H. Waterman,

Steam-Boiler Condenser.

No. 12,079. Patented Dec. 12, 1854.

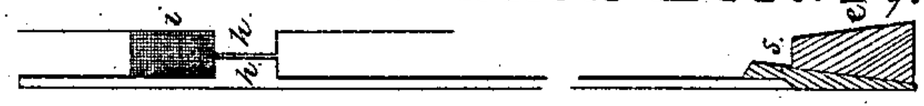

Fig: 6.

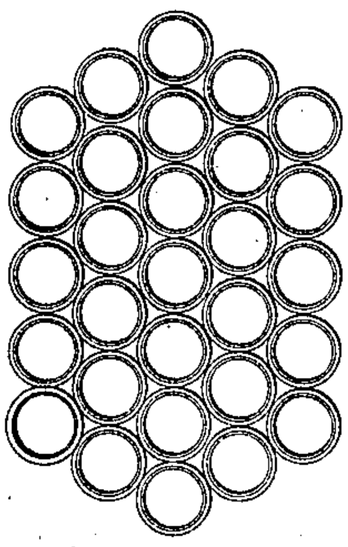

Fig: 4.

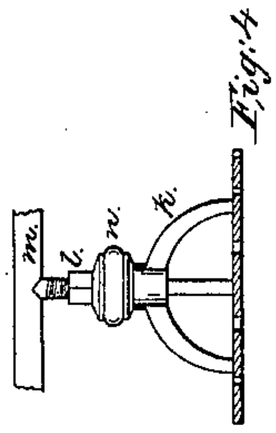

Fig: 2.

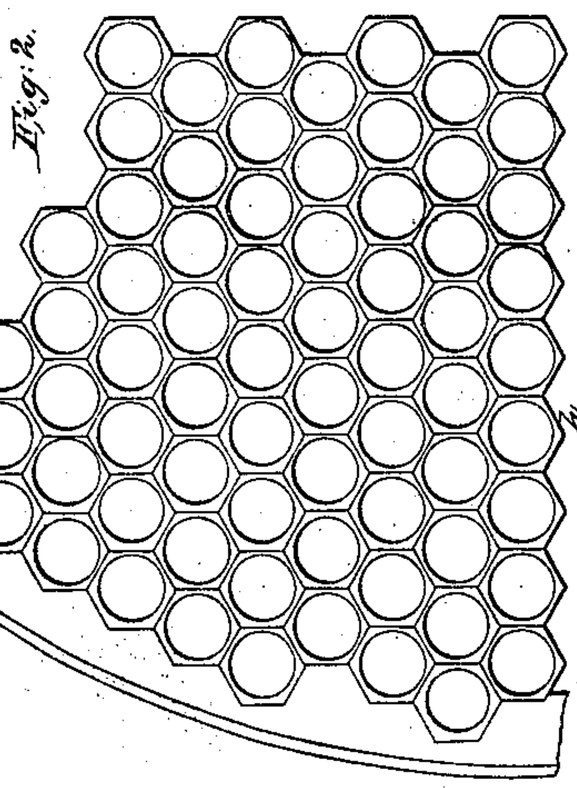

Fig: 1.

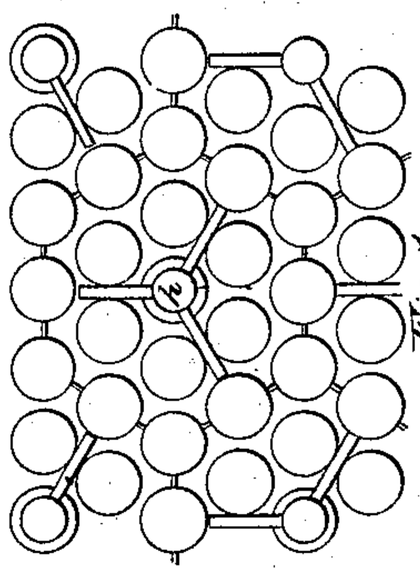

Fig: 3.

