No. 782,488. PATENTED FEB. 14, 1905.

F. J. COLE.

STEAM BOILER SUPERHEATER.

APPLICATION FILED NOV. 28, 1904.

2 SHEETS—SHEET 1.

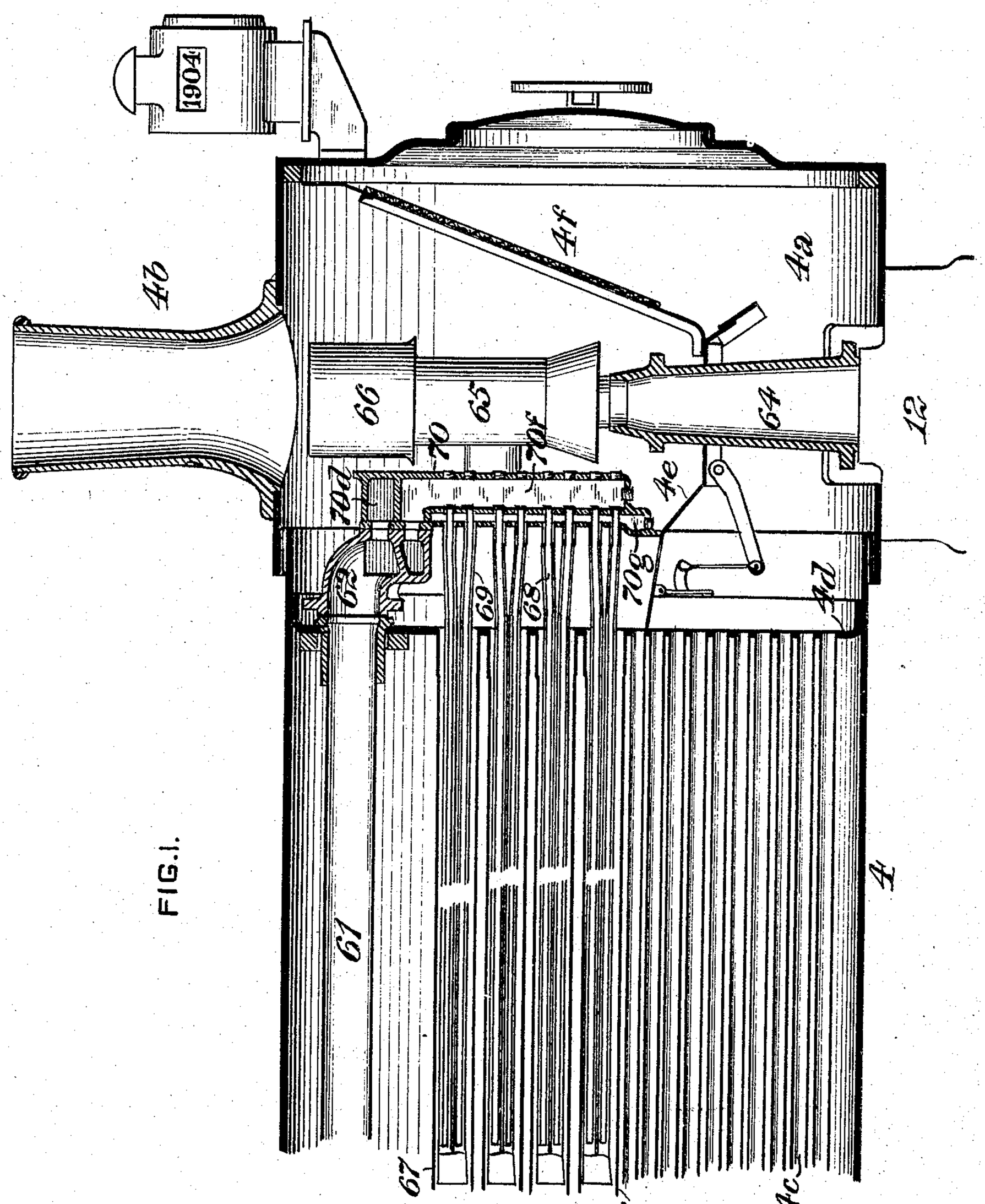

FIG. 1.

WITNESSES

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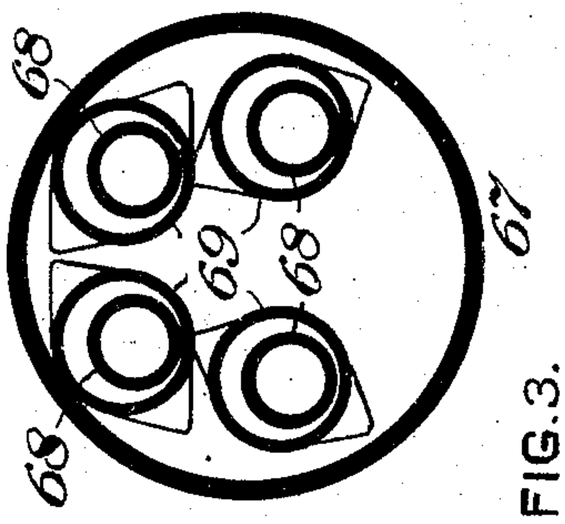

FIG. 5.

