

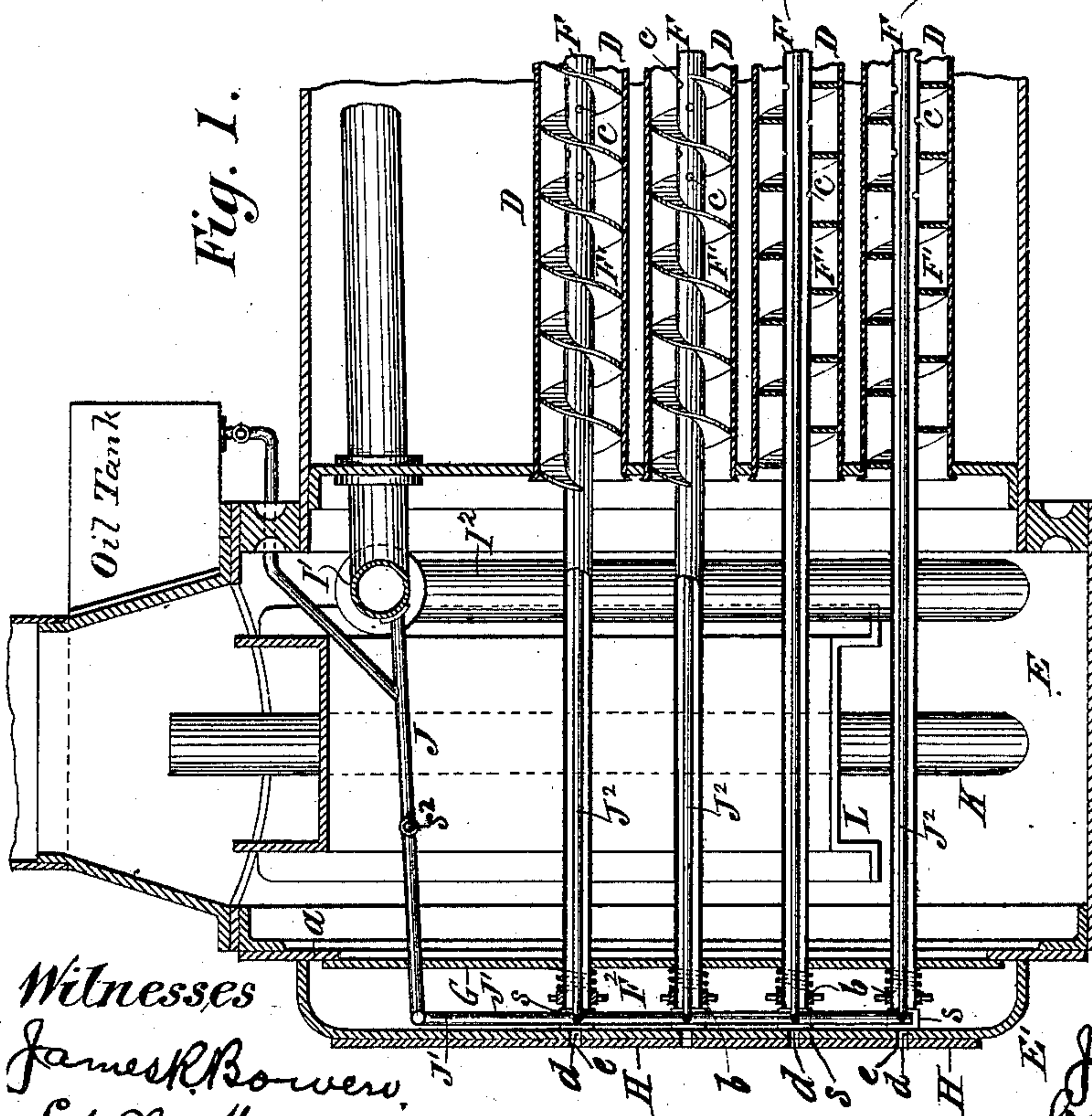
