Oct. 31, 1950 C. B. ARNOLD ET AL 2,528,292

GASEOUS FLUID DISTRIBUTING SYSTEM
FOR FURNACES AND THE LIKE

Filed March 27, 1946 5 Sheets-Sheet 1

Fig. 1.

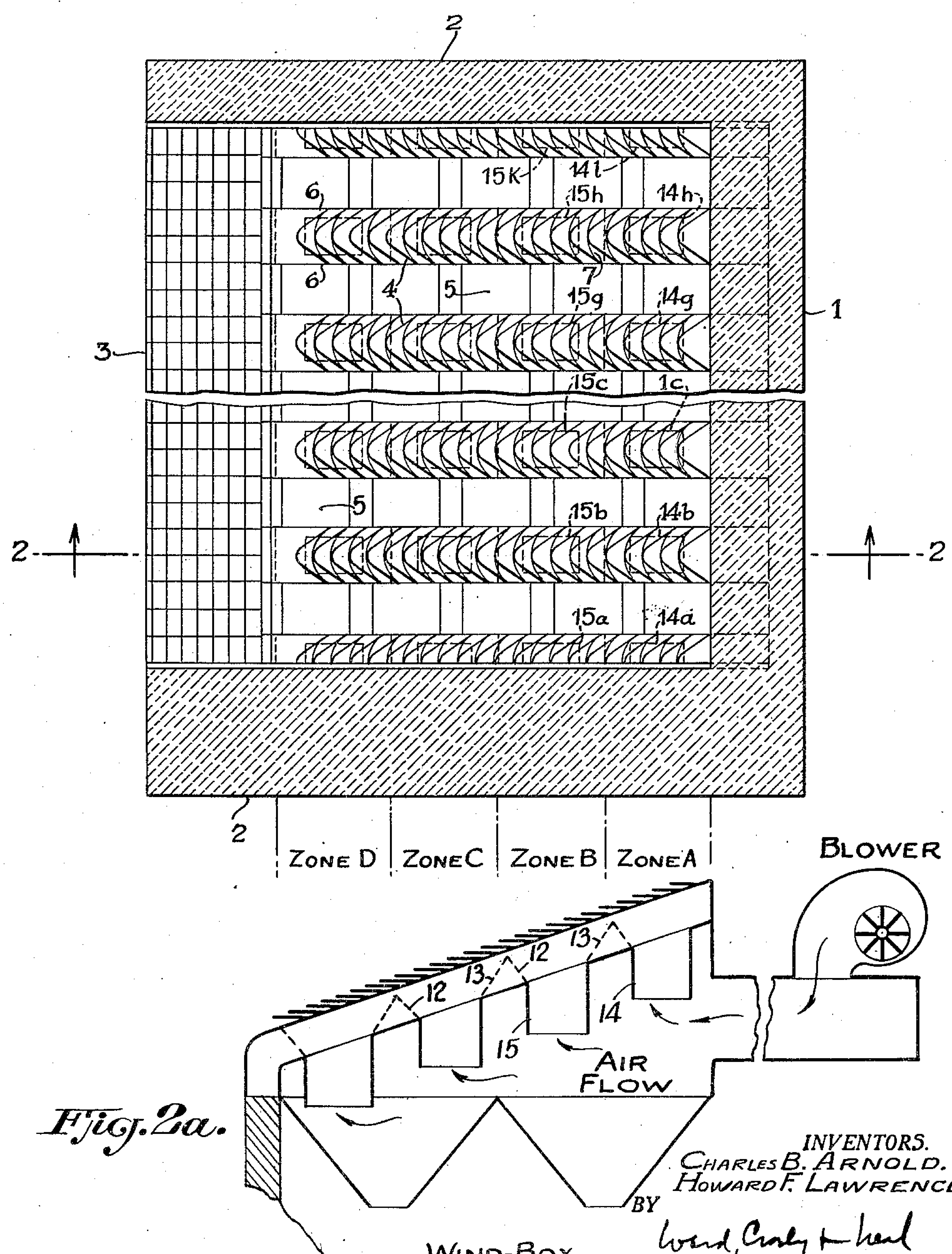

Fig. 2a.

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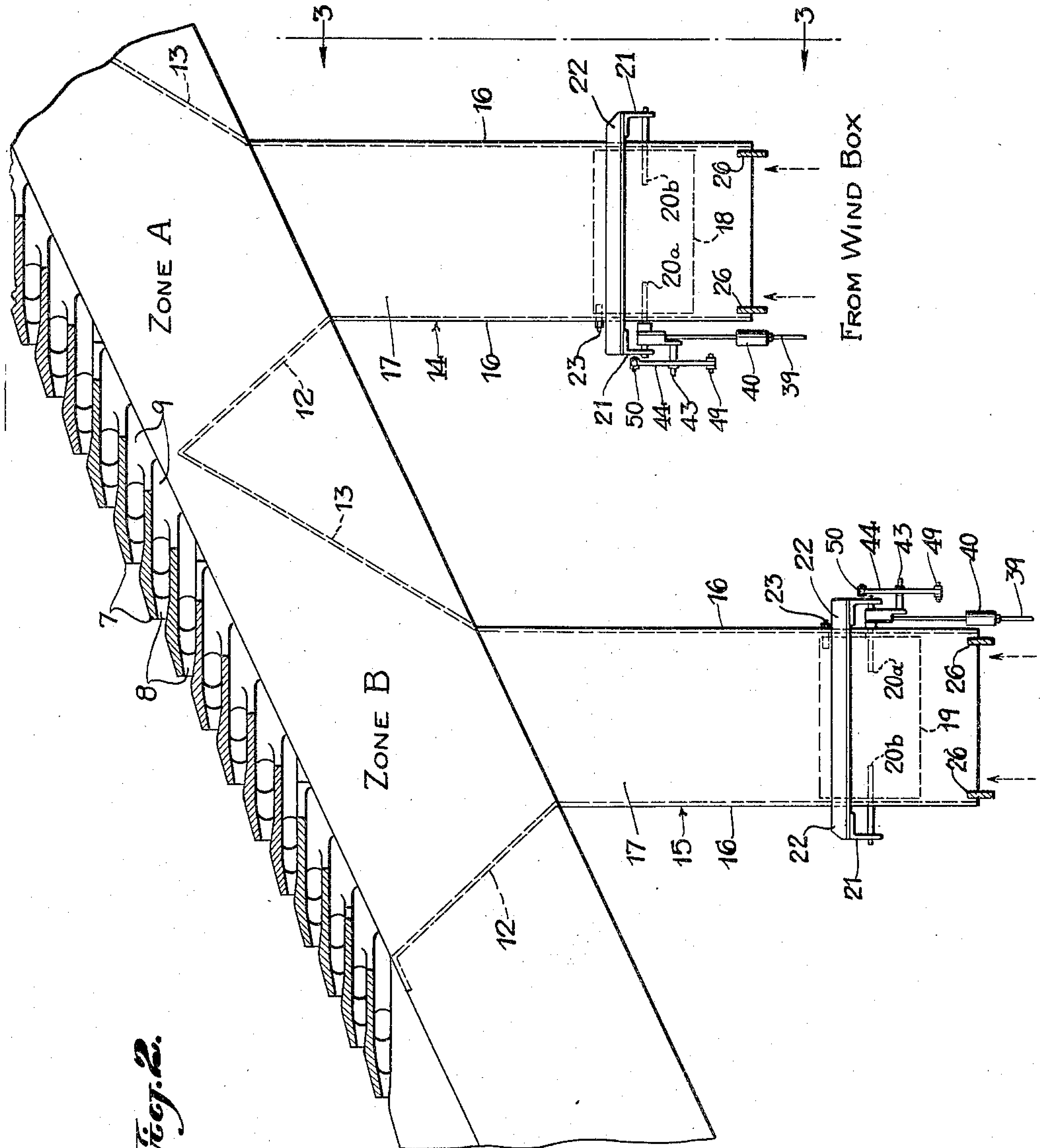

