No. 782,490. PATENTED FEB. 14, 1905.

F. J. COLE & C. J. MELLIN.

STEAM BOILER SUPERHEATER.

APPLICATION FILED DEC. 2, 1904.

4 SHEETS—SHEET 1.

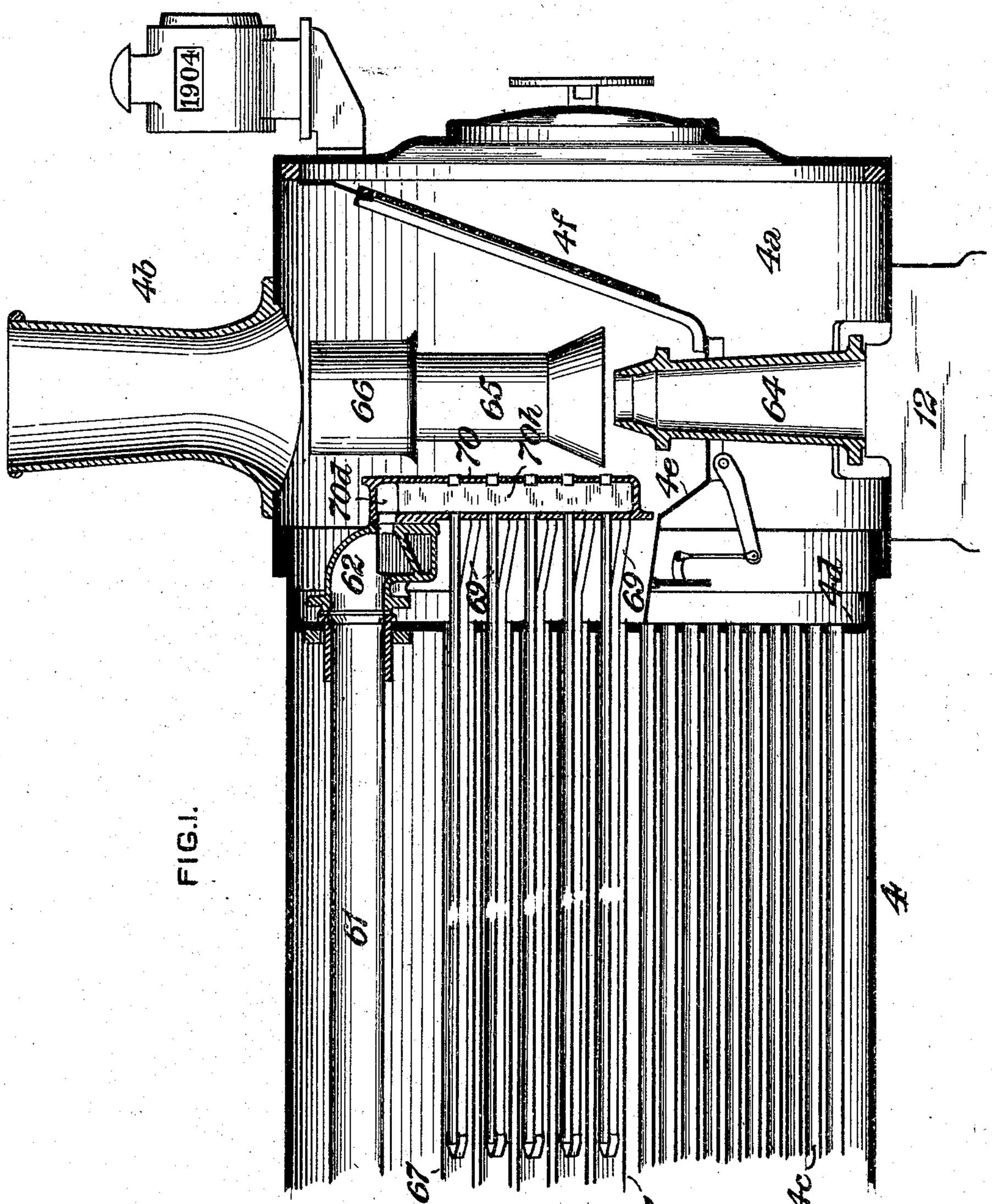

FIG. I.

WITNESSES

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4 SHEETS—SHEET 2.

FIG. 5.

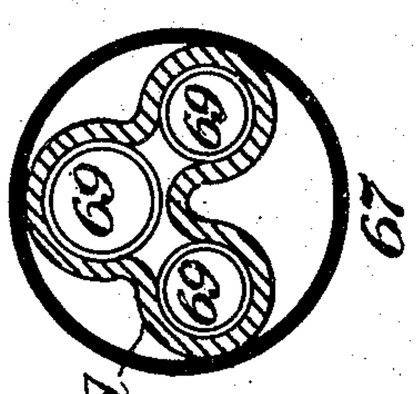


FIG. 3.

