

F. J. COLE.
STEAM BOILER SUPERHEATER.

APPLICATION FILED AUG. 9, 1907.

6 SHEETS—SHEET 1.

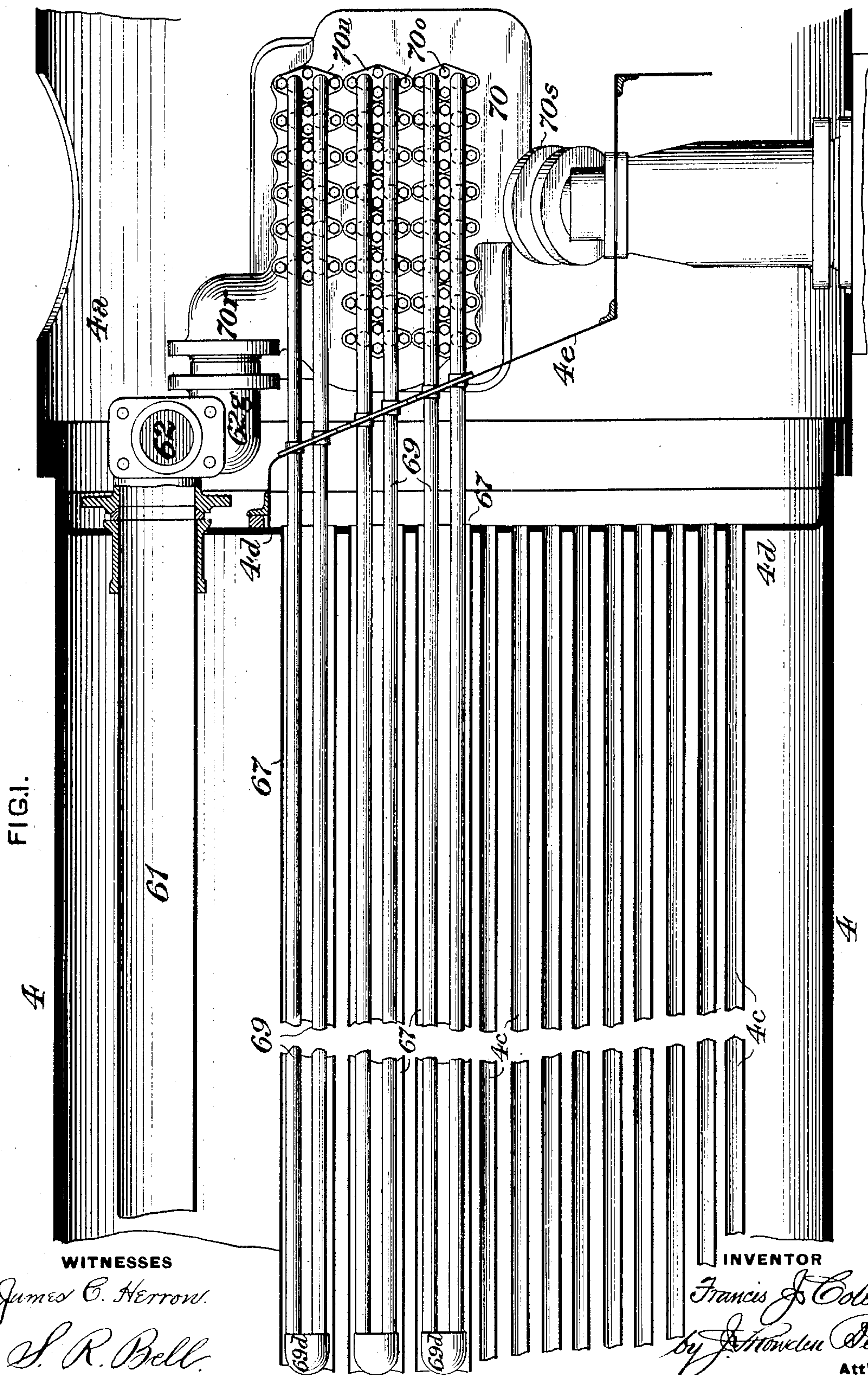


FIG. 1.

WITNESSES

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Francis J. Cole

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No. 875,895.