Fig. 2.

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GASEOUS FLUID DISTRIBUTING SYSTEM
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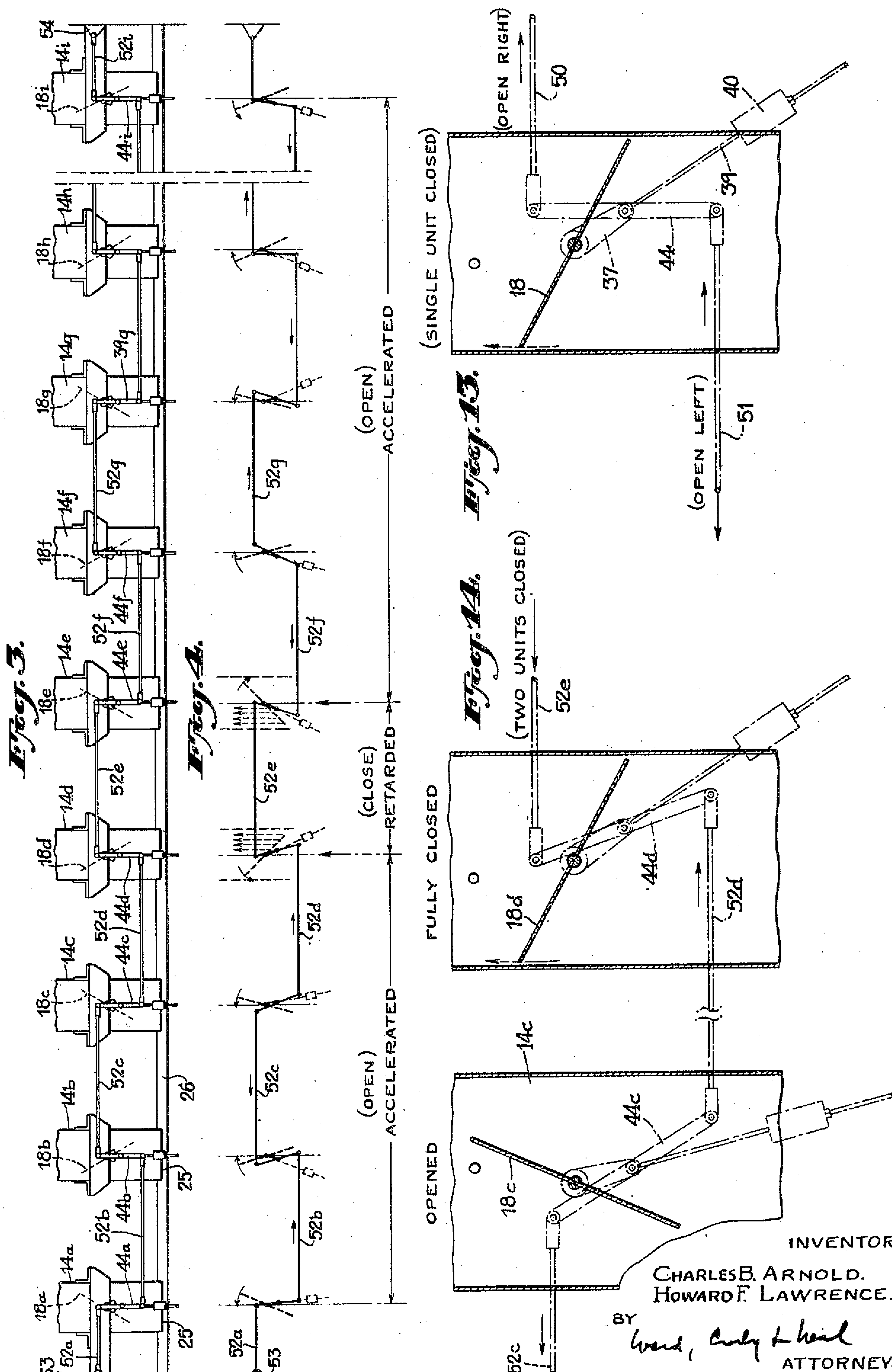

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Fig. 6.

