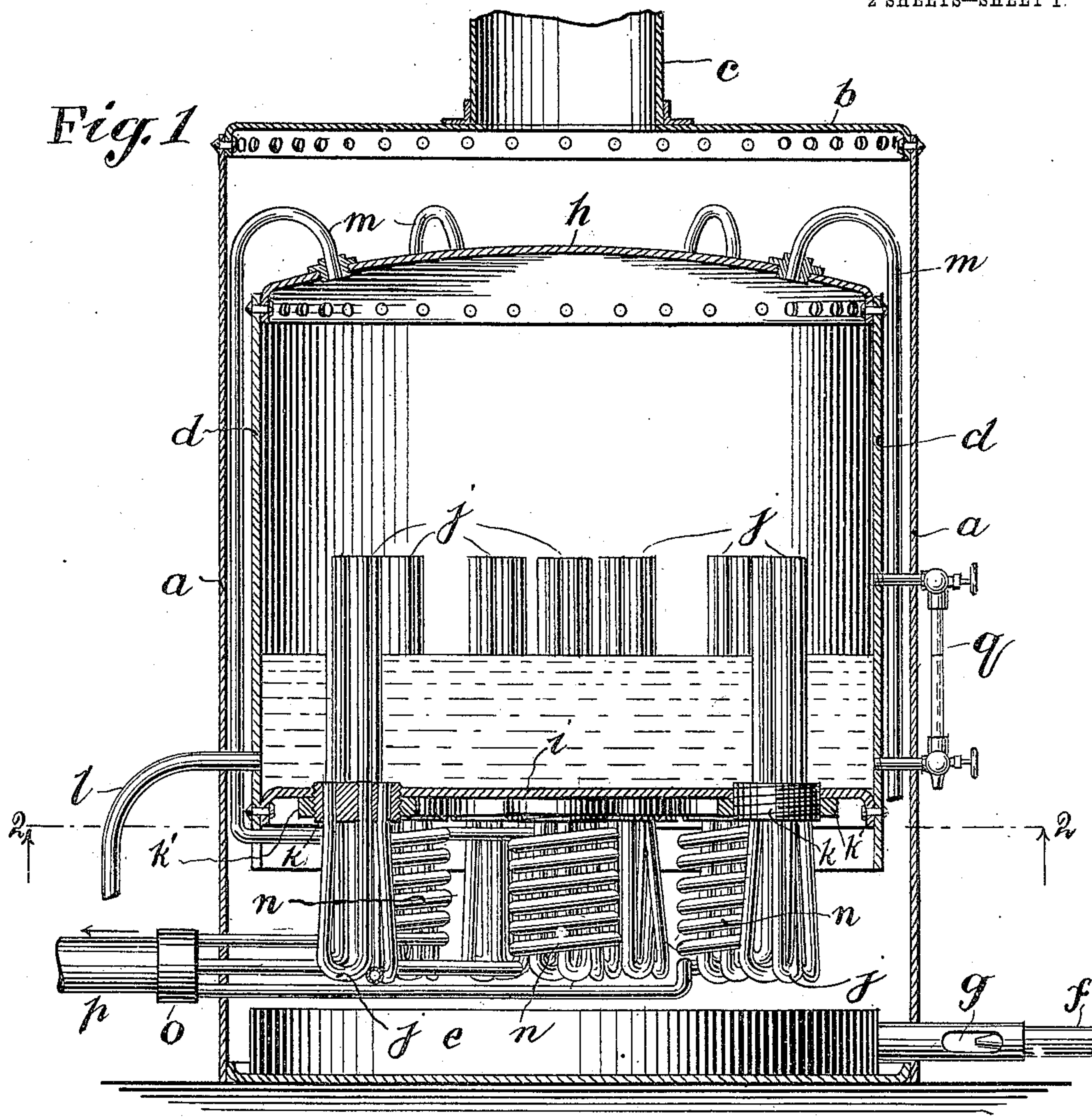


No. 820,013.

PATENTED MAY 8, 1906.

H. E. RIDER.  
STEAM GENERATOR.  
APPLICATION FILED JULY 17, 1900.

2 SHEETS—SHEET 1.



WITNESSES:

