative to the burning out of the fire in that section of the fire bed controlled by the unit *b* would be effective in a similar manner upon the remaining units of the series regardless of which one of the units should become operable in event of the fire burning through in the section of the fire bed controlled by that particular unit.

It will be understood that the balancing of the volume of air to each and every one of the units is directly controlled by the bed of fuel overlying the particular section of the fire bed which that particular unit communicates with, and should the fuel bed overlying each of the units vary with respect to the other units the amount of air passing to that particular section of the fire would vary in accordance therewith.

In Figure 11, I have illustrated diagrammatically a method of connecting the motor blades 43 of all the control boxes 27 for the entire fire bed, in such a manner that an in-

crease in the air flow through any one control box thereof will be automatically checked and the flow in the remainder of the boxes will be increased to burn the fire up at the points not burned through. As illustrated in said figure, the motor blades 43 of each pair of adjacent control boxes are connected to the lever 61 in the same manner as illustrated in Figure 5. One lever 61 of the side tuyère bank is pivoted to a lever 75 at 62^a, the lever 75 being pivoted at 76 to one end of the main balance lever 63^a, pivoted at 64^a to the beam 28 in the manner above noted. The opposite end of the lever 75 is connected by a link 77 to a stationary pivot 78. The other lever 61 of the side tuyère bank is connected in the manner above noted with the following exception, the lever 75^a is connected by a link 77^a to the lever 75^b of the control box of the first intermediate tuyère bank as illustrated, and so on throughout the entire fire box, the last lever 75^c of the opposite side of the tuyère bank being anchored at 78^a in a manner similar to the link 77 at the other side of the fire box. By interconnecting the control boxes of the several tuyère banks, any movement of one of the motor blades will affect the position of each of the other blades throughout the stoker and subsequently the damper which it controls with a consequent adjustment of the amount of air passing through that particular control box.

As illustrated in Fig. 1, each of the main balance levers comprises a central pivot hub 35, having integrally formed therewith and at each side thereof an arm, comprising an upper and lower rail 36 and 37 respectively, which are connected at their outer ends by a transversely extending integrally formed rectangular pivot yoke 38 for receiving the pivot element 62 of the arm 61, attached respectively to each end of the main lever 63. The rails 36 and 37 are integrally connected intermediate the hub 35 and each yoke 38 by means of a ribbed web 39 provided with open portions 40, 41 and 42 for the purpose of reducing the weight of the lever, the opening 40 providing clearance for the lever 61, it being noted that the pivots 62, 64 and 62 are in true alignment with each other.

The pivot 64 for the lever 63 comprises a pair of hardened steel plugs 44, 44 adapted to apertures 45, 45 formed in the opposite ends of the hub 35. Each center plug is conically bored at its outer end to receive a correspondingly shaped point of an adjustable aligning pivot screw 46 which is adapted to a threaded opening, one in each of a pair of arms 47, 47. The arms 47, 47 are integrally connected to a plate 48 secured by a bolt 49 to the rear face of the web of one of the beams 28 and extend beyond the outer edges of the flanges of said beam as clearly shown in Fig. 3. Screws 50, 50 are provided in the arms 47, 47 and engage the respective flanges of the beams 28, for

maintaining the pivot element 64 in position.

Each of the levers 61 is composed, in the present instance, of a flat plate which has pivot bearings 51, 51 rigidly secured thereto on its opposite faces. Each pivot bearing is provided with a conical aperture 52 adapted to receive the conical end of a pivot screw 53, mounted one in each of the top and bottom portions of the pivot yoke 38, on each end of the main lever 63.

The opposite ends of each lever 61 are each connected by means of an adjustable link 60 to one of the motor blades 43 in each control box 27. Each link 60 comprises a stem 80 having left hand threads and pivotally mounted in an aperture 81 in the lever 61 and a second stem 82 having right hand threads and having a ball 83 secured to one of its ends. The ball 83 is confined in an opening 84 in the motor blade 43 by means of a concaved plate 85 on one side thereof and a concaved plate 86 on the other side thereof as shown in Fig. 5. The plate 86 is provided with an opening 87 through which the stem 82 projects.

Rivets 88, or other suitable retaining means, pass through the plates 43, 85 and 86, and thereby maintain these elements in correct position to form a universal socket for the ball end 83 of the link 60.

A sleeve 89 having right and left hand internal threads which engage the respective threads on the stems 80 and 81, forms means whereby the aggregate length of the link 60 may be varied and a lock nut 90 is mounted on the stem 82 and adapted to engage the sleeve 89, when the length of the link 60 is finally determined.

