

(No Model.)

T. L. & T. J. STURTEVANT.  
STEAM GENERATOR.

No. 480,417.

Patented Aug. 9, 1892.

Fig. 1.

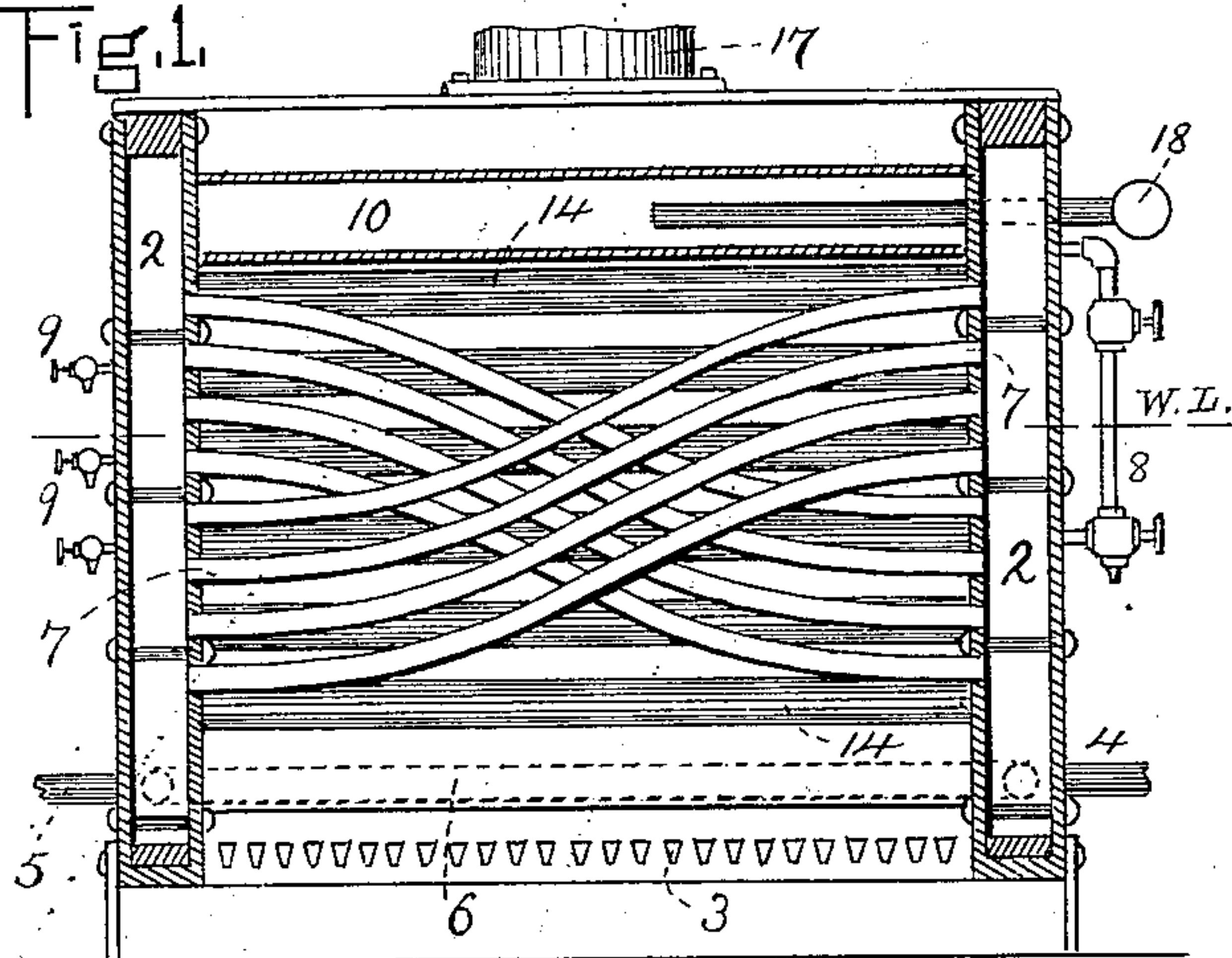


Fig. 2.