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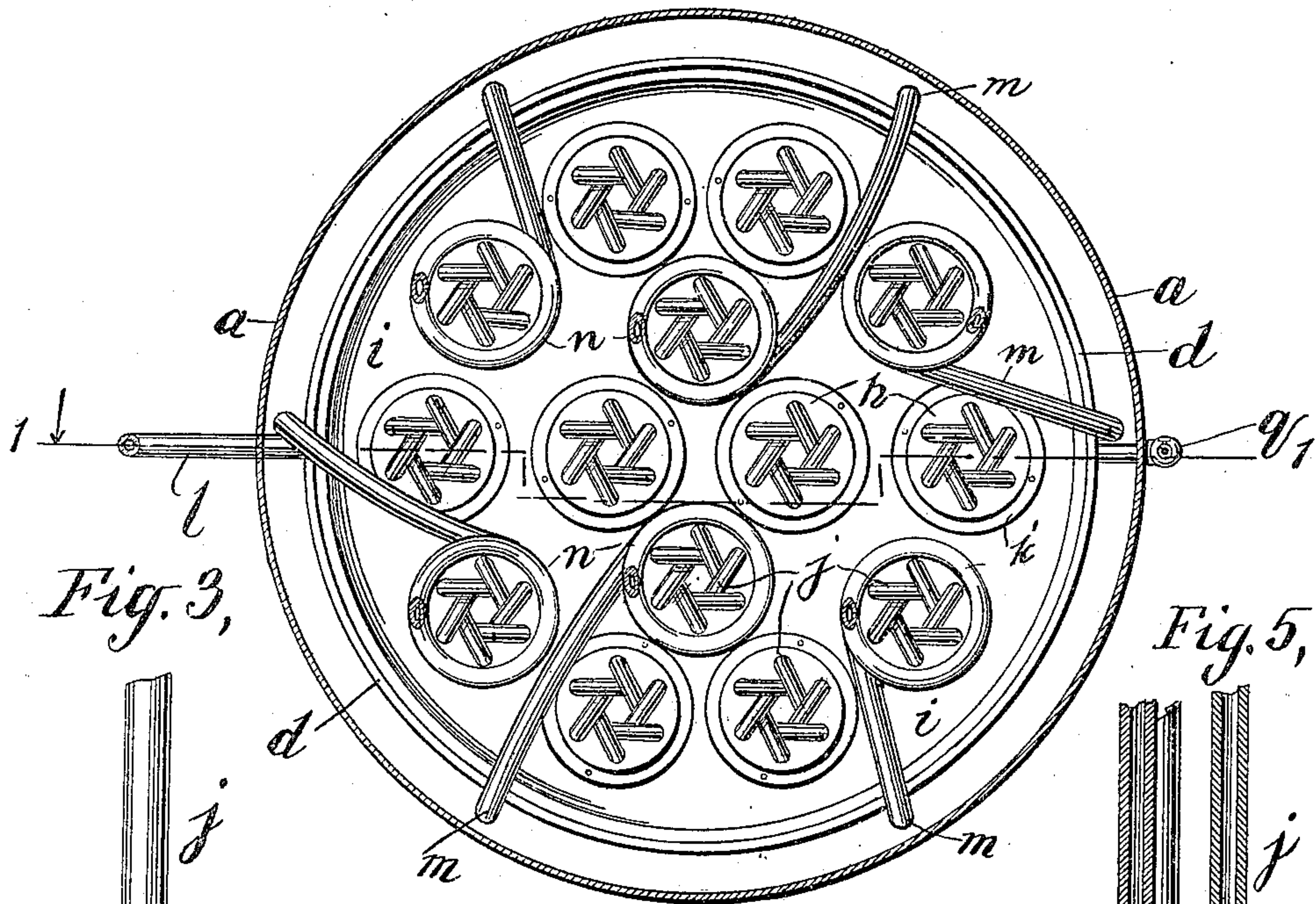
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