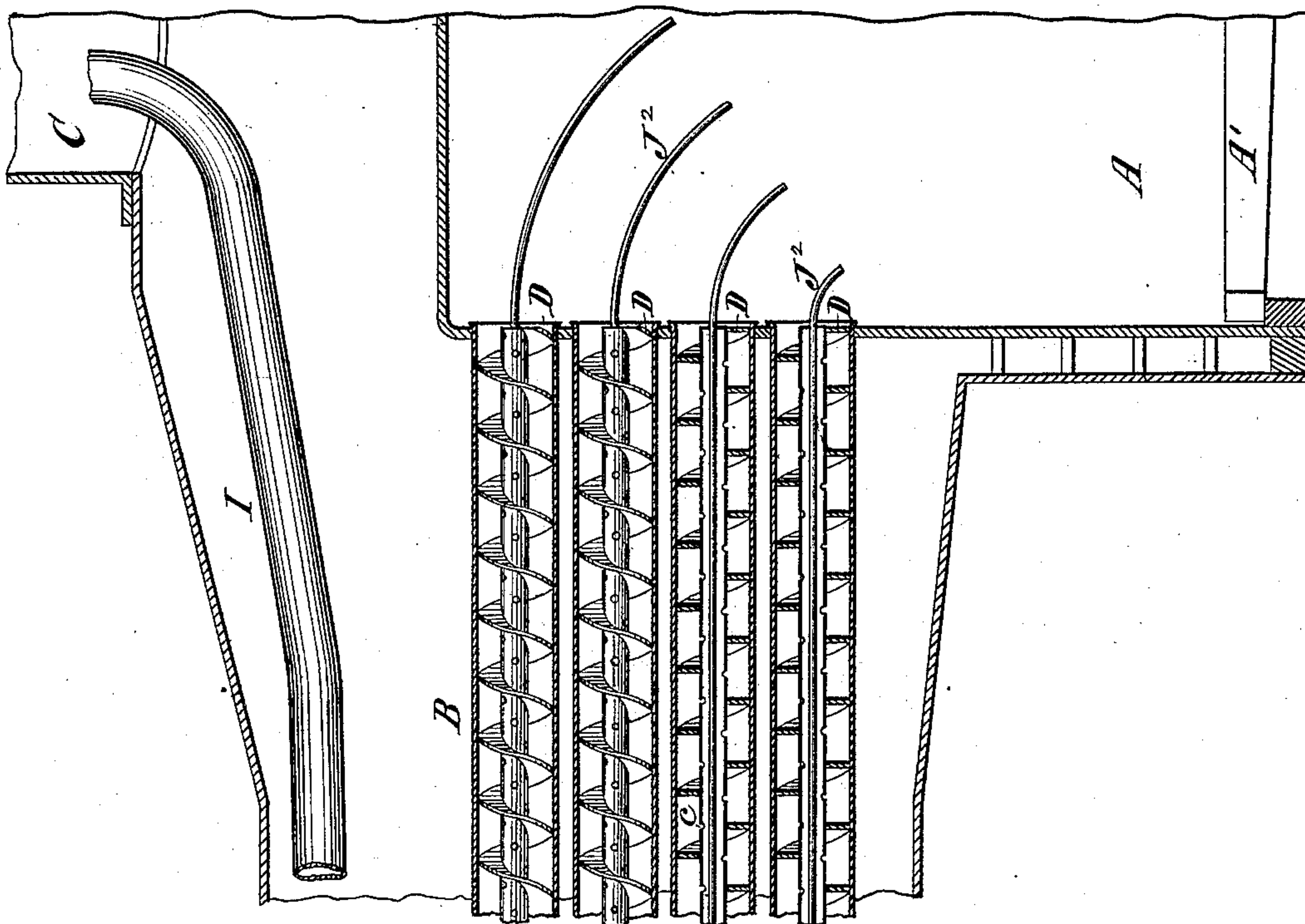
(No Model.)