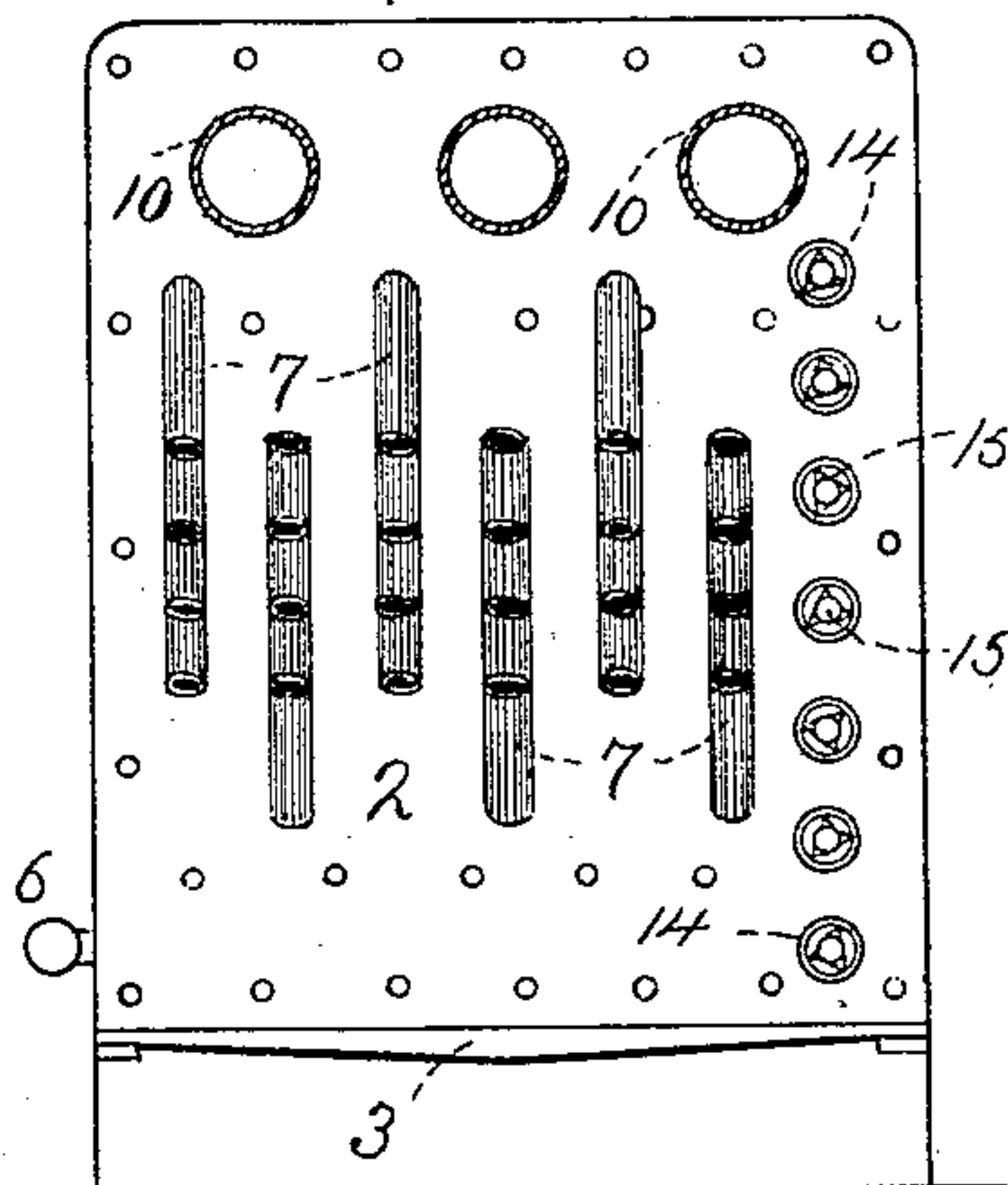


Fig. 3.