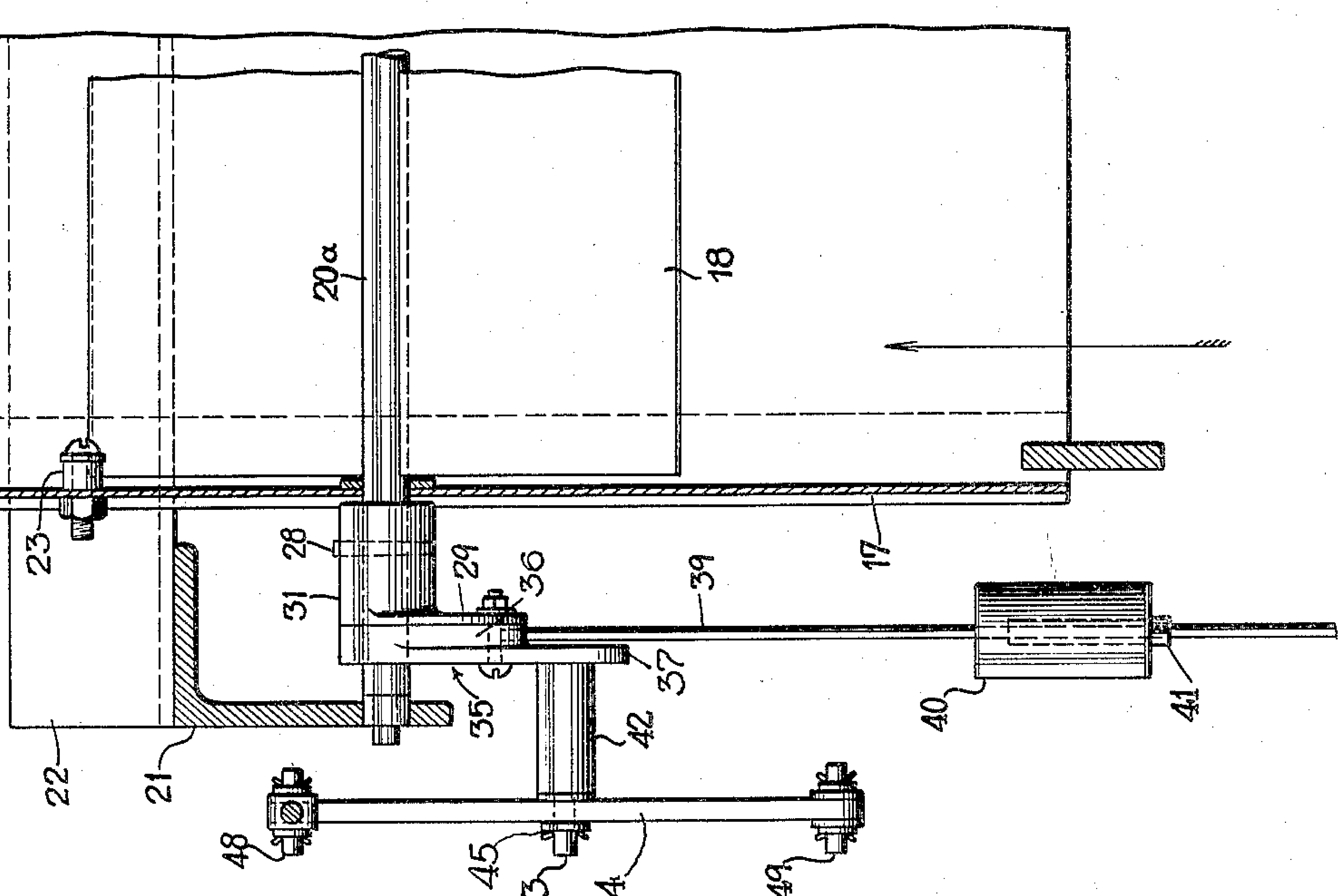
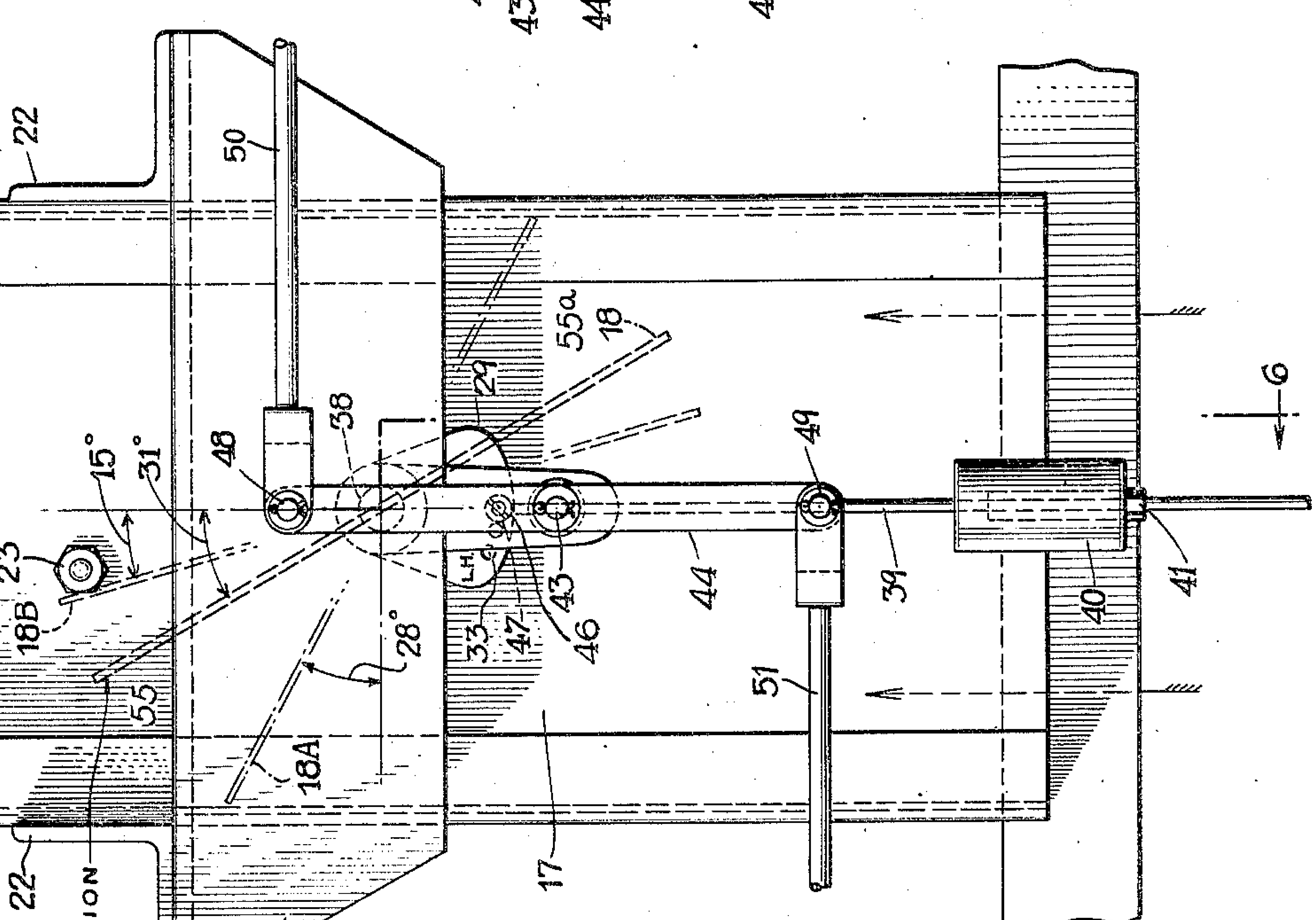


Fig. 5.