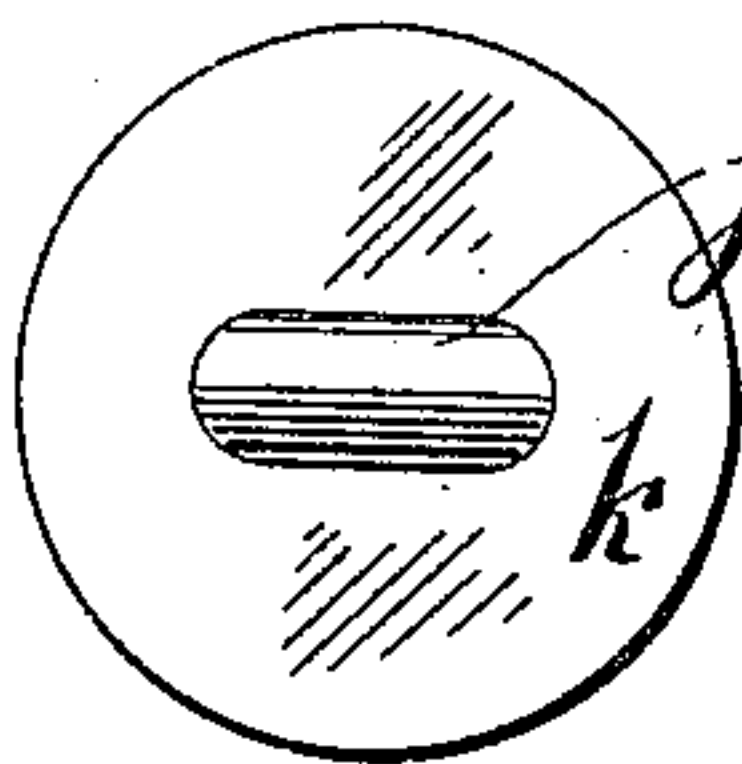
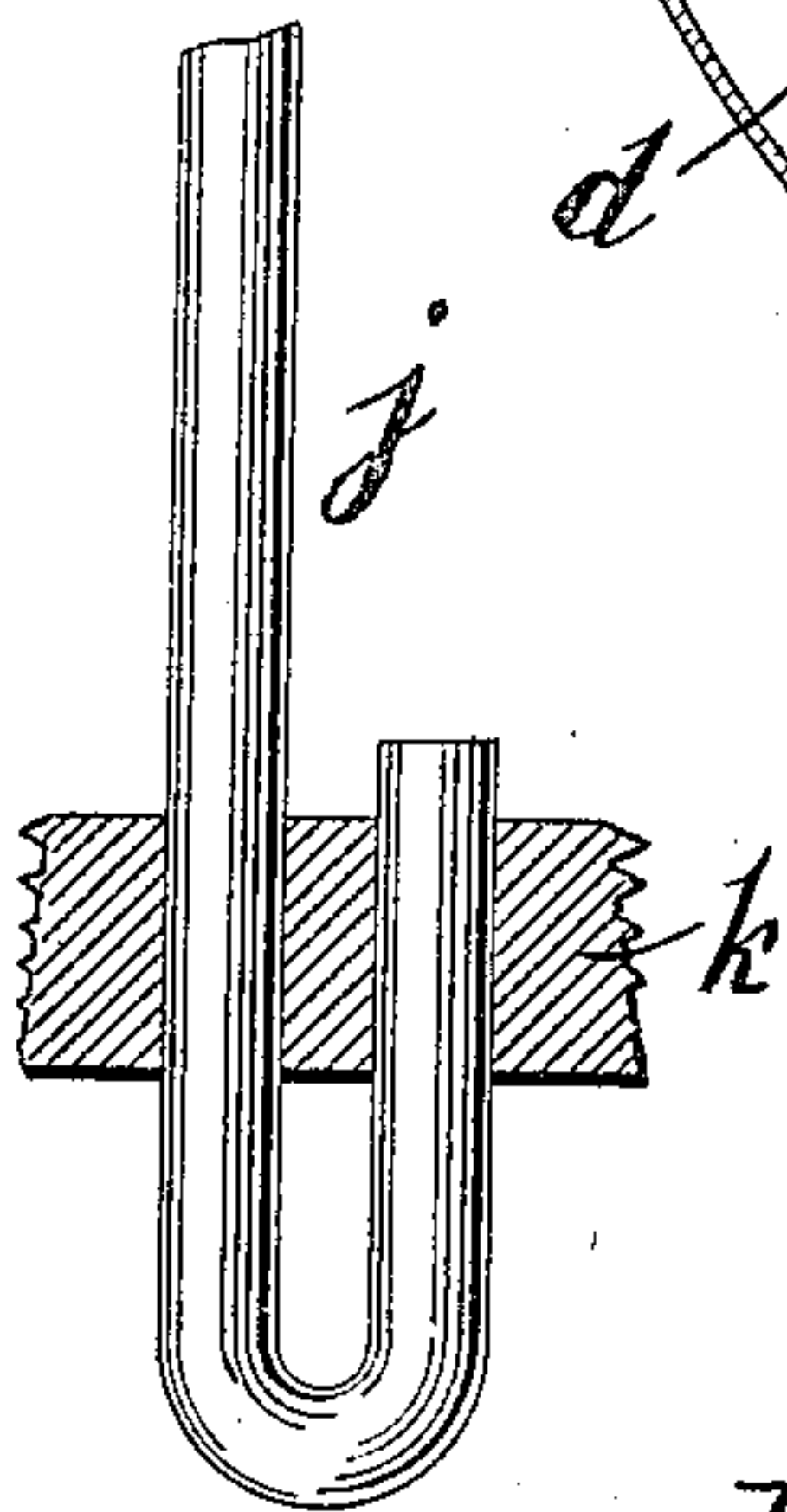
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2 SHEETS—SHEET 2.