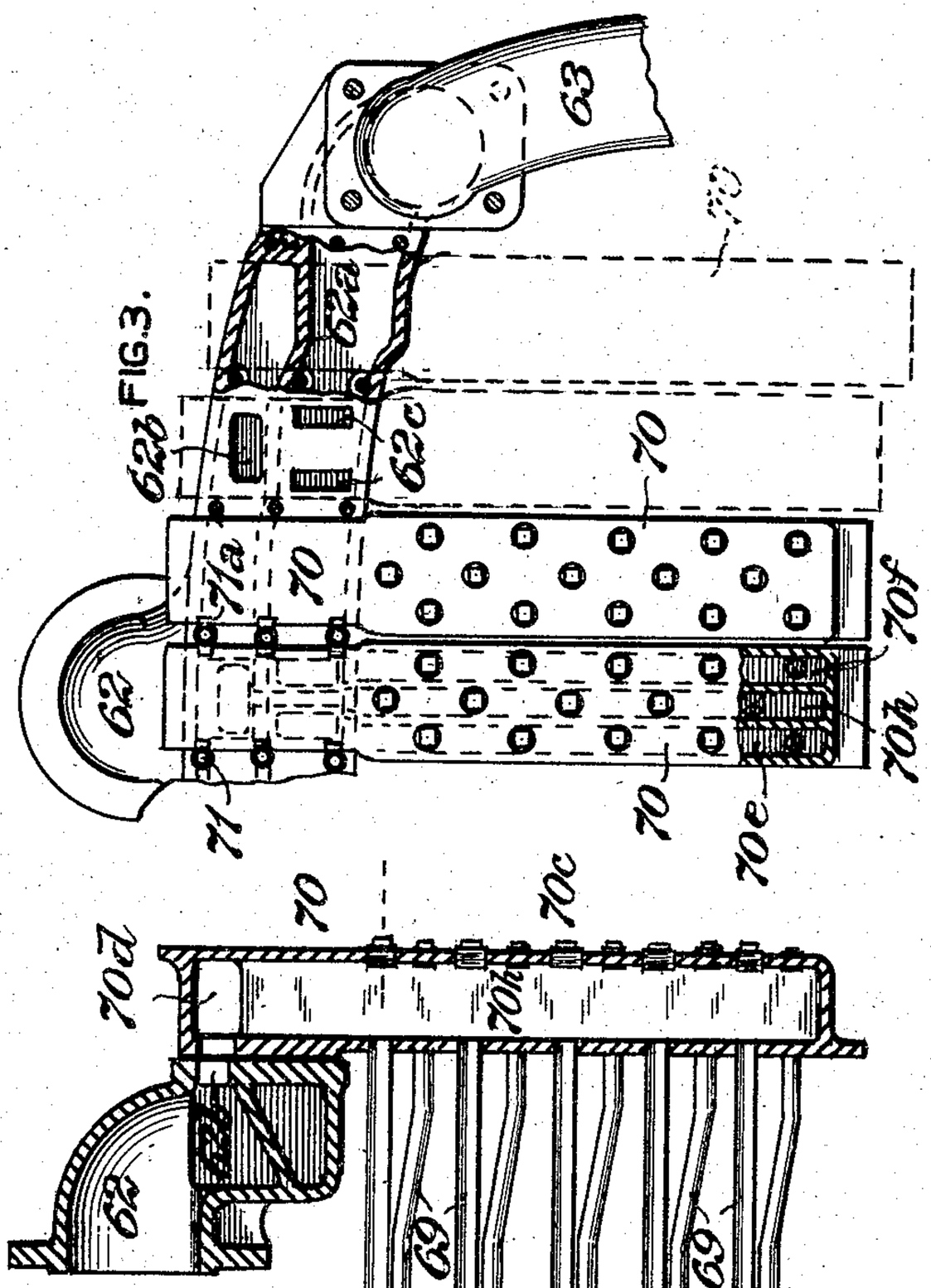


FIG. 4.

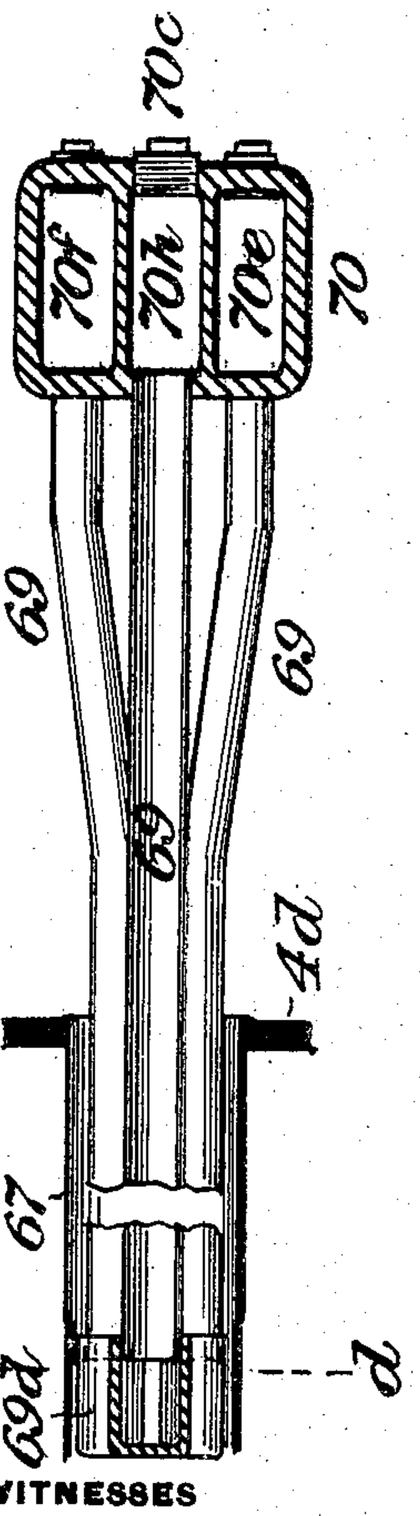
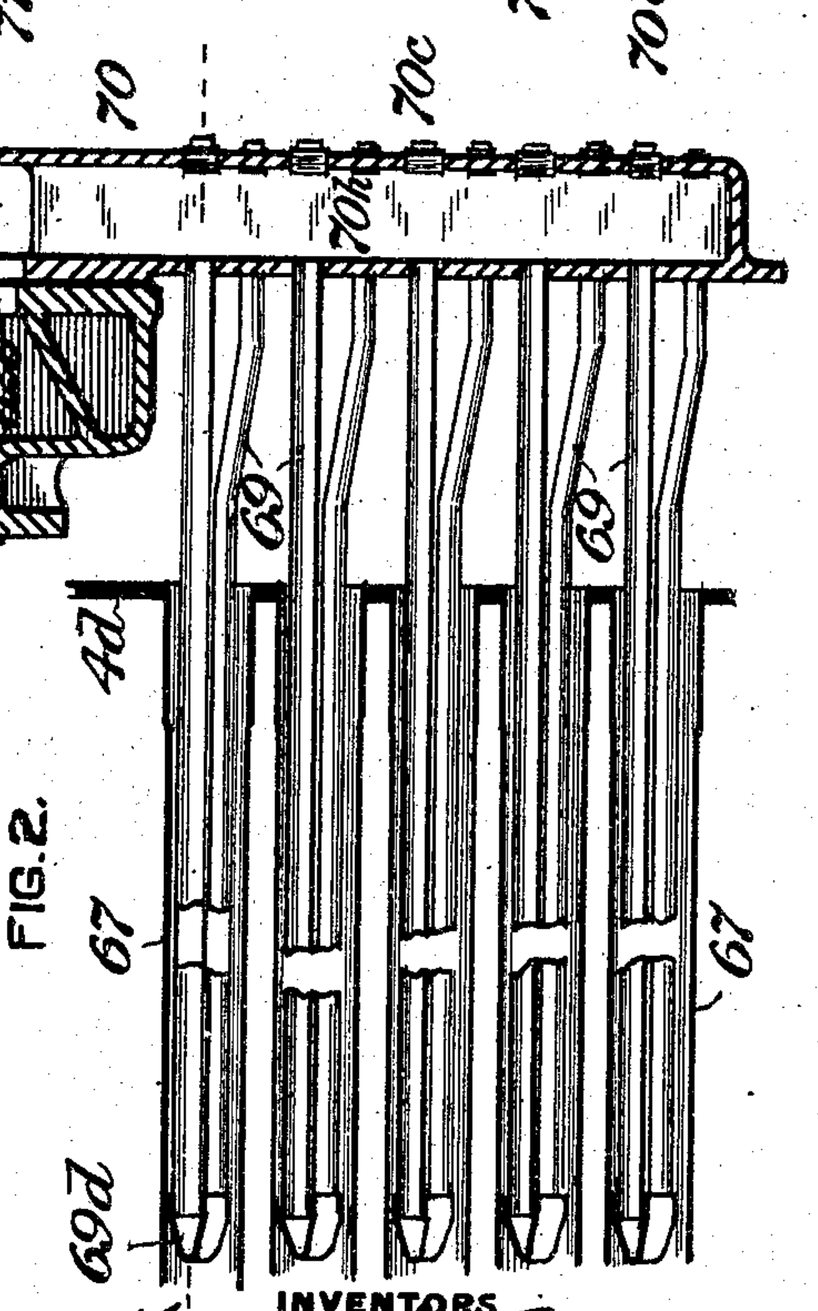