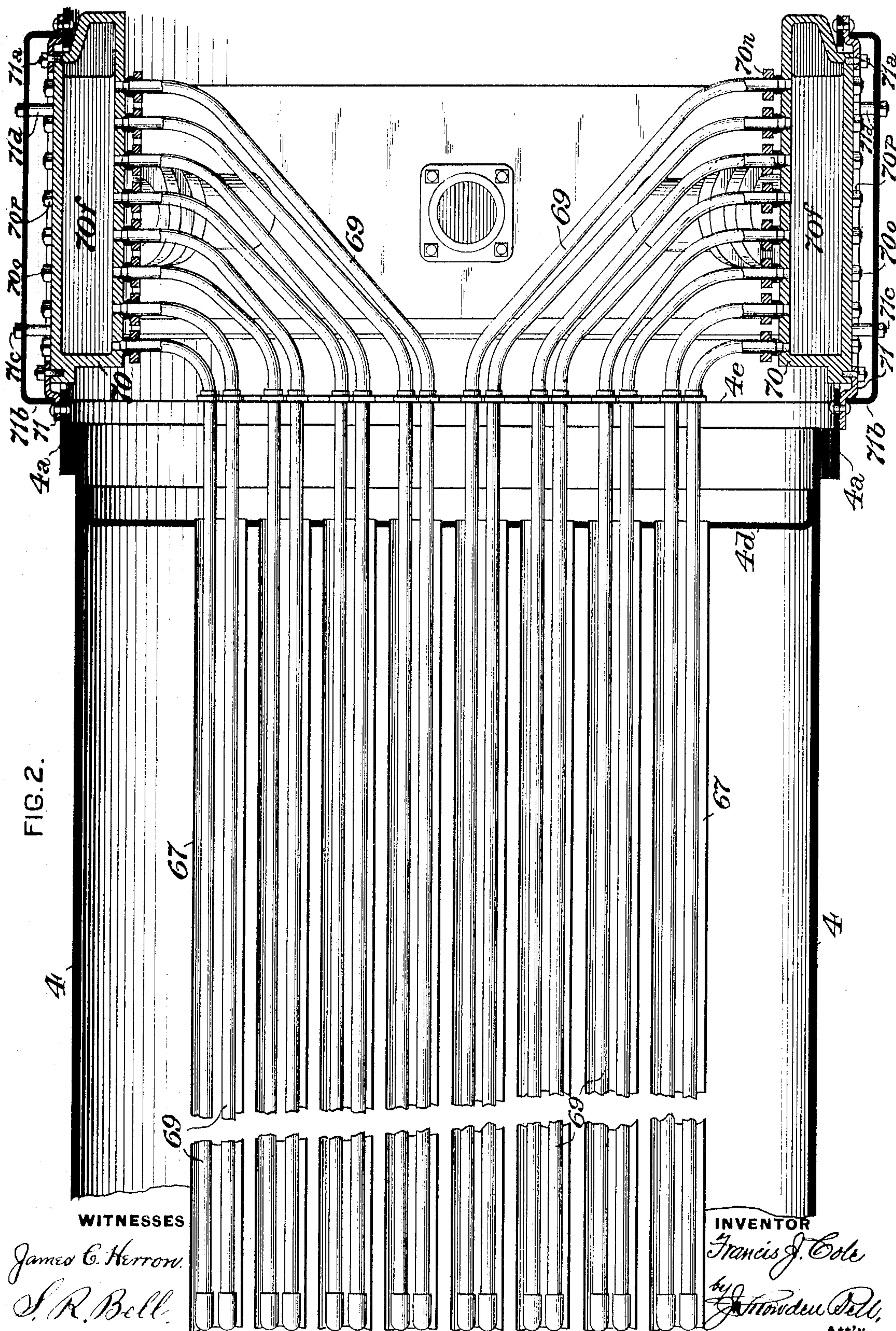
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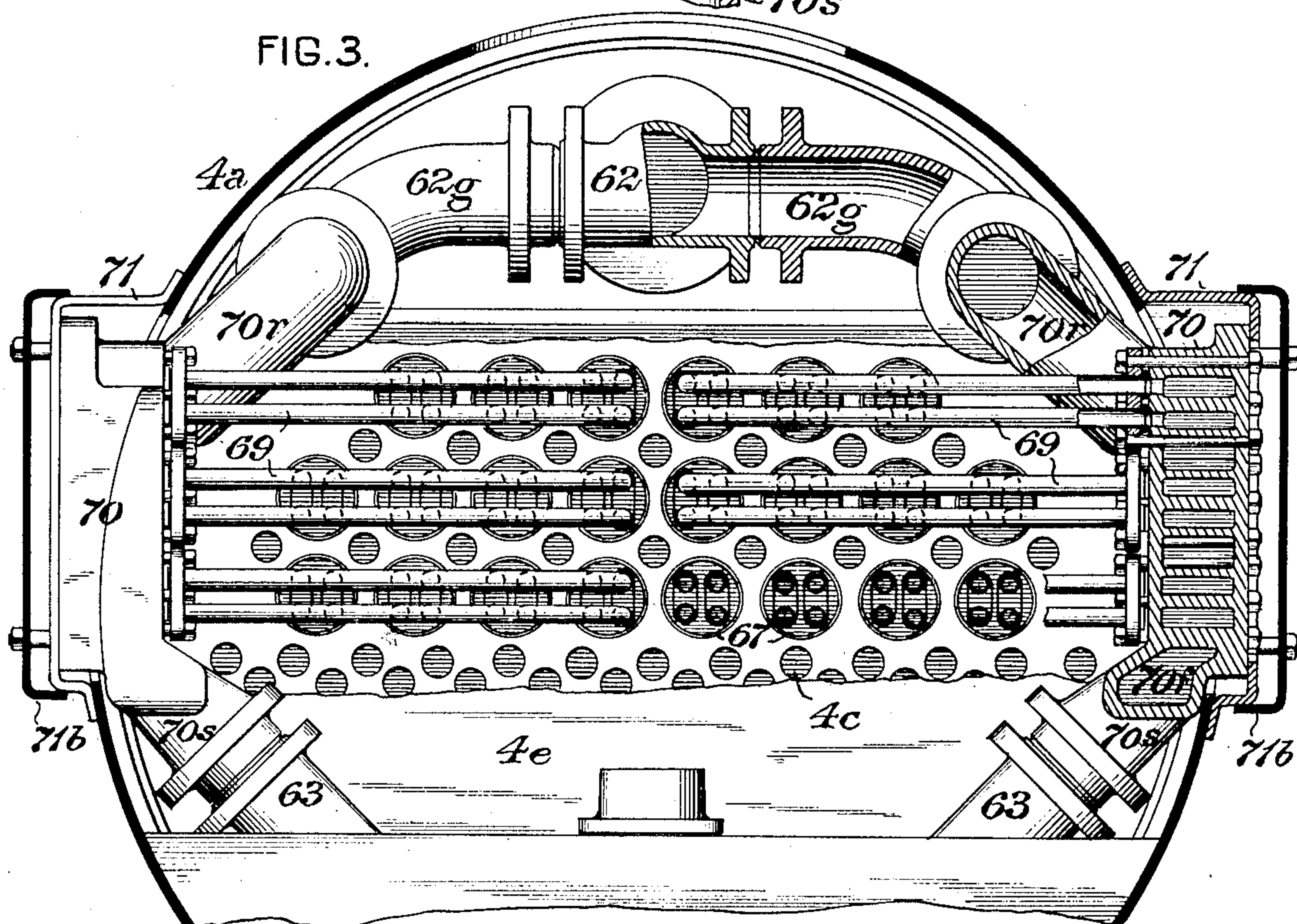
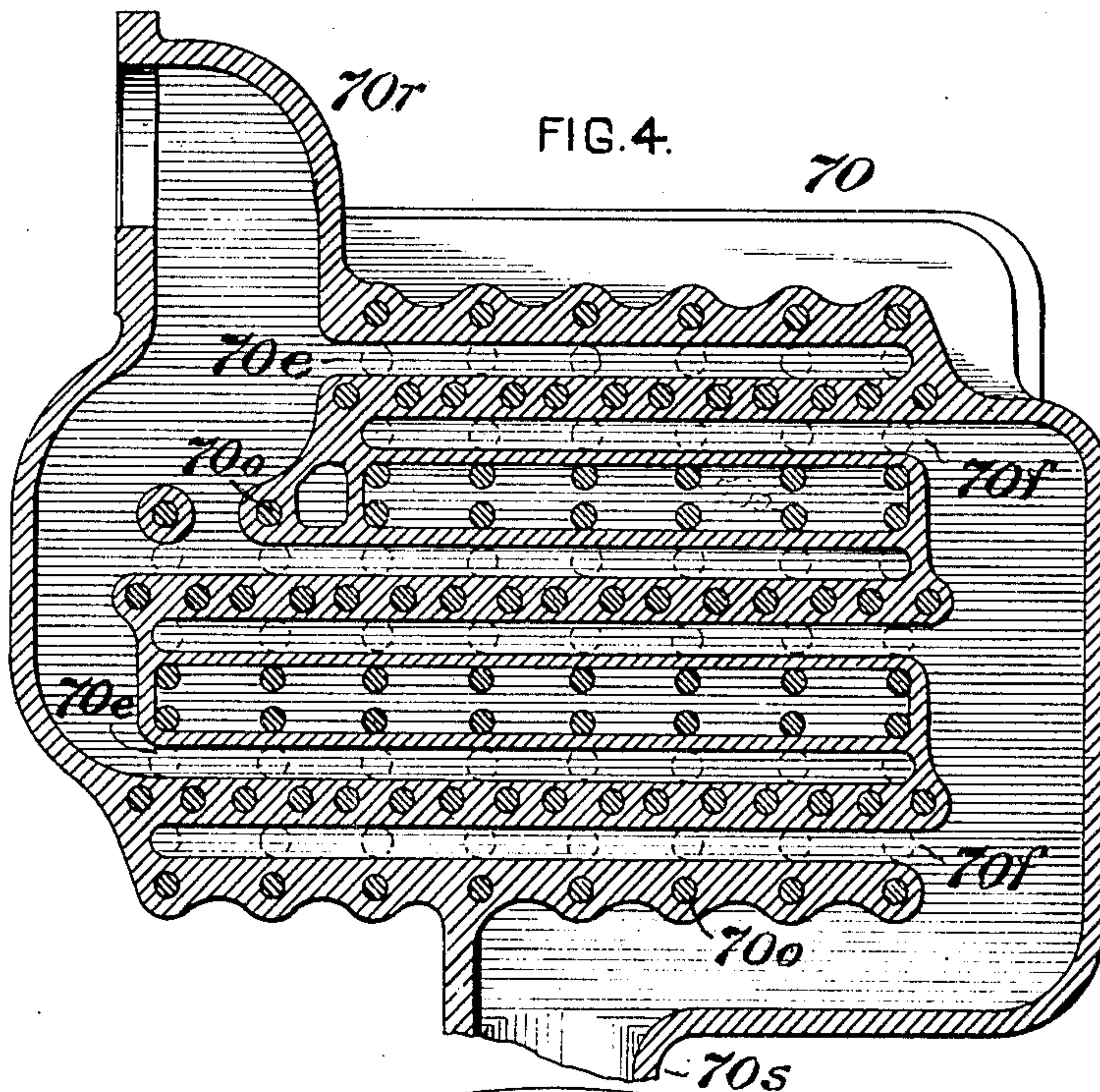
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6 SHEETS—SHEET 3.



