No. 724,993. PATENTED APR. 7, 1903.

J. B. CONGER.

DUPLEX FURNACE.

APPLICATION FILED JAN. 11, 1901.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1.

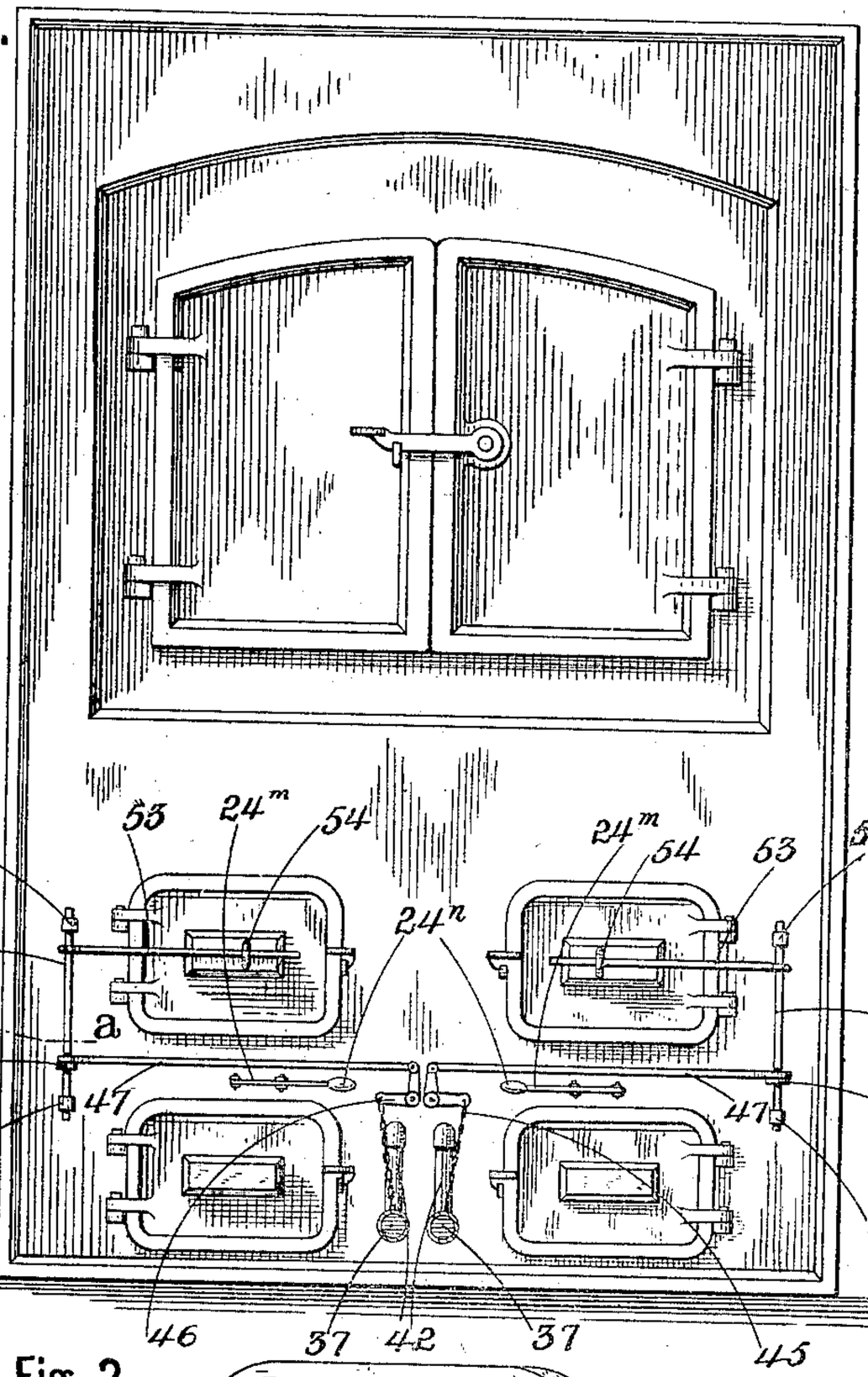


Fig. 2.

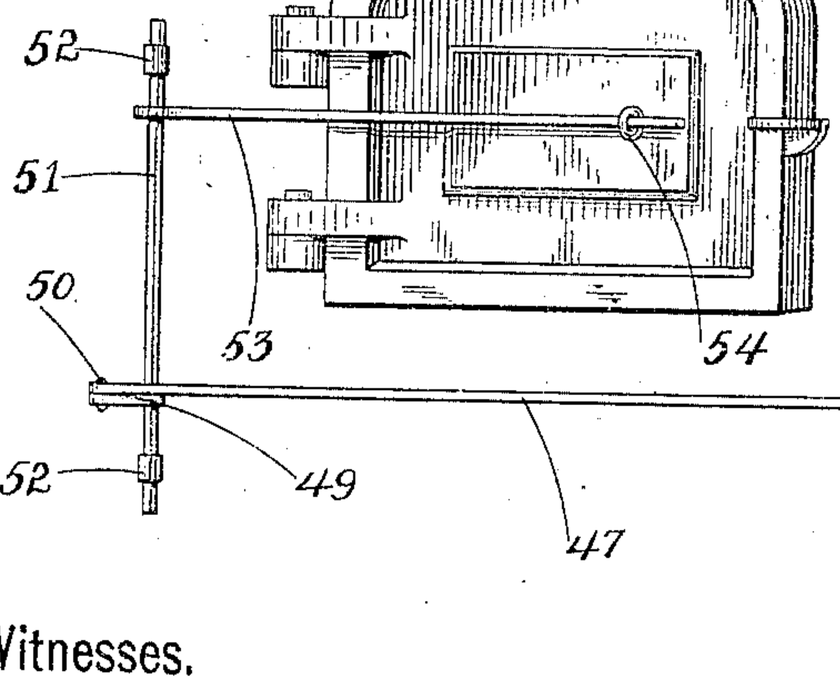


Fig. 3.