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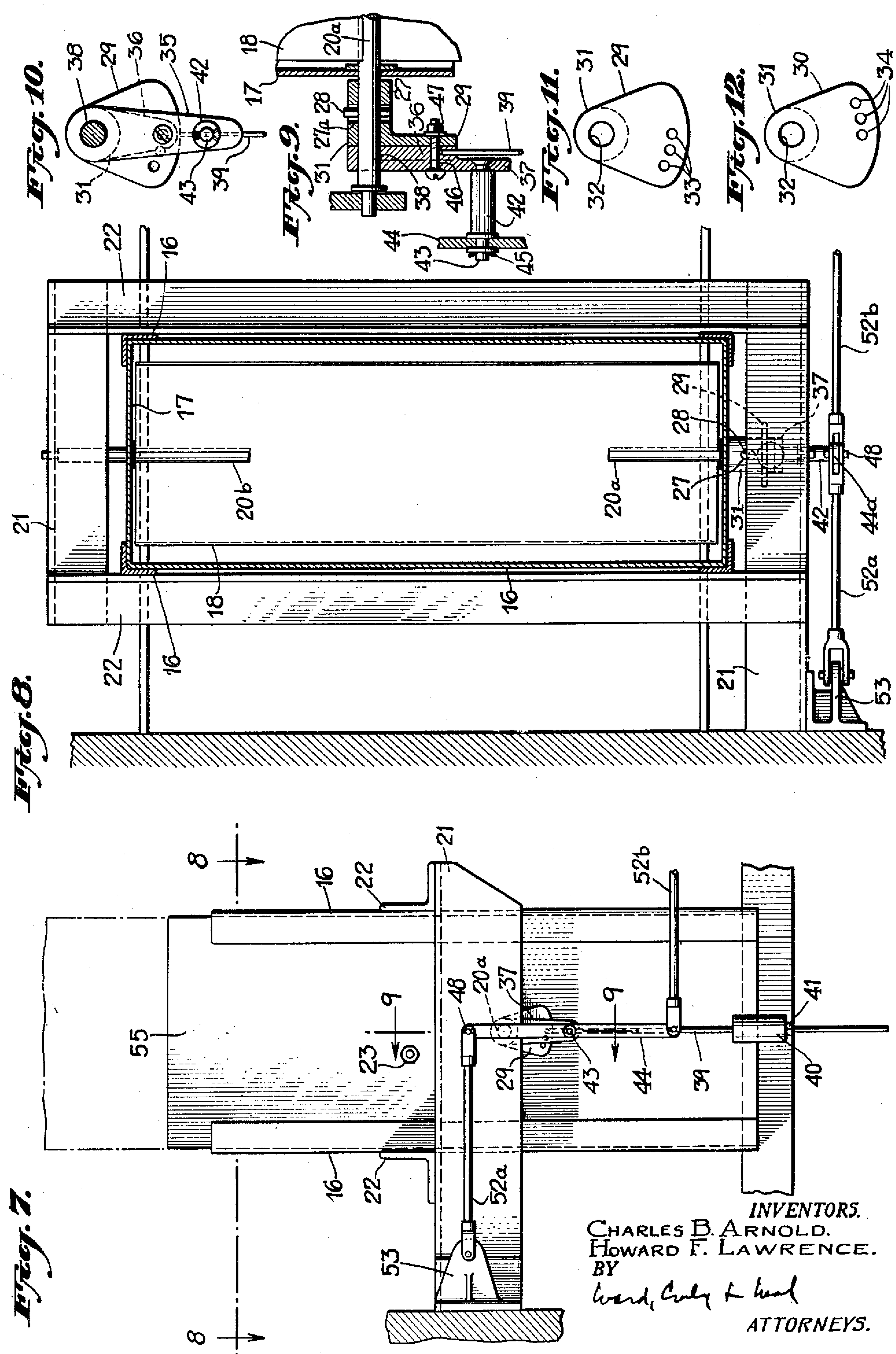
5 Sheets-Sheet 5



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GASEOUS FLUID DISTRIBUTING SYSTEM FOR FURNACES AND THE LIKE

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Application March 27, 1946, Serial No. 657,370

4 Claims. (Cl. 137—152)

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This invention relates to systems for distributing fluids, in either gaseous or liquid state, from a common source to numerous outlets, and comprises means for so regulating the flow of such fluids in passing through such a system, as automatically to reduce the flow in portions of the system where otherwise the flow would tend to become excessive, and compensatively to increase the flow proportionately in other portions of the system.

The invention finds application in heating and ventilating systems, air conditioning systems, etc. It finds particular application in supplying air, under forced draft pressure, through the grate area of large boiler furnaces and the like, especially those employing automatic stokers, and in accordance with the principles aforesaid, namely, automatically to reduce the air supply to portions of the fuel bed which have become thin, and thus mitigate the tendency for such thin portions to "burn out," while at the same time to compensatively increase the air supply to the denser portions of the fuel bed where such increased air supply is desired.

