

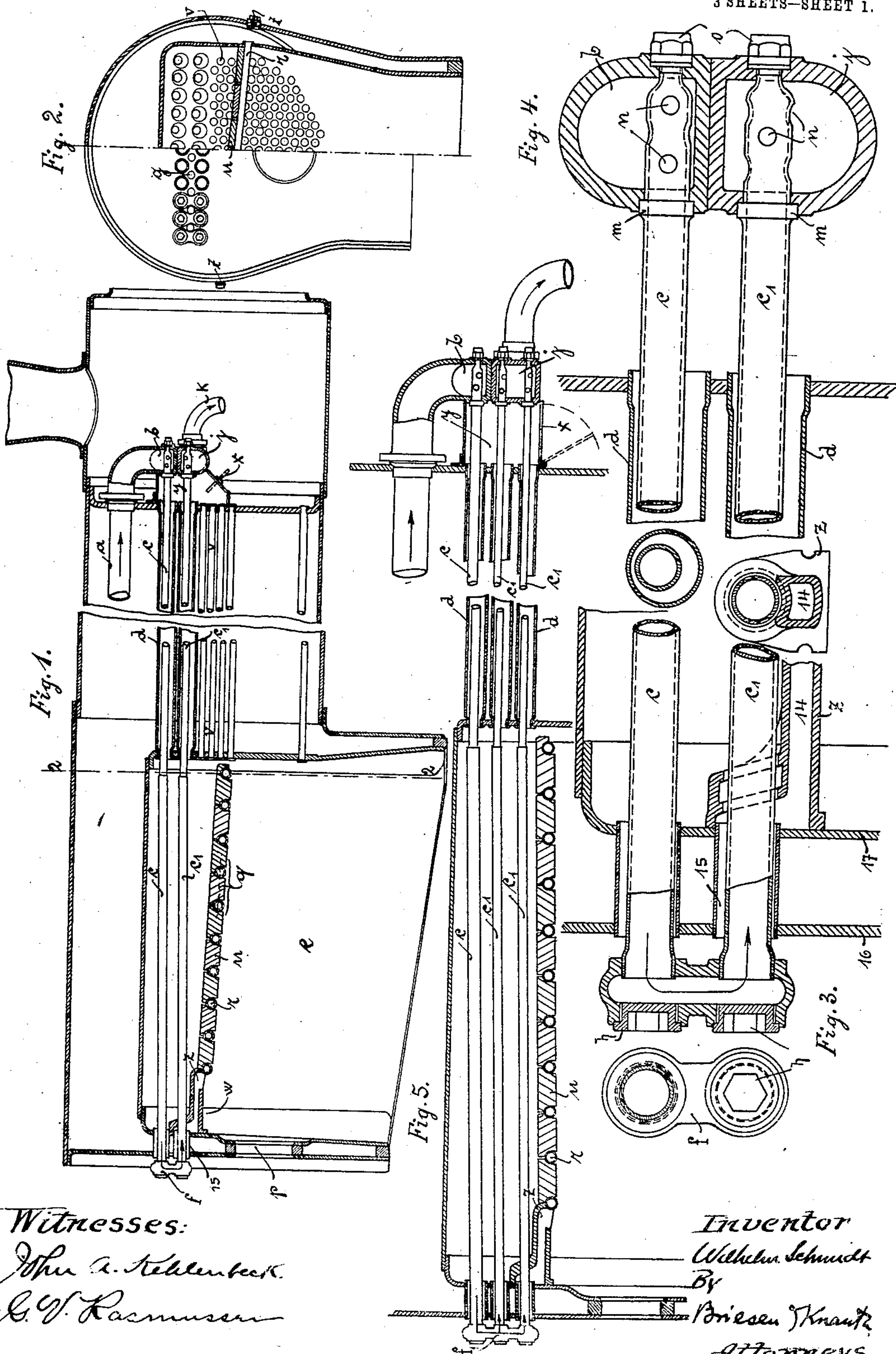
917,668.

W. SCHMIDT.  
SUPERHEATER.

APPLICATION FILED DEC. 10, 1908.

Patented Apr. 6, 1909.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2.

Fig. 7.