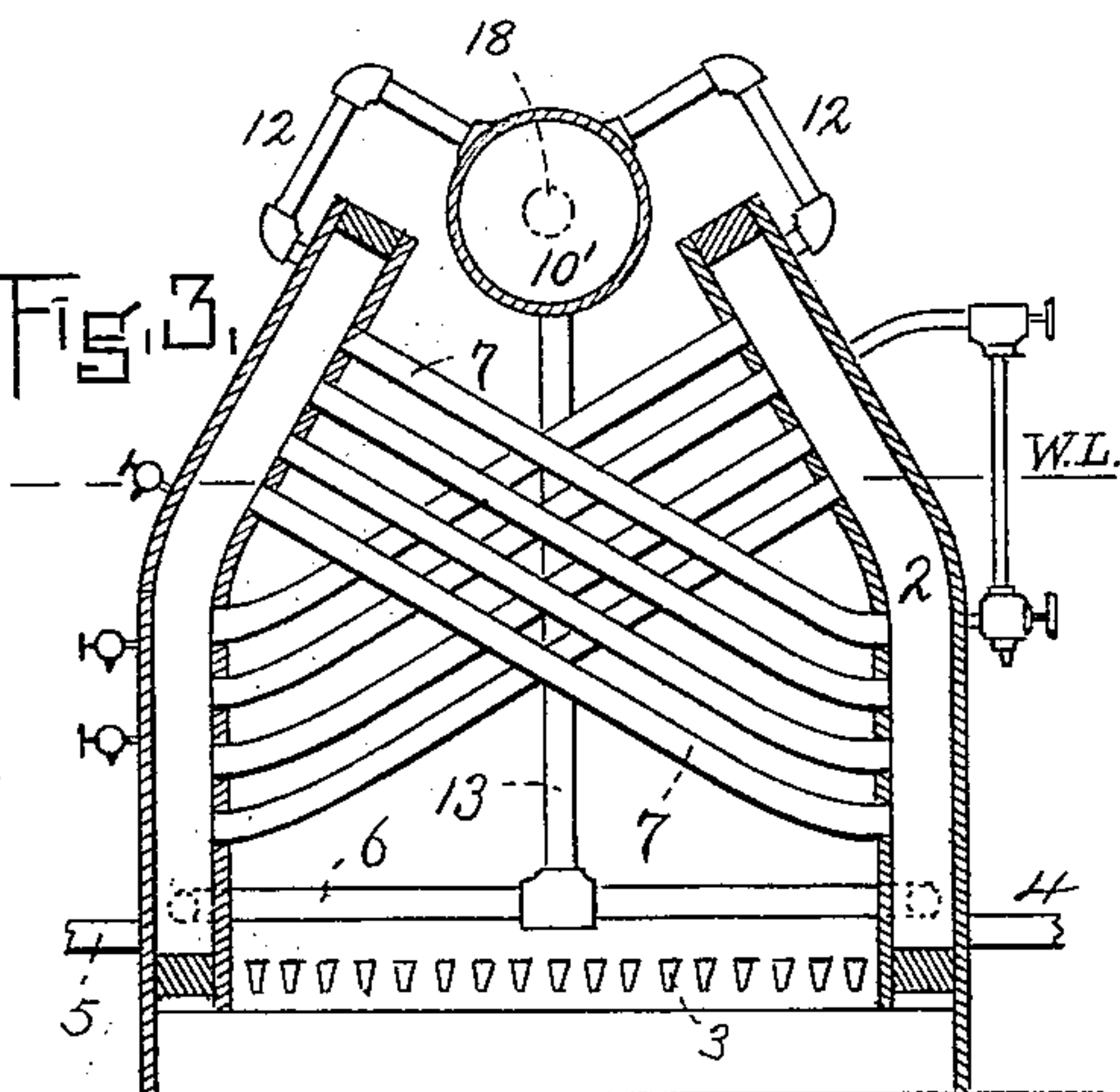


Fig. 4.