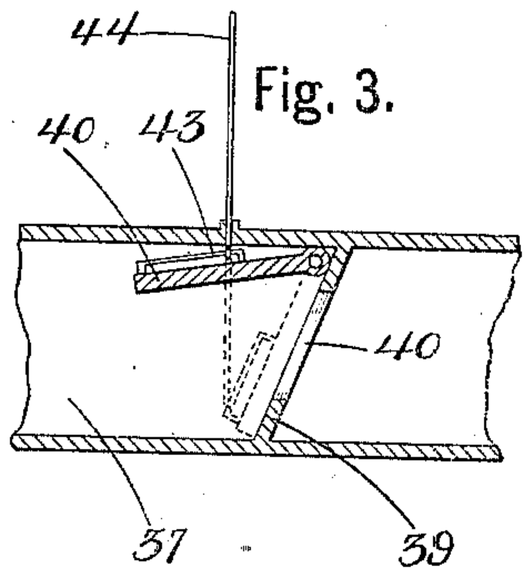


Fig. 4.

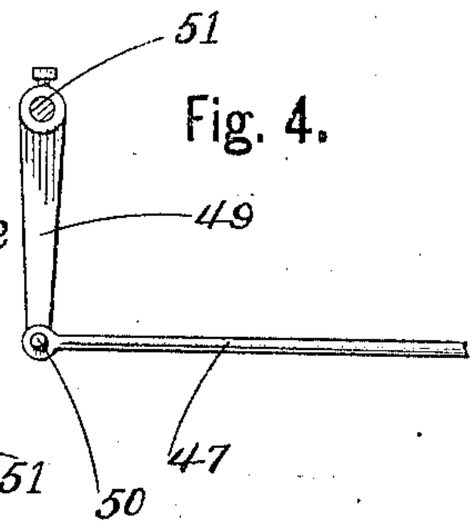
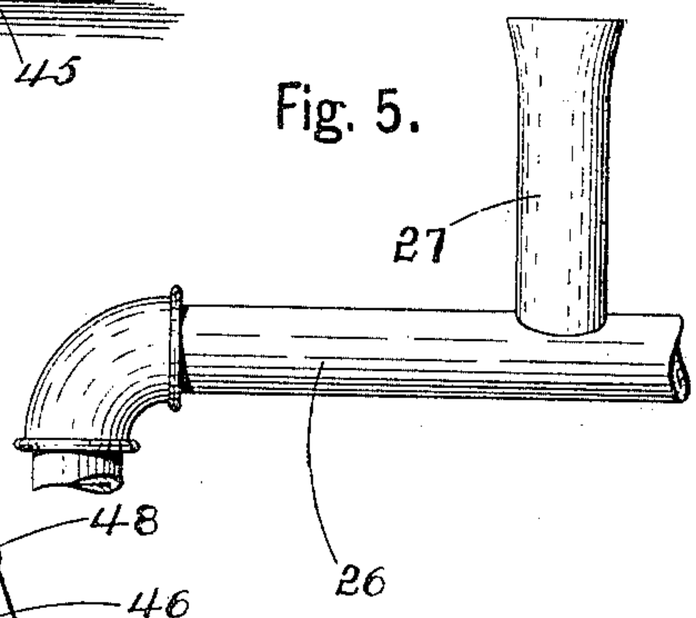


Fig. 5.



Witnesses.

L. M. Billings.

Geo. A. Neubauer

Inventor.

By John B. Conger,

W. J. Langston Attorney.

No. 724,993. PATENTED APR. 7, 1903.

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DUPLEX FURNACE.

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NO MODEL. 5 SHEETS—SHEET 2.

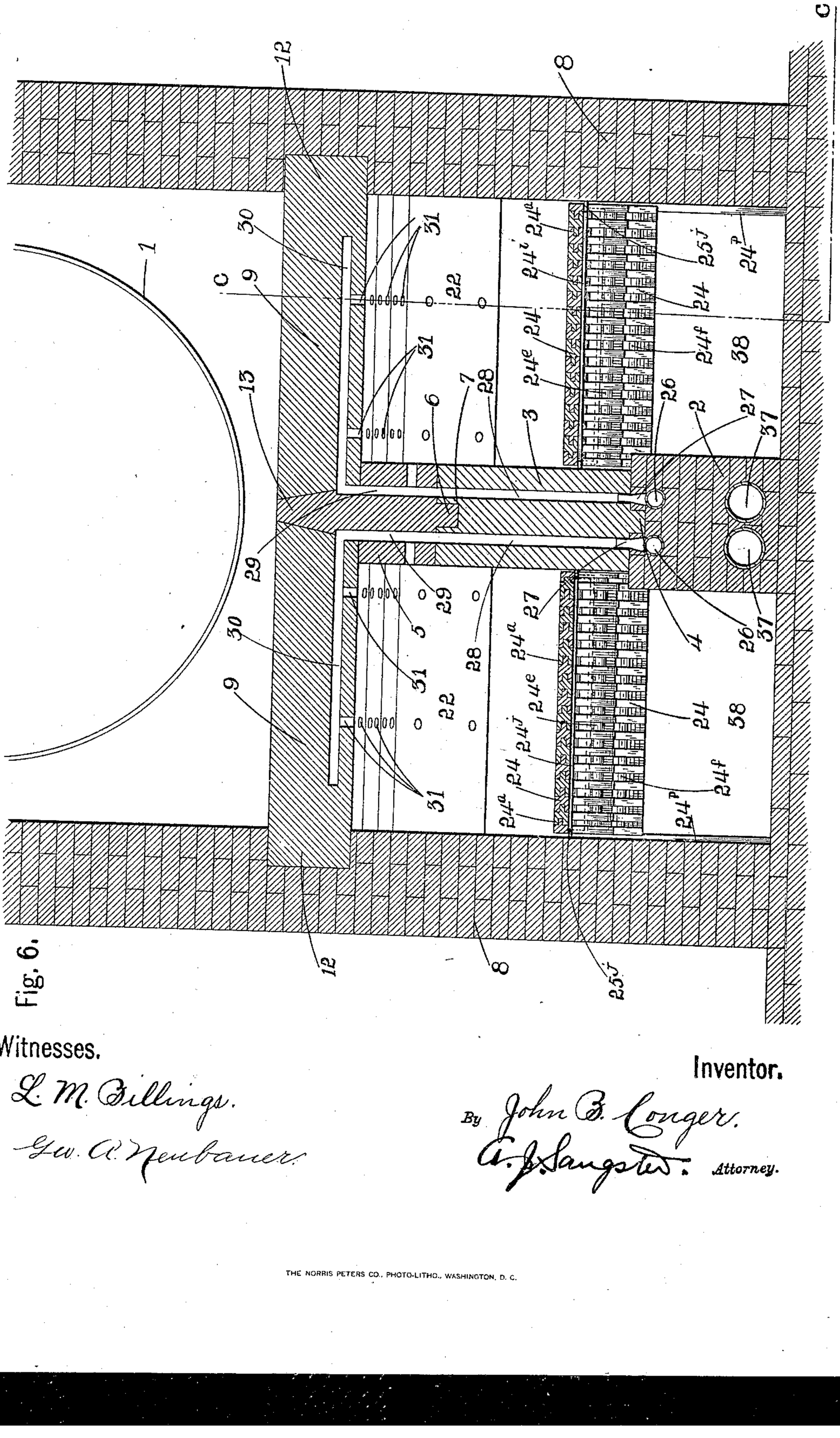


Fig. 6.