FIG. 2.



WITNESSES

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4 SHEETS—SHEET 3.

FIG. 9.

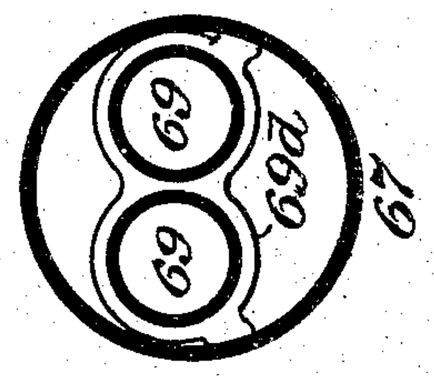
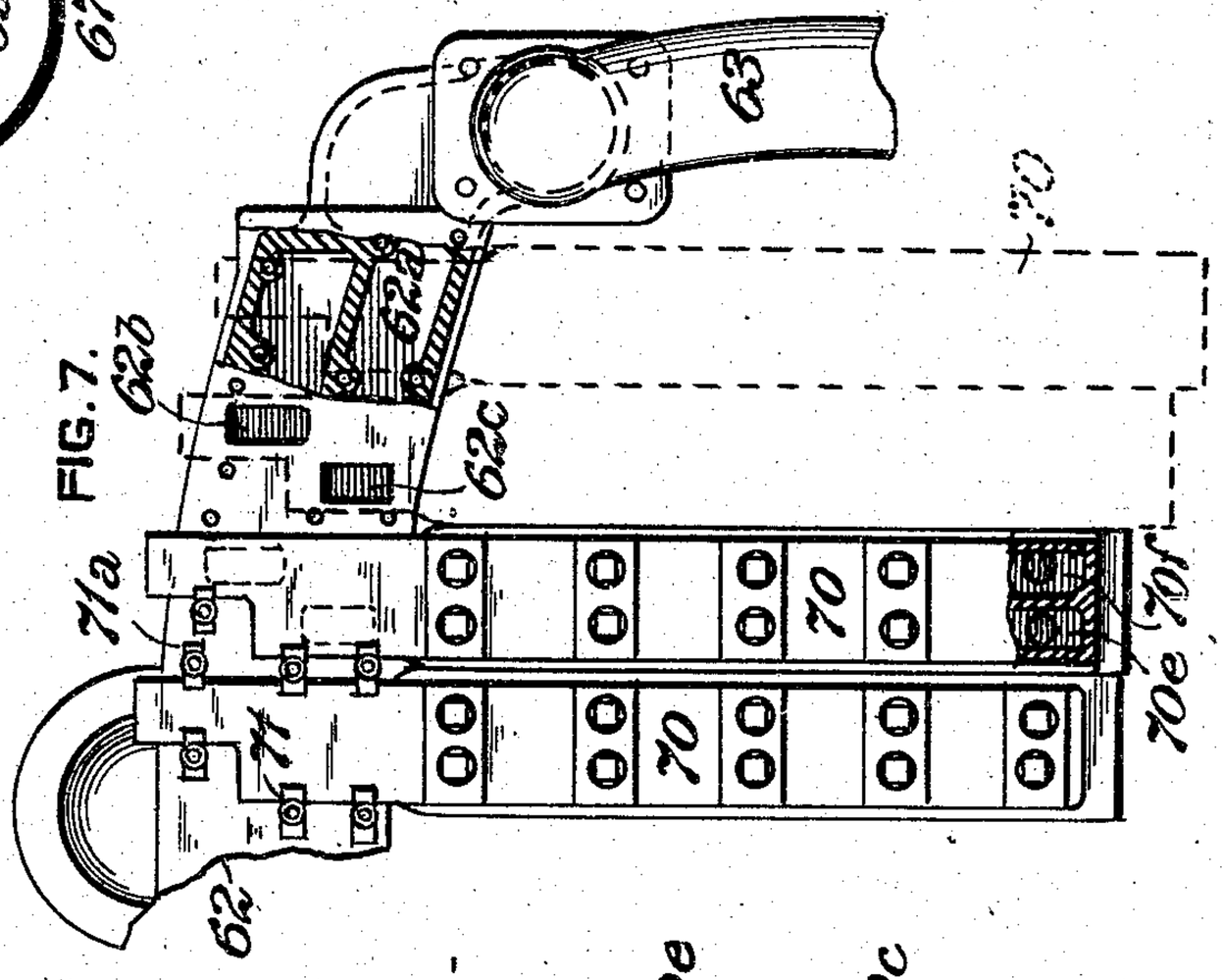