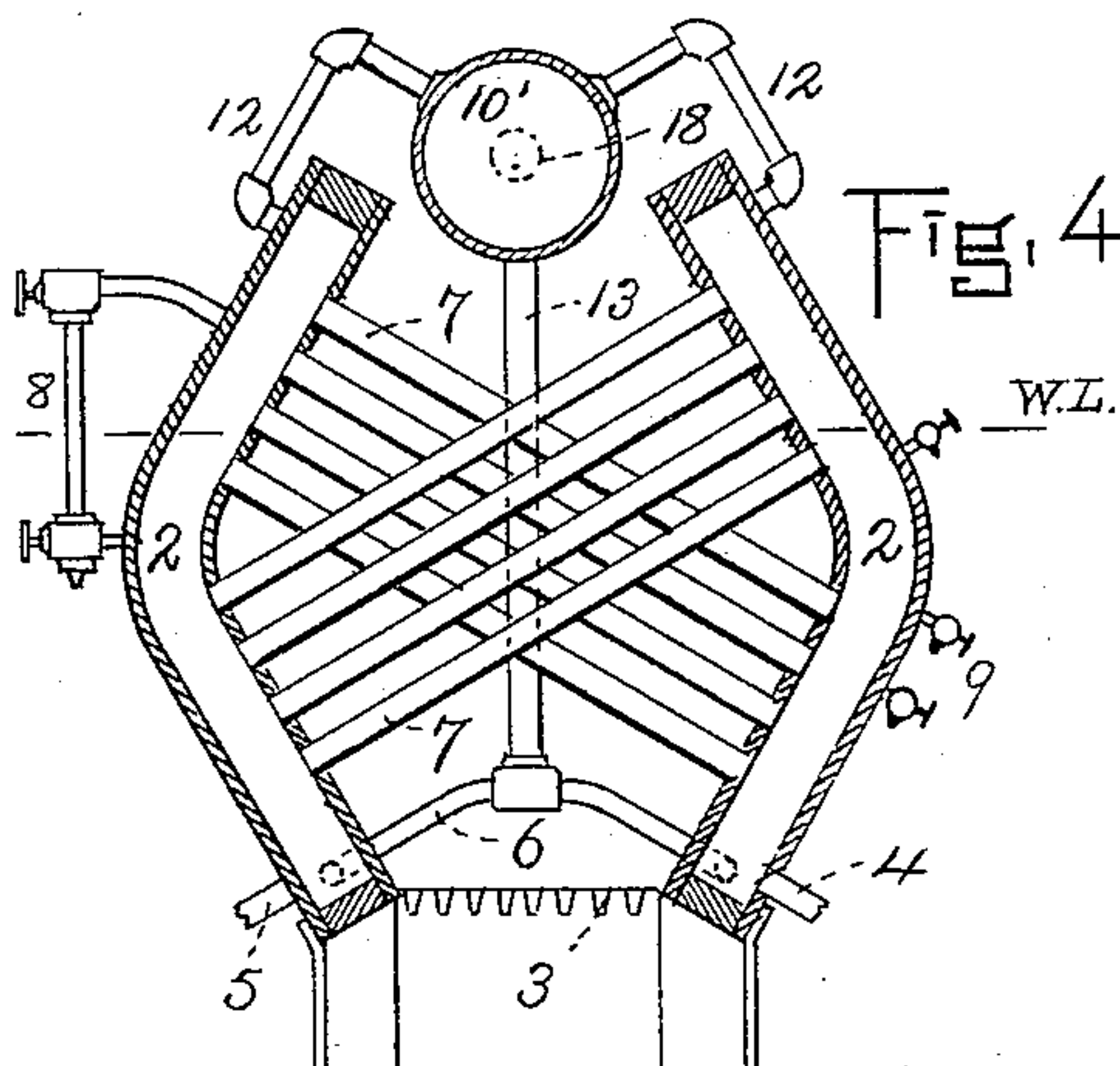


Fig. 5.