3 Sheets—Sheet 1.

J. ROBERTS.
STEAM BOILER.

No. 297.009.

Patented Apr. 15, 1884.

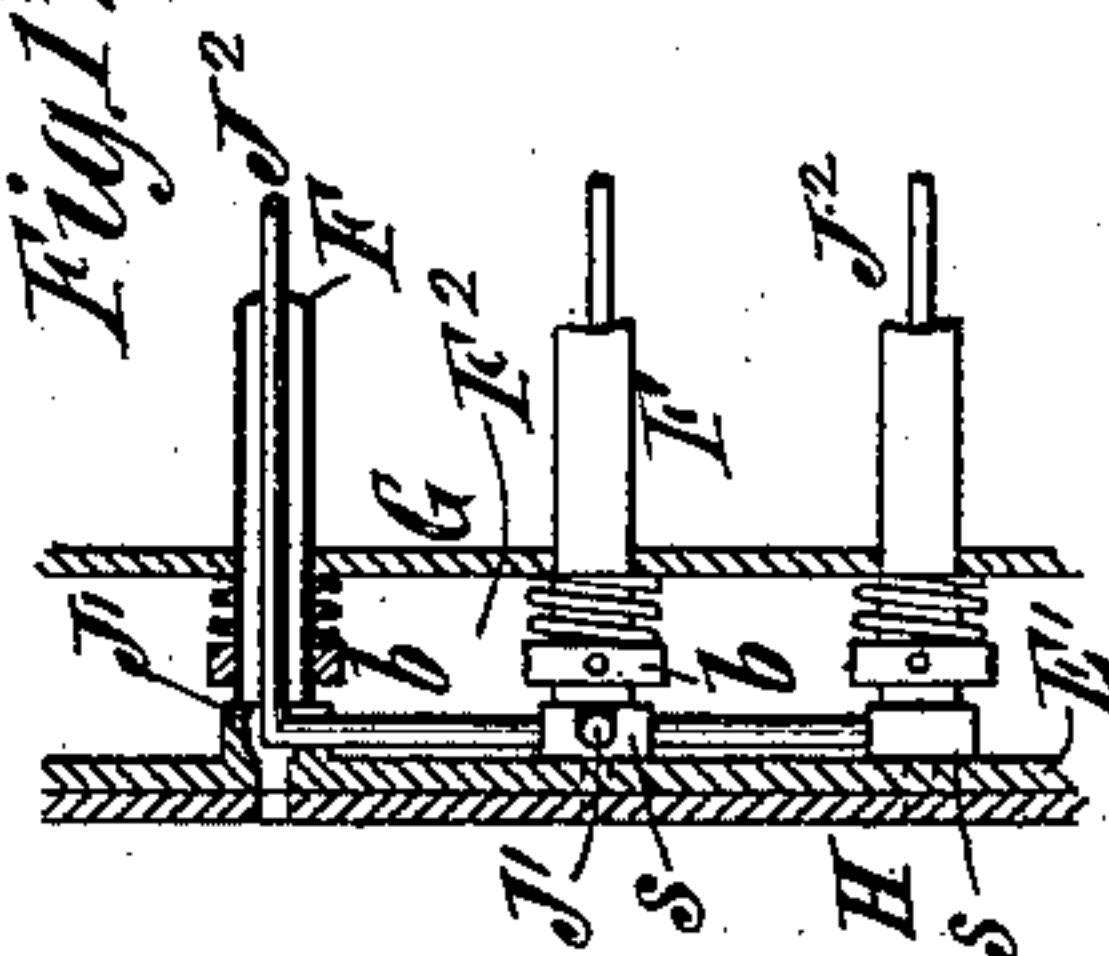


Witnesses

James R. Bowers

Ed. L. Moran

*Fig. 1.**



Inventor

*Jacob Roberts,