FIG. 7.



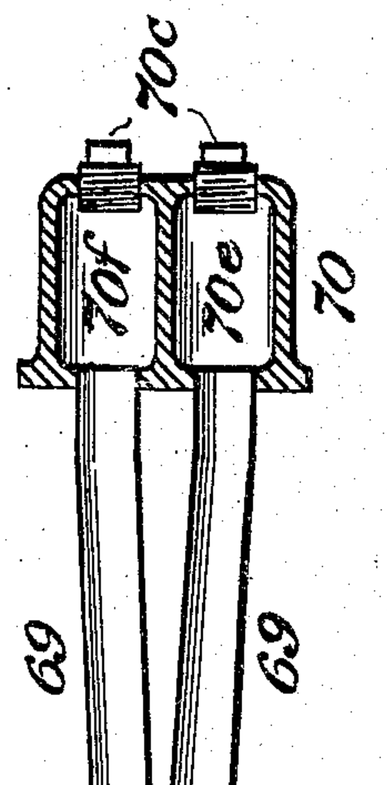


FIG. 8.

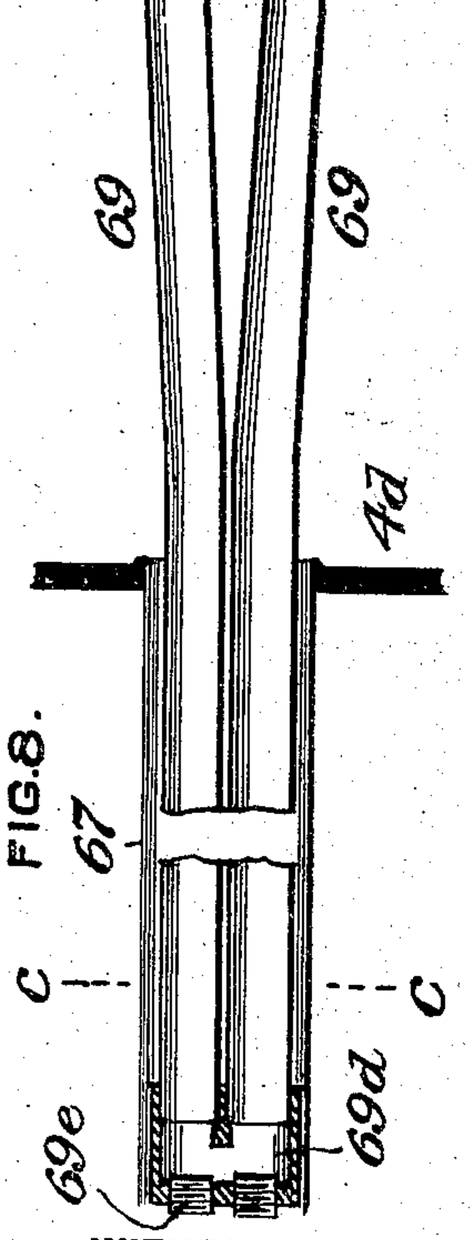
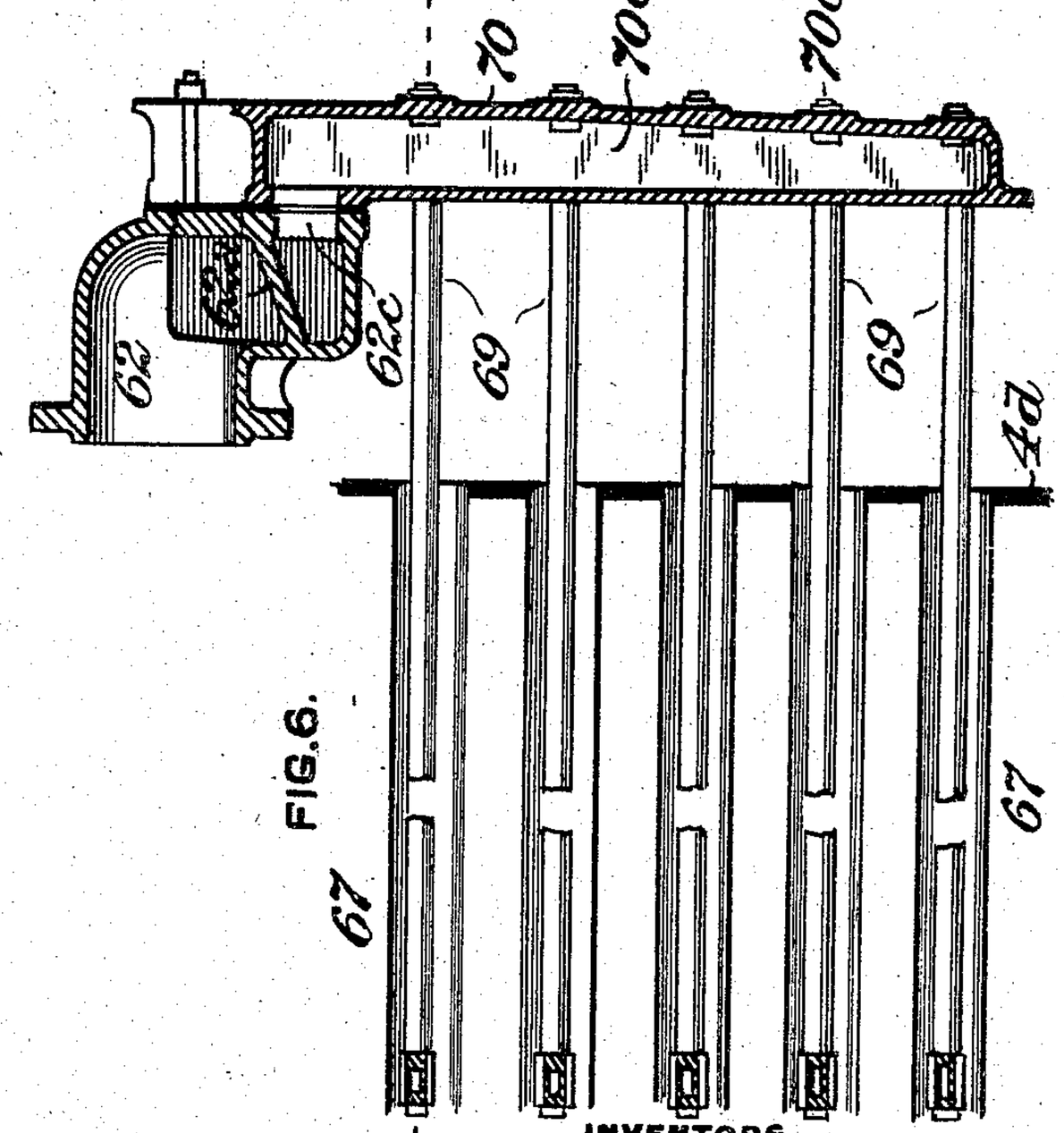