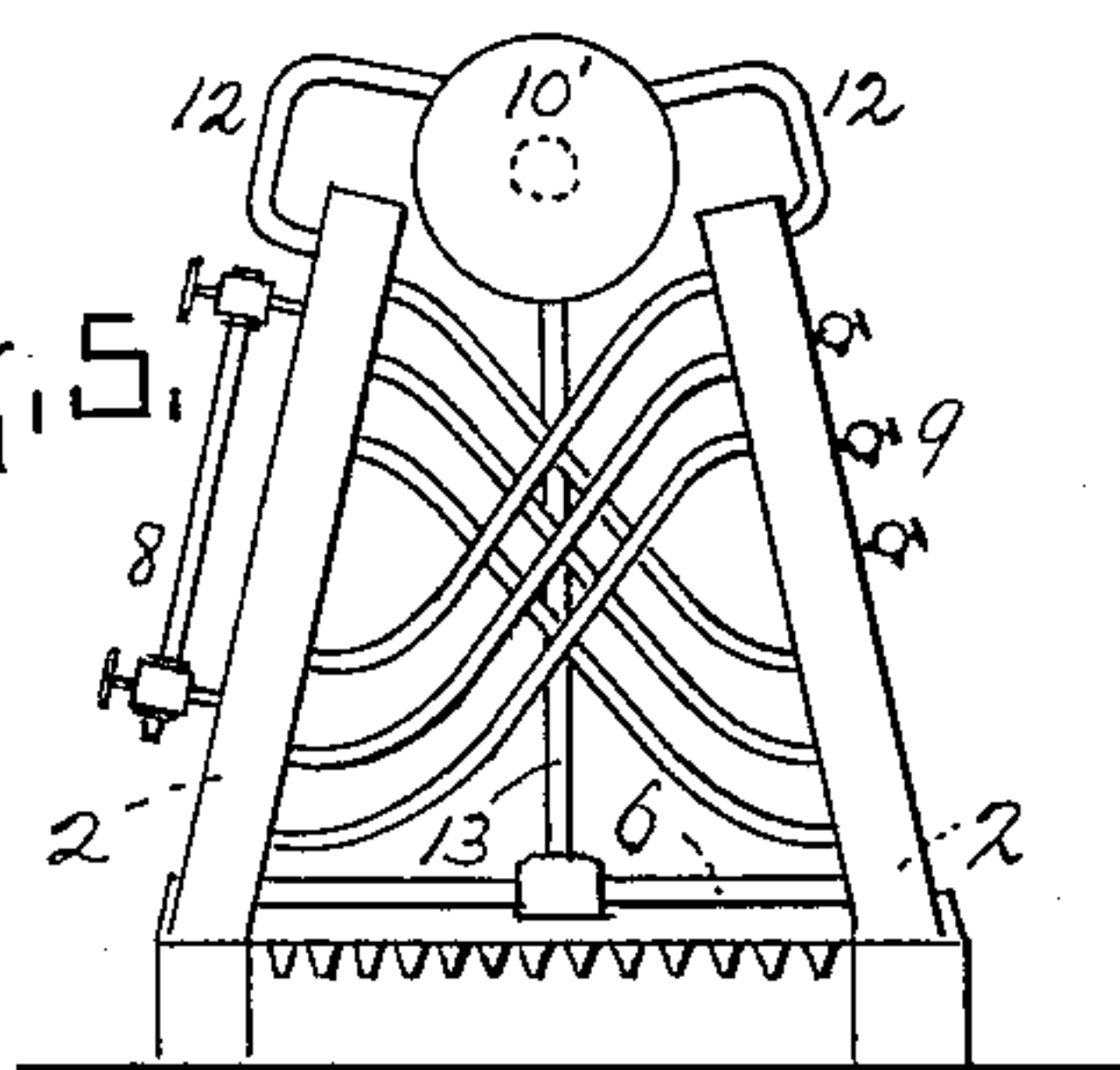
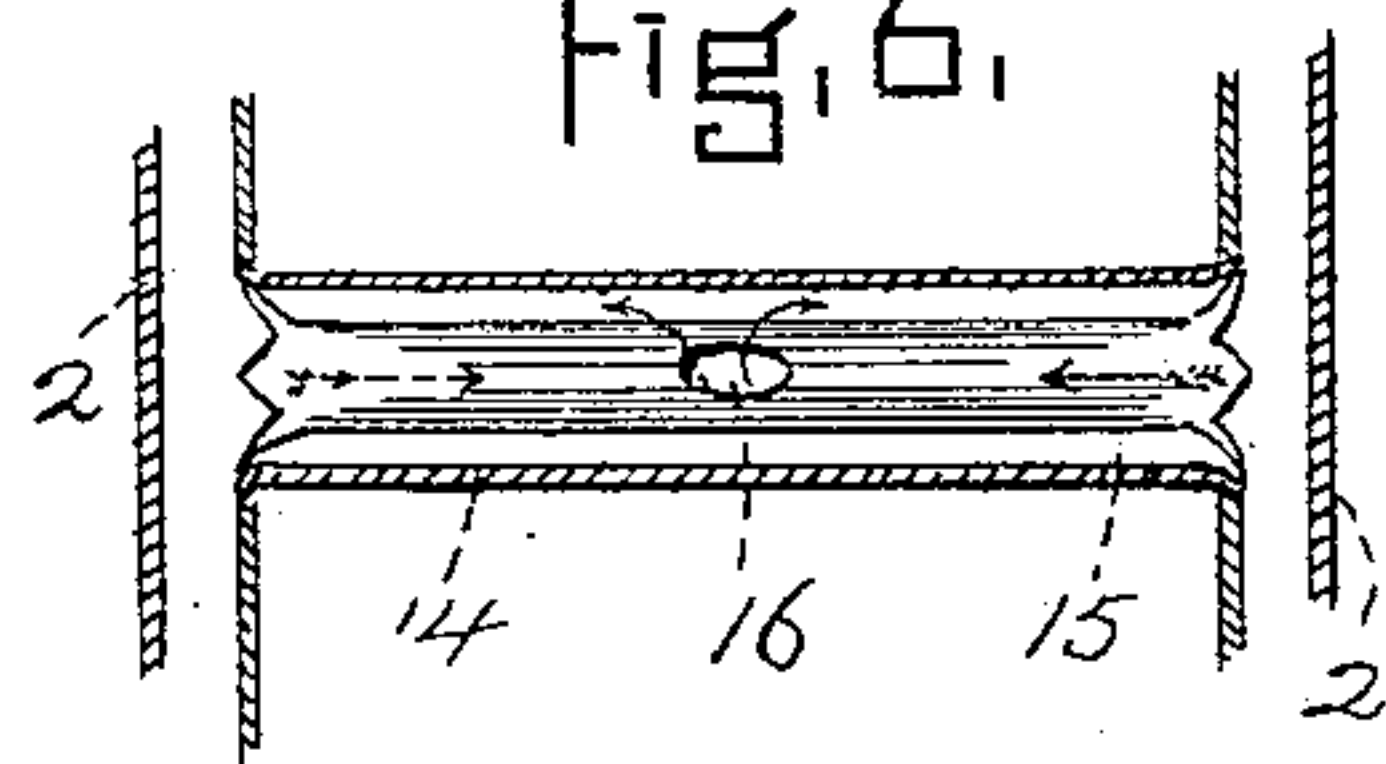