Witnesses.

L. M. Billings.

Geo. A. Neubauer.

Inventor.

By John B. Conger.

A. J. Sangster. Attorney.

No. 724,993. PATENTED APR. 7, 1903.

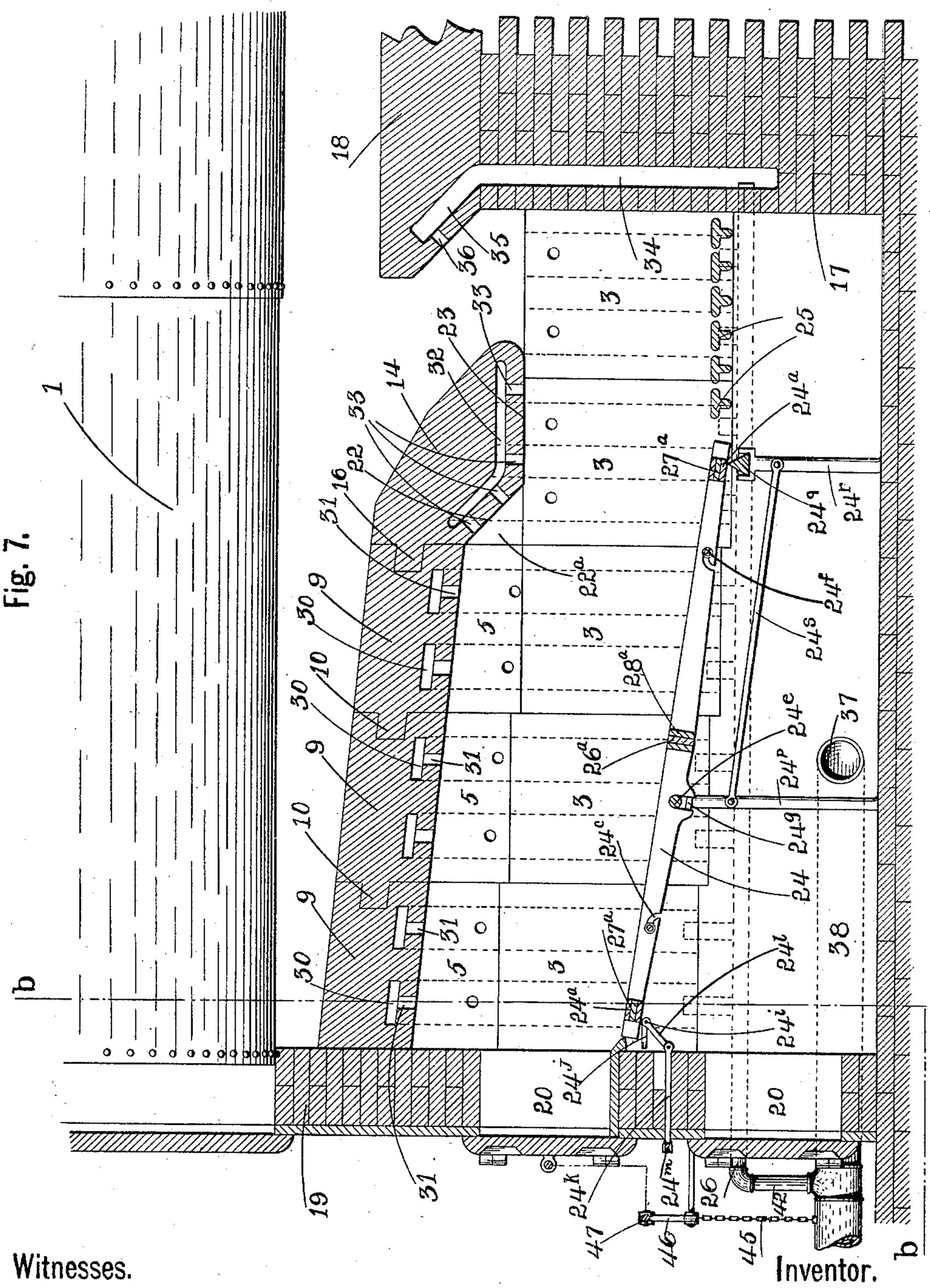
J. B. CONGER.

DUPLEX FURNACE.

APPLICATION FILED JAN. 11, 1901.

NO MODEL. 6 SHEETS—SHEET 3.

Fig. 7.



Witnesses.

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Inventor.

By John B. Conger.

A. J. Langston. Attorney.

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APPLICATION FILED JAN. 11, 1901.

NO MODEL.

5 SHEETS—SHEET 4.

Fig. 8.

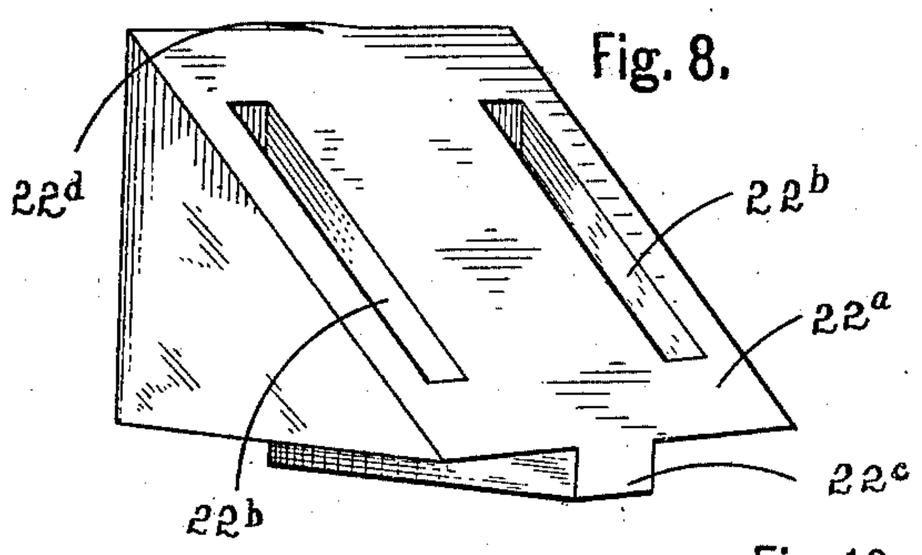


Fig. 9.