For purposes of illustrating a specific application of the invention, as described more in detail hereinafter, we have chosen a boiler and furnace employing a system for supplying air under forced draft, and one which is provided with an automatic stoker of the under-feed type. In this type of furnace, the coal is fed to the bed of the fire by means of suitable power-driven rams and pushers, and the air under pressure is supplied, for the purpose of supporting combustion, through a series of tuyères arranged in banks alternating with said rams and pushers. 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 to the tuyères and through suitable apertures in the tuyères to the fuel bed, where the oxygen in the air combines with the carbon in the coal and 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 times when the coal-feeding apparatus fails to distribute the coal uniformly over the tuyères, whereby some portions of the fuel bed become unduly thin, while other portions become comparatively dense. Obviously, these different portions of the fuel bed having different thicknesses or densities will present resistance to the flow of air which varies in accordance with the density of the fuel bed in these different areas. The thin

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areas, offering the least resistance to the draft, will have a tendency to burn through more quickly than the dense areas, thus permitting an excessive rush of air through these thin portions of the fuel bed and thereby causing a reduction in the amount of air accessible in the denser areas. Moreover, this excessive rush of air through the thinner areas of the fuel bed produces a rapid burning of the fuel thereat, and consequently causes abnormal and extremely rapid "burning out" to develop in these areas, thus allowing quantities of air in excess of that required for proper combustion to pass through them which is uneconomical. Conversely, the denser areas of the fuel bed do not receive a sufficient amount of air, so that the fuel is not completely consumed thereat, resulting in an unevenly burning fire, which is quite unsatisfactory and uneconomical.

In applying the present invention to a boiler, furnace and stoker of the type above mentioned, the fire bed is theoretically divided into a plurality of approximately equal areas, and an automatic, air flow controlling device is provided for each of these areas which is interposed between the tuyères and the wind-box of the furnace. These air flow controlling devices are mechanically interlinked in groups in such manner that air flow regulating actuation of any such device of a group will produce proportional and compensating actuation of all other devices in said group.

More specifically, in accordance with the invention, the forced draft air from the wind-box is conveyed to the furnace through a series of vertically extending and horizontally spaced air ducts or flues, each adapted to supply the tuyères over different areas of the fuel bed, adjacent such air ducts being arranged to supply adjacent fuel bed areas, and in aggregate to supply forced draft air over the entire grate area. These air ducts, sometimes called "zone control boxes," are arranged in horizontally spaced alignment, in successive rows across the stoker, underneath the tuyères, so that each air duct will supply a given number of tuyères. Dampers are provided in each of the air ducts which are rotatably mounted on horizontal shafts, and arranged to swing to either side of a normal position, as for example, about 31° from the vertical, to a fully opened or vertical position (or to a stop of, for example, 15° from the vertical) and to a fully closed position of, for example, about 28° from the horizontal. The dampers of the successive air ducts in any given row are arranged to swing alternately clockwise and counter-clockwise to close, for reasons explained hereinafter. Each damper has affixed thereto a weighted lever arm which tends to maintain the associated damper in its normal position aforesaid. Also there is secured to each damper shaft and the aforementioned weighted lever arm an operating arm, at the extremity of which there is fulcrumed or pivotally supported at its midpoint for rotation about a horizontal axis, a control lever. The control levers of adjacent air ducts in a given row are interconnected by horizontally extending link members which are pin-connected to the control levers at their extremities, in such a manner that one end of each control lever is pin-connected by a horizontal link member to the control lever next adjacent on one side thereof, while the other end of said control lever is similarly connected to the control lever next adjacent on the opposite side thereof. This mode of mechanical interlinking extends throughout all control levers in a given row of air ducts, with the exception that the horizontal link member extending from one end of each of the control levers in the terminal air ducts of any given row, is pin-connected to a fixed support. By virtue of this mechanical interlinking of the successive dampers in a given row of air ducts, coupled with the arrangement aforesaid whereby the successive dampers are mounted to swing alternately clockwise and counterclockwise to close, rotary movements of any damper in the row will be transmitted to all other dampers in the row in such manner as proportionately to adjust the same in compensating fashion. That is to say, if one damper tends to be rotated toward the closed position, the interconnected control members and link members operate in such manner as proportionately to rotate all other dampers toward the open position.

When the air flows through the various ducts of a given row are uniform, the dampers will assume, by virtue of their weighted arms aforesaid, their aforesaid normal positions intermediate between the closed and fully opened positions, and all pneumatic forces on the dampers will be maintained in balance by virtue of the aforesaid interconnecting linkages, which cause the forces on each damper to be balanced against the forces on each of the other dampers. When, however, due to localized weaknesses of the fuel bed, the air which flows through any particular duct or each of several ducts is increased more than the air which flows through each of the remaining ducts, the pneumatic forces acting on the dampers passing the increased rates of air flow are increased in a direction to rotate these dampers towards the closed position. In so doing, all other dampers are compensatingly opened in the manner aforesaid. Equalization of the forces between the dampers is reestablished when the dampers have moved sufficiently to adjust the pneumatic forces acting on them to values such that all the forces acting on any given damper are equal to all the forces acting on each of the other dampers. In accomplishing this result, the rate of air flow through the ducts feeding weakened fuel bed sections is actually reduced below the rate of air flow through normal sections of the fuel bed, thereby permitting the subsequent building up of the fuel bed resistance in such weakened sections, after which the dampers return to their normal positions.

This tendency of a damper, in accordance with the invention, to close down by passage of

air, under forced draft, around it, is brought about by venturi action as follows: As stated above, the damper is normally inclined at an angle of about 31° to the vertical, i. e., to the direction of the air duct, whereby the damper, in conjunction with the duct wall toward which it is inclined, constitutes what is, in effect, a venturi tube. Accordingly, as the air, under forced draft pressure, passes along the lower face of the damper from its inlet to its outlet edge, its velocity progressively increases. This progressive increase in velocity of air flow across the lower damper face produces a corresponding progressive decrease in static pressure acting on the lower face of the damper, in passing from its inlet to its outlet edge. In consequence, the total static pressure on the lower face of the outlet half of the damper becomes less than that on the lower face of the inlet half, thereby tending to rotate the damper toward its closed position. The action above described is enhanced by the portion of the air flow in the duct which passes between the inlet edge of the damper and the duct wall adjacent thereto, since this portion of the air flow is accelerated rapidly along the upper face of the inlet half of damper after it has passed the constriction formed by the inlet edge of the damper and the adjacent duct wall. On the other hand, as the damper is rotated toward its closed position by the pneumatic forces above described, the total air flow in the duct is correspondingly decreased, in consequence of which the pneumatic forces tending to close down the damper are likewise correspondingly decreased. Due to these opposing tendencies, the damper will not ordinarily close down completely as a result of an increase in total air flow through the duct from an initial state of equilibrium, but will be rotated sufficiently toward its closed position to establish a new condition of equilibrium in which the total air flow through the duct is reduced below that of the aforesaid initial state of equilibrium.