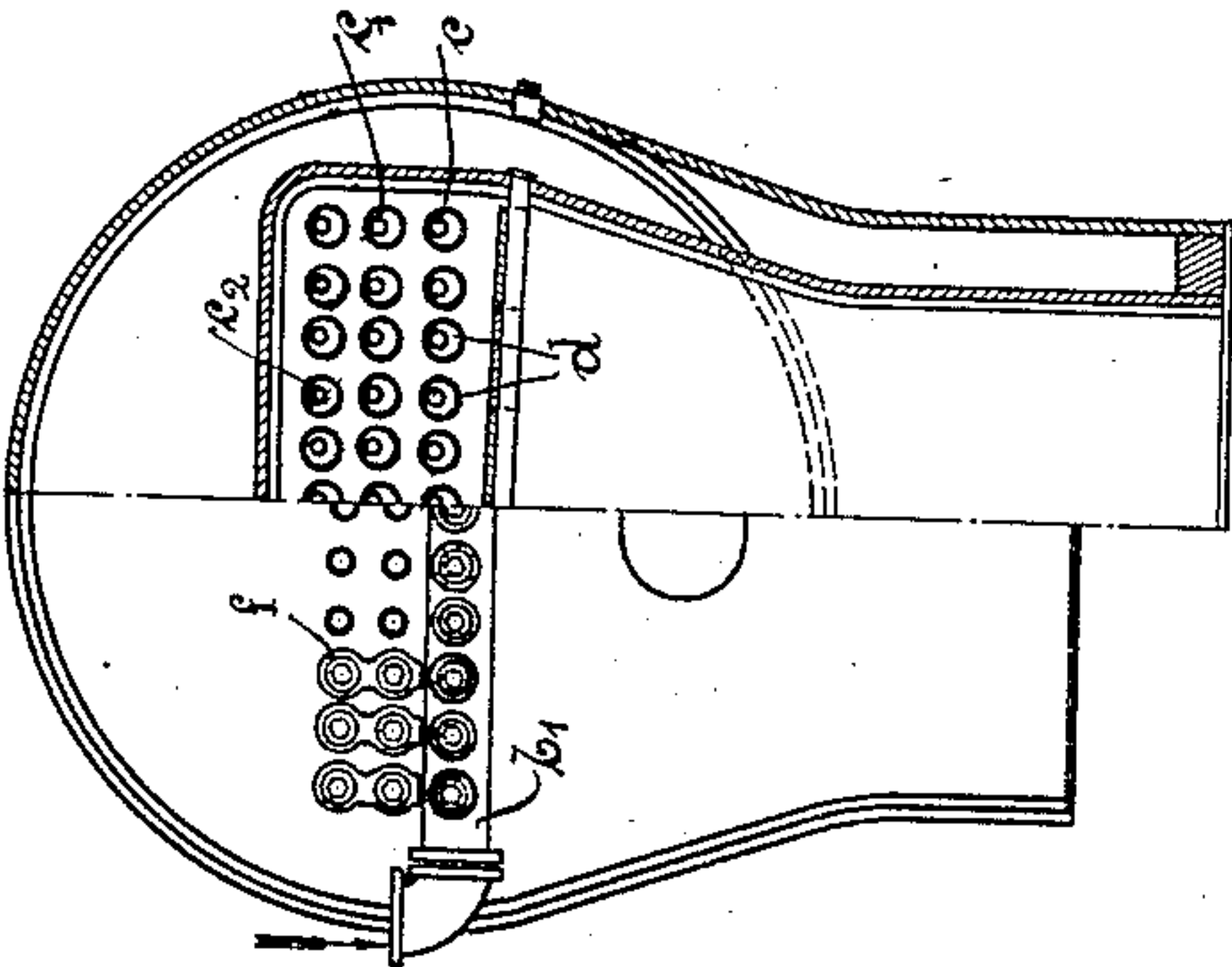


Fig. 6.

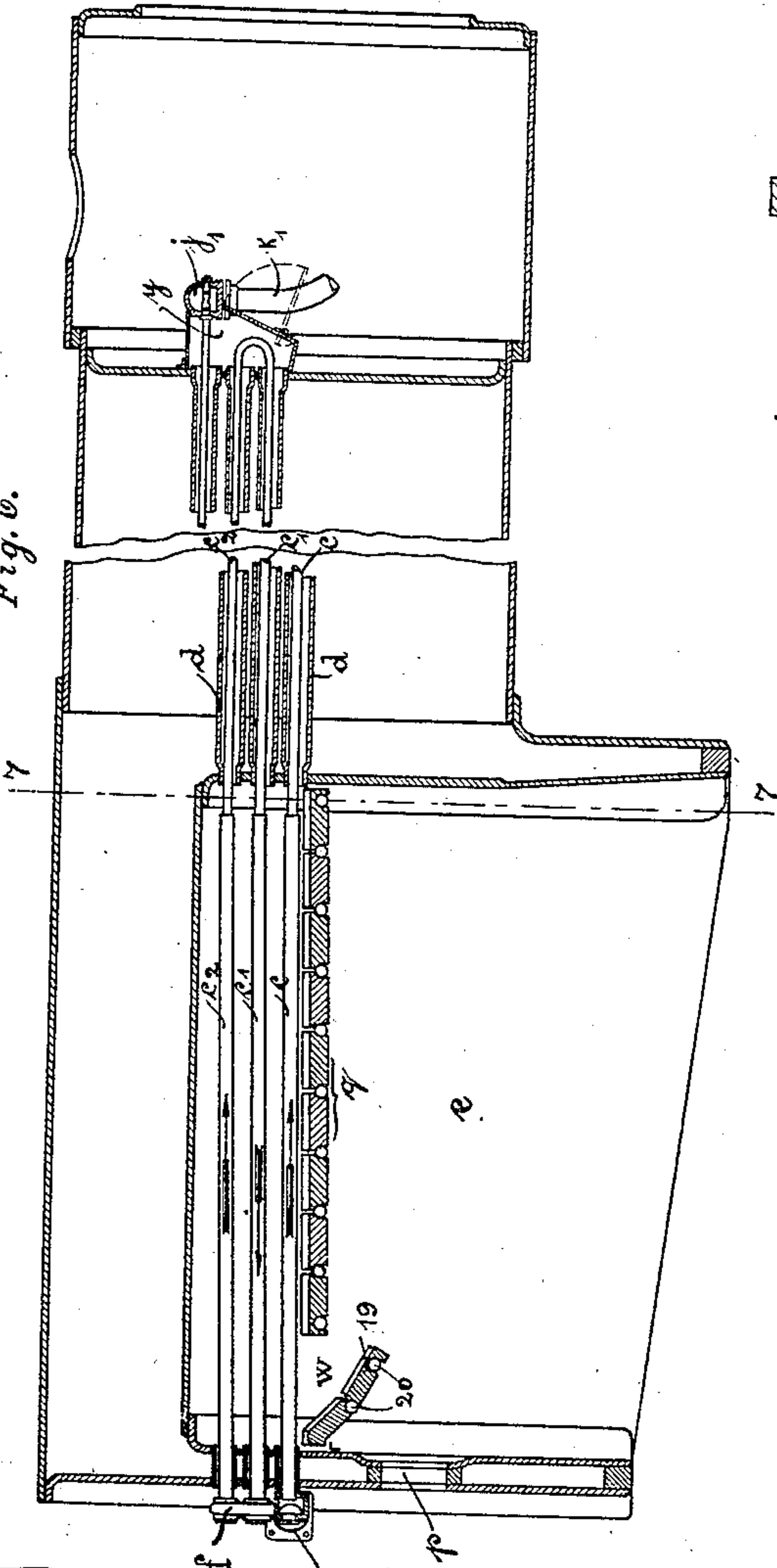


Fig. 9.