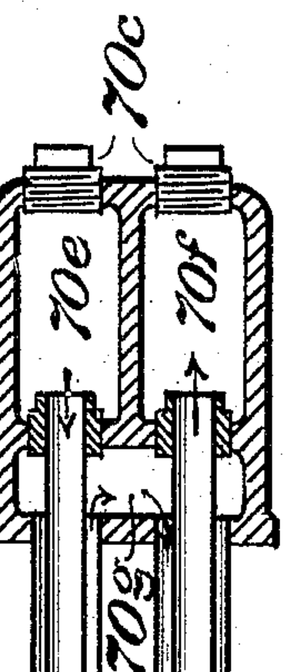

FIG. 4.

FIG. 3.

FIG. 2.

WITNESSES

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No. 782,488. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

FRANCIS J. COLE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO AMERICAN LOCOMOTIVE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

STEAM-BOILER SUPERHEATER.

SPECIFICATION forming part of Letters Patent No. 782,488, dated February 14, 1905.

Application filed November 28, 1904. Serial No. 234,491.

To all whom it may concern:

Be it known that I, FRANCIS J. COLE, of Schenectady, in the county of Schenectady and State of New York, have invented a certain 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 exemplified in Letters Patent of the United States No. 765,307, granted and issued to the American Locomotive Company as my assignee under date of July 19, 1904; and its object is to provide a superheating appliance of such type in which the length of traverse of the steam to be superheated while exposed to the hot gases shall be largely increased relatively to any determined length of superheating fire-tube and the superheating of the steam be consequently effected to a correspondingly higher degree.

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 my invention; Fig. 2, a vertical longitudinal section, on an enlarged scale and on the line *b b* of Fig. 3, 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 the superheater-pipes located in said tube; and Fig. 5, a transverse section, on a further enlarged scale, on the line *a a* of Fig. 4.

My 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-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 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 my invention I 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 fire-tubes extending between and being expanded into the front flue-sheet 4^d and the rear of fire-box tube-sheet. Within each of the superheating fire-tubes there are located two or more pairs (preferably, as in the instance shown, four pairs) of inner superheater-pipes 68 and inclosing outer superheater-pipes 69, said pipes extending longitudinally in the superheating fire-tubes from a vertical plane a short distance—say thirty inches or thereabout—forward of the fire-box tube-sheet to vertical planes in the smoke-box forward of the T-head. The pairs of superheater-pipes are disposed in the superheating fire-tubes 67 in such manner as to give as much clear space

as possible in the lower portion of the tubes, as shown in Fig. 5, in order to reduce to a minimum the tendency of soot and cinders passing through the tubes to be retained in and clog the same. The ends of the outer superheater-pipes nearer the fire-box are closed either by welding or by plugs and may be held pu in normal position in the tubes by any suitable supports, and the forward ends of both the outer and the inner superheater-pipes are open. The outer superheater-pipes 69 are made of sufficiently small diameter to permit free passage of the products of combustion around them through the superheating fire-tubes, and the inner superheater-pipes 68 are made of sufficiently smaller diameter than the outer ones to provide a channel between the two for the passage of steam.

The four pipes 68 69 68 69 of each of the two or more horizontal rows or sets of inner and outer superheater-pipes which are located in each of the superheating fire-tubes 67 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 a continuous avenue or channel, throughout the length of which the steam which is to be superheated traverses twice backwardly and twice forwardly or makes a "double return" within the superheating fire-tubes in its passage from the supply steam-pipe to the branch or delivery steam-pipes. To this end the pairs of inner and outer superheater-pipes which are located in each vertical row of superheating fire-tubes 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 side chambers 70^e 70^f, one of which, 70^e, is open to the top chamber, and a rear chamber 70^g. The headers 70 are set side by side and as closely as practicable together in the smoke-box 4^a, the upper portions of their rear sides abutting against the front of the T-head 62, and the headers are preferably, as shown, independently insertible and removable. The forward ends of the outer superheater-pipes 69 are expanded into the back walls of the rear chambers 70^g of the headers, and the adjacent ends of the inner superheater-pipes 68 are expanded into removable sleeves or sockets 70^b, screwed into the partitions which separate the rear chambers from the side chambers 70^e 70^f of the headers. By reference to Figs. 3 and 4 it will be seen that all the inner superheater-pipes on one side of the vertical central plane of each vertical row of superheating fire-tubes communicate with one side chamber, as the chamber 70^e of the header of said vertical row, while all the inner superheater-pipes on the other side of the vertical central plane communicate with the other side chamber, as the chamber 70^f. All the outer superheater-pipes of each vertical row of superheating fire-tubes communicate with the rear chamber 70^g of its header. Openings closed by removable plugs 70^c are formed in the front walls of the headers, these openings providing for the insertion, examination, cleaning, and repairs of the superheater-pipes. In the event of leakage at the joints the plugs can be detached and the inner pipes expanded, or an inner pipe or pipes can be withdrawn and the adjacent outer pipe or pipes be expanded, as the case may require.