Referring to the drawings:

Figure 1 is a longitudinal sectional plan view of a furnace embodying the novel features of the invention, this section being taken just above the grate and looking down on the grate.

Figure 2 is a partial sectional elevation through one of the tuyère banks of the furnace as taken at **2—2** of Figure 1, these tuyère banks being divided into zones supplied with forced draft through damper-controlled air ducts in accordance with the present invention, which are also shown in sectional elevation in the drawing. Figure 2*a* is a more or less schematic view similar to Figure 2, but including a blower, and duct connections therefrom for supplying air under forced draft to the vertical air ducts of Figure 2.

Figure 3 is an elevation taken at **3—3** of Figure 2 and showing a row of the damper-controlled air ducts or zone control boxes, with their interconnecting linkages as above described.

Figure 4 is a schematic showing of the interlinked, damper-controlled system of Figure 3, and illustrative of its mode of operation.

Figure 5 is an enlarged fragmentary view in side elevation of one of the intermediate air ducts or zone control boxes of a given row, illustrative of the mounting of the damper and associated linkage mechanism therefore; while Figure 6 is a sectional elevation thereof taken substantially at **6—6** of Figure 5.

Figure 7 is an enlarged fragmentary view in side elevation of one of the terminal air ducts or zone control boxes of a given row, showing the damper and associated linkage mechanism, and the manner in which the end linkage of a given row is pivotally secured to a stationary support; while Figure 8 is a sectional plan view thereof taken at 8—8 of Figure 7.

Figure 9 is a fragmentary view in axial section through one end of the damper shaft, taken at 9—9 of Figure 7 and illustrating the assembly thereon of the weighted lever arm and the operating arm or eccentric, on which latter the control lever or linkage mechanism is fulcrumed; while Figure 10 is a view in front elevation of the Figure 9 assembly.

Figures 11 and 12 are detail plan views of quadrant members, shown in assembly in Figures 9 and 10, and providing a means for adjustably setting the clockwise and counterclockwise damper respectively.

Figure 13 is an enlarged fragmentary view corresponding to Figure 5, but showing the damper in its closed position; while Figure 14 is a similar view of two adjacent air ducts, in one of which the damper is operated to the closed position, whereas in the adjacent air duct the damper is concurrently actuated toward its opened position by the interconnecting linkage mechanism.

As illustrated in Figs. 1, 2 and 2*a*, the furnace embodying the novel features of the invention, comprises a front wall **1** and side walls **2**, **2**, defining a fire bed, generally indicated at **3**, and comprising spaced rows of tuyère banks, as at **4**, alternating with automatically actuated coal-feeding units or retorts, as at **5**. Each of the tuyère banks includes a pair of side walls, as at **6**, suitably mounted in the furnace, and each tuyère bank comprises a series of tuyère units, as at **7**, of the usual construction, embodying spaced air outlets, as at **8**, Fig. 2, which communicate with air passages, such as **9**, formed within the tuyère units.

Each of the tuyère banks **4** is divided into a series of zones, such as A to D inclusive, by means of metal partitions such as **12**, **13**, Fig. 2, forming funnel-shaped passageways communicating at their bases with air ducts or flues, such as **14**, **15**, of substantially rectangular cross-section, as illustrated in Fig. 8, the walls **16**, **17** of which are likewise made of sheet metal. These air ducts **14**, **15**, etc. extend from the zoning chambers A, B, etc. to the wind-box located beneath the furnace, Fig. 2*a*, from whence they are supplied with air under forced draft as indicated by the arrows in Figs. 2 and 2*a*.

Referring to Fig. 1, it will be noted that the air ducts supplying the successive zones A, B, etc. of the successive tuyère banks are arranged, for this purpose, in spaced parallel rows, such as **14***a* to **14***i*, and **15***a* to **15***i*, across the stoker underneath the tuyère banks, so that, as above stated, each air duct will supply air under forced draft to a different and corresponding number of tuyères, comprising in aggregate all of the tuyères. It will also be noted, for example, that the first row of air ducts **14***a* to **14***i* inclusive supplies air under forced draft to the portions of the successive tuyère banks which are located in zone A; similarly the second row of air ducts **15***a* to **15***i* inclusive supplies air to the portions of the successive tuyère banks located in zone B, and so on.

Each air duct or flue, such as **14**, **15**, etc., is provided with a damper, as at **18**, **19**, Fig. 2, which, as shown in detail at **18** in Figs. 5, 6, 8 and 13, is mounted on a shaft **20***a* extending through apertures in the end walls **17** of the duct, and journaled to angle plates such as **21**, mounted in spaced relation to the duct end walls **17** by means of other angle members, such as **22**, which are welded, riveted or otherwise secured to the duct side walls **16**. The damper **18** is thus rotatable about a horizontal axis between a fully closed position of about 28° from the horizontal, as indicated at **18**A, Fig. 5, and a fully opened position of about 15° from the vertical, as indicated at **18**B, Fig. 5. For limiting rotation of the damper in the direction of opening, inwardly projecting studs, as at **23**, are appropriately secured to the duct end walls **17**; while the side walls **16** of the duct serve to limit rotary movements of the damper in the direction of closing, in the manner shown at **18**A, Fig. 5. The damper **18** is so mounted, as explained below, as normally to maintain a normal inclination of about 31° from the vertical, as shown at **18** in Fig. 5.

As above explained, the air ducts are disposed, equally spaced, in rows extending transversely across the stoker underneath the tuyères, as indicated at **14***a*—**14***i* and **15***a*—**15***i*, etc., Fig. 1. Fig. 3 illustrates such a row of air ducts, as viewed in side elevation looking in the direction of **3**—**3** of Fig. 2, to assure equal spacing of the ducts, they are mounted in equally spaced, rectangularly notched portions **25** of alignment bars, such as **26**, Figs. 2 and 3, on which the air ducts are supported within the wind-box. Still referring to Fig. 3, the dampers, such as **18***a*, **18***b*, etc. of the successive air ducts **14***a*, **14***b*, etc. are arranged, as indicated, to swing alternately in clockwise and counter-clockwise directions, respectively, for closing. Fig. 3 also shows the aforesaid mechanical interlinkages extending between the successive dampers, whereby rotary movements of any one are oppositely and compensatively transmitted to all of the others, which interlinkages, however, are best explained by reference to the detail drawings of Figs. 5 to 12 inc.