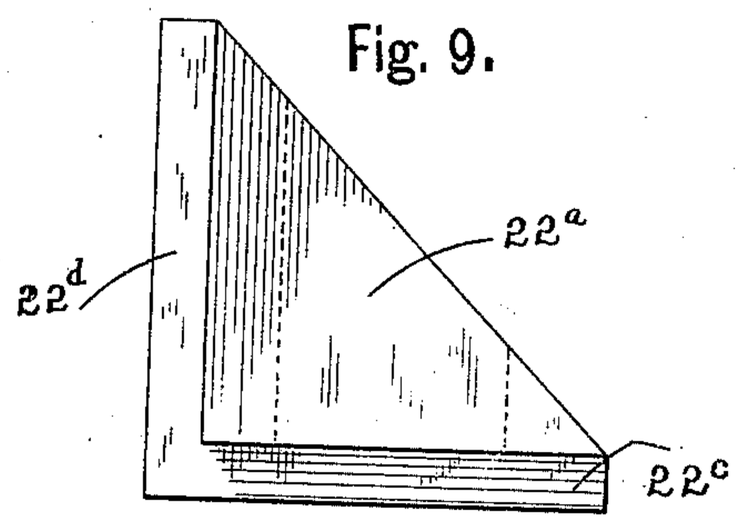


Fig. 10.

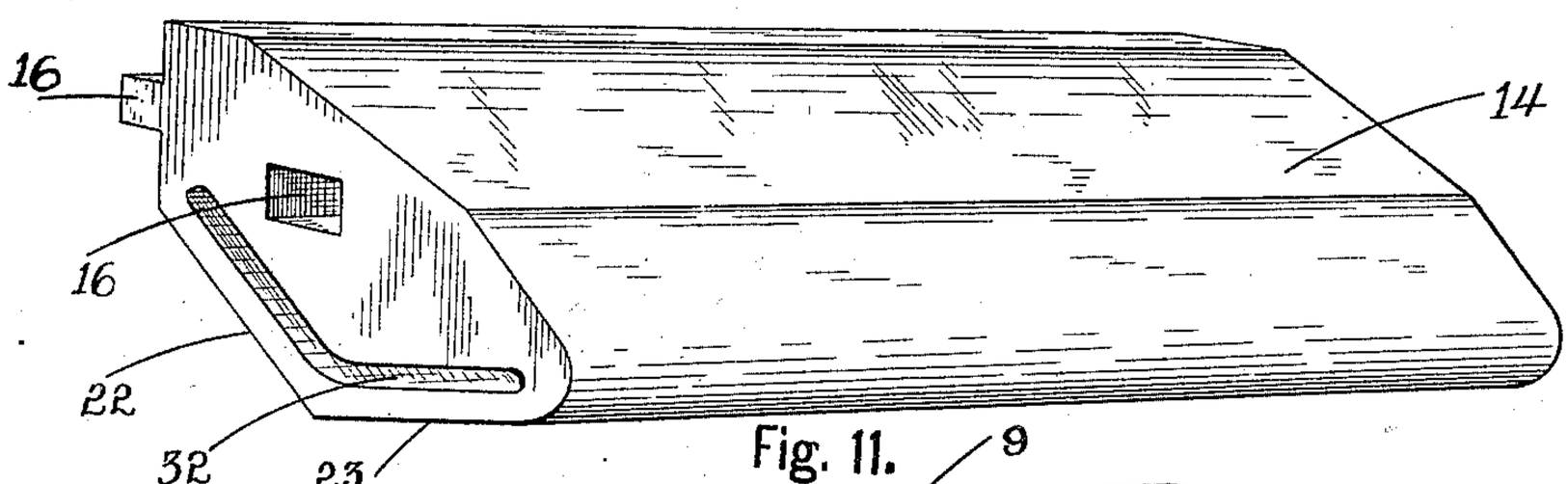


Fig. 11.

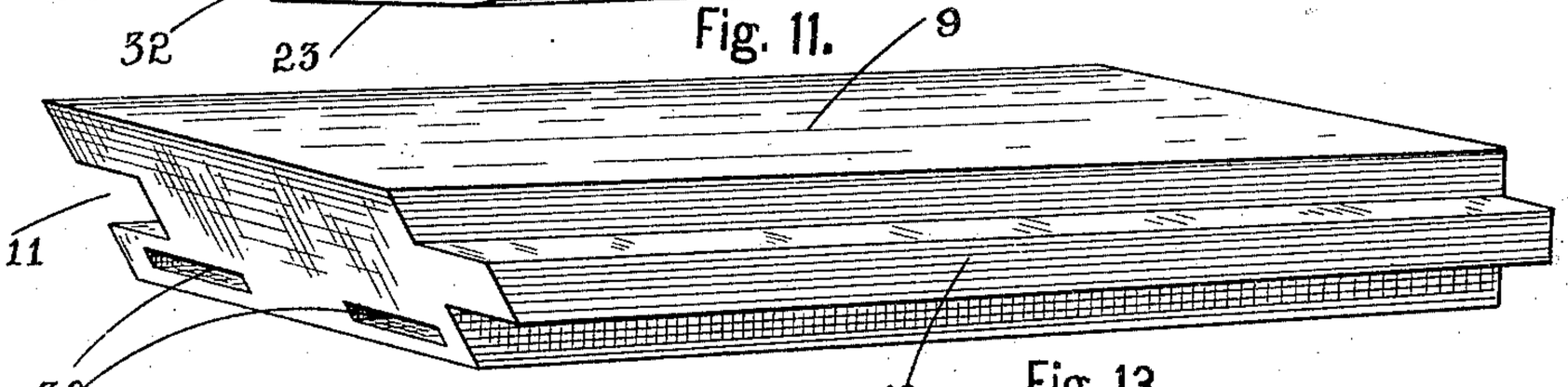


Fig. 12.