Figs. 6 to 10 inclusive illustrate methods of connecting the motor blades of tuyère banks having varied numbers of control boxes, for example with the levers shown in Fig. 6, only two control boxes are employed; in Fig. 7, three; in Fig. 8, four; in Fig. 9, five; and in Fig. 10, six. In either instance, levers of the same general construction as above described are employed.

In Fig. 7, which illustrates but three box connections, the link 60 of one of the boxes is connected directly to one end of a slightly modified form of intermediate lever 91 and to the opposite end of this lever is pivoted the usual supplementary lever 61. In Fig. 10, the construction illustrated in Fig. 7 is duplicated and the pair of intermediate levers 91, 91 therein shown are pivoted to the opposite ends of a main lever 63.

In Fig. 12 I have illustrated a series of control units designated as *a*, *b*, *c*, *d*, *e*, *f* and *g*. Each control unit has the usual pair of cooperating motor blades 43, 43, each connected to one end of a link 47, 47. The opposite end of each of these links 47 is respectively connected to opposite ends of a lever 46 which is pivoted intermediate its end to any suitable fixed support, so that each pair of blades 43,

43, so connected, will move in unison toward or away from each other a like distance when one of the blades of a pair is moved.

One of the blades 43 of each pair is pivotally connected at 83 to one end of a link 60, the opposite end of each link 60 being connected at 81^a to and intermediate the opposite ends of a floating lever 95. Each end of each of the levers 95 of the control units *b*, *c*, *d*, *e* and *f* is connected by a link 96 to the adjacent end of the lever 95 of adjacent control units, and the ends 95^a and 95^s of the units *a* and *g* respectively are connected by a link 96^a and 96^s respectively to a fixed pivot 97^a and 97^s respectively.

As shown in Fig. 12 the oppositely disposed blades 43, 43 of alternate units are connected to the lever 95 associated with the respective unit, thus, for example, when the blades 43, 43 of any of the control units move toward each other, the blades of the remaining control units will be moved away from each other, or vice versa, to an extent permitted by the resistance prevailing in the respective units, the sum of the movements of the blades in one direction being equal to the sum of the movements of the blades moving in the opposite direction. If the resistance in any of the units is so strong that movement of the blades 43 therein is not permitted the floating levers 95 connected to the respective immovable blades merely pivot on their respective fulcrums 81^a and thereby pass the movement on to the next adjacent unit.

The balancing operation described above is obtained by each of the combinations illustrated with equal effectiveness.

Having described one general form of lever apparatus for carrying out the principles of my invention, various other equivalents thereto will obviously occur to those familiar with the art, therefore, only such limitations should be placed on the scope of the invention as are prescribed in the appended claims or dictated by the prior art of record.

I claim:

1. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating element therefor, a system of balanced levers for interconnecting the individual operating elements of the series, whereby relative movement of any of said operating elements is transmitted in reverse order to the other operating elements of the series.

2. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating element therefor, a primary balance lever operatively connected to each control unit operating element of a pair of adjacent control units; and a pivot element for each primary balance lever equidistantly located from and intermediate the opposite ends of said lever.

3. In an automatic fluid control system:

comprising a series of control units, each control unit being provided with an operating element therefore, a primary balance lever operatively connected to each control unit
 5 operating element of a pair of adjacent control units; a pivot element for each primary balance lever equidistantly located from and intermediate the opposite ends of said lever; a main balance lever having a relatively fixed
 10 pivot intermediate its ends; and a pivot element for each primary balance lever adjacent each end of said main balance lever.

4. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating
 15 element therefor; a primary balance lever operatively connecting the control unit operating elements of one pair of control units; and a pivoted balance lever, pivotally connected
 20 at one of its ends to said primary balance lever and having its opposite end connected to the operating element of each of the remaining control units of the series.

5. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating
 25 element therefor; a primary lever operatively connecting the control unit operating elements of one adjacent pair of control units; a primary lever operatively connecting the
 30 control unit operating elements of a second pair of control units; an intermediate lever pivotally connected at one of its ends to the primary lever of said second pair of control
 35 units and at its opposite end to the operating element of each remaining control unit of the series; a main lever having a relatively fixed pivot intermediate its ends and being
 40 pivotally connected adjacent its respective ends to the primary lever of the said first pair of control units and the said intermediate lever.

6. In an automatic fluid control system comprising a series of control units, each control
 45 unit being provided with an operating element therefor; a primary lever operatively connecting the control unit operating elements of one adjacent pair of control units; a primary lever operatively connecting the
 50 control unit operating elements of a second pair of control units; intermediate levers, each of which is connected at one of its ends to one of said primary levers and at its opposite
 55 end to an individual control unit operating element; and a main balance lever pivoted intermediate its ends to a relatively fixed element and at each of its respective
 60 ends to one of said intermediate levers at a point intermediate the ends thereof.