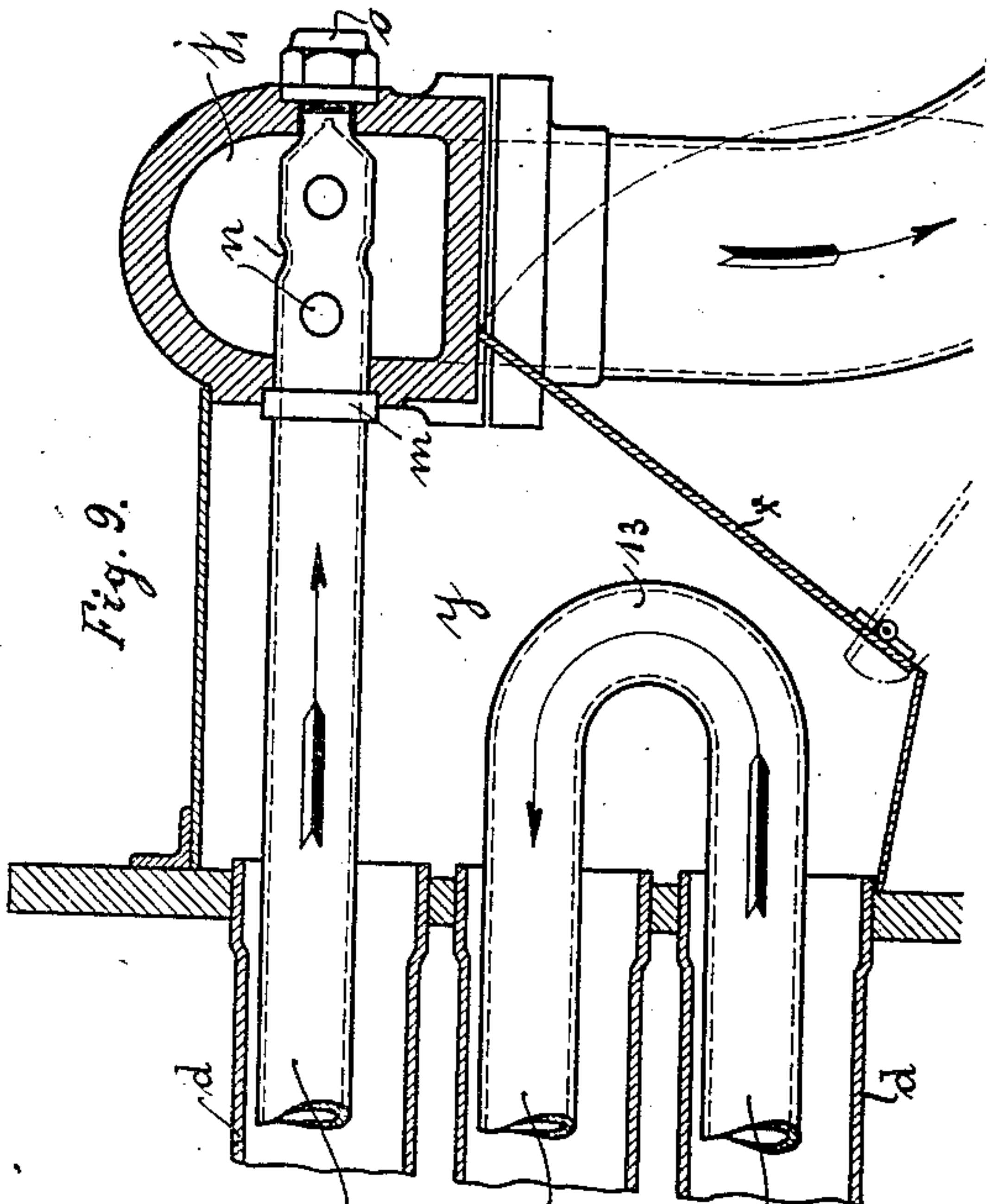
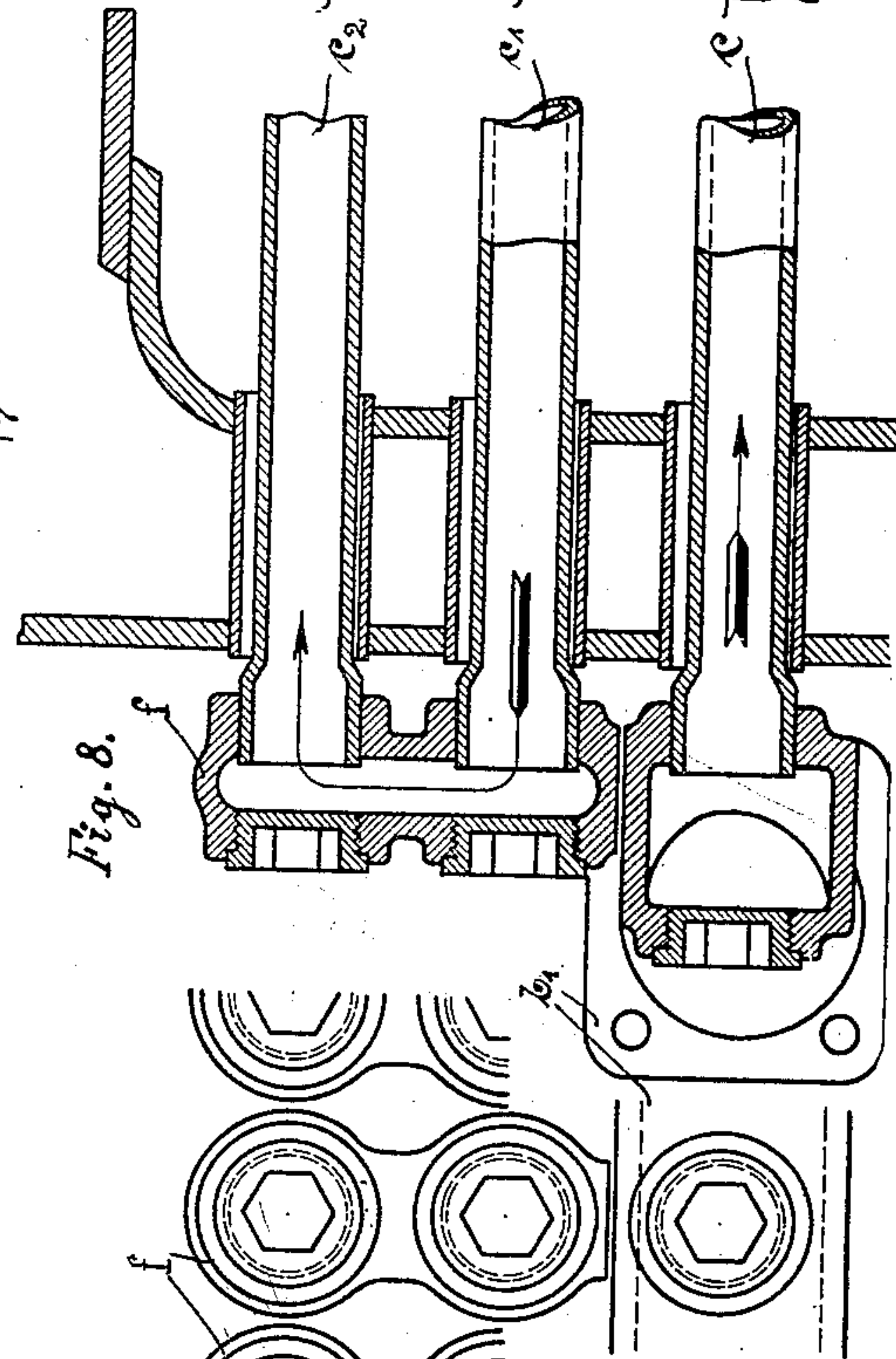