by his atty,
Edwin H. Brown.*

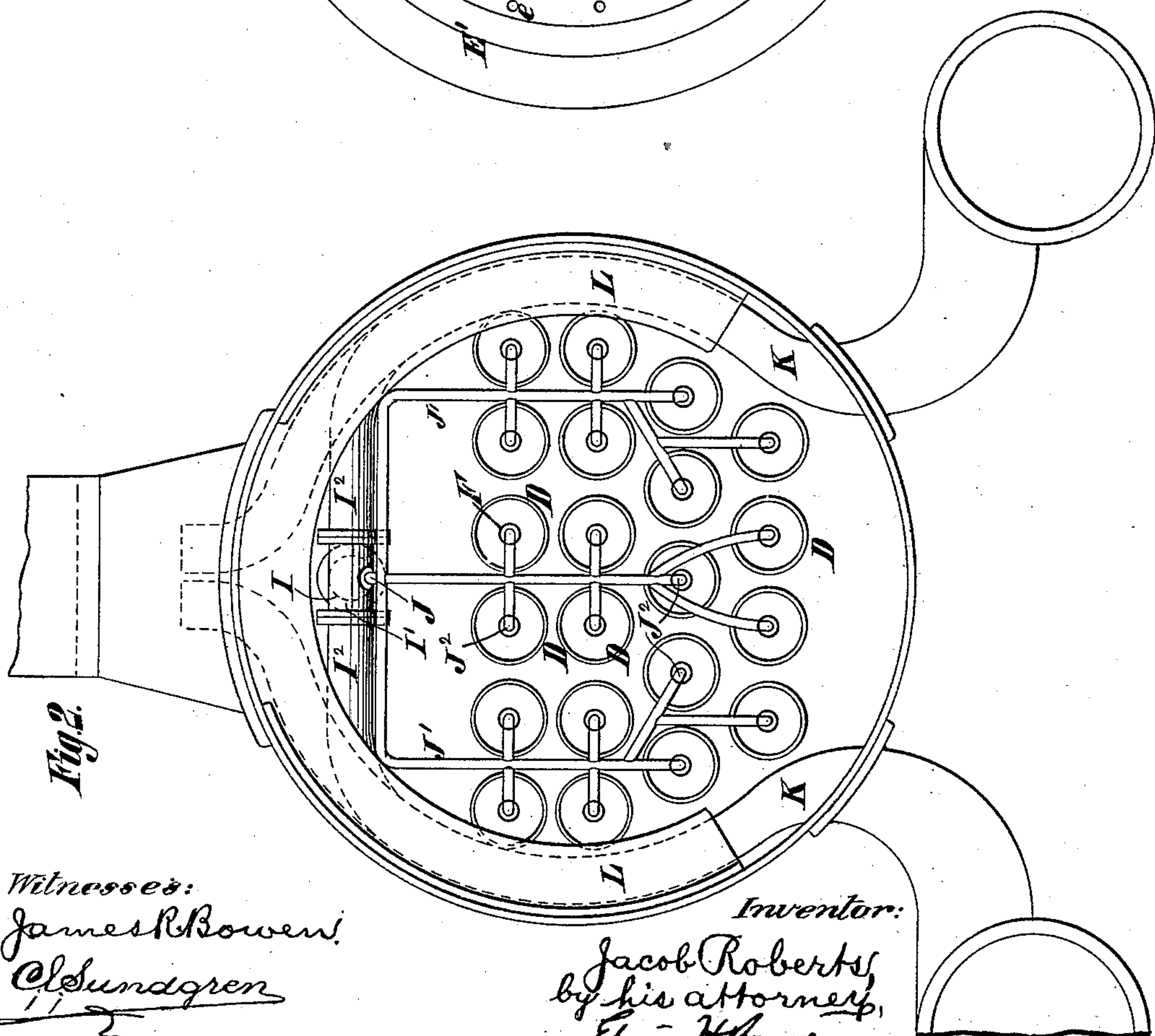
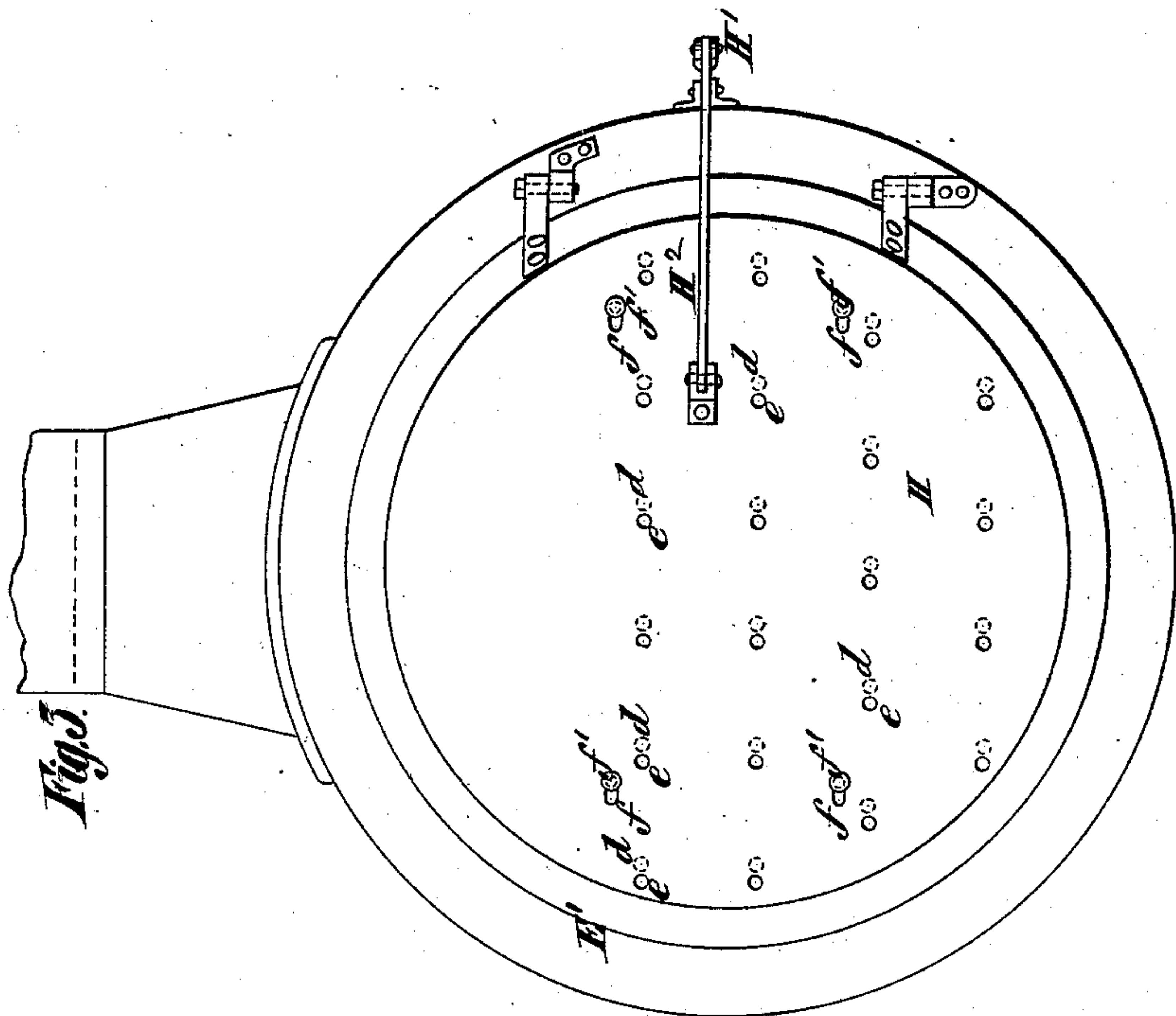
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Witnesses:
James R Bowen
Ol Sundgren