7. In an automatic fluid control system comprising a series of control units, each control
 65 unit being provided with an operating element therefor, a system of balanced levers for interconnecting the individual operating
 35 elements of the series; an adjustable con-

necting link for connecting the control unit operating elements with the respective levers of the system, comprising a stem pivotally
 connected to said lever and having a threaded end; a second stem having an end threaded
 70 opposite to the threads of said first stem; a sleeve having threads adapted to co-operate with the different threads of said stems; a lock nut on one of said stems and engaging
 said sleeve; and a universal coupling, by
 75 which the said second stem is operatively connected to the said control unit operating element.

8. In an automatic fluid control system comprising a series of control units, each
 80 control unit being provided with an operating element therefor, a system of balanced levers for interconnecting the individual operating elements of the series comprising primary
 levers, links operatively connected to
 85 said operating elements, and levers for interconnecting said primary levers; each primary lever consisting of a flat plate provided, adjacent its opposite ends with a pivotal
 connection for one of said links; and a control
 90 pivot bearing at the centre of said primary lever intermediate said link pivots.

9. In an automatic fluid control system comprising a series of control units, each
 control unit being provided with an operating
 95 element therefor, a system of balanced levers for interconnecting the individual operating elements of the series comprising primary levers, pivot elements for said primary levers; links, connecting said primary levers with
 100 said control unit operating elements; main levers each having a central hub; arms extending from said hub; pivot yokes on said arms for receiving the pivot elements of said
 primary levers; and pivot bearings in said
 105 central hub.

10. In an automatic fluid control system comprising a series of control units, each control
 unit being provided with an operating
 110 element therefor, a system of balanced levers for interconnecting the individual operating elements of the series; a supporting frame for said control units and said lever system; primary
 levers; links connecting said primary
 115 levers and said operating elements; pivot elements for said primary levers; a main lever having a central hub; conical pivot bearings in said hub; arms on said hub; pivot yokes on said arms for receiving the pivot elements
 of said primary levers; a pivot plate on said
 120 frame; arms on said pivot plate; conical ended pivot elements adjustably mounted in said arms and adapted to said conical pivot bearings in said central hub; and means for
 adjusting said pivot plate relative to said
 125 frame.

11. In an automatic fluid control system comprising a series of control units, each
 control unit being provided with an operating
 130 element therefor, a primary balance lever

operatively connected to each control unit operating element of a pair of adjacent control units; and a pivot element for each primary balance lever equidistantly located 5 from and intermediate the opposite ends of said lever, said primary lever pivot and said operating element pivots being aligned with each other and arranged in a single plane extending longitudinally through the pivotal 10 centre of each of said pivots.

12. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating element therefor, a system of balanced levers 15 for interconnecting the individual operating elements of the series including primary levers; and a main lever; a stationary pivot element for said main lever; a pivot element adjacent each end of said main lever for said 20 primary levers, said main lever pivot element and said primary lever pivot elements being in alignment with each other and arranged in a single plane passing longitudinally through the pivotal centre of each of 25 said pivot elements.

13. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating element therefor, a system of balanced levers 30 for interconnecting the individual operating elements of the series including primary levers; a main lever; intermediate levers; and connecting links attached to said operating elements; a stationary pivot element for 5 said main lever; a pivot element adjacent each end of said main lever for one of said intermediate levers, said main lever pivot

element and said intermediate lever pivot elements being in alignment with each other and arranged in a single plane extending 40 longitudinally through the pivotal centre of each of said pivot elements, a pivot element on one end of each intermediate lever for one of said primary levers; a pivot element at the opposite end of said intermediate lever 45 for one of said connecting links, said primary lever pivot element, said connecting link pivot element and the pivot element for said intermediate lever being aligned with each other and arranged in a single plane extend- 50 ing longitudinally through the pivotal centre of said pivot elements.

14. In an automatic fluid control system comprising a series of control units, each control unit being provided with an operating 55 element therefor, a system of balanced levers for interconnecting the individual operating elements of the series; a main lever; a pivotal centre for said lever extending vertically at right angles to the longitudinal 60 horizontally extending centre line thereof; primary levers on said main lever; a pivotal centre for each of said primary levers extending vertically at right angles to the longitudinal horizontally extending centre 65 line thereof, the longitudinal centre lines of the main lever and the primary levers thereon coinciding in a single horizontal plane and the pivotal centres of the said primary levers and main lever being aligned with each 70 other and arranged in a single vertical plane extending through each of said pivotal centres.

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