Fig. 6.



Witnesses.

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# UNITED STATES PATENT OFFICE.

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## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 480,417, dated August 9, 1892.

Application filed January 16, 1892. Serial No. 418,324. (No model.)

*To all whom it may concern:*

Be it known that we, THOMAS L. STURTEVANT and THOMAS J. STURTEVANT, citizens of the United States, residing at Framingham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to steam-generators; and it consists in the peculiar disposition of the steam-generating tubes.

A marked feature in this steam-generator is embodied in the arrangement of opposite end headers or steam and water tight receptacles and in the several series of cross-tubes for the generation of steam. These tubes, as will be seen, may be curved or straight and disposed in groups alternately oppositely inclined. The lower ends of one group connect with the corresponding part of that header in which they are located, while the upper ends thereof enter the corresponding portion of the opposite header.

The drawings herewith annexed represent in Figure 1 a front sectional elevation of a steam-generator having straight end headers embodying our invention. Fig. 2 is a vertical transverse section. Fig. 3 is a front sectional elevation of a generator in which the upper end portions of the headers are bent and converge. Fig. 4 is a similar view, in which both ends of the headers converge to adapt them to the use of straight cross-tubes. Fig. 5 is a modified view in end elevation of a generator in which the headers are straight but incline toward each other. Fig. 6 is a sectional view of a cross-tube containing an apertured circulating-pipe.

In the above-described drawings, 2 2 represent end headers or water-legs, which are upright hollow receptacles steam and water tight. The grate-bars are shown at 3, the feed-pipe at 4, a blow-off at 5, and a connecting-pipe 6 between the headers at their base. This pipe is located outside of the fire-box

and at the rear of the generator proper. (See Figs. 1 and 2.)

A prominent point in this steam-generator, as shown in Fig. 1, consists in the combination, with the opposite headers, of a series of cross-tubes 7 7, arranged in groups or sections, as shown in Fig. 2. The individual tubes may be curved or straight, dependent upon the form of the headers, and are united therewith by expanding the ends. Each alternate group has the same inclination, but oppositely of the other, and co-operating groups which compose the steam-generating surface. These tubes effect a good exchange of the water between the two headers when the fire is applied and insure a rapid circulation. Further, their position directly above the fire presents a highly-effective heating-surface, while the greater the angle of inclination of these cross-tubes the more rapid will be the circulation and exchange of water between the headers. In practice the exchange of water is so nearly equal between the headers that no other water connection has been found necessary; but we prefer to put in one or two cross-connection pipes 6, before mentioned, making a water-circuit outside of the fire and insuring an equal water-level. By curving the cross-tubes 7 7 all difficulties occasioned by the unequal expansion of said tubes are avoided.