Inventor:
Jacob Roberts,
by his attorney,
Eduard H. Brown

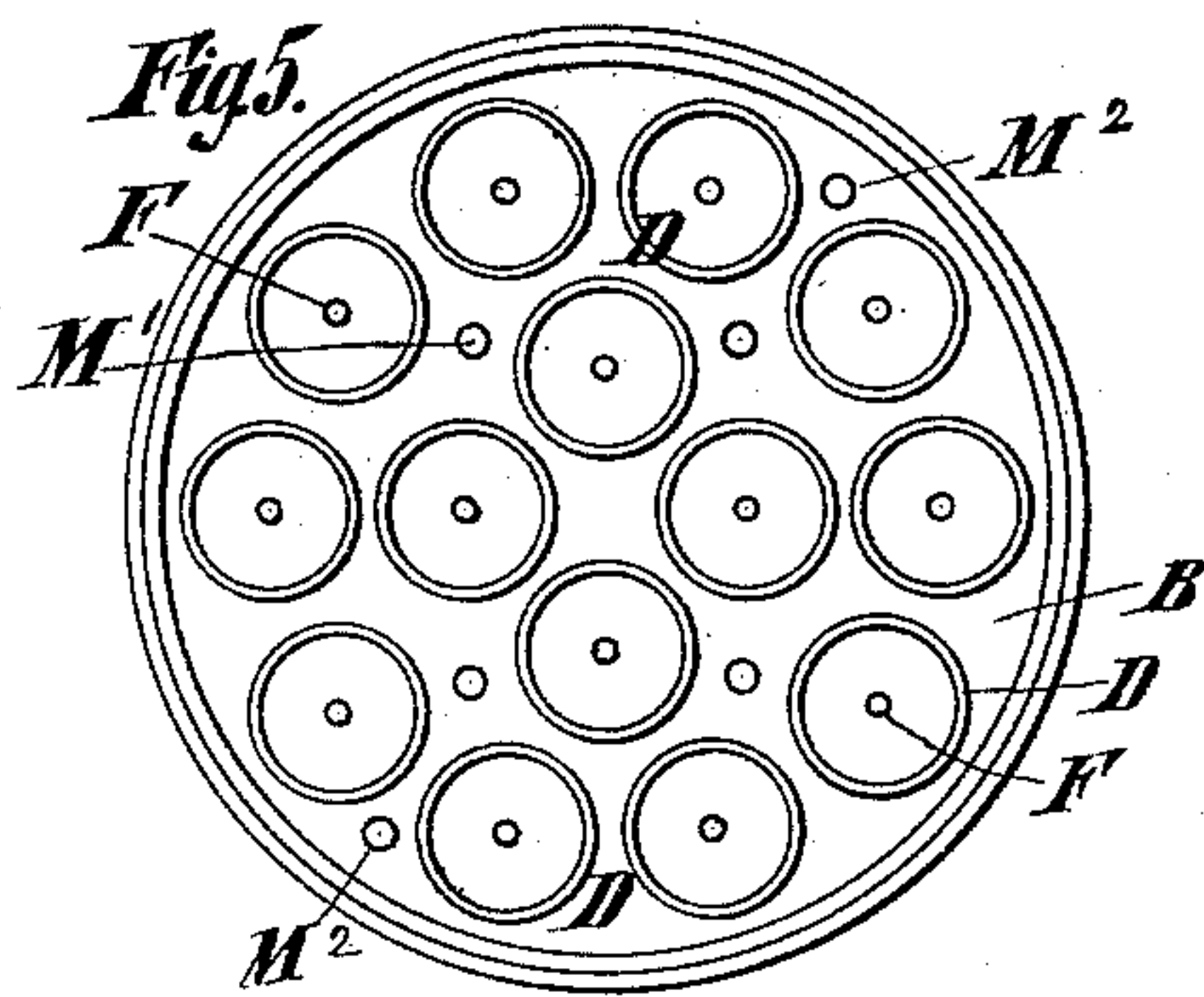