Referring to these detail drawings, one end of each damper shaft **20***a* is provided with a collar **27** keyed thereto by a dowel, as at **28**. Mounted on the shaft adjacent to and welded on the collar **27** is a quadrant member, such as that shown at **29** in Fig. 11, or that shown at **30** in Fig. 12, the particular type of quadrant member employed for any particular damper depending on whether the damper is to be arranged for counter-clockwise or clockwise rotation for closing. Where the damper is to be rotated counter-clockwise for closing, the quadrant member **29** of Fig. 11 is employed, and, conversely, the quadrant member **30** of Fig. 12 where the damper is to rotate clockwise for closing. It will be noted that each of these quadrant members is provided with a rearwardly extending collar portion **31** integral therewith, which is drilled, as at **32**, for mounting on shaft **20***a*. Also, each quadrant member is provided adjacent its lower periphery with a series of arcuately spaced holes **33**, Fig. 11, or **34**, Fig. 12, the lowermost hole of the series being in vertical alignment with the shaft aperture **32**, with the series of holes extending to the left, as at **33**, from the vertical for the counter-clockwise type of quadrant, and extending to the right, as at **34**, for the clockwise type of quadrant. The quadrant member is initially assembled on the damper shaft **20***a* with its collar portion **31** abutting the dowelled shaft collar **27** and welded thereto. The damper **18** is thereupon adjusted to its desired normal position of about 31° from the vertical, while maintaining the quadrant member with the lowermost hole in the arcuate group 33 or 34, in vertical alignment with the shaft aperture 32, whereupon the abutting collars 31 and 27 are welded together as at 27*a*.

Following the above assembly, there is slidably mounted on shaft 20*a* an eccentric member 35, comprising a pair of elongated metal straps 36, 37 welded together, and suitably drilled, as at 38, Fig. 9, for slidable reception of shaft 20*a*. From the inner member 36 is suspended an arm 39 having a weight 40 removably secured thereon by means of a threaded portion and cooperating nut 41, Fig. 6. The outer metal strap 37 is the operating arm for the control lever above referred to, and for this purpose has secured to the lower end thereof an outwardly projecting stud 42, terminating in a spindle 43, on which is pivotally mounted, at its midpoint, a control lever 44 held in place by means of a washer and cotter pin assembly 45.

Near its lower end, the eccentric member 35 is provided with a single drilled hole, as at 46, whereby this aperture 46 in the eccentric member may be rotatably aligned with any of the apertures 33 or 34 in the quadrant members 29 or 30, and secured thereto in such alignment by means of a bolt and associated nut assembly 47. Ordinarily, the eccentric member 35 will thus be secured to the quadrant member, employing for this purpose the lowermost hole of the arcuate series in the quadrant group, as illustrated for example in Fig. 5, whereby the weighted arm 39, 40 will normally maintain the entire assembly in the position shown in Fig. 5, with the damper at the aforesaid angle of about 31° from the vertical, representing the normal inclination of the damper. In the event, however, that any particular lamper requires a somewhat different setting in relation to the other dampers of a given row of air ducts, in order to provide the proper operation for the entire series of dampers, the eccentric 35 may be secured in another of the arcuately spaced holes 33 or 34 of the quadrant members 29 or 30; or all dampers in any one zone of dampers may similarly be set for a greater or lesser normal opening than those in some other zone. It will be observed that, in consequence of the assembly above described, the weighted lever arm 36, 39, 40, the operating arm 37 (comprising assembly 35), and the quadrant member 29 or 30, are all integrally united to each other, and in turn rigidly secured to shaft 20*a*, to which the damper 18 is also rigidly secured, whereby all of these components rotate as a unit.

Referring to Figs. 3 and 5 to 8 inclusive, each control lever, such as 44, Figs. 5 and 6, or 44*a*, 44*b*, 44*c*, etc., Fig. 3, has pin-connected thereto at its outer extremities, as at 48, 49, Figs. 5 and 6, link members, such as 50, 51, which extend in opposite horizontal directions respectively, to the corresponding control members of the next adjacent air ducts, situated on the opposite sides, respectively, of the duct in question, and similarly pin-connected to the extremities of the control levers thereat, in the manner shown in Fig. 3 by the successive link members 52*b*, 52*c*, 52*d*, etc. As there shown, this mode of interlinking the successive damper controls extends throughout all air ducts 14*a*—14*i* inclusive of a given row, with the exception of the terminal air ducts 14*a* and 14*i* at the opposite ends of a given row, the control members 44*a* and 44*i* of which have one extremity thereof pin-connected to a link member, such as 52*a* or 52*i*, the opposite end of which is pin-connected to a fixed support, as at 53 or 54.

Fig. 7 illustrates, in enlarged detail, the terminal link connection shown at the left in Fig. 3, and comprising the horizontally extending link member 52*a* pin-connected at one end to a fixed support, as at 53, and having its opposite end pin-connected to the upper end of the control lever 44*a*.

In the operation of the system as thus described, when the fuel bed is substantially and uniformly distributed over the grate, the forced draft supplied through the various air ducts of a given row, such as 14*a* to 14*i* inclusive, Fig. 3, will be substantially uniform, in consequence of which all of the dampers 18*a* to 18*i* inclusive will assume their normal positions, as at 18, Fig. 5, and all of the pneumatic forces on the dampers will be maintained in balance through the medium of the interlinked operating arms, such as 37, Fig. 6, control levers, such as 44*a* to 44*i*, Fig. 3, and horizontal link members, such as 52*a* to 52*i* etc., Fig. 3, which thereby adjust the forces on each damper to be balanced against the forces on each of the other dampers in any given row. When, however, due to localized weakness in the fuel bed within an area supplied by any given air duct or ducts, such as 14*a*, 14*b*, 14*c*. etc., Fig. 3, the forced draft air supplied through such duct or ducts is increased more than the rate of flow through the remaining ducts, the pneumatic forces acting on the dampers passing the increased rate of air flow, will increase in a direction to close down these dampers by pneumatic action, while proportionately opening the remaining dampers.

Thus, referring for example to Fig. 5, it will be observed that, since each damper thereof is normally in the inclined position indicated at 18, it forms in conjunction with the side wall 16 at the left of the duct, what is in effect a venturi tube, whereby, as the rate of air flow through the duct increases, regions of diminished pressure occur at the constrictions 55 and 55*a* in the air flue formed by the damper 18 and the side walls 16, whereby the damper is rotated toward the closed position 18A. As a result of this action, however, all of the other dampers in the row are compensatively and proportionately opened by virtue of the mechanical interlinking of the dampers as above described. Equalization of forces between dampers is reestablished when all closing dampers have moved sufficiently to reduce the pneumatic forces acting on them to values such that the forces on the closing dampers are again in equilibrium with the pneumatic forces on all other dampers in their new positions.