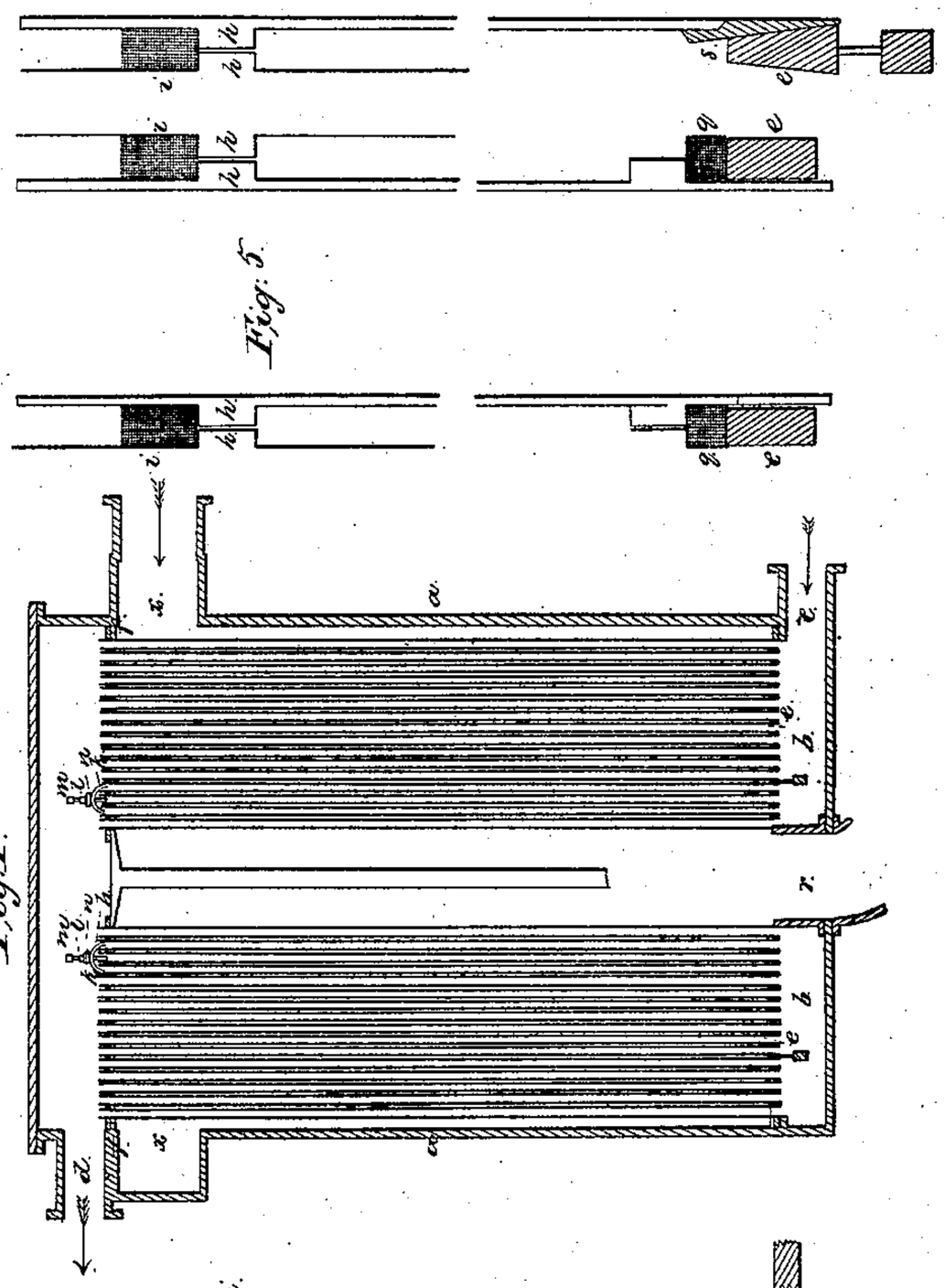

Fig: 3'

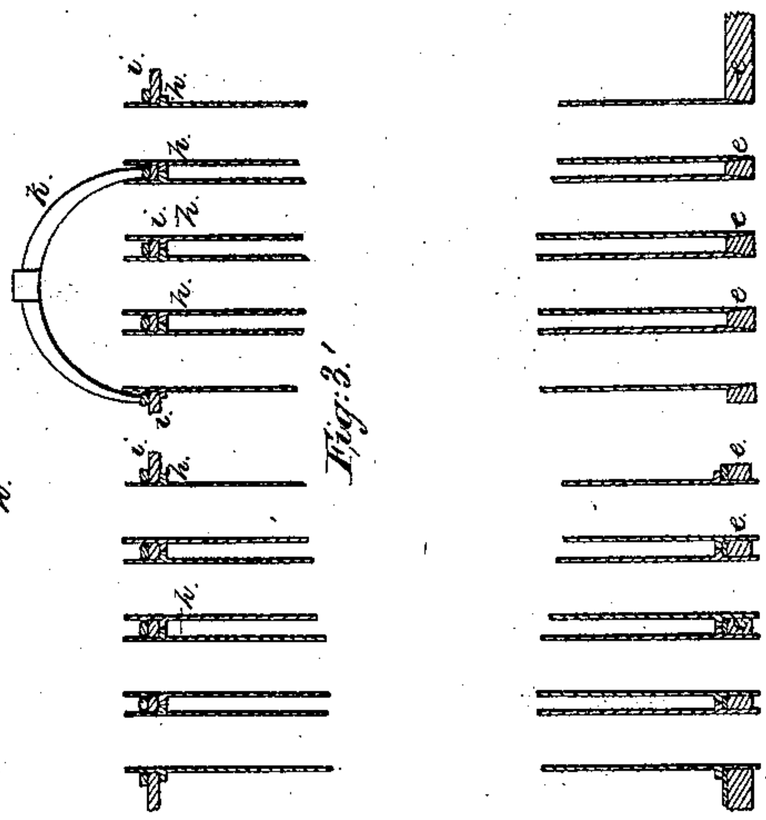

Fig: 5.

Fig: 2.

UNITED STATES PATENT OFFICE.