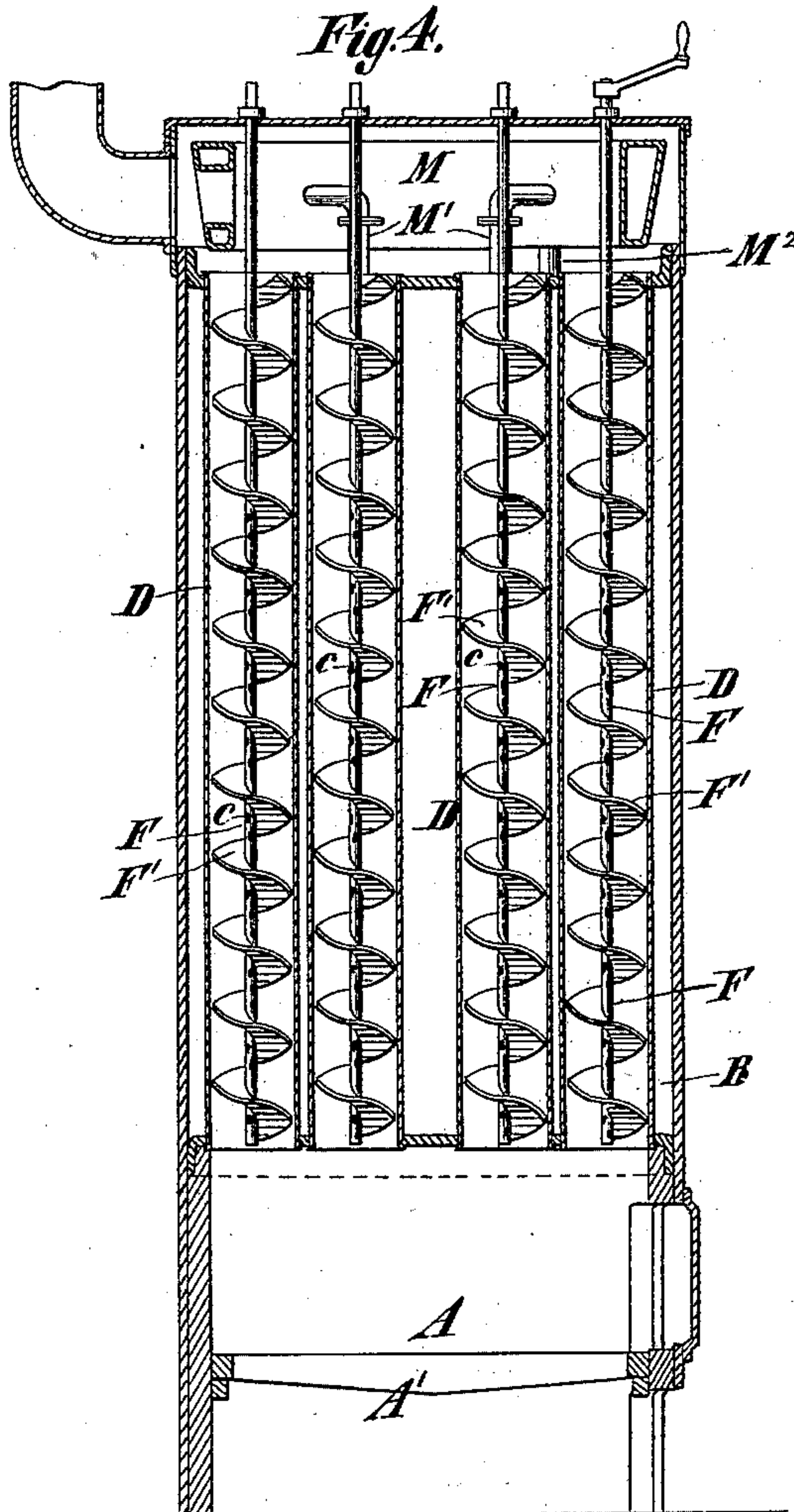
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3 Sheets—Sheet 3.