*Fig. 2,*

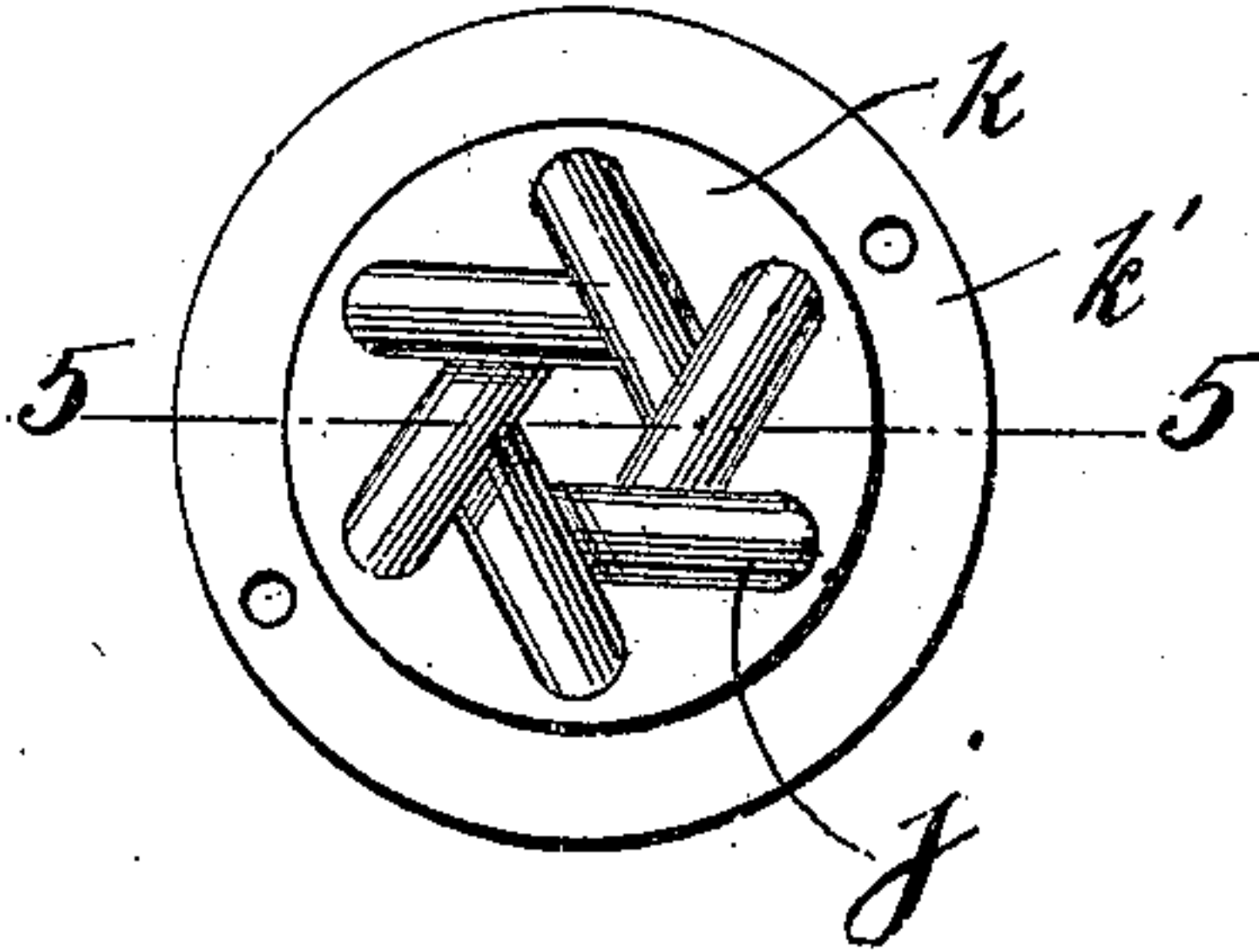


*Fig. 3,*

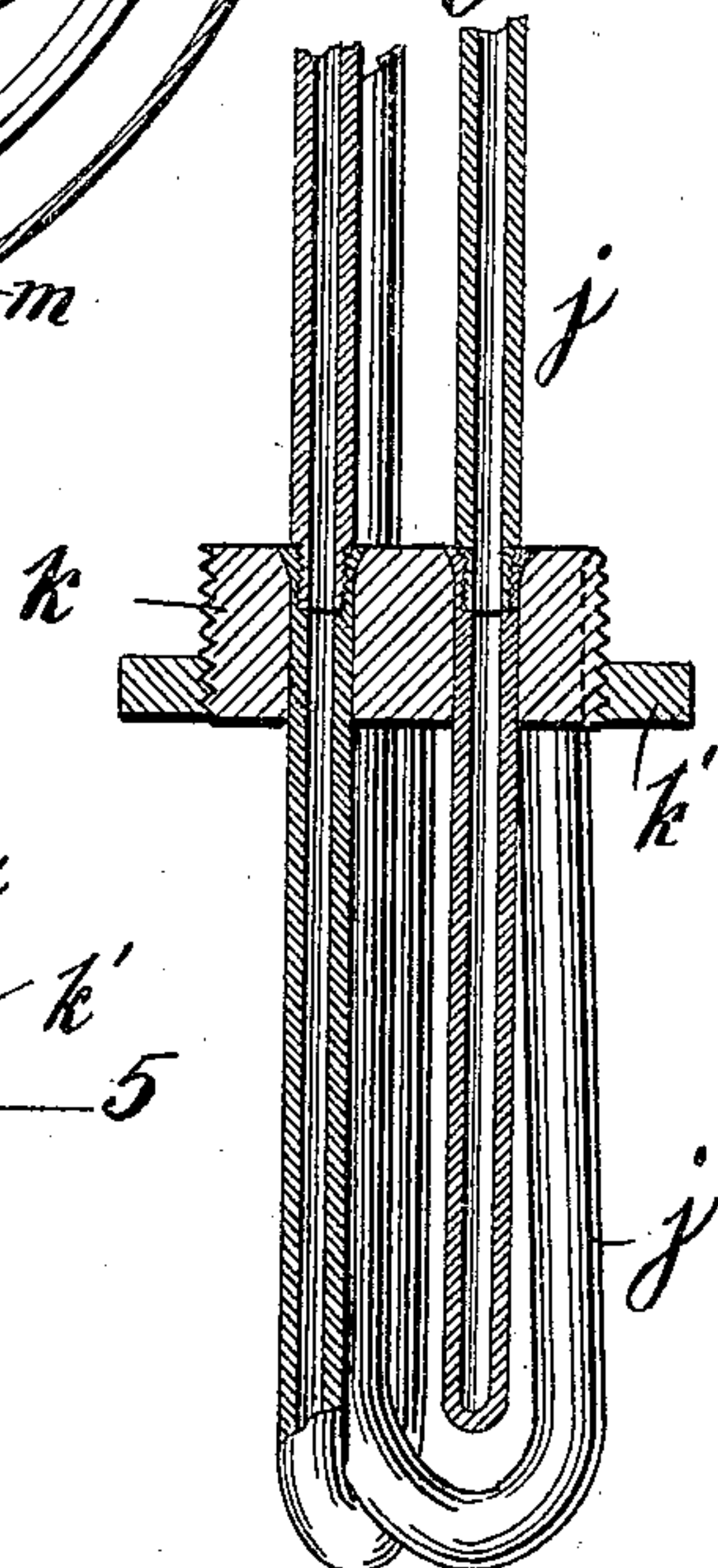


*Fig. 4*

*Fig. 6,*



*Fig. 5,*



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# UNITED STATES PATENT OFFICE.

HERBERT E. RIDER, OF NEW YORK, N. Y., ASSIGNOR TO GEORGE A. WALTON, OF NEW YORK, N. Y.

## STEAM-GENERATOR.

No. 820,013.

Specification of Letters Patent.

Patented May 8, 1906.

Application filed July 17, 1900. Serial No. 23,885.

*To all whom it may concern:*

Be it known that I, HERBERT E. RIDER, a citizen of the United States, and a resident of the borough of Manhattan, in the county of New York, city of New York, and State of New York, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof.

My invention relates to improvements in steam-generators; and it consists in the provision of new and improved constructions whereby steam may be quickly and practically instantaneously generated and may be delivered for use in a dry condition.

According to my invention the boiler is provided with generating-tubes wherein the water is flashed into steam at the point of greatest heat and whereby the steam-flashing point is directly connected to the steam-space of the boiler; and my invention includes various improvements in the arrangement and construction of the boiler and tubes, and also includes the provision of superheating-coils wherein the steam conducted from the steam-space is brought to the point of greatest heat in the combustion-chamber and is superheated, and also includes means for carrying off the steam so generated and superheated.

My invention further consists in certain novel details of construction and combination of parts by which a steam-generator is provided which has a maximum capacity with a minimum weight and bulk.

By reason of the foregoing my improved steam-generator is particularly applicable to automobile road-carriages; and one of the objects of my invention is the reduction of weight and bulk in a steam-generator for the purpose of applying the same for such use.

Another object of my invention is the rapid generation and delivery of dry steam.

I will now proceed to describe a steam-generator embodying my invention, referring to the accompanying drawings, forming part hereof, and will then point out the novel features in claims.