FIG. 6.



WITNESSES

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F. J. COLE & C. J. MELLIN.

STEAM BOILER SUPERHEATER.

APPLICATION FILED DEC. 2, 1904.

4 SHEETS—SHEET 4.

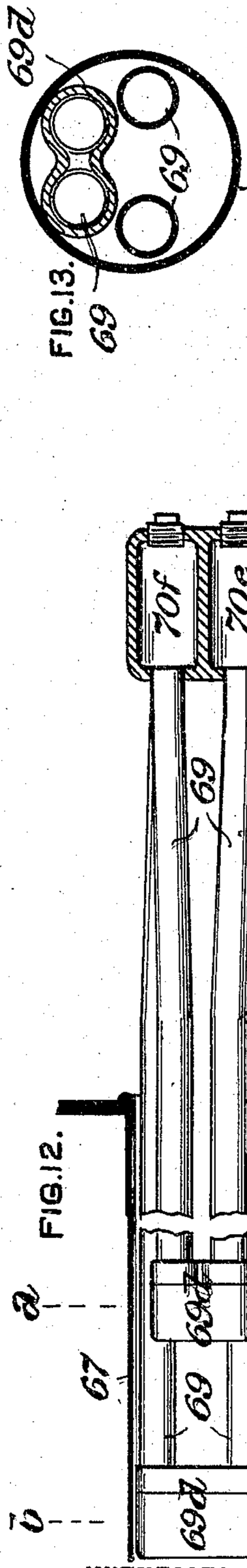

FIG. 12.

FIG. 13.

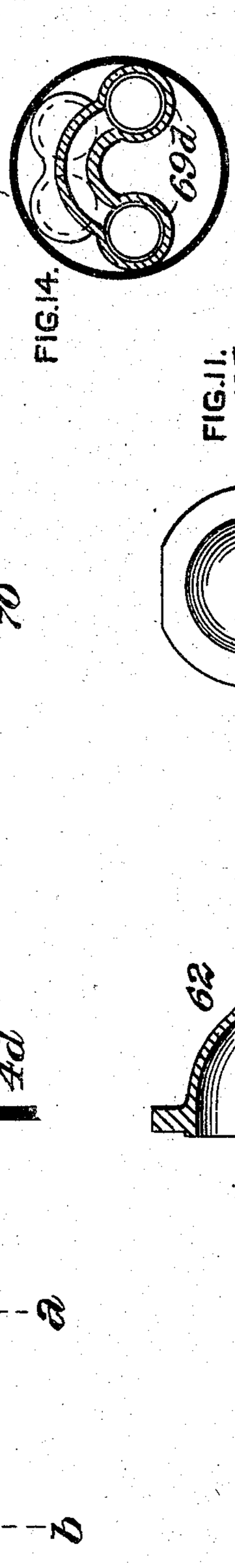

FIG. 14.