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Witnesses:
James R. Bowen
O. Sundgren
[Signature]

Inventor:
Jacob Roberts,
by his attorney,
Edwin H. Brown.

UNITED STATES PATENT OFFICE.

JACOB ROBERTS, OF BROOKLYN, NEW YORK.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 297,009, dated April 15, 1884.

Application filed July 16, 1883. (No model.)

To all whom it may concern:

Be it known that I, JACOB ROBERTS, of Brooklyn, in Kings county and the State of New York, have invented a certain new and useful Improvement in Steam-Boilers, of which the following is a specification.

This improvement will be first described in detail, and then pointed out in the claims.

In the accompanying drawings, Figure 1 is a central longitudinal section of a locomotive-boiler embodying my improvement. Fig. 1* is a horizontal section of a portion of the front end of the boiler. Fig. 2 is a front view of the same with the end removed. Fig. 3 is a front view of the same with the end and cover in place. Fig. 4 is a central vertical section of an upright boiler embodying my improvement, and Fig. 5 is a top view of the same with certain parts removed.

Similar letters of reference designate corresponding parts in all the figures.

Referring first to Figs. 1, 2, and 3, A designates the fire-box of the boiler. It may be made of the usual form, and is provided with grate-bars A'.

B is the water and steam space of the boiler, and C is the steam-drum.

D designates a number of flues, which extend from the fire-box A to the smoke arch or chamber E, which is located at the front of the boiler. These will, preferably, be made larger than such flues ordinarily are made.

F designates a number of tubes, which extend through the flues D to the front of the smoke arch or chamber E. The smoke-chamber has a hinged door, E', at the front and communicates with a smoke-stack. These tubes F are open at the forward ends, but closed at the rear ends. Their portions which extend through the flues D are provided with spiral flanges F', which fit snugly in the flues. These flanges may be made of steel or iron. The heated gases and other products of combustion from the fire-box cannot pass directly through the flues, but have to pass spirally between the convolutions of the spiral flanges. In thus passing spirally through the flues they are made to do more effective work in heating the flues than they would if allowed to pass straight through the flues. This is due not only to the fact that they are kept longer in

contact with the flues