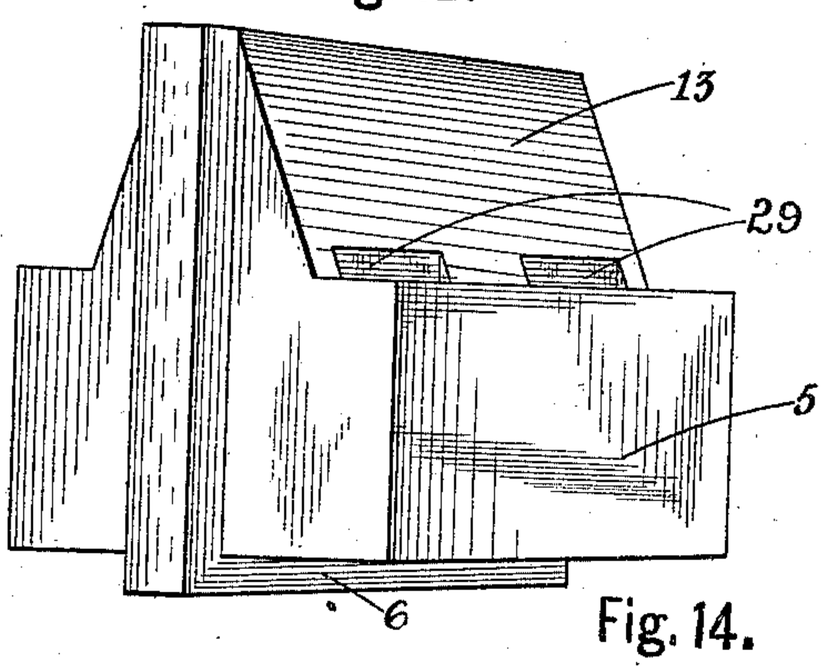


Fig. 13.

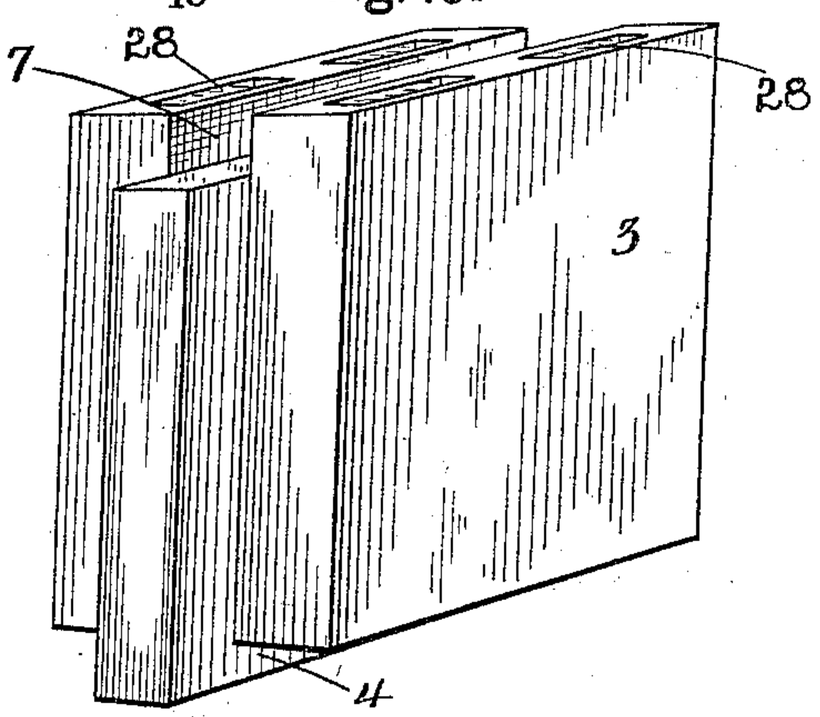
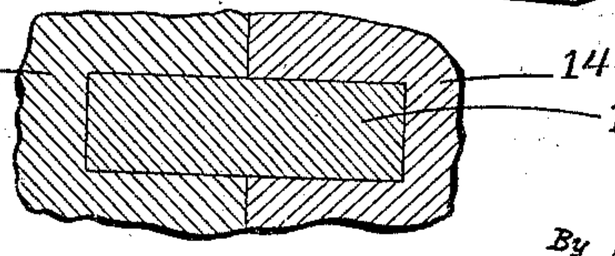


Fig. 14.



Witnesses.

L. M. Billings.

Geo. A. Neubauer.

Inventor.

By John B. Conger.

A. J. Langsdale, Attorney.

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J. B. CONGER.

DUPLEX FURNACE.

APPLICATION FILED JAN. 11, 1901.

NO MODEL. 5 SHEETS—SHEET 5.