HENRY WATERMAN, OF HUDSON, NEW YORK.

IMPROVEMENT IN CONDENSERS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **12,079**, dated December 12, 1854.

To all whom it may concern:

Be it known that I, HENRY WATERMAN, of Hudson, in the county of Columbia and State of New York, have invented certain new and useful Improvements in the Construction of the Joints of Surface Condensers for Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form an essential part thereof.

It is understood by engineers that one of the principal difficulties in the practical employment of surface condensers arises from the constant working and loosening of their joints by contraction and expansion, and thereby causes leaks, and thus prevents the obtaining a vacuum and also admits salt-water into the vacuum-chamber, by which a rapid destruction of the joints is caused and the water of the boilers impregnated with salt, which the condenser is intended to prevent. To prevent the leakage of the joints of tubular condensers, allow for any degree of expansion and contraction required, and to so form the parts as to place the tubes at the minimum distance apart, and thereby obtain the greatest amount of surface within a given limit, while I retain all the strength necessary, are the objects of my invention. The construction is shown in the accompanying drawings, but of course the size may vary considerably, as well as the proportions, number of the tubes, and form of the interior case.

The case *a a* is formed of any figure, cylindrical or polygonal, and the best position for the tubes is vertical. There is a water-space at the bottom of this cylinder at *b*, the whole size of the bottom, into which an induction water-pipe *c* opens, the water therefrom passing up through the tubes and making its exit at an eduction-pipe *d* above. The steam to be condensed is let into the case around the outside of the tubes at the top, and when condensed is drawn off below, at the center, by a pipe passing through space *b*. The temperature of water thus conforms in position with that of the steam, the hottest being above, the coldest at the bottom. Although the reverse of this arrangement might be made, I prefer that first named.

The mode of constructing, inserting, and retaining the tubes in place constitutes the important feature of my improvement. One modification of it is as follows: I form a tube-sheet of composition metal, copper, or other suitable metal. I then form therein holes at proper distances apart for inserting the tubes, which should be as near as is possible without touching. I then put this tube-sheet into position at *e*, at the bottom of the case, just above the space *b* before named. A templet is then put into the cylinder at the point *f*, near the top of the case, to serve as a guide to a reamer. The reamer is then put down through a hole in the templet, having a shank long enough to reach the tube-sheet *e*, and I thus truly ream out the hole in the tube-sheet conical, as clearly shown in the drawings at Figure 3. When all the holes are thus reamed out, the tubes are inserted, being first constructed as follows: The cheapest and in many respects the best material for forming the tubes is iron, the lap-welded tube being preferable. The lower end of this tube had better have a short piece of composition metal *s* (see Fig. 3) brazed onto it to prevent corrosion at the joint. This part is turned off conical to fit the tube-sheet. On the upper part of the tubes, near the top, there is also a collar *h*, brazed or otherwise secured, of hexagonal or other proper form, as shown at Figs. 2 and 6. As the tubes are put in place, these hexagonal collars all fit each other, forming the equivalent of an upper tube-sheet, (see Fig. 2,) but each independent of the others, so that each separate tube is at liberty to expand and contract *ad libitum*. Above these collars there is a thick sheet of india-rubber *i*, vulcanized, that is pierced with holes, and fits down around the ends of the tubes over the collars. This is kept pressed tightly down to its place, forming a perfect joint, by means of a series of hexagonal pieces, each covering the space around a half dozen (more or less) tubes, as shown by shade lines. A tripod-brace *k* connects this with a hub or socket above, which is screwed by a screw *l*, that bears against a bar or other fixture *m* above. By introducing cork or other elastic substance *n* between the screw and tripod a yielding pressure will be obtained. In this manner a perfect series of joints are made, and as each tube is independent of all the others all or

any one of them can be removed and returned or replaced with facility, while the others can remain undisturbed.

It is obvious that instead of the conical seats for the lower ends of the tubes similar collars to those above may be made on them (see Fig. 6) and a packing of india-rubber placed between them and the tube-sheets *e*. The tubes may also, if preferred, be laid horizontal, instead of perpendicular, without changing the character of my invention, which is the construction of the joints.

The independent character of the tubes and their ready removal and replacement give me the power conveniently to clean the tubes and inspect them, and I propose in using the iron tubes to galvanize, japan, or otherwise coat them with some suitable non-oxidizing material. By the use of iron thus prepared I get rid of a galvanic action, which is found to exist in copper-tube condensers, to their great injury and destruction of the copper tubes, with their salt-water bath, being an enlarged battery of great magnitude. Instead of india-rubber for packing, felt or other analogous packing may be employed.

The accessories of this condenser may be of any suitable construction for the purpose and position for which it is wanted, all of which is well understood by any competent engineer, and therefore needs no particular explanation.

I claim as my invention—

The mode herein described of forming and placing the tubes of a condenser by the employment of collars, as above described, either with or without the conical pierced tube-sheet, and made at the joints air-tight by means of the india-rubber packing or its equivalent, as above specified.

HENRY WATERMAN.

Witnesses:

JACOB HATZEL,

CHS. H. WARREN.