Fig. 8.



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3 SHEETS—SHEET 3.

Fig. 11.

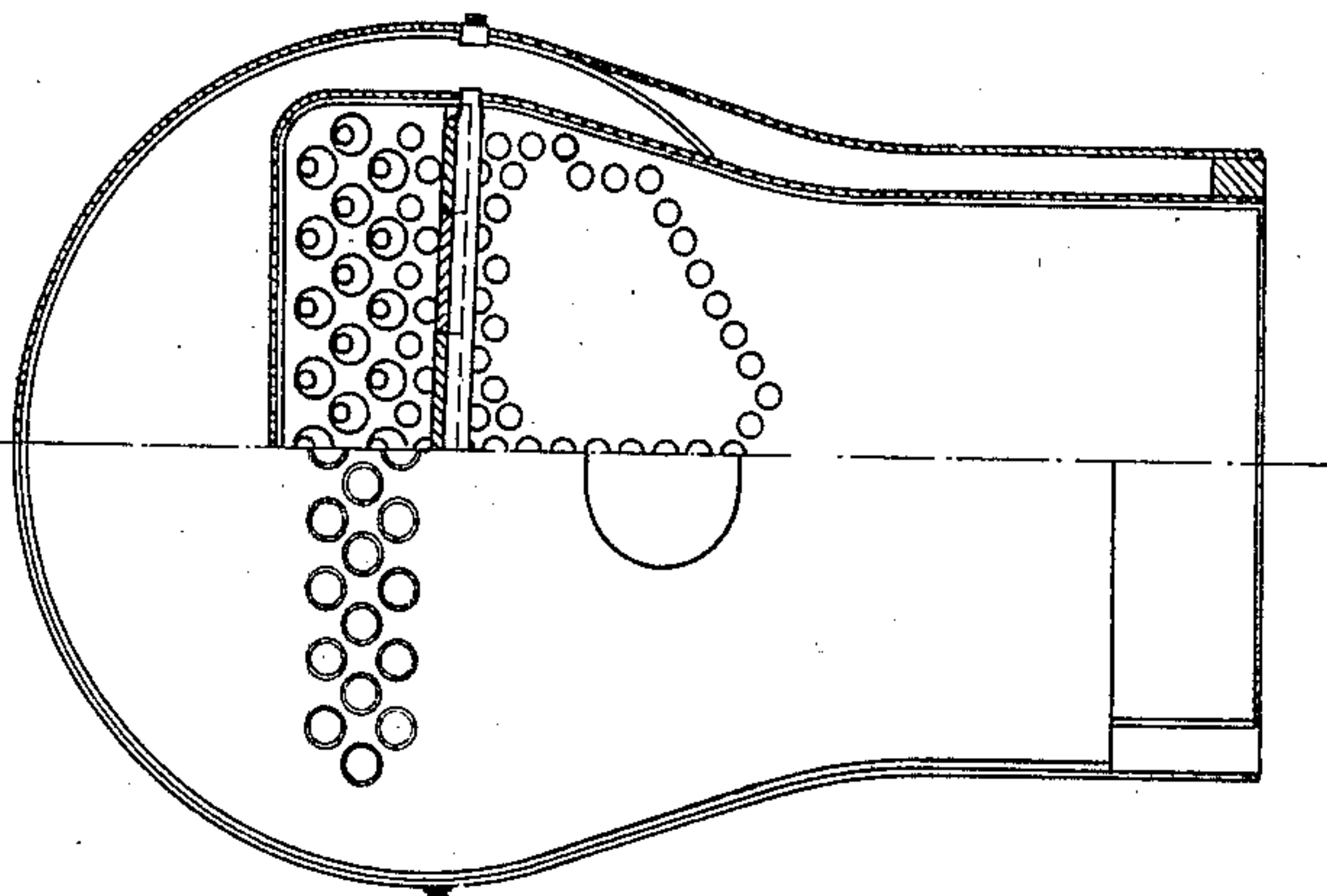
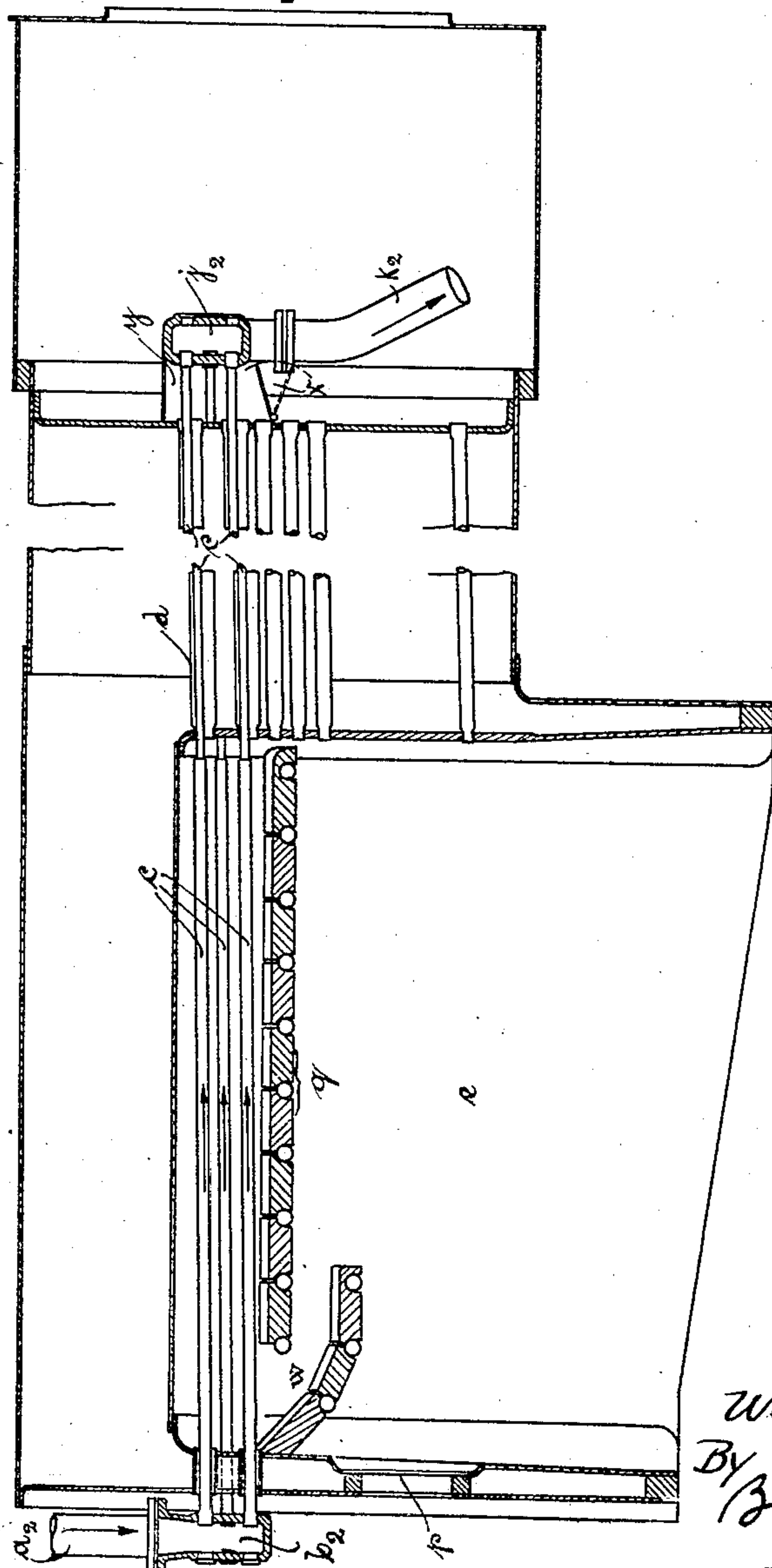


Fig. 10.



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# UNITED STATES PATENT OFFICE.

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## SUPERHEATER.

No. 917,668.

Specification of Letters Patent.

Patented April 6, 1909.

Application filed December 10, 1908. Serial No. 466,742.

*To all whom it may concern:*

Be it known that I, WILHELM SCHMIDT, a subject of the Emperor of Germany, and resident of Wilhelmshoehe, near Cassel, Germany, have invented certain new and useful Improvements in Superheaters Suitable for Boilers of the Locomotive Type, of which the following is a specification.

My invention relates to superheaters specially suitable for use in boilers of the locomotive type.

In prior patents I have described forms of superheaters in which the superheating tubes were arranged within some of the smoke tubes in boilers of the locomotive type. It has also been proposed to arrange superheaters in the fire-box of such boilers but in all constructions previously suggested where the whole or a part of the superheating surface was arranged in the fire-box, difficulties have been met with, which it is the object of the present invention to overcome.

The following specific ends have been sought for in the present invention. 1. Preventing burning of the tubes and tube joints during operation or when no steam is being used; 2. Arranging the superheater so that it does not occupy too much space or interfere with the efficiency of the boiler; 3. Providing for easy renewal, repairing and cleaning of the parts and 4. Avoiding excessive weight.

The above features must be embodied in one structure if full success is to be obtained.