The T-head 62 is divided by a horizontal 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 side chambers 70^e, and the lower or delivery compartment having ports 62^c in its front, which register with ports in the side chambers 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 thereinabove 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 side chambers 70^e, thence rearwardly through the connected inner superheater-pipes 68 and out of their open rear ends into the spaces between them and the outer superheater-pipes. The steam then passes forwardly through said spaces into the rear chambers 70^g of the headers, from which it again passes rearwardly through the connected outer superheater-pipes, and then forwardly through the inner superheater-pipes to the side chambers 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 fire-tubes, and by its double return in the superheater-pipes, as above described, the length of its traverse in the pipes and the period of its exposure to the hot products of combustion are caused to be substantially twice as great as in the appliance set forth in Letters Patent No. 765,307 aforesaid. The means whereby this double return of the steam is effected constitute the leading and characteristic feature of my present invention, and it will be obvious that they differ wholly, both in structure and operative result, from the mere duplication or multiplication of the single pairs of superheater-pipes of Patent No. 765,307. Such structural modification of the latter would of

course attain the result of increasing the area of superheating-surface within each of the superheating fire-tubes, but would have no effect in increasing the length of traverse of the steam in the superheater-pipes and the duration of its exposure to the hot products of combustion which is resultant in the operation of the construction herein set forth.

The disposition of the superheater-pipes of each pair one within another, as herein described and shown, while advantageous in the particular of economizing space within the superheating fire-tubes, is not an essential of my invention, as it will be obvious to those skilled in the art that, if preferred, the two pipes of each pair may without departure from the principle and characteristic feature of my invention be located side by side with their rear ends connected by return-bend couplings, their forward ends being connected to the chambers 70^e 70^f and the chamber 70^g, respectively, of the headers, as in the specific embodiment of the invention which has been herein exemplified.

My present invention embodies all the substantial practical advantages of that of Patent No. 765,307, together with the further one of enabling the steam to be superheated to a materially higher degree, which under certain conditions of operation may be of considerable practical importance and value in railroad service.

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

1. The combination, with a tubular steam-boiler, of a superheating fire-tube, a set of four superheater-pipes located therein and constituting a continuous channel for a double return of steam, a main steam-supply pipe passing through the flue-sheet above the superheating fire-tube, a steam-delivery pipe located in the smoke-box of the boiler, and a vertical casing or header located forward of the superheating fire-tube and divided into compartments, one of which is provided with a port in its rear wall open to the steam-supply pipe, and which also communicates with the receiving end of one of the superheater-pipes, another which communicates with the delivery end of another superheater-pipe and which is provided with a rear-wall port adjoining the port of the first compartment and open to the delivery steam-pipe, and another which establishes communication between the ends of the two other superheater-pipes, midway of the continuous steam-channel.

2. The combination, with a tubular steam-boiler, of a superheating fire-tube, a set of four superheater-pipes located therein and constituting a continuous channel for a double return of steam, 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 compartments, one of which communicates with the supply-chamber of the T-head, and with the receiving end of one of the superheater-pipes, another with the delivery end of another superheater-pipe and with the delivery-compartment of the T-head, and another which establishes communication between the ends of the two other superheater-pipes, midway of the continuous steam-channel.

3. The combination, with a tubular steam-boiler, of a vertical row of superheating fire-tubes, sets of four superheater-pipes located in the superheating fire-tubes, each set constituting a continuous channel for a double return of steam, a main steam-supply pipe passing through the flue-sheet above the row of superheating fire-tubes, a steam-delivery pipe, and a vertical casing or header located in the smoke-box in front of the row of superheating fire-tubes and divided into compartments, one of which is provided with a port in its rear wall open to the steam-supply pipe and which also communicates with the receiving end of one superheater-pipe of each set, another which communicates with the delivery end of another superheater-pipe of each set and which is provided with a rear-wall port adjoining the port of the first compartment and open to the delivery steam-pipe, and another which establishes communication between the ends of the two other superheater-pipes of each set, midway of the continuous steam-channels of the several sets.

4. The combination, with a tubular steam-boiler, of a vertical row of superheating fire-tubes, sets of four superheater-pipes located in the superheating fire-tubes, each set constituting a continuous channel for a double return of steam, 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 compartments, one of which communicates with the supply-chamber of the T-head and with the receiving end of one superheater-pipe of each set, another with the delivery end of another superheater-pipe of each set and with the delivery-compartment of the T-head, and another which establishes communication between the ends of the two other superheater-pipes of each set, midway of the continuous steam-channels of the several sets.

5. The combination, with a tubular steam-boiler, of a superheating fire-tube, outer superheater-pipes projecting thereinto and having their rear ends closed, inner superheater-pipes open at both ends and located within the outer superheater-pipes, 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 compartments, one of which communicates with the supply-chamber of the T-head and with the receiving end of one of the outer superheater-pipes, another with the delivery end of another outer superheater-pipe and with the delivery-compartment of the T-head, and another with the forward ends of the inner superheater-pipes.

FRANCIS J. COLE.

Witnesses:
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CLARENCE A. WILLIAMS.