Fig. 4 illustrates diagrammatically the movements of the various dampers and linkage mechanisms in a given row, such as that of Fig. 3, when, for example, an increased rate of air flow occurs in the two intermediate air ducts 14*d*, 14*e*. This increased air flow causes each of these dampers to be rotated toward their closed positions, which, as above explained, results in opposite directions opposite directions of rotation thereof for adjacent dampers, since one damper 14*d* must rotate counter-clockwise to close, while the adjacent damper 14*e* must rotate clockwise to close. In consequence of this opposite rotation of the dampers in the air ducts 14*d*, 14*e* toward their closed positions, all other dampers in the row are proportionately and compensatively rotated toward their opened positions as indicated by the arrows thereat, the accompanying movements of the associated linkage mechanisms being likewise indicated by the arrows thereon in Fig. 4.

A comparison of Figs. 5 and 13 illustrates the relative movements which occur in the operating arm **37**, control lever **44**, weighted arm **39**, **40** and horizontal linkage mechanisms **50**, **51**, when the damper **18** is operated from its normal position of Fig. 5, to its fully closed position of Fig. 13.

In a similar manner, Fig. 14 illustrates, in enlarged view, the linkage movements which occur in air ducts **14***c* and **14***d* of Fig. 3, when the two intermediate ducts **14***d* and **14***e* thereof are actuated to their closed positions, as illustrated diagrammatically in Fig. 4, like elements being similarly designated in Figs. 3 and 14. It will be observed, referring to Fig. 14, that when the damper **18***d* is operated to its fully closed position, the adjacent damper **18***e* is not operated to its fully opened position, but is opened to such an extent along with dampers **14***a* and **14***b* of Fig. 3 that the forces on all dampers will be balanced.

We claim:

1. In combination: a plurality of spaced, fluid passageways; a baffle in each said passageway rotatably mounted on a shaft intermediate opposite edges of said baffle, and adapting said baffle to be rotated between closed and opened positions; means normally positioning successive baffles in oppositely inclined relation in said passageways respectively, and intermediate their open and closed positions, whereby said baffles are rotatable to their closed positions alternately clockwise and counterclockwise by venturi action produced by fluid flowing between such baffles and the walls of the passages associated therewith; a lug keyed to each said shaft; a first group of link members individual to and centrally pivoted to the ends of said lugs respectively; and other link members pivotally interconnecting the opposite ends respectively of adjacent said first link members, and in opposite directions therefrom respectively, whereby rotary movements of any said baffle are oppositely transmitted to the remaining said baffles, and whereby unequal rates of fluid flow through said passageways compensatively adjust said baffles from one state of equilibrium to another.

2. In combination: a row of substantially equally spaced and vertically arranged fluid passageways; a baffle in each said passageway rotatably mounted on a shaft intermediate opposite edges of said baffle, and adapting said baffle to be rotated between opened and closed positions; a weighted member keyed to each said shaft for normally maintaining the associated baffle in an inclined position relative to the direction of said passageway, and intermediate between said opened and closed positions; the successive baffles of said row being arranged to rotate alternately clockwise and counter-clockwise to close by venturi action produced by fluid flowing between such baffles and the walls of the passages associated therewith; a lug keyed to each said shaft; a first group of link members individual to said lugs, and centrally pivoted to the ends of said lugs respectively; and additional link members pivotally interconnecting the opposite ends respectively of adjacent said first link members, and in opposite directions therefrom respectively, whereby rotary movements of any said baffle are oppositely transmitted to the remaining said baffles, and whereby unequal rates of fluid flow through said passageways tend, by Venturi action, to actuate certain of said baffles toward their closed positions, and compensatively to actuate the remaining said baffles toward their opened positions.

3. In combination: a row of spaced, substantially parallel, fluid passageways; a baffle in each said passageway rotatably mounted on a shaft intermediate opposite edges of said baffle, and adapting the same to be rotated between closed and opened positions, said shaft being substantially perpendicular to the direction of the associated passageway; means normally maintaining each said baffle in inclined relation relative to the direction of the associated passageway, and intermediate between said opened and closed positions; the successive baffles in said row being arranged to rotate alternately clockwise and counter-clockwise to close by Venturi action produced by fluid flowing between such baffles and the walls of the passages associated therewith; a lug keyed to each said shaft; a first group of link members individual to said lugs and centrally pivoted to the ends thereof respectively; and other link members pivotally interconnecting the opposite ends respectively of adjacent said first link members, and in opposite directions therefrom respectively, whereby rotary movements of said baffle are oppositely transmitted to the remaining said baffles, thereby automatically and compensatively to adjust said baffles for otherwise unequal rates of fluid flow through said passageways.

4. In combination: a plurality of fluid passageways; means for supplying fluid to said passageways under pressure from a common source; a baffle in each said passageway rotatably mounted on a shaft intermediate opposite edges of said baffle, said shaft being substantially perpendicular to the direction of said passageway, and said baffle being adapted for rotation thereon between closed and opened positions, inclined to the direction of said passageway; means normally positioning successive baffles in oppositely inclined relation in said passageways respectively, and intermediate their open and closed positions, whereby said baffles are rotatable to their closed positions alternately clockwise and counterclockwise by Venturi action produced by fluid flowing between such baffles and the walls of the passages associated therewith; a lever arm keyed to each said shaft; and means mechanically interconnecting said lever arms whereby rotary movements of any said baffle are oppositely transmitted to the remaining said baffles, and whereby unequal rates of fluid flow through said passageways tend, by Venturi action, to actuate certain of said baffles toward their closed positions, and compensatively to actuate the remaining said baffles toward their opened positions.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
323,539	Smith	Aug. 4, 1885
1,268,424	Beers	June 4, 1918
1,745,238	Alpern	Jan. 28, 1930
2,010,694	Jones	Aug. 6, 1935
2,255,681	Sauter	Sept. 9, 1941
2,375,479	Langhaar	May 8, 1945

FOREIGN PATENTS

Number	Country	Date
23,103	Great Britain	of 1907