Figure 1 represents a central vertical section of a steam-generator embodying my invention, the plane of section being taken upon the line 1 1 of Fig. 2. Fig. 2 represents a horizontal transverse section of the same, the plane of section being taken upon the line

2 2 of Fig. 1 in a direction looking upwardly. Figs. 3 and 4 are detail views illustrating a number of certain generator-tubes employed and a plug in which they are fitted. Figs. 5 and 6 illustrate detail views of a modified form of plug with a single generator-tube fitted therein.

In carrying out my invention I employ an outer casing *a*, having a suitable head *b* and an uptake or flue connection *c*. The greater portion of the upper half of the interior of the casing *a* is occupied by a boiler or shell *d*, which is suitably supported therein. The shell *d* is of a slightly smaller diameter than the casing *a*, so that an annular space is provided between the shell and the casing, through which the products of combustion from the combustion-chamber of the furnace are adapted to pass. The uptake or flue connection *c* opens into the extreme upper end of the interior of the casing above the head of the shell, and the space between the shell and the sides of the casing communicates over the top of the shell with the said uptake or flue connection.

The lower portion of the interior of the casing forms a combustion-chamber, and within the said combustion-chamber a gas or vapor burner *e* is provided. An inlet gas or vapor pipe *f* is provided for the purpose of supplying gas or vapor to the said burner *e*, and an orifice *g* is arranged in the said burner, through which atmospheric air may be drawn for the purpose of mixing with the gas or vapor. Any suitable burner or burners may of course be employed and any gas or vapor used for burning therein. I have illustrated therein a well-known form of "Bunsen burner," which is well adapted for the purpose.

The shell *d* is provided at the top with a head *h*, which may be secured thereto by riveting, as is usual, and is closed at the bottom by a crown-sheet *i*, which may be also riveted to the sides of the shell in the usual manner. A number of U-shaped generator-tubes *j* are supported in the said crown-sheet and have their looped portions projecting into the combustion-chamber and their ends projecting into the interior of the shell. The two ends of each tube *j* are of unequal length, the shorter end communicating with the interior of the shell at a point below the water-line, preferably at a point in close proximity with the bottom of the shell, and the longer end



communicating with the interior of the shell at a point above the water-line, and hence into a space which forms the steam-space of the shell. As a result of this construction the generator-tubes have two points of communication with the boiler subjected to different pressures, the gravity of the water above the shorter end of the generator-tube being constantly exerted at the shorter end of the generator-tube. Also as a result of this construction the steam escaping from the longer end of the generator-tube does not have to pass through the water in the boiler, but passes from the tube directly into the steam-space. Under the conditions of use a constant and rapid circulation is maintained through the generator-tubes, and this rapid circulation not only brings about a rapid generation of steam, but also protects the tubes by preventing their overheating beyond the point necessary for evaporation.

The generator-tubes are freely exposed on all sides to the heated gases from the point where they leave the shell to the point where they again enter the shell, and in each generator-tube the water flowing down the shorter leg approaches the point of maximum heat as it flows toward the bottom or turning-point of the loop and is flashed into steam at such turning-point and has then a free communication with the steam-space of the boiler through the longer leg of the tube. Thus the flashing-point is the point nearest to the heating-flame, (the point of maximum heat,) whereby a maximum generation of steam is effected, and yet the constant and rapid circulation prevents injury to the tube at such point of maximum heat.

The generator-tubes may be inserted into and carried by the crown-sheet of the shell in any suitable or desired manner; but according to my invention these tubes are inserted into plugs secured in the crown-sheet, and, as shown, these plugs *k* are screw-threaded and in Figs. 1, 2, 3, and 4 have jam-nuts, whereby tight joints may be effected, and, as shown in Figs. 5 and 6, these plugs have taper-threads for forming a tight connection.

In the main views illustrating my invention and in detail views, Figs. 3 and 4, I have shown each plug *k* as provided with a plurality of generator-tubes *j*, and these generator-tubes are arranged as close together as possible with their U-shaped portions overlapping, so as to provide a large heating-surface. These generator-tubes may be otherwise arranged in the plugs and in some cases I may have only a single generator-tube in each plug, as illustrated in Figs. 5 and 6. The tubes may be of brass or copper and brazed into the plugs or they may be of iron or other material and may be secured in the plugs, as shown in the main views of the drawings, and particularly shown in Fig. 3, the tubes as first inserted into the plugs having ends of equal

length which terminate near the top of the plug and which are expanded to make tight contact therewith in the usual manner, and one of the expanded ends being then tapped to provide it with an internal thread and a section of tube being screwed therein to provide the longer arm or end.

Each plug with its one or more generator-tubes may be designated as a "generating unit," and the number of such units employed would be determined by the relation of the size and capacity of the generating unit to the size and capacity of the boiler. In some instances a single generating unit might be sufficient.