The various drawings show different forms of headers designed to facilitate the construction of the generators and in some instances permit the cross-tubes to be straight, as shown in Fig. 4, and are to be preferred, since they can be cleansed more readily than the curved ones.

These generators are adapted to carry a water-level; hence the employment of a water-gage 8 and try-cocks 9. The steam-space of the generator by means of the construction indicated in Figs. 1 and 2 is contained in the connecting transverse pipes 10 10, while in Figs. 3, 4, and 5 a single drum or cylinder 10' performs a similar office, being united by the pipes 12 with the upper ends of the headers. In such construction a pipe 13, leading to the pipe 6, conveys away condensed water.

In connection with this class of generators a vertical series of large horizontal cross-tubes



14 are arranged at the rear end of the generator. Said tubes are arranged in a vertical series at the rear end of the inclined tubes, and besides providing steam and water space 5 increase the heating-surface of the generator and incidentally perform the important duty of protecting the end of the casing from the most intense heat of the fire, thus insuring a cooler interior. These several tubes 14 are 10 fitted with internal circulating-pipes 15. The latter are formed with an opening 16 midway of their length, which permits the water to enter both ends of the said pipe and be discharged from either extremity of the cross-tube 14. Inasmuch as the cooler water of the 15 headers must run into the circulating-pipes and be discharged from the central opening 16 into the outer tubes to take the place of the hotter water driven out toward the headers by the heat from the fire there are no opposing currents set up within either tube, the water currents performing a steady and regular circuit.

The operation of this generator, as herein- 25 before described, is as follows: A fire is made upon the grate under the steam-tubes and the products of combustion rise up between the headers and the spaces between the tubes directly to the chimney, (shown at 17.) The 30 tubes thus heated being previously supplied with water to the proper level, such water as is contained in the several groups of cross-tubes 7 7 immediately becomes heated and commences to rise and flows over into the 35 headers, while cold water enters at their lower ends from said headers. Thus a rapid exchange of water between the headers is established as the heat from the fire increases. The steam formed in the cross-tube 7 is liberated as discharged into the headers, and, 40 separating from the water, rises with such steam as is generated in the headers and passes into the steam-space of the generator in Figs 1 and 2 into the pipes 10 10 in Figs. 45 2, 4, and 5 into the cylinder 10', whence it is drawn out, as required, through the steam-pipe 18 and its connections. The water in this form of generator makes a very short and rapid circuit back and forth between the headers. As the latter extend the entire length 50 of the generator, they afford in marine boilers protection to the boat, arresting the effects of a hot fire in two directions.

What we desire to claim is—

55 1. In a steam-generator, the combination,

with opposite headers constructed to form watertight receptacles, of groups of inclined tubes arranged in series and communicating at their lower ends with the lower part of one header and at their upper ends with the upper part 60 of the opposite header, and horizontal cross-tubes arranged in vertical series at the rear of the said inclined tubes, substantially as set forth.

2. In a steam-generator, the combination, 65 with opposite headers, of oppositely-inclined groups of cross-tubes communicating at their lower ends with the lower part of one header and at their upper ends with the upper part of the opposite header, and a series of horizontal cross-tubes forming transverse communications between said headers, each of 70 said horizontal tubes having an interior circulation-pipe.

3. In steam-generators, the combination, 75 with opposite headers and the oppositely-inclined alternate groups of crossed tubes, of a series of horizontal cross-tubes uniting the headers and an interior circulating-pipe formed with an opening midway of its length 80 and located within each horizontal tube, substantially as explained.

4. In a steam-generator, the water-tight headers, the oppositely-inclined alternate groups of curved steam-generating tubes, and one 85 or more steam-collecting tubes which interconnect said headers, combined with a series of horizontal cross-tubes likewise uniting opposite headers and interior circulating-pipes apertured midway of their length and contained one within each cross-tube, substantially as set forth. 90

5. In a steam-generator, the opposite watertight headers formed with their corresponding ends bent toward each other, combined 95 with one or more groups of straight crossed tubes alternately oppositely inclined, which unite said headers, the exterior circulating-pipe 6, one or more steam-collecting pipes, and a series of cross-tubes, each adapted to 100 contain a circulating-pipe formed with a lateral aperture about midway of its length, all operating substantially as explained.

In testimony whereof we affix our signatures in presence of two witnesses.

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Witnesses:

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