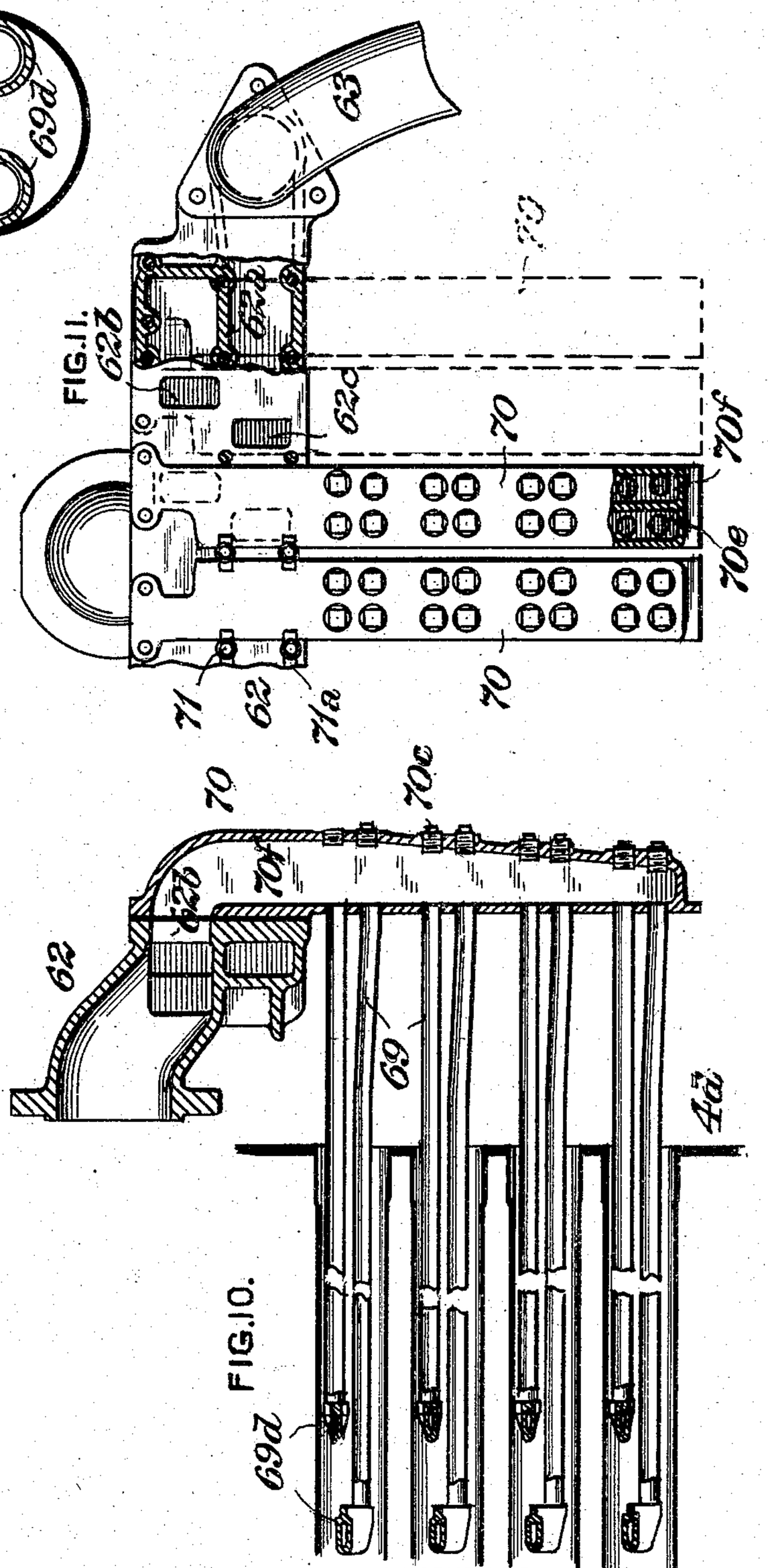

FIG. 11.

FIG. 10.

WITNESSES

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No. 782,490. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

FRANCIS J. COLE AND CARL J. MELLIN, OF SCHENECTADY, NEW YORK, ASSIGNORS TO AMERICAN LOCOMOTIVE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

STEAM-BOILER SUPERHEATER.

SPECIFICATION forming part of Letters Patent No. 782,490, dated February 14, 1905.

Application filed December 2, 1904. Serial No. 235,180.

To all whom it may concern:

Be it known that we, FRANCIS J. COLE and CARL J. MELLIN, of Schenectady, in the county of Schenectady and State of New York, have jointly invented a certain new and useful Improvement in Steam-Boiler Superheaters, of which improvement the following is a specification.

Our invention relates to superheaters of the general class or type exemplified in Letters Patent of the United States No. 765,307, granted and issued to the American Locomotive Company as the assignee of Francis J. Cole under date of July 19, 1904; and its object is to provide in a superheating appliance of such type means whereby a materially-increased area of steam superheating-surface may be presented within each of the superheating fire-tubes, to the end of enabling the steam to be more thoroughly and highly superheated than in the appliance of Patent No. 765,307 aforesaid, while retaining all the substantial practical advantages thereof.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a vertical longitudinal central section through the smoke-box and a portion of the waist of a locomotive-boiler, illustrating an application of our invention; Fig. 2, a similar section, on an enlarged scale, through the T-head, one of the headers, and the connected superheater-pipes; Fig. 3, a front view, partly in section, of slightly more than one-half of the T-head with two of the headers detached and indicated in dotted lines; Fig. 4, a horizontal longitudinal section, on a further enlarged scale, through one of the headers, a portion of a superheating fire-tube, and one of the superheater-pipes located in said tube; Fig. 5, a transverse section, on a further enlarged scale, on the line *d d* of Fig. 4; Fig. 6, a section similar to that of Fig. 2, showing a modification of structural detail; Fig. 7, a view similar to that of Fig. 3 of the construction shown in Fig. 6; Fig. 8, a horizontal longitudinal section through one of the headers, a portion of a superheating fire-tube, and the two superheater-pipes located in said tube of the construction shown in Fig. 6; Fig. 9, a transverse section, on an enlarged scale, on the line *c c* of Fig. 8; Fig. 10, a section similar to those of Figs. 2 and 6, showing another modification of structural detail; Fig. 11, a view similar to those of Figs. 3 and 7 of the construction shown in Fig. 10; Fig. 12, a horizontal longitudinal section through one of the headers and a portion of a superheating-tube, showing the superheater-pipes in elevation; and Figs. 13 and 14, transverse sections, on an enlarged scale, on the lines *a a* and *b b*, respectively, of Fig. 12.