The object of the present invention therefore, as stated above, is to provide an improved construction of fire-box superheater which shall incorporate the above mentioned features.

In the accompanying drawings I have shown as examples, several embodiments of my invention, according to which the superheater consists of straight superheating tubes extending from the smoke-box through enlarged smoke tubes to the fire-box and thence through hollow stay-bolts or thimbles in the rear wall of the boiler.

The scope of my invention is defined in the appended claims.

I prefer that those sections of the superheater tubes which are actually in the fire box and therefore exposed to the greatest heat shall have a greater wall thickness than the sections of said tubes which lie within

the smoke tubes; preferably, also, I cause the superheater tubes to pass eccentrically through the smoke tubes and so as to lie, as is shown by the drawings, closer to the upper wall of said smoke tubes than to the lower. Below the superheating tubes in the fire-box a fire-proof cross wall is arranged forming a superheating chamber in the upper part of the fire-box, the object being to protect the tubes against the direct action of the fire and also to guide and regulate the flow of the fire gases along them, these gases entering by openings in the cross wall near the rear wall of the boiler. By sloping or lowering the cross wall so that it incloses not only the enlarged smoke tubes but also a number of ordinary tubes, the amount of gases passing through the superheater chamber and thus the efficiency of the superheating surface in the chamber formed in the upper part of the fire-box can be increased. In this way I obtain a very efficient action of the heating surface within the chamber so that a high degree of superheat may be obtained with a superheater of comparatively small weight and bulk. The smoke-box ends of the smoke tubes arranged above the cross wall may be inclosed by a casing provided with a damper, by the regulation of which any desired quantity of gases from zero upward may be passed through the superheater chamber and a corresponding degree of superheat obtained. Opposite the passage or passages in the cross wall protecting means for the superheater parts may be arranged.

In the drawings Figure 1 is a longitudinal section through a locomotive boiler provided with a superheater and superheater chamber according to this invention; Fig. 2 is partly an external end view and partly a section on the line 2—2 of Fig. 1; Fig. 3 is a sectional detail showing the junction-box for the tube-ends at the back end of the boiler; Fig. 4 illustrates the collecting headers or pipes at the front or smoke-box end of the boiler; Fig. 5 illustrates another form of superheater; Fig. 6 illustrates a further construction in which the steam is given three passes through the length of the boiler; Fig. 7 is a partly external end view and partly a section on the line 7—7 of Fig. 6; Figs. 8 and 9 are sectional details of the end connection in the case where the steam is given three passes through the boiler, while Figs. 10 and 11 show an arrangement in which



the steam is only given one pass through the length of the boiler and this in the same direction as the furnace gases.

In carrying the invention into effect according to the form shown in Figs. 1-4 steam from the boiler passes by way of a pipe, *a*, into a distributing header, *b*, arranged within the smoke-box. From this header, *b*, superheating tubes, *c*, pass through enlarged smoke tubes, *d*, in the upper part of the boiler. The superheater tubes, *c*, after passing through the entire length of the smoke tubes, *d*, pass through the upper part of the furnace chamber, *e*, and connect with end-pipes, *f*, arranged outside the rear wall of the boiler. Where the superheater tubes pass through the furnace chamber they are preferably made of thicker metal as indicated in the drawings. By means of the junction-boxes, *f*, illustrated in enlarged detail in Fig. 3, a closed passage is provided between the ends of the superheater tubes, *c*, and the return superheater tubes, *c'*. The junction-boxes, *f*, are, as shown, provided with closing plugs, *h*, by which access to the ends of the superheater tubes, *c* and *c'* can be readily obtained. Additional access plugs, *g*, are provided in the back wall of the boiler for the purpose of enabling the smoke tubes to be cleaned. The tubes, *c'*, lead from the connection, *f*, back through the furnace chamber, *e*, and through the smoke tubes, *d*, to a superheated steam collecting header, *j*, arranged beneath the distributing header, *b*. From the collecting header, *j*, pipes, *k*, lead to the engine cylinders. As can be clearly seen from Fig. 2, the superheater tubes, *c* and *c'*, are arranged eccentrically within the smoke tubes, *d*, so that the superheater tubes are closer to the upper wall of the smoke tubes than to the lower wall. In this way a space is left in the smoke tubes for the passage of soot and cinders and also a freer passage is given to the furnace gases. Where the superheater tubes, *c* and *c'*, enter the headers they are provided with shoulders, *m*, and perforated portions, *n*, within the header, nuts, *o*, being employed for holding the superheater tubes in place. By arranging the collecting headers one above the other in the manner shown a very convenient construction is obtained which avoids complications in the piping as the superheated steam from the header, *j*, can be readily led by the downtake pipes, *k*, to the engines while the saturated steam connection, *a*, from the boiler is also very simply arranged.

Further, according to this device, the headers are able to move relatively to one another as there is no rigid connection between them as can be seen in Fig. 4. This is of importance as the expansion of the tubes, *c* and *c'* is not the same owing to the

greater temperature of the steam passing through the return tubes, *c'*.