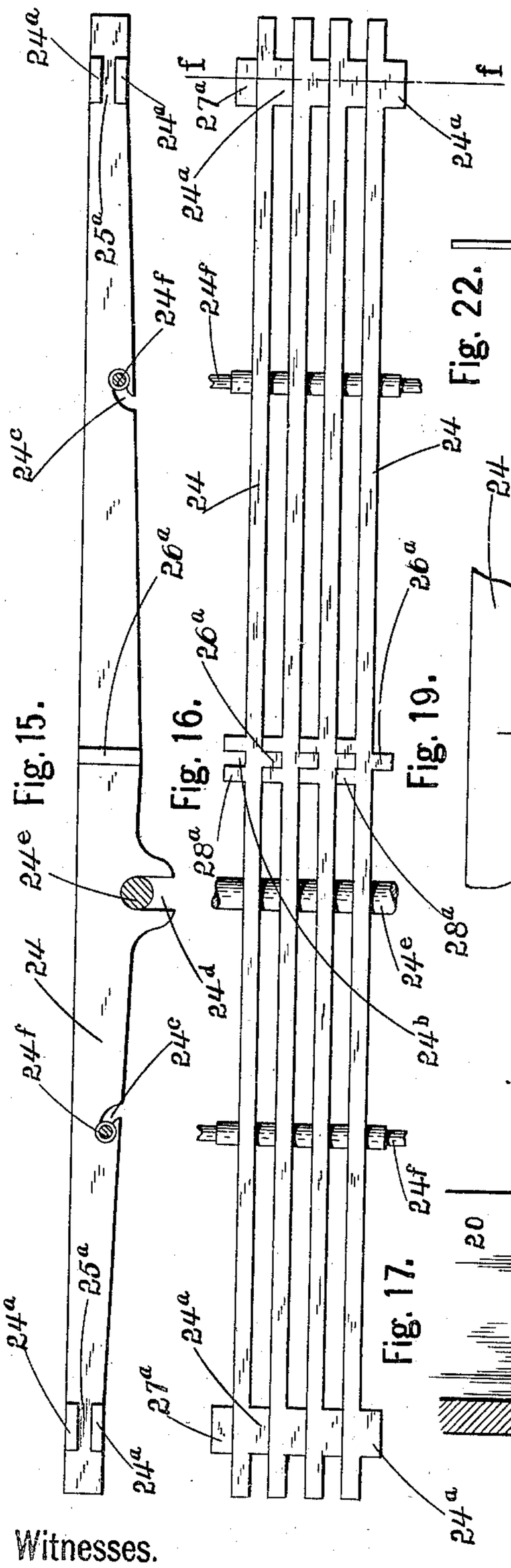

Fig. 15. Fig. 16. Fig. 17. Fig. 18. Fig. 19. Fig. 20. Fig. 21. Fig. 22.

Witnesses.

L. M. Billings.

Geo. A. Neubauer.

Inventor.

By John B. Conger.

A. J. Sawyer. Attorney.

UNITED STATES PATENT OFFICE.

JOHN B. CONGER, OF BUFFALO, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RICHARD A. SCHWAB, OF BUFFALO, NEW YORK.

DUPLEX FURNACE.

SPECIFICATION forming part of Letters Patent No. 724,993, dated April 7, 1903.

Application filed January 11, 1901. Serial No. 42,888. (No model.)

To all whom it may concern:

Be it known that I, JOHN B. CONGER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Duplex Furnaces, of which the following is a specification.

My invention relates to an improved duplex furnace; and the main objects of the invention are to arrange the furnace parts so as to provide as perfect combustion as possible, to bring the fire directly beneath the boiler, to provide a comparatively large space for fuel, and thus avoid frequent firing, to enable the filling of one portion of the furnace with fuel while the other is in full operation, thereby maintaining comparatively uniform heat beneath the boiler, and to prevent drafts of cold air upon the boiler-surface when the doors are opened.

For a full understanding of the merits and advantages of the invention reference is to be had to the accompanying drawings and the following description.

The invention is susceptible to various changes in the form, proportions, and minor details of construction without departing from the principle or sacrificing any of the advantages thereof, and to a full disclosure of the invention an adaptation thereof is shown in the accompanying drawings, in which—

Figure 1 represents a front elevation of my improved furnace. Fig. 2 is an enlarged detached view of a door and the mechanism for operating the forced-draft valve. Fig. 3 is an enlarged fragmentary section through the draft-pipe to show the preferred form of valve. Fig. 4 is an enlarged fragmentary section on line *a a*, Fig. 1. Fig. 5 is an enlarged fragmentary view of the draft-pipe. Fig. 6 is a vertical transverse section on line *b b*, Fig. 7. Fig. 7 is an enlarged fragmentary section on line *c c*, Fig. 1. Fig. 8 is an enlarged perspective view of the three-cornered block. Fig. 9 is an enlarged side elevation of the three-cornered block. Fig. 10 is an enlarged perspective view of the angular-shaped end block. Fig. 11 is an enlarged perspective view of one of the top or dome blocks. Fig. 12 is an enlarged perspective view of one of the key-blocks. Fig. 13 is an enlarged perspective view of one of the blocks forming the vertical dividing-wall. Fig. 14 is an enlarged fragmentary section showing the manner of fastening the angular-shaped end blocks together. Fig. 15 is an enlarged detached side elevation of one of the forward-tilting grate-bars. Fig. 16 is a fragmentary top plan view of a portion of the forward grate. Fig. 17 is an enlarged fragmentary vertical section on line *d d*, Fig. 18. Fig. 18 is an enlarged fragmentary horizontal section on line *e e*, Fig. 17. Fig. 19 is an enlarged fragment of one of the tilting grate-bars. Fig. 20 is an enlarged fragment of one of the tilting grate-bars, showing the curved slot. Fig. 21 is an enlarged section on line *f f*, Fig. 16. Fig. 22 is an enlarged view of the cranked operating-bar.

In referring to the drawings in detail like numerals designate like parts.

The furnace is usually arranged beneath a boiler 1 and is divided into two sections by a vertical wall formed of fire-clay or like material. The vertical wall is preferably formed with a bottom foundation 2, built of fire-brick, a series of blocks 3, which are shaped substantially as shown in Fig. 13 and mounted upon the foundation 2, the bricks being arranged to leave a central depression along the top of the foundation in which the downwardly-extending bottom tongues 4 of the blocks are fitted, and a series of top key-blocks 5, which have downwardly-extending bottom tongues 6, that fit in the top depression 7 in the block 3. The side walls 8 are built of fire-brick, and the top wall is formed of a plurality of blocks 9, each having a projecting tongue 10 on one side edge, which fits into a depression in the side edge of the adjacent block, and a depression 11 in the opposite side edge, which receives the tongue of an adjacent block. (See Figs. 7 and 11.) These blocks 9 are arranged in two series, with their outer ends (distinguished by the numeral 12 in Fig. 6 (set in the brick side wall 8. The top key-blocks 5 are provided with upper key portions 13, which fit between the two series of blocks 9 and have slanting sides corresponding to the slanting inner edges of the blocks 9. (See Fig. 6.) The rear end of the top wall is formed by the angular-shaped

end blocks 14, shaped substantially as shown in Fig. 10. Two of these blocks are preferably employed, and their outer ends are fitted in the side walls in substantially the same manner as the blocks 9. To secure the inner ends of these blocks 14 together, a locking-brick 15 is fitted in the depression 16 in the ends of the blocks, substantially as shown in Fig. 14. The angular blocks 14 are also provided with projecting tongues 16, which fit into the depression 11 of the rearward blocks 9. The substantially three-cornered space between the slanting bottom surface 22 of the angular blocks 14 and the top of the dividing-wall is fitted with a three-cornered block 22^a, formed substantially as shown in Figs. 8 and 9. This block has one or more vertical flue-openings 22^b, a bottom tongue 22^c, which seats in the top recess 7 in one of the blocks 3, and a horizontal tongue 22^d, which fits in a recess (not shown in the drawings) in the rear end of the rearwardly-arranged top block 5. By this means the parts of the dividing-wall and the top wall are firmly secured together by tongue-and-groove connections, and the top wall is rigidly fastened to the side walls and the dividing-wall.