Our invention is herein, as in Letters Patent No. 765,307 aforesaid, exemplified as applied in connection with a locomotive-boiler 4, which is of the ordinary construction and is provided at its forward end with a smoke-box 4^a, which is supported upon the usual cylinder-saddles 12. A plurality of fire-tubes 4^c, ordinarily of comparatively small diameter, extend from a fire-box at the rear end of the boiler, which is not shown, to the front flue-sheet 4^d, and the products of combustion pass through said tubes and through other tubes, which will presently be described, to the smoke-box 4^a, from which they are discharged into the atmosphere through the stack 4^b. Steam is supplied from the boiler to the cylinders through a main steam-supply pipe or dry pipe 61, passing through the front flue-sheet 4^d and connected in front thereof to a transverse T-head 62, from which branch or delivery steam-pipes 63, located on opposite sides of the smoke-box, lead to the cylinders. The exhaust-steam is discharged from the cylinders through a vertical exhaust-pipe 64, secured to the saddles 12 in line axially with the stack, and in the instance shown two petticoat or draft pipes 65 66 are interposed between the exhaust-pipe and the stack. The smoke-box is, where solid fuel is used, fitted with a spark-arresting appliance of any suitable and preferred construction, which is here shown as comprising a diaphragm or deflecting-plate 4^e and a sheet of netting or perforated plate 4^f.

In the practice of our invention we substitute in lieu of a number of the usual small-diameter fire-tubes 4^c in the upper and middle

portion of the space within the boiler, which would in the usual practice be occupied by such number of said tubes, a correspondingly smaller number of tubes 67 of greater diameter, which will be descriptively termed "superheating-tubes," said superheating-tubes extending between and being expanded into the front flue-sheet 4^d and the rear or fire-box tube-sheet. Referring first to Figs. 1 to 5, inclusive, within each of the superheating-tubes 67 there are located three superheater-pipes 69, one near the top of the superheating-tube and the other two in line horizontally below the first one, said pipes extending longitudinally in the superheating-tubes from a vertical plane a short distance—say thirty inches or thereabout—forward of the fire-box tube-sheet to a vertical plane in the smoke-box forward of the T-head. The superheater-pipes are made of sufficiently small diameter to permit the free passage of the products of combustion around them through the superheating-tubes, and their rear ends—that is to say, their ends nearer the fire-box—are connected by return-bends 69^d or other suitable fittings, as presently to be described, and may be held up in normal position in the superheating-tubes by any suitable supports. The superheater-pipes are open at their forward ends, at which they are connected, as presently to be described, with the main supply steam-pipe 61 and the branch or delivery steam-pipes 63, so as to constitute continuous avenues or channels throughout the length of which the steam which is to be superheated traverses from the supply steam-pipe to the branch or delivery steam-pipes. To this end the several sets of superheater-pipes which are located in each vertical row of superheating-tubes 67 are connected at their forward ends to a vertical casing or header 70, which is divided by partitions into four chambers or compartments—to wit, a top chamber 70^d, two vertical side chambers 70^e 70^f, and a vertical central chamber 70^h, which is open to the top chamber 70^d. The headers 70 are set side by side and as closely as practicable together in the smoke-box 4^a substantially at right angles to the superheating-tubes, the upper portions of the rear sides of the headers abutting against the front of the T-head 62, and the headers are preferably, as shown, independently insertible and removable. The forward end of the upper superheater-pipe 69 of each superheating-tube 67 is expanded into the back wall of the central chamber 70^h of the header of the vertical row in which it is located, and the adjacent ends of the two lower superheater-pipes are expanded into the back walls of the side chambers 70^e 70^f of said header. By reference to Figs. 2 and 3 it will be seen that all the upper superheater-pipes of the superheating-tubes of each vertical row communicate with the center chamber 70^h of the header of such vertical row. All the lower superheater-pipes on one side of the central plane of the vertical row communicate with one of the side chambers, as the chamber 70^e, and all the lower superheater-pipes on the other side of the vertical plane communicate with the other side chamber, as the chamber 70^f. Openings closed by removable plugs 70^c are formed in the front walls of the headers, these openings providing for the insertion, examination, cleansing, and repairs of the superheater-pipes. In the event of leakage at the joints the plugs can be detached and the pipes expanded, as may be required.

The T-head 62 is divided by an inclined partition 62^a into upper and lower chambers or compartments, the upper or supply compartment having ports 62^b in its front, which register with ports in the top chambers 70^d of the headers and communicate, through said chambers, with the center chambers 70^h, and the lower or delivery compartment having ports 62^c in its front, which register with ports in the side chambers 70^e 70^f. The branch steam-pipes 63 are connected to nozzles at the ends of the lower compartment of the T-head. The front face of the T-head and the rear faces of the headers which surround the ports therein above specified are finished so as to make tight joints, and the headers are secured removably to the T-head by bolts 71 and clamps 71^a.

In operation steam from the boiler passes through the dry-pipe 61 into the upper compartment of the T-head 62 and thence into the top chambers 70^d of the headers 70, from which it passes downwardly in the communicating center chambers 70^h, thence rearwardly through the connected upper superheater-pipes 69, from the rear ends of which it passes through the return-bends 69^d into the two lower superheater-pipes of each superheating-tube and then forwardly through said lower superheater-pipes into the side chambers 70^e 70^f of the headers, and thence into the lower compartment of the T-head 62, from which it passes through the branch steam-pipes 63 to the engine-cylinders for utilization therein. In its traverse through the superheater-pipes the steam is thoroughly superheated by the hot products of combustion which pass through the inclosing superheating-tubes, in which a substantial increase of superficial area operative for that purpose is provided by a construction embodying the essential features of that above described.