By the construction above described provision is made for the renewal of any group of generator-tubes in a plug by merely unscrewing the plug and inserting a new plug or for the removal in like manner of any plug for the purpose of repairing its tubes. This construction also provides a tube-receiving surface of such thickness and strength that the tubes may be arranged very closely together. The flame from the burner will play directly upon the looped portion of the generator-tubes, and in this way an intense heat will be applied at such point. The small quantity of water which is contained within the tube will be almost instantly converted into steam, causing an exceedingly rapid generation of steam, which will be ready for use almost the instant the burner is lighted. As fast as the water within the tubes is converted into steam the steam is discharged into the steam-space within the shell, and water from within the shell will enter the shorter ends of the generator-tubes to take the place of that converted into steam and will itself be so converted. Thus a constant circulation of fluid entering in the form of water and leaving in the form of steam will be maintained in the generator-tubes. A feed-water pipe *l* communicates with the interior of the shell near the lower end thereof and is connected to a suitable source of water-supply, (not shown,) and a suitable gage-cock *q* is provided for indicating the water-line.

The steam which has been generated passes from the interior of the shell through a plurality of pipes *m*, which communicate with the interior of the said shell through the head thereof. The pipes pass downwardly, preferably between the shell and the casing, and are connected with superheating-coils *n*, which are arranged in the path of the heating-flame. As shown, there are six pipes *m* and six superheating-coils *n*, one for each pipe *m*, and each superheating-coil *n* surrounds a group of generator-tubes *j*. The superheating-coils all connect with a header *o* upon the steam-pipe *p*, along which pipe the steam is delivered for use in its superheated and dried condition. This construction of superheating-coils and generator-tubes brings about a



concentration of the parts to be heated, so that they may be arranged in close proximity to the heating flame or flames. The combustion and heating are concentrated in a small fire-chamber in which a perfect combustion can be attained.

The arrangement of the generator-tubes *j* is such that steam is generated in a dry condition in the first instance. Furthermore, the likelihood of priming is largely reduced. The dry steam being passed through the superheating-coils is still further dried and the tension thereof increased, so that perfectly-dry steam at a high pressure is delivered through the steam-pipe *p*. It will be observed, however, that should a superheated steam be not desired in any of the uses to which my steam-generator may be applied the superheating-coils may be omitted or diminished in number or capacity, or both, and so, also, the degree of superheating may be varied to suit any requirements by increasing or diminishing the number or capacity, or both, of the superheating-coils.

The foregoing arrangement and construction provides a steam-generator of great simplicity and of small bulk and weight and at the same time provides for the instantaneous and economical generation of steam. Such a generator would well fulfil all the requirements for such devices in automobiles or might serve for a fire-engine boiler or could be advantageously used in any place in which rapid and economical generation of steam is required and the reduction of bulk and weight is a consideration.

It is evident that various modifications in construction may be made within the purview of my invention.

What I claim, and desire to secure by Letters Patent, is—

1. The combination, in a steam-generator, of an outer casing having a combustion-chamber formed therein, a boiler arranged within such casing and above the combustion-chamber and constructed so as to provide a flue-opening between the outer periphery of the boiler and the wall of the casing, such flue-opening being contiguous with the crown-sheet formed by the bottom of the boiler, the boiler having a plurality of plugs arranged in the shell thereof, the plugs carrying a plurality of generator-tubes having looped portions extending into the combustion-chamber and exposed freely on all sides to the heated gases therein from the points where they leave the plugs to the points where they again enter the plugs, the tubes having ends of unusual length which project through the plugs into the interior of the boiler, their shorter ends terminating below the water-line and their longer ends terminating above the water-line.

2. The combination, in a steam-generator, of an outer casing having a combustion-cham-

ber formed therein, a boiler arranged within such casing and above the combustion-chamber and constructed so as to provide a flue-opening between the outer periphery of the boiler and the wall of the casing, such flue-opening being contiguous with the crown-sheet formed by the bottom of the boiler, a plurality of plugs arranged in such crown-sheet, the said plugs carrying U-shaped generator-tubes having ends of unequal length, the said generator-tubes arranged in the said plugs so that their looped portions are below said plugs and are within the combustion-chamber and that their end portions project through the said plugs into the interior of the boiler, their shorter ends terminating below the water-line and their longer ends terminating above the water-line.

3. A steam-generator comprising a combustion-chamber and a boiler, the boiler having a plurality of plugs arranged in the shell thereof, each of said plugs carrying a plurality of generator-tubes having looped portions extending into the combustion-chamber and having ends of unequal length which project through the plugs into the interior of the boiler, their shorter ends terminating below the water-line, and their longer ends terminating above the water-line, substantially as set forth.