WITNESSES

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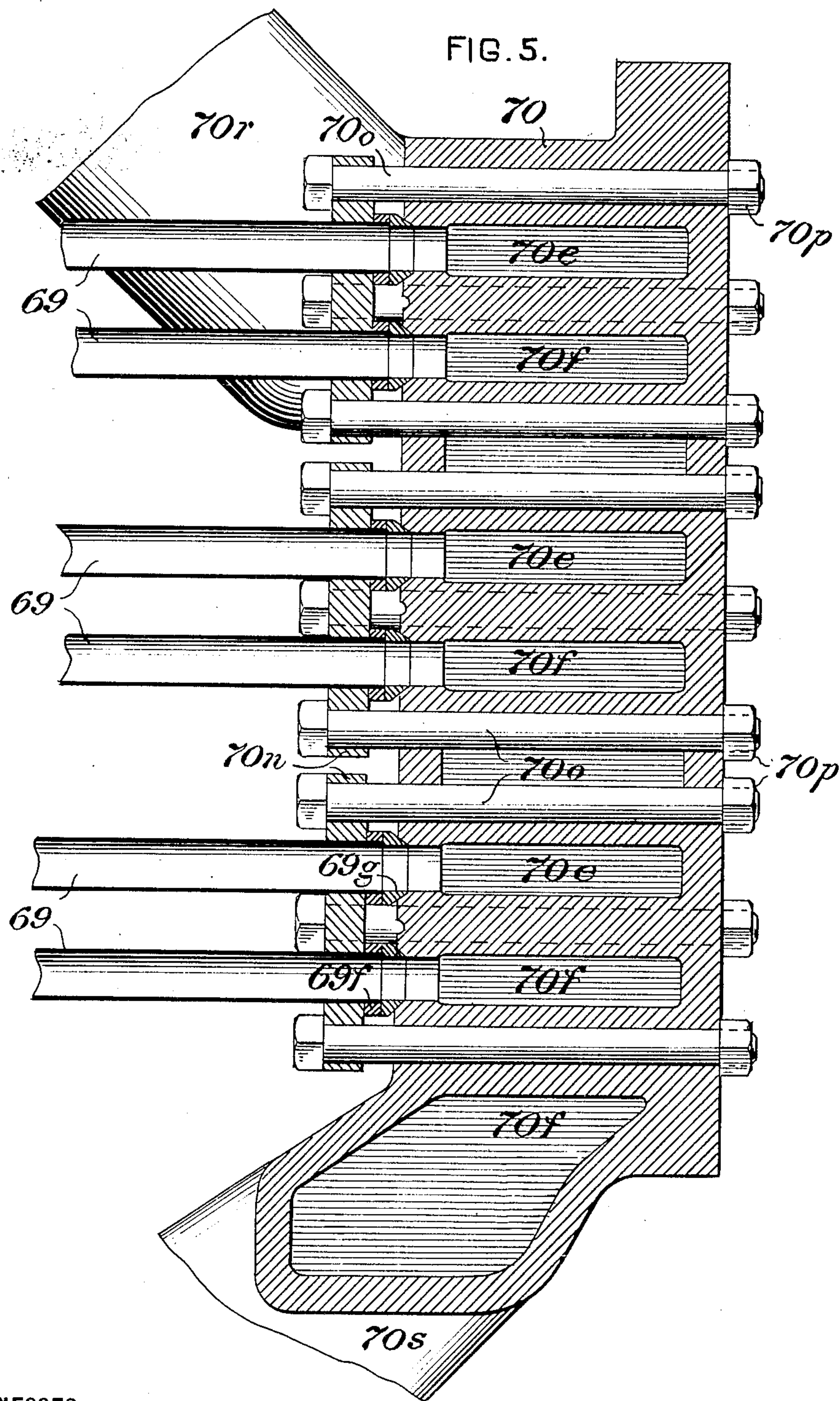
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6 SHEETS—SHEET 4.



WITNESSES

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6 SHEETS—SHEET 5.

FIG. 7.