A bridge-wall is arranged in the furnace and preferably consists of a foundation 17 of fire-brick and a top block 18.

The front wall 19 of the furnace is preferably formed of fire-brick and has the usual openings 20 for the furnace-doors 21.

The top wall gradually slants downward, and the angular end blocks 14 have a diagonally-extending front under surface 22 and a horizontal rear under surface 23.

A forward-tilting grate is arranged in each furnace-section and gradually slants downward and rearward when in its normal position, substantially as shown in Figs. 6 and 7. These forward grates are composed of a plurality of longitudinally-extending grate-bars 24, interlocked together at their ends and middle, substantially as shown in Fig. 16. Each of the bars 24 is provided on one side with a pair of laterally-extending substantially horizontal lugs 24^a at or near each end, each pair being separated sufficiently to leave a depression or recess 25^a between them, and a middle laterally-extending lug 26^a, and on the opposite side with a lug 27^a at or near each end, adapted to fit in the depression 25^a in an adjacent bar, and a middle pair of laterally-extending lugs 28^a, which are sufficiently separated to leave a recess 24^b to receive the lug 26^a of an adjacent bar. Each bar is also provided with a curved slot or recess 24^c and a straight vertical recess 24^d in its lower surface. A supporting-shaft 24^e passes through the recesses 24^d in all the grate-bars and serves as the support upon which the grate turns or tilts. Tie-rods 24^f are placed in the curved slots 24^c and serve to lock the grate-bars together against horizontal displacement.

To prevent vertical movement of the grate upon the shaft 24^e, a cross-piece 24^g is arranged across the recess 24^d in each of the outside grate-bars below the shaft, substantially as shown in Fig. 29, and fastened in place by bolts 24^h.

The forward grate is held in its normal position by an angular bar 24^i, having portions near its ends bent at substantially right angles to form the crank portions 24^j and the extreme ends 25^j bent so as to extend parallel with the main portions 24^i, and two rods 24^k, extending through the furnace-front, are connected to the bar 24^i by the connecting-rods 24^l. The ends 25^j are journaled in the furnace-wall. Two levers 24^m, each having a handle 24^n, are pivoted to supports 24^o, extending from the furnace-front, (see Fig. 18,) and serve to move the rods 24^k and turn the crank ends 24^j, and thus release or secure the grate. The shaft 24^e is supported by the vertical rods 24^p, and the rear end of the grate rests upon an iron 24^q of a triangular form in cross-section, which is supported upon the forked upper ends of rods 24^r. A brace-rod 24^s connects the rods 24^p to the rods 24^r. (See Fig. 7.)

The tilting grate is operated by raking the cinders to its forward end and there releasing it by moving the levers 24^s and turning the crank ends 24^j of the bar 24^i downward. The weight of the cinders tilts the forward end downward, so that the cinders can slide off into the ash-pit, and then, as the rear portion of the grate is the heavier, the grate immediately returns to its normal position and is locked therein by moving the levers in the required direction.

In the rear of the forward grates are arranged the rear grates, which consist of a plurality of transverse shaker grate-bars 25.

One or more pipes 26 are embedded in the foundation 2 of the vertical dividing-wall and extend longitudinally and horizontally therethrough. A plurality of short vertical pipes 27 extend vertically upward from the pipes 26, and the blocks 3 and 5 are provided with vertical openings 28 and 29, which are preferably rectangular in cross-section and register with each other to form vertical continuous air-conducting flues, into the lower ends of which the short vertical pipes 27 extend.

The blocks 9 of the top wall are provided with deep horizontal depressions 30, which extend outwardly from their inner ends (see Fig. 6) and form horizontal conducting-flues that communicate with the vertical air-conducting flues 29 in the block 5. Apertures or openings 31 extend upward through the lower surface of the blocks 9 into communication with the depressions 30. (See Fig. 6.) The depressions 30 are preferably rectangular in cross-section.

The angular end blocks 14 are provided with deep depressions 32, which extend horizontally from their inner ends to within a short distance of their outer ends. These depressions 32 are preferably of an enlarged an-

gular shape in cross-section, (see Fig. 7,) and a series of openings or apertures 33 extend downward from the depressions 32 through the lower surface of the end blocks 14. (See Fig. 7.)

The forward end of the pipes 26 project through the front of the furnace and are provided with air-valves, which are automatically operated by the movement of the furnace-doors, as will be more specifically described farther on.

The rear ends of the pipes 26 extend into the foundation 17 of the bridge-wall, which is provided with a vertical air-conducting flue 34. The top block 18 is provided with a deep depression 35, which extends diagonally upward and forward from the lower surface thereof to near the top surface (see Fig. 7) and forms a continuation of the flue 34 in the foundation. An opening or openings 36 extend diagonally downward and forward from the depression 35, through the block 18, and serve to jet air upon the fire.

Pipes 37 of larger area than the pipes 26 are arranged in the foundation 2 beneath the pipes 26 and extend horizontally rearward from a short distance and then bend at substantially right angles and extend through the side surface of the foundation. These pipes serve as lower air-conducting or draft pipes and conduct air to the ash-pit 38 beneath the forward grate. By this means air is conducted through the walls above and below the fire.

The automatic valve controlling the air-supply will be readily understood by reference to Figs. 1, 2, 3, and 4.

Referring to Fig. 3, a partition 39 is arranged in each of the pipes 37, having an opening 40, and a leaf-valve 41 is pivoted at its upper end in the pipe and is adapted to swing into contact with the partition and close the opening 40, and thus shut off the air-supply. Two of the pipes 26 and 37 are preferably employed, and a valve is placed in the outer end of each of the pipes. Short vertical pipes 42 connect the pipes 26 and the pipes 37, so that the same valves serve for both sets of pipes and all the pipes are opened and closed simultaneously. A rod 43 is attached to the upper surface of each leaf by bending its ends at an angle and securing said ends to the leaf-surface, (see Fig. 3,) and a slide-bar 44 passes through an opening in the top of the pipe 37 and has its lower end slidably secured to the rod 43. The upper end of the slide-bar is hung from a chain 45, and an angular bar 46, pivoted to the furnace-front, is fastened to the upper end of the chain. The other end of the angle-bar 46 is pivoted to a connecting-rod 47 by a pivot-pin 48, and the opposite end of the connecting-rod is pivoted to a crank-rod 49 by a pivot-pin 50. The crank-rod 49 extends horizontally from a vertical rock-shaft 51, journaled in lugs or ears 52, projecting from the furnace-front, and a horizonal rod 53 extends from the rock-shaft 51 and passes through an eyepiece 54, projecting from the furnace-door.