According to this invention, as shown in Figs. 1 and 2, there is provided within the furnace chamber and above the furnace door, *p*, a protecting wall, *q*, composed of transverse water tubes, *r*, expanded into the side walls, *s*, of the furnace and arranged at convenient distances apart; plugs, *t*, are provided in the outer boiler shell for obtaining access to the water tubes, *r*. On the water tubes, *r*, there are placed fire bricks, *u*, which are cut away at their lower bottom corners so as to fit between adjacent pairs of tubes. As shown in Figs. 1 and 2 the wall, *q*, is arranged with a slight slope in the length of the boiler and also in the breadth. The slope of the wall, *q*, in Fig. 1 is shown as sufficient to inclose conveniently any desired number of rows of smoke tubes, *v*, of the ordinary size used in locomotive boilers. In this way a greater proportion of the furnace gases is led through the superheated chamber than through the enlarged smoke tubes, *d*, and the efficiency of the heating surface in the superheating chamber is thereby increased. Of course the wall may also be arranged horizontally in the length of the boiler and still be adapted to inclose a larger number of smoke tubes than the number of enlarged smoke tubes. At the front end of the boiler the group of smoke tubes closed off by the wall, *q*, is also closed by a casing, *y*, provided with a damper, *x*. In this way a regulatable quantity of furnace gases may be lead through the superheater chamber in the upper part of the fire box and the smoke tubes, *d*, and *v*, or the flow of furnace gases through the superheater chamber may be entirely stopped to meet the requirements at various times. Near the back wall of the boiler where there is left an opening or openings *w* for the furnace gases to pass through into the superheater chamber there are provided shields, *z*, for protecting the superheater tubes from direct impingement by the furnace gases. The shields, *z*, as shown in Fig. 3, are provided with passages, *14*, which connect with thimble tubes, *15*, placed between the back wall, *16*, of the boiler and the inner back wall, *17*, of the fire box. It is through the tubes, *15*, as can be easily seen from the figures that the superheater tubes, *c* and *c'*, pass and the size of the tubes, *15*, is such that a space is left between the exterior of the superheater tubes, *c'*, and the pipes, *15*, for the passage of air. This air acts as a cooling agent for the shields, *z*, and for the rear ends of the upper superheating tubes. It will be seen that according to this construction each superheater element formed by a pipe, *c*, and a pipe *c'*, may be withdrawn from the back end of the boiler without disturbing adjacent superheater elements; further, ow-



ing to the easily removable construction of the protecting wall,  $q$ , access can readily be obtained to the upper rows of the smoke tubes,  $v$ , for the purpose of cleaning or re-setting the same. Cleaning of the smoke tubes may be effected from the smoke box or fire-box end of the boiler, in the latter case by means of the access or sooting holes,  $g$ , Fig. 2. The whole arrangement, as can be readily seen, is very compact and does not interfere with the efficient working of the boiler.

It will be understood, of course, that very many modifications might be made without departing from the present invention; thus in Fig. 5, I have illustrated a form in which three rows of enlarged smoke tubes,  $d$ , are provided and three rows of superheater tubes. In this form the boiler steam is also given two passes through the length of the boiler, that is the saturated steam is led from the header,  $b$ , through the upper row of superheater tubes,  $c$ , and then back through the two lower rows of return tubes,  $c'$ . In this form also the protecting wall,  $q$ , may as shown be arranged horizontally and the casing,  $y$ , within the smoke box only incloses the enlarged smoke tubes,  $d$ , because where three rows of enlarged smoke tubes are employed the proportion of the furnace gases passing through the enlarged smoke tubes may in this case be sufficient to efficiently utilize the superheating surface disposed within the superheater chamber.

According to the form shown in Figs. 6 to 9, three rows of enlarged tubes,  $d$ , and three rows of superheater tubes,  $c$ ,  $c'$ ,  $c^2$ , are employed and are so arranged as to give the steam three passes through the length of the boiler. This is accomplished by introducing saturated steam at  $b'$ , at the back end of the boiler, the steam then passing by the lowest row of the tubes,  $c$ , to the smoke-box end of the boiler where a bend, 13, is provided to connect the lower row,  $c$ , with the middle row  $c'$ . At the back end of the boiler the middle row  $c'$ , is connected to the upper row,  $c^2$ , by a connection,  $f$ , such as is shown in Fig. 7 and in enlarged detail in Fig. 3. The superheating tubes,  $c^2$ , in the uppermost row connect at their front ends with the superheated steam header,  $y'$ , arranged within the smoke box, this connection being effected for example, in the same way as has already been described with reference to Fig. 4. From the header, pipes  $k'$ , lead the superheated steam to the engine. In this case I have illustrated the protecting wall,  $q$ , in the fire-box as inclosing only the enlarged smoke tubes,  $d$ , and of course in consequence the casing,  $y$ , at the smoke box only incloses the smoke-box end of these tubes. As in the previously described forms a damper,  $x$ , is provided in the casing,  $y$ . In this form of my invention also I have illustrated a modi-

fied form of protecting device for the superheater tubes opposite the opening,  $w$ , in the protecting wall through which the furnace gases pass. In this case the opening,  $w$ , is provided with a protecting lip, 19, which is supported by means of transverse water tubes, 20, whereby direct action of the flame upon the superheater tubes is prevented. It will be seen that the uppermost row of tubes,  $c^2$ , can be readily extracted for repairs at the rear end of the boiler while the middle row,  $c'$ , and the lower row,  $c$ , can be extracted at the smoke-box end after they have been cut off at their rear ends, so that accessibility for cleaning and repairing is obtained by this construction.

According to the form of my invention illustrated in Figs. 10 and 11, the steam is given only one pass through the length of the boiler, and for this purpose the superheater tubes all connect at the back end of the boiler with a saturated steam header,  $b^2$ , and at the front or smoke box end of the boiler with a superheated steam header,  $j^2$ . In this case it will be seen that the steam passes through the superheater tubes,  $c$ , in the same direction as the furnace gases; otherwise the construction illustrated in Figs. 10 and 11 is substantially the same as that already described with reference to Figs. 6 to 9.

I claim as my invention:

1. In a steam superheater, for use with fire tube boilers, the combination of superheating means extending from the smoke box of the boiler through boiler smoke tubes and fire box and through the back wall of the boiler, and a protecting cross wall in the fire box below said superheating means, said cross wall comprising sections separated but overlapped thereby admitting fire gases to the superheating means above the wall while cutting off direct radiation from the fire.