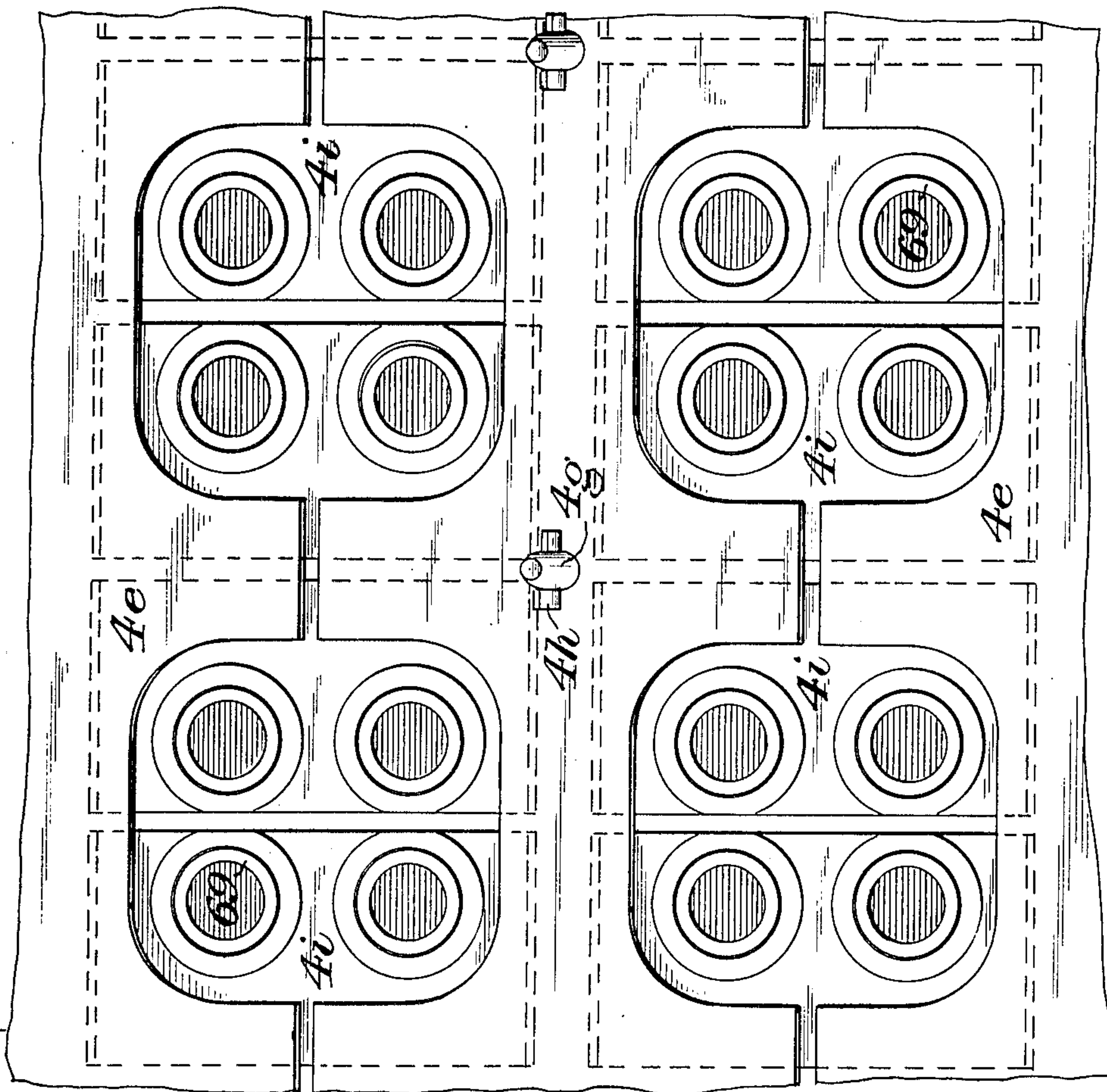
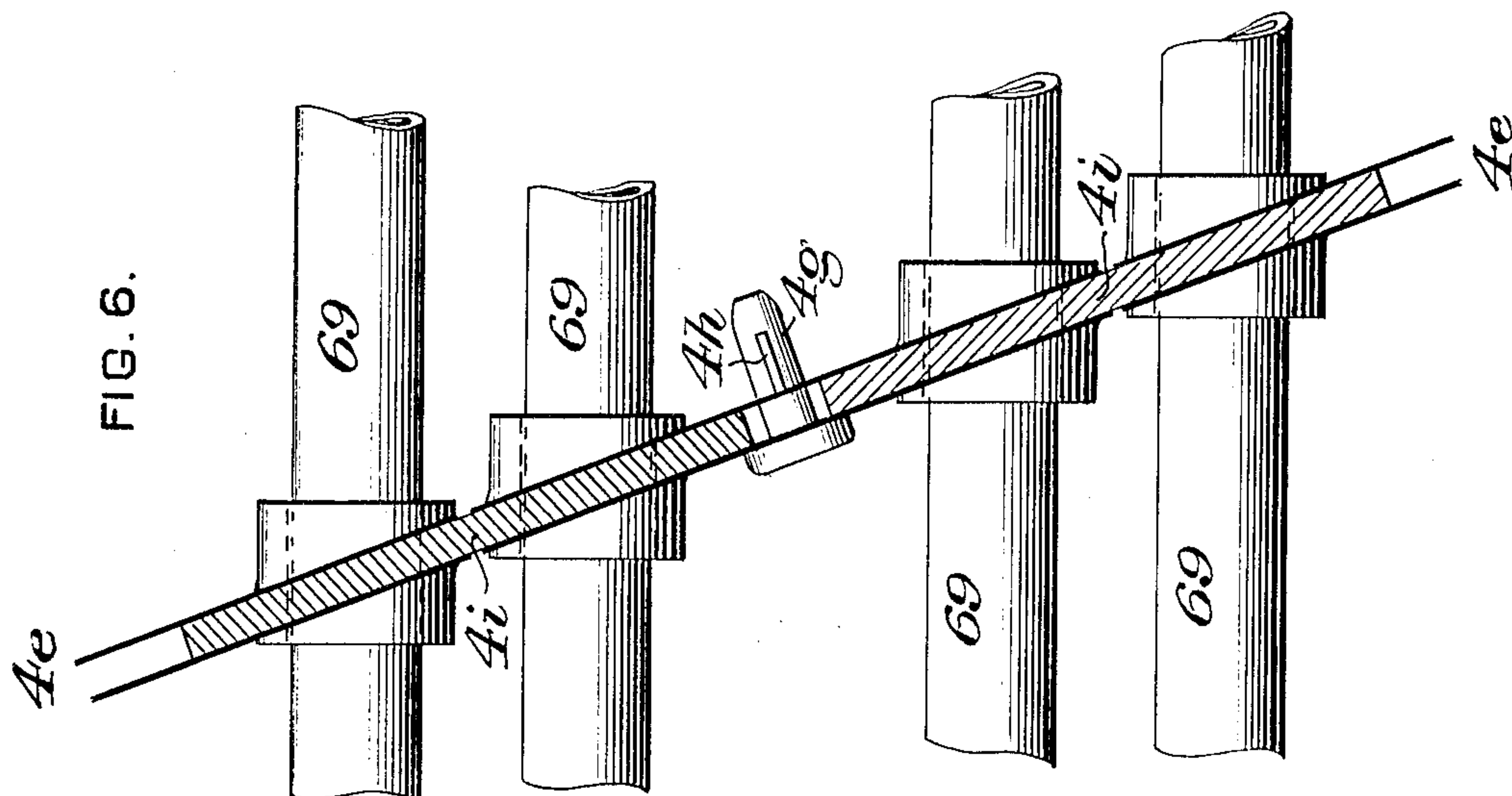