Two sets of the above mechanism are employed, one for each valve, and each set is operated from a different furnace-door, and the pipes and air-conducting flues are arranged in two sets, each set leading to one of the sections of the furnace. By this means each section is supplied with air by entirely separate systems of piping and flues, and each system is controlled by an independent valve which is operated by opening and closing the door of the section with which that particular system communicates.

The operation of the valve mechanism is as follows: A furnace-door being opened, the end of the rod 53 slides in the eye 54 and partially rotates the rock-shaft. This moves the crank 49 and through that the connecting-rod 47. The connecting-rod turns the angle-bar 46 on its pivot, thereby lowering the chain 45 and permitting the leaf 41 to drop against the partition 39 and close the opening 40 in the partition. Owing to the comparatively large area of the combustion-chamber 55 in each section of the furnace sufficient fuel can be placed therein to last for quite a length of time, so that the fire will not require frequent replenishing. The combustion first takes place over the rear grate in the rear of the furnace-sections, the fire gradually extending from the rear to the front of the combustion-chamber, and the jet-openings of the flues are arranged so that forced drafts of air play upon the upper surface of the fuel and circulate through the same from the front to the rear of the furnace. These drafts carry the gases in the fuel in the front and middle portions of the furnace to and through the burning bed of fuel, where they are consumed, and also render the combustion as perfect as possible. The air is heated as it passes through the flues and before it comes in contact with the fuel.

Another advantage of the invention is that comparatively little smoke escapes, as the gases are practically consumed in the furnace.

Referring to Fig. 7, it will be noted that the combustion-chambers are extremely elongated and that the end of the top wall extends above the greater portion of the chambers, terminating at a short distance from the bridge-wall and leaving but a small space at the rear end of each combustion-chamber for the passage of the products of combustion. The object of this construction is to provide as nearly perfect combustion as possible of the coal-gases before the products of combustion pass beneath the boiler. The currents of air passing through the openings 31, 33, and 36 play upon and mingle with the gases at various points in the combustion-chambers, and thereby materially aid in combustion.

I claim as my invention—

1. A duplex furnace having two combus-

tion-chambers, a wall between said chambers having two independent sets of vertical draft-flues and each chamber having communication with one of said sets only, a top wall having transverse horizontal draft-flues connecting with the vertical draft-flues and having draft-openings leading to the combustion-chambers.

2. A duplex furnace divided into two sections by a vertical wall having two independent sets of vertical air-flues, and each section having a top wall provided with a plurality of flues communicating with one of the sets of vertical flues in the vertical wall.

3. A duplex furnace divided into two sections by a vertical dividing-wall having two sets of vertical air-conducting flues; each section of said furnace having a top wall provided with horizontal flues communicating with one of the sets of flues in the dividing-wall and an independent draft valved device connecting to each set.

4. A duplex furnace divided into two sections by a vertical dividing-wall formed of a plurality of blocks having openings forming two sets of vertical air-flues and having a top wall formed of a plurality of blocks; said blocks having openings forming horizontal air-flues, the horizontal flues on one side of the vertical walls communicating with one set of the vertical air-flues in the dividing-wall and the horizontal flues on the opposite side of the wall communicating with the other set of air-flues.

5. A duplex furnace divided into two sections by a vertical dividing-wall consisting of a plurality of blocks having tongue-and-groove connection with each other and each having two vertical openings forming two independent sets of air-flues, and each section of said furnace having a top wall consisting of a plurality of blocks having tongue-and-groove connection with each other and having openings forming horizontal air-flues which communicate with one of the sets of vertical flues in the dividing-wall.

6. A furnace having a top wall, a vertical dividing-wall having draft-flues, and a bridge-wall provided with draft-flues, and an air-conducting pipe communicating with the flues in the bridge-wall and having short pipes extending into the flues in the vertical dividing-wall.

7. A furnace having two independent longitudinally-elongated combustion-chambers which slant downward from the front to the rear, a top wall for said combustion-chambers having a slanting lower surface and a plurality of air-conducting flues and a bridge-wall at the rear of the combustion-chambers having a plurality of air-conducting openings, substantially as set forth.

8. A furnace having a vertical dividing-wall formed of a foundation of fire-brick, a series of blocks arranged on said foundation and having interlocking tongues and grooves; the top blocks having key portions, a top wall which slants downward from the front to the rear formed of blocks having interlocking tongues and grooves, and arranged in two series, one on each side of the key portions of the top blocks of the vertical dividing-wall and a bridge-wall at the rear of the furnace, as set forth.

9. A furnace having an air-draft device, a valve in said device, an angular bar pivoted to the furnace-front, a connection between the angular bar and the valve, a vertical rock-shaft supported from the furnace-front, a crank on said rock-shaft, a connection between the crank and the angular bar, an eye portion extending from a furnace-door, and a rod extending from the rock-shaft and projecting through the eye portion.

10. A furnace having an air-circulating pipe, a perforated partition in said pipe, a leaf-valve in the pipe adapted to contact with the partition and close the perforation, a connection between the angular bar and the leaf-valve, a vertical rock-shaft supported from the furnace-front, a crank on said rock-shaft, a connection between the crank and the angular bar, an eye portion extending from a furnace-door, and a rod extending from the rock-shaft and projecting through the eye portion.

11. A furnace having an air-circulating pipe, a perforated partition in said pipe, a leaf-valve in the pipe adapted to contact with the partition and close the perforation, a rod attached to the upper surface of the leaf-valve, a slide-rod passing through the pipe and slidably fastened to the rod on the leaf-valve, an angular bar pivoted to the furnace-front, a connection between the slide-rod and the angular bar, a vertical rock-shaft supported from the furnace-front, a crank on said rock-shaft, a connection between the crank and the angular bar, an eye portion extending from a furnace-door, and a rod extending from the rock-shaft and projecting through the eye portion.

JOHN B. CONGER.

Witnesses:
L. M. BILLINGS,
GEO. A. NEUBAUER.