4. The combination in a steam-generator, of a combustion-chamber, a shell arranged above the said combustion-chamber, and a plurality of plugs arranged in the crown-sheet of the said shell, each of the said plugs carrying a plurality of generator-tubes having ends of unequal length, the said generator-tubes arranged in the said plugs so that their looped portions are below the said plugs and are within the combustion-chamber and their end portions project through the said plugs into the interior of the shell, their shorter ends terminating below the water-line, and their longer ends terminating above the water-line, substantially as set forth.

5. A generating unit for a steam-boiler comprising a plug adapted to be secured in the shell of the boiler and having one or more generator-tubes with a looped portion or portions at one side of the plug and ends of unequal length at the other side of said plug, substantially as set forth.

6. A generating unit for a steam-boiler comprising a plug adapted to be secured in the shell of the boiler and having one or more generator-tubes, the generator-tube or each generator-tube consisting of one part having a looped portion at one side of the plug and ends expanded into the plug at the other side of the plug, and another part fitted into one of said ends to provide an elongated end for such generator-tube, substantially as set forth.

7. A generating unit for a steam-boiler comprising a plug adapted to be secured in



the shell of the boiler and having a plurality of generator-tubes therein each generator-tube having a U-shaped portion with ends expanded into the plug and another portion fitted into one of said ends to provide an elongated end for such generator-tube, and the generator-tubes being arranged closely together with their U-shaped portions overlapping, substantially as set forth.

8. The combination in a steam-generator, of a shell, a combustion-chamber below the said shell, a U-shaped generator-tube arranged with its looped portion within the said combustion-chamber, said generator-tube having ends of unequal length which project through the crown-sheet of said shell into the interior thereof and terminate the one below the water-line therein and the other above the water-line therein, a burner arranged within the combustion-chamber, and a superheating-coil arranged in the path of the flame of the burner and connecting upon one side with the steam-space within the said shell, and upon the other side with a steam-supply pipe, substantially as set forth.

9. The combination in a steam-generator, of an outer casing the top portion of which communicates with an uptake and the lower portion of which forms a combustion-chamber, a shell arranged within the upper portion of said casing, the crown-sheet of said shell being provided with a plurality of U-shaped generator-tubes having ends of unequal length whose looped portions project into the combustion-chamber and whose ends project within the said shell, the shorter ends thereof terminating below the water-line and the longer ends terminating above the water-line, a burner arranged within the combustion-chamber, a plurality of superheating-coils arranged in the path of the flame of the said burner, the said superheating-coils connected upon one side with the steam-space within the shell and upon the other side with a steam-supply pipe, substantially as set forth.

10. The combination in a steam-generator, of a combustion-chamber, a shell arranged above the combustion-chamber, a plurality of plugs arranged in the crown-sheet of the shell, each of the plugs having a plurality of generator-tubes therein, each of said generator-tubes having a looped portion extending into the combustion-chamber, a plurality of superheating-coils each arranged about a group of generator-tubes on a plug, each of

said superheating-coils being connected to the steam-space in the shell, and a main steam-supply pipe with which all of said superheating-coils are connected at their discharge ends, substantially as set forth.

11. The combination in a steam-generator of a combustion-chamber, a shell arranged above the combustion-chamber, a plurality of plugs arranged in the crown-sheet of the shell, each of the plugs having a plurality of generator-tubes therein, each of said generator-tubes having a looped portion extending into the combustion-chamber, and the generator-tubes on each plug being arranged closely together with their looped portions overlapping, a plurality of superheating-coils each arranged about a group of generator-tubes on a plug, each of said superheating-coils being connected to the steam-space in the shell, and a main steam-supply pipe with which all of said superheating-coils are connected at their discharge ends, and a burner arranged within the combustion-chamber in proximity to such groups and coils, substantially as set forth.

12. The combination in a steam-generator, of an outer casing the top portion of which communicates with an uptake and the lower portion of which forms a combustion-chamber, a shell arranged within the upper portion of said casing, a plurality of plugs arranged in the crown-sheet of the shell, each of the plugs having a plurality of generator-tubes therein, each of said generator-tubes having a looped portion extending into the combustion-chamber and having ends of unequal length, projecting within the shell, the shorter ends terminating below the water-line and the longer ends terminating above the water-line, a plurality of superheating-coils each arranged about a group of generator-tubes on a plug, each of said superheating-coils being connected to the steam-space in the shell, and a main steam-supply pipe with which all of said superheating-coils are connected at their discharge ends, substantially as set forth.

Signed in the borough of Manhattan, in the county of New York, city of New York, and State of New York, this 16th day of July, A. D. 1900.

HERBERT E. RIDER.

Witnesses:

HERBERT H. GIBBS,  
HENRY D. WILLIAMS.