FIG. 6.



WITNESSES

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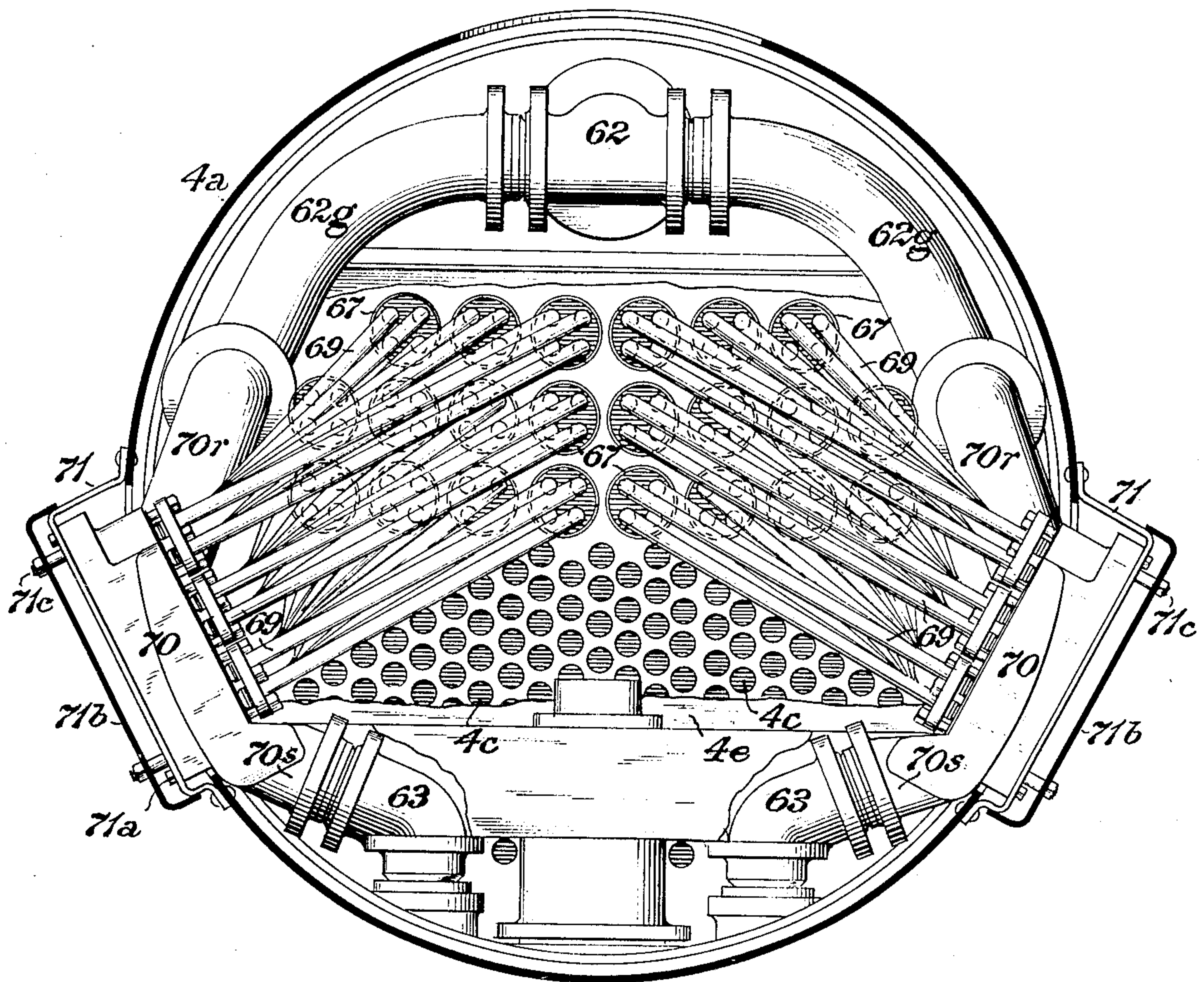
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6 SHEETS—SHEET 6.

FIG. 8.



WITNESSES

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UNITED STATES PATENT OFFICE.

FRANCIS J. COLE, OF NEW YORK, N. Y.

STEAM-BOILER SUPERHEATER.

No. 875,895.

Specification of Letters Patent.

Patented Jan. 7, 1908.

Application filed August 9, 1907. Serial No. 387,815.

To all whom it may concern:

Be it known that I, FRANCIS J. COLE, of the borough of Manhattan, in the city and State of New York, have invented a certain
5 new and useful Improvement in Steam-Boiler Superheaters, of which improvement the following is a specification.

My present invention relates to superheaters of the general class or type in which
10 the superheater pipes are located in fire tubes of a steam boiler, instances of which are exemplified in Letters Patent of the United States Nos. 765,307 and 849,052 granted and issued to American Locomotive
15 Company, as my assignee, under dates of July 19, 1904 and April 2, 1907, respectively.

The object of my invention is to provide a superheater of such general type which shall embody, among others, the following structural and operative advantages, viz: first, independent connection of pairs of superheater pipes to steam headers at the sides of the smoke box, whereby detachable or integral headers depending from the T head are
20 dispensed with; second, connections securing the superheater pipes to the steam headers, which are accessible for manipulation, when desired, from the exterior of the smoke box; third, removal of nuts and threaded portions of bolts from the corroding influence and heat in the interior of the smoke box, and facilities for examination and adjustment from the exterior thereof by the removal of light covers or casings; fourth, provision for expansion of the superheater pipes
35 by lateral bends therein, so as to permit freedom of expansion and contraction without inducing injurious strains or loosening joints; fifth, presentation of joints between the superheater pipes and steam headers in exposed position, so as to be readily examinable for the detection of leaks and accessible for adjustment, renewal, and repair; sixth, capability of independent removal and insertion of each pair of superheater pipes, and exemption from the necessity of taking
45 out an entire vertical row; and, seventh, provision of increased area of superheater pipe surface.