Figs. 6 to 9, inclusive, illustrate an application of our invention, which accords in all essential particulars with that above described and differs therefrom only in the following structural details: In this instance two instead of three superheater-pipes 69 are located in each of the superheating-tubes 67, and the headers 70 are partitioned into two vertical side chambers 70^e 70^f only. The T-head 62 is divided into an upper or supply compartment having ports 62^b, which communicate

with the side chambers 70^f of the headers, and a lower or delivery compartment having ports 62^c, which communicate with the opposite side chambers 70^e. The open rear ends of the superheater-pipes 69 of the several sets are expanded into return-bend fittings 69^d opposite openings therein, which are thereafter closed by plugs 69^e, and the forward ends of all the superheater-pipes on one side of the central plane of each vertical row of superheating-tubes are expanded into the back wall of one of the side chambers, as the chamber 70^e, of the header of that vertical row. The forward ends of all the superheater-pipes on the other side of the central plane are expanded into the back wall of the other side chamber, as the chamber 70^f. Steam to be superheated passes from the dry-pipe and supply compartment of the header downwardly in one side chamber of each header, rearwardly through the superheater-pipes connected thereto, forwardly through the opposite superheater-pipes of the several sets into the opposite side chambers of the headers, and upwardly therein to the communicating delivery-compartment of the T-head and the branch steam-pipes.

Another modification of structural detail is shown in Figs. 10 to 14, inclusive, this specific embodiment of our invention differing from that last-above described in the particulars that two pairs of superheater-pipes 69 are located one above another in each of the superheating-tubes 67 and that the rear ends of the pipes of each pair are screwed into return-bends 69^d instead of being expanded thereinto, as in the former case. The headers 70 are similarly partitioned into two side chambers 70^f 70^e, communicating, respectively, with the supply and the delivery compartments of the T-head, and the traverse of steam from the supply to the delivery connections of the T-head is effected through the superheater-pipes, as in the instance last-above described.

Our invention embodies all the substantial practical advantages of that of Patent No. 765,307, together with the further and important one of materially increasing the area of superheating-surface without involving structural complication or difficulty in maintenance, and thereby correspondingly enhancing the thoroughness and efficiency of the operation of the improvement.

We claim as our invention and desire to secure by Letters Patent—

1. The combination, with a tubular steam-boiler, of a superheating-tube, a plurality of superheater-pipes extending longitudinally therein, a fitting connecting said pipes at their ends nearer the fire-box so as to form a steam-channel which is directly exposed, throughout its length, to the heat of the superheating-tube, a main steam-supply pipe, a steam-delivery pipe, and an integral vertical casing or header connected to the superheater-pipes, substantially at right angles to the superheating-tube and divided into chambers, one of which communicates with the steam-supply pipe and with the receiving end of the steam-channel formed by the superheater-pipes and another with the delivery end of said channel and with the steam-delivery pipe.

2. The combination, with a tubular steam-boiler, of a superheating-tube, a plurality of superheater-pipes extending longitudinally therein, a fitting connecting said pipes at their ends nearer the fire-box so as to form a steam-channel which is directly exposed, throughout its length, to the heat of the superheating-tube, a main steam-supply pipe, a steam-delivery pipe, a T-head partitioned into two chambers, one of which is open to the main steam-supply pipe and the other to the steam-delivery pipe, and a casing or header divided into two chambers, one of which communicates with the supply-chamber of the T-head and with the receiving end of the steam-channel formed by the superheater-pipes and another with the delivery end of said channel and with the delivery-chamber of the T-head.

3. The combination, with a tubular steam-boiler, of a vertical row of superheating-tubes, sets of superheater-pipes extending longitudinally in the superheating-tubes, fittings connecting the ends of the pipes of each set nearer the fire-box so as to form a steam-channel which is directly exposed, throughout its length, to the heat of the superheating-tube, a main steam-supply pipe, a steam-delivery pipe, and an integral vertical casing or header located in front of, and substantially at right angles to, the superheating-tubes and divided into chambers, one of which communicates with the steam-supply pipe and with the receiving ends of the steam-channels formed by the vertical row of sets of superheater-pipes, and another with the delivery ends of said channels and with the steam-delivery pipe.

4. The combination, with a tubular steam-boiler, of a vertical row of superheating-tubes, sets of superheater-pipes extending longitudinally in the superheating-tubes, fittings connecting the ends of the pipes of each set nearer the fire-box so as to form a steam-channel which is directly exposed, throughout its length, to the heat of the superheating-tube, a main steam-supply pipe, a steam-delivery pipe, a T-head partitioned into two chambers, one of which is open to the main steam-supply pipe and the other to the steam-delivery pipe, and a casing or header divided into chambers one of which communicates with the supply-chamber of the T-head and with the receiving ends of the steam-channels formed by the vertical row of sets of superheater-pipes and another with the delivery ends of said channels and with the delivery-chamber of the T-head.

5. The combination, with a tubular steam-boiler, of a superheating-tube, three super-

heater-pipes extending longitudinally therein, a fitting connecting said pipes at their ends nearer the fire-box so as to form a channel directly exposed, throughout its length, to the heat of the superheating-tube, for the traverse of steam in one direction through one of the superheater-pipes and in the reverse direction through the other two of said pipes, a main steam-supply pipe, a steam-delivery pipe, and a casing or header divided into chambers, one of which communicates with the steam-supply pipe and with one of the ends of the steam-channel formed by the superheater-pipes and two other chambers which communicate with the opposite ends of said channel and with the steam-delivery pipe.

6. The combination, with a tubular steam-boiler, of a superheating-tube, a plurality of superheater-pipes extending longitudinally therein, a chambered casing or header into which the forward ends of the superheater-pipes are expanded, a return-bend fitting into which the rear ends of the superheater-pipes are expanded, and plugs closing openings in said fitting opposite the ends of the superheater-pipes.

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