2. In a tube superheater, for use with boilers of the locomotive type, the combination of superheating tubes extending from the smoke box of the boiler through boiler smoke tubes and fire box and through the back wall of the boiler, and a protecting cross wall for said tubes where they pass through the fire box, said cross wall comprising sections separated but overlapped to form a passage to the superheater for fire gases while cutting off direct radiation from the fire and at least one of said cross wall sections being constituted of transverse water tubes with fire brick laid thereon.

3. In a tube superheater for use with boilers of the locomotive type, the combination of superheating tubes extending from the smoke box of the boiler through boiler smoke tubes and fire box and through the back wall of the boiler, a protecting cross-wall forming a superheating chamber for



said tubes where they pass through the fire box, said protecting wall consisting of cross water tubes arranged in the upper part of the fire box and fire bricks resting on said water tubes, a passage or passages for the fire gases being provided at the rear end of said protecting cross-wall, and protecting means for the superheater tubes opposite said passage or passages into the superheating chamber.

4. In a superheater for use in locomotive and like boilers, the combination of a number of enlarged upper smoke tubes comprising straight tubes passing through said enlarged smoke tubes and extending from the smoke box through the back end of the boiler, a protecting cross wall provided with a passage or passages for furnace gases at the rear end thereof, said cross wall closing off a number of upper smoke tubes at least equal to the number of enlarged smoke tubes at the upper fire box front wall, a casing in the smoke box inclosing said number of upper smoke tubes, and a damper on said casing for regulating the flow of fire gases drawn into the superheating chamber and through said inclosed upper smoke tubes.

5. In a superheater for locomotive and like boilers, the combination of superheater tubes passing through enlarged smoke tubes in the upper part of the boiler, continuations of said superheater tubes passing through the upper part of the fire box and through the back wall of the boiler, a saturated steam header in the smoke box with which said superheater tubes connect, a set of return superheater tubes arranged similarly to the above mentioned superheater tubes, an end connection for the back wall ends of said superheater tubes, and a superheated steam header arranged in the smoke box below said saturated steam header and adapted to move relatively thereto and connected with all said return tubes, substantially as described.

6. In a superheater for locomotive and like boilers, the combination of enlarged smoke tubes in the upper part of the boiler, straight superheated tubes passing eccentrically through the top row of enlarged smoke tubes, a saturated steam header arranged in the smoke box, with which said superheater tubes connect, a thickened continuation of said superheater tubes passing through the upper parts of the fire box and through the back wall of the boiler, a set of similarly arranged return tubes, an end connection for said superheater tubes, with access holes at the back end of the boiler, a superheated steam header placed in the smoke box below said saturated steam header and connecting with said return tubes, a protecting cross wall for said superheater in the upper part of the fire box, a

passage or passages for furnace gases being provided at the rear end of said protecting cross wall.

7. In a superheater for locomotive and like boilers, the combination of enlarged smoke tubes in the upper part of the boiler, straight superheater tubes passing through the top row of enlarged smoke tubes, a saturated steam header arranged in the smoke box, with which said superheater tubes connect, a thickened continuation of said superheater tubes passing through the upper part of the fire box and through the back wall of the boiler, a set of similarly arranged return tubes, an end connection for said superheater tubes at the back end of the boiler, a superheated steam header placed in the smoke box below said saturated steam header and connecting with said return tubes, a protecting cross wall provided with a passage or passages for furnace gases at the rear end thereof, said cross wall closing off a certain number of the upper smoke tubes in the fire box, a casing in the smoke box inclosing said number of upper smoke tubes, and a damper on said casing for regulating the flow of fire gases drawn into the superheating chamber and through said inclosed upper smoke tubes.

8. In a superheater for locomotive and like boiler, the combination of three rows of enlarged smoke tubes in the upper part of the boiler, straight superheater tubes passing through one row of enlarged smoke tubes, a saturated steam header arranged in the smoke box, with which said superheater tubes connect, a continuation of said superheater tubes passing through the upper part of the fire box and through the back wall of the boiler, two rows of similarly arranged return tubes, an end connection for said superheater tubes at the back end of the boiler, a superheated steam header placed in the smoke box below said saturated steam header and connecting with said two rows of return tubes.

9. In a superheater for locomotive and like boiler, the combination of three rows of enlarged smoke tubes in the upper part of the boiler, straight superheater tubes passing through one row of enlarged smoke tubes, a saturated steam header arranged in the smoke box, with which said superheater tubes connect, a continuation of said superheater tubes passing through the upper part of the fire box and through the back wall of the boiler, two rows of similarly arranged return tubes, an end connection for said superheater tubes at the back end of the boiler, a superheated steam header placed in the smoke box below said saturated steam header and connecting with said two rows of return tubes, a protecting cross-wall for said superheater in the upper part of the fire box.



comprising water tubes, a passage or passages being provided for the fire gases at the rear end of said protecting cross wall.

10. In a superheater for locomotive and like boilers, the combination of three rows of enlarged smoke tubes in the upper part of the boiler, straight superheater tubes passing through one row of enlarged smoke tubes, a saturated steam header arranged in the smoke box, with which said superheater tubes connect, a continuation of said superheater tubes passing through the upper part of the fire box and through the back wall of the boiler, two rows of similarly arranged return tubes, an end connection for said superheater tubes at the back end of the boiler, a superheated steam header placed in the smoke box below said saturated steam

header and connecting with said two rows of return tubes, a protecting cross-wall having a passage or passages for furnace gases at the rear end thereof closing off said three rows of enlarged smoke tubes in the fire box, a casing in the smoke box inclosing said enlarged smoke tubes, and a damper on said casing for regulating the flow of fire gas drawn into the superheating chamber and through said inclosed smoke tubes.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILHELM SCHMIDT.

Witnesses:

JULIUS FRANKE,  
GUSTAV RETTIG.