50 The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a vertical longitudinal section through the forward portion of a locomotive boiler, illustrating an application of my invention; Fig.
55 2, a horizontal section through the same;

Fig. 3, a vertical transverse section through the smoke box; Fig. 4, a vertical longitudinal section through one of the steam headers; Fig. 5, a vertical transverse section, on
60 an enlarged scale, through one of the steam headers, showing the bolt and follower connections of the superheater pipes thereof; Fig. 6, a vertical section, on an enlarged scale, through the deflecting plate, showing
65 the superheater pipe sockets; Fig. 7, a partial front view, on a similar scale, of the same; and, Fig. 8, a vertical transverse section through the smoke box, showing a structural modification.

70 My invention is herein, as in Letters Patent Nos. 765,307 and 849,052 aforesaid, set forth as applied in connection with a locomotive boiler, 4, which is of the ordinary construction, and is provided at its forward
75 end with a smoke box, 4^a. A plurality of fire tubes, 4^c, ordinarily of comparatively small diameter, extend from the fire box at the rear end of the boiler, which is not shown, to the front flue sheet, 4^d, and the products
80 of combustion pass through said tubes, and through a number of tubes, 67, of larger diameter, which are located in the upper and middle portion of the space within the boiler, and which will be herein descriptively termed
85 "superheating tubes", to the smoke box, 4^a, from which they are discharged into the atmosphere through a stack in the ordinary manner. Steam is supplied from the boiler
90 to the cylinders through a main steam 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 it is conducted through superheater pipes, 69,
95 which, with their connections, will be presently described, and, after being superheated in said pipes, passes to the cylinders through branch steam pipes, 63, located on opposite sides of the smoke box.

In the practice of my invention, I locate in
100 each of the superheating tubes, 67, one or more pairs (preferably, as shown, an upper and a lower pair) of superheater pipes, 69, said pipes extending longitudinally in the superheating tubes from a vertical plane a
105 short distance—say thirty inches or thereabout—forward of the fire box flue sheet, to connections with steam headers, 70, located on opposite sides of the smoke box, 4^a, as hereinafter described. The superheater pipes
110 of each pair are connected in U form at their rear ends, as by a return bend, 69^d, and

are held up in normal position in the superheating tubes by any suitable and preferred supports, as, for example, those set forth in Letters Patent of the United States No. 782,489, granted to American Locomotive Company, as my assignee, February 14, 1905. The superheater pipes, 69, are open at their forward ends, at which they communicate, through connections hereinafter described, with the main steam supply pipe, 61, and the branch or delivery steam pipes, 63, respectively, so as to constitute continuous avenues or channels, throughout the length of which the steam which is to be superheated passes from the supply steam pipe to the branch or delivery steam pipes.

The T head, 62, is, as heretofore, located in front of the upper portion of the front flue sheet or flue head, 4^d, and is of substantially the ordinary form, having a flanged central rear supply opening and two flanged lateral delivery openings. The main steam supply pipe, 61, is connected to the flange of the rear opening of the T head in the usual manner, and each of the lateral openings of the T head communicates with a plurality of saturated steam chambers or compartments, 70^e, formed in one of a pair of steam headers, 70, which are connected to, and supported on, opposite sides of the smoke box, 4^a. For convenience of construction and erection, the T head, 62, and steam headers, 70, are preferably, as shown, connected by short interposed branch saturated steam supply pipes, 62^g, fitted with ball joints in the ordinary manner.

The steam headers, 70, are chests or casings, which are made of proper strength to safely sustain the maximum pressure of steam carried in the boiler, and are substantially rectangular in vertical and horizontal section. In the instance shown, they project slightly outside of the smoke box, through openings formed in its shell, said openings being closed by casings, 71, which are riveted or bolted to the smoke box shell, and to which the steam headers are secured detachably by studs, 71^a. Caps or outer casings, 71^b, of light plate metal, are secured to the casings, 71, at a proper distance therefrom to provide space for the connecting bolts and nuts hereinafter to be described, by studs, 71^c, passing through sockets or thimbles, 71^d, the caps being thus readily detachable to admit of access to the headers whenever required. It will, however, be obvious to those familiar with locomotive construction, that the steam headers may, if preferred, be located entirely within the smoke box, and simple cover plates, curved to the radius of the smoke box shell, be substituted for the casings and caps shown and described.

Each of the steam headers, 70, is divided by horizontal walls or partitions into a plu-

ality of saturated steam chambers or compartments, 70^e, all of which communicate, through a chamber at one end of the header, with a flanged nozzle or supply passage, 70^r, thereon, which is connected to one of the branch saturated steam pipes, 62^g, leading from the T head, and a plurality of superheated steam chambers or compartments, 70^r, all of which communicate, through a chamber at the opposite end of the header, with a flanged nozzle or delivery passage, 70^s, thereon, which is connected to one of the branch delivery steam pipes, 63, leading to the engine cylinders.

The pipes of all the pairs of superheater pipes, 69, on one side of the vertical longitudinal central plane of the boiler, are each bent outwardly to a connection with the steam header, 70; on that side of the smoke box, and the pipes on the other side of said central plane are similarly bent, in the opposite direction, to connections with the opposite steam header. The opposite ends of the steam superheating channel formed by each pair of superheater pipes are connected to a saturated steam compartment, 70^e, and a superheated steam compartment, 70^r, respectively, of one of the steam headers, 70, in such manner as to effect a reduction in the number of steam tight joints, insure tight joints, and admit of convenient inspection for detection of leaks and of the ready and convenient attachment and detachment of any one or more pairs of superheater pipes to and from a header as may from time to time be desired. To this end, a collar, 69^t, is fitted on the forward end of each of the superheater pipes, 69, one of the collars of each pair of pipes abutting against a ball joint, 69^g, fitting in an opening in the inner wall of a saturated steam compartment of one of the steam headers, 70, and the other collar abutting against a similar ball joint, fitting in an opening in the inner wall of a superheated steam compartment of said steam header. The pipe collars and ball joints are adjusted and held to a steam tight bearing on the walls of the steam headers by glands or followers, 70ⁿ, connected to the headers by bolts, 70^o, passing through the partitions and upper and lower walls of the headers, and through the spaces between the compartments thereof, and provided with nuts, 70^p, engaging screw threads on their outer ends and bearing on the outer walls of the headers.

In the structural modifications shown in Fig. 8, the steam headers, 70, are set at a lower level in the smoke box than in the construction above described, and the superheater pipes, 69, instead of extending horizontally from the superheating tubes to the headers, as in that construction, are bent downwardly, as well as laterally, thereto. This disposition of the steam headers and superheater pipes attains all the advantages

of that first described, as well as the further one of enabling a pair of superheater pipes to be removed when desired, with the minimum degree of interference with other pairs.

5 It will be seen that the threads and nuts of the connecting bolts are, under my invention, completely protected from the injurious action of the heat in the smoke box, and are so located that they are accessible for adjustment whenever desired by merely removing the outer casings or caps, 71^b, of the steam headers. It will also be obvious that provision is made for expansion and contraction of the superheater pipes, and a substantial increase of area of superheating surface attained, by the extension of the superheater pipes forwardly and by lateral bends, to connections with steam headers located, as above described, at the sides of the smoke box, and considerably in advance of the flue head, 4^d.

Where, as in the majority of instances is the case, solid fuel is used, an inclined diaphragm or deflecting plate, 4^e, extending across the smoke box, in front of the ends of the tubes, is ordinarily applied, in which application it becomes necessary to suitably provide for carrying the superheater pipes, 69, through the diaphragm or deflecting plate. To this end, the upper portion of said diaphragm, through which the superheating tubes pass, is made in separable sections, consisting of parallel front and rear plates, which are connected by pins, 4^g, and keys, 4^h. Sockets 4ⁱ, each consisting of a plate having bearing rings adapted to surround the two pairs of superheater pipes, 69, of one of the superheating tubes, 67, are fitted in the spaces between the diaphragm plates, as shown in Figs. 6 and 7. This construction enables any pair of superheater pipes to be readily inserted and removed, whenever required, without taking down the entire diaphragm.

45 In operation, saturated steam from the boiler passes through the dry pipe, 61, T head, 62, and communicating branch steam supply pipes, 62^e, into each of the saturated steam compartments, 70^e, of the steam headers, from which it passes, first rearwardly and then forwardly, through the pairs of superheater pipes, into the superheated steam compartments, 70^f, of the headers, being, in its traverse through the superheater pipes and headers, thoroughly superheated by the hot products of combustion which pass through the superheating tubes inclosing the superheater pipes and through the smoke box. The superheated steam passes from the superheated steam compartments, 70^f, of the headers, into the communicating branch delivery steam pipes, 63, and through the latter to the engine cylinders for utilization therein.

65 It will be obvious to those familiar with locomotive boiler construction and operation,

that the assembling and taking down of the entire superheating appliance, and the removal and insertion of any desired part or parts thereof, as may from time to time become necessary or desirable, are greatly facilitated by the form of the superheater and the location and connection thereto of the two lateral steam headers in the manner above described, as compared with prior constructions in which a plurality of headers, depending from a T head in front of the flue head, are used. The joints between the superheater pipes and headers, being all fully exposed to view, can be readily examined for the detection of leaks, by opening the smoke box door, and can be made tight by the adjustment, from the outside of the smoke box, of the nuts of the connecting bolts, which latter are not only readily accessible by the removal of the outer casing, but are also, as well as the threads of the connecting bolts, fully protected from the injurious action of the heat of the smoke box. Any pair of superheater pipes may be independently removed and replaced, without the necessity of interfering with an entire vertical row, and the lateral bends and forward extension of the superheater pipes obviate injurious results from expansion and contraction and provide additional superheating surface exposed to the heat of the smoke box.

I claim as my invention and desire to secure by Letters Patent:

1. In a steam boiler superheater, the combination of steam headers supported adjacent to the sides of a boiler smoke box, and a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having their forward portions bent laterally to connections with the steam headers.

2. In a steam boiler superheater, the combination of steam headers supported adjacent to the sides of a boiler smoke box, and a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having their forward portions bent laterally and downwardly to connections with the steam headers.

3. In a steam boiler superheater, the combination of a steam header supported adjacent to the shell of a boiler smoke box and divided into steam receiving and delivery compartments, and a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having their forward portions bent laterally to connections with the steam receiving and delivery compartments, respectively.

4. In a steam boiler superheater, the combination of a steam header supported adjacent to the shell of a boiler smoke box and divided into steam receiving and delivery compartments, and a plurality of pairs of superheater pipes extending in U form in tubes of

the boiler and having their forward portions bent laterally and downwardly to connections with the steam receiving and delivery compartments, respectively.

5 5. In a steam boiler superheater, the combination of a steam header supported adjacent to the shell of a boiler smoke box and divided into steam receiving and delivery compartments, a plurality of pairs of superheater
10 pipes extending in U form in tubes of the boiler and having their forward portions bent laterally to communicate with the steam receiving and delivery compartments, respectively, and connections, accessible and adjustable from the outer side of the steam header,
15 securing the forward ends of the superheater pipes thereto.

6. In a steam boiler superheater, the combination of a steam header supported adjacent to the shell of a boiler smoke box and divided into steam receiving and delivery compartments, a plurality of pairs of superheater
20 pipes extending in U form in tubes of the boiler and having their forward portions bent laterally to communicate with the steam receiving and delivery compartments, respectively, and connections securing the forward
25 ends of the superheater pipes to the steam header and having their engaging members protected from the heat of the smoke box by
30 being located on the outer side of the steam header.

7. In a steam boiler superheater, the combination of a steam header supported adjacent to an opening in the shell of a boiler
35 smoke box and divided into steam receiving and delivery compartments, a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having their
40 forward portions bent laterally to communicate with the steam receiving and delivery compartments, respectively, connections accessible and adjustable from the outer side of the steam header, securing the forward
45 ends of the superheater pipes thereto, and a detachable cap or cover closing the opening in the smoke box shell.

8. In a steam boiler superheater, the combination of a steam header supported adjacent to the shell of a boiler smoke box and divided into steam receiving and delivery
50 compartments, a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having their forward portions bent laterally to communicate with the steam receiving and delivery compartments,
55 respectively, bolts, connected to the forward ends of the superheater pipes and extending through the steam header, and nuts engaging threads on said bolts and bearing on the
60 outer side of the steam header.

9. A steam header for steam boiler superheaters which is divided by transverse partitions into a plurality of steam receiving
65 compartments, all communicating with a

chamber at one of its ends, and a plurality of interposed steam delivery compartments, all communicating with a chamber at its opposite end, and is provided with openings or nozzles on its end chambers for the connection of the receiving and delivery compartments to a steam supply pipe and a steam delivery pipe, respectively. 70

10. A steam header for steam boiler superheaters, which is divided by transverse partitions into a plurality of communicating steam receiving compartments and a plurality of communicating steam delivery compartments, and is provided with bolt holes in its partitions for the reception of superheater pipe connecting bolts, and with openings or nozzles for connection of the receiving and delivery compartments to a steam supply pipe and a steam delivery pipe, respectively. 75 80 85

11. In a steam boiler superheater, the combination of a steam header which is divided by transverse partitions into a plurality of communicating steam receiving compartments and a plurality of communicating steam delivery compartments, and is provided with openings or nozzles for the connection of the receiving and delivery compartments to a steam supply pipe and a steam delivery pipe, respectively, a plurality of pairs of superheater pipes having their forward portions bent laterally to communicate with the steam receiving and delivery compartments, respectively, and bolts independently connecting the pairs of pipes to the steam header. 90 95 100

12. In a steam boiler superheater, the combination of a steam header which is divided by transverse partitions into a plurality of communicating steam receiving compartments and a plurality of communicating steam delivery compartments, and is provided with openings or nozzles for the connection of the receiving and delivery compartments to a steam supply pipe and a steam delivery pipe, respectively, a plurality of pairs of superheater pipes having their forward portions bent laterally to communicate with the steam receiving and delivery compartments, respectively, and having collars on their forward ends, followers, each engaging the collars of a pair of superheater pipes, bolts, bearing on said followers and passing through the steam header, and nuts, engaging threads on said bolts and bearing on the steam header. 105 110 115 120

13. The combination, with a tubular steam boiler, of a superheating tube, a pair of superheater pipes extending longitudinally therein, said pipes being connected at their rear ends and having their forward portions bent laterally, a steam header supported adjacent to the shell of the smoke box and comprising a receiving and a delivery compartment, with which the forward 125 130

ends of the superheater pipes respectively communicate, a steam supply connection opening into the receiving compartment, and a steam delivery connection leading out of the delivery compartment.

14. The combination, with a tubular steam boiler, of a superheating tube, a pair of superheater pipes extending longitudinally therein, said pipes being connected at their rear ends and having their forward portions bent laterally, a steam header supported adjacent to the shell of the smoke box and comprising a receiving and a delivery compartment, means, adjustable from the exterior of the smoke box, for connecting the forward ends of the superheater pipes to the receiving and the delivery compartment, respectively, a steam supply connection opening into the receiving compartment, and a steam delivery connection leading out of the delivery compartment.

15. The combination, with a tubular steam boiler, of a superheating tube, a pair of superheater pipes extending longitudinally therein, said pipes being connected at their rear ends and having their forward portions bent laterally, a casing connected to, and surrounding an opening in, the shell of the smoke box, a steam header connected to said casing and comprising a receiving and a delivery compartment, means, adjustable from the outer side of the header, for connecting the forward ends of the superheater pipes to the receiving and the delivery compartment, respectively, a steam supply connection opening into the receiving compartment, and a steam delivery connection leading out of the delivery compartment.

16. The combination, with a tubular steam boiler, of a superheating tube, a pair of superheater pipes extending longitudinally therein, said pipes being connected at their rear ends and having their forward portions bent laterally, a steam header supported adjacent to an opening in the shell of the smoke box and comprising a receiving and a delivery compartment, bolts, passing through the steam header and connecting the forward ends of the superheater pipes to the receiving and the delivery compartment, respectively, nuts engaging threads on said bolts and bearing on the outer side of the steam header, a steam supply connection opening into the receiving compartment, and a steam delivery connection leading out of the delivery compartment.

17. The combination, with a tubular steam boiler, of a superheating tube, a pair of superheater pipes extending longitudinally therein, said pipes being connected at their rear ends and having their forward portions bent laterally, a steam header supported adjacent to an opening in the shell of the smoke box and comprising a receiving and a delivery compartment, means, adjustable from the exte-

rior of the smoke box, for connecting the forward ends of the superheater pipes to the receiving and the delivery compartments, respectively, an outer casing or cap detachably connected to the smoke box over the opening therein, a steam supply connection opening into the receiving compartment, and a steam delivery connection leading out of the delivery compartment.

18. The combination, with a tubular steam boiler, of rows of superheating tubes, pairs of superheater pipes extending longitudinally therein, the members of each pair being connected at their rear ends and having their forward ends bent laterally, steam headers supported adjacent to the shell of the smoke box on opposite sides thereof, and comprising a plurality of receiving and delivery compartments, means for connecting the forward ends of each pair of pipes to a receiving and a delivery compartment, respectively, of one of the steam headers, steam supply connections opening into the receiving compartments of the headers, and steam delivery connections leading out of the delivery compartments thereof.

19. The combination, with a tubular steam boiler, of rows of superheating tubes, pairs of superheater pipes extending longitudinally therein, the members of each pair being connected at their rear ends and having their forward ends bent laterally, steam headers supported adjacent to openings in the shell of the smoke box on opposite sides thereof and comprising a plurality of receiving and delivery compartments, bolts, passing through the steam headers and connecting the forward ends of each pair of pipes to a receiving and a delivery compartment, respectively, of one of said headers, nuts engaging threads on said bolts and bearing on the outer sides of the steam headers, outer caps or casings detachably connected to the smoke box over the openings therein, steam supply connections opening into the receiving compartments of the headers, and steam delivery connections leading out of the delivery compartments thereof.

20. The combination, with a tubular steam boiler, of rows of superheating tubes, pairs of superheater pipes extending longitudinally therein, the members of each pair being connected at their rear ends and having their forward ends bent laterally, steam headers supported adjacent to the shell of the smoke box on opposite sides thereof and comprising a plurality of receiving and delivery compartments, means for connecting the forward ends of each pair of pipes to a receiving and a delivery compartment, respectively, of one of the steam headers, a T head communicating with the receiving compartments of both the headers, and branch steam delivery pipes, each communicating with the delivery compartments of one of the headers.

21. The combination, with a tubular steam boiler, of a diaphragm or deflecting plate, located in front of the flue head and having its upper portion formed in separate sections, 5 sockets fixed to said sections, and a plurality of pairs of superheater pipes extending longitudinally in tubes of the boiler and passing through said sockets.

22. The combination, with a tubular steam 10 boiler, of a diaphragm or deflecting plate, located in front of the flue head and having its upper portion formed in separate sections,

each comprising a front and a rear plate, sockets comprising a plate fitting between the diaphragm plates and having bearing 15 rings adapted to fit around superheater pipes, and a plurality of pairs of superheater pipes extending longitudinally in tubes of the boiler and passing through the bearing rings of the sockets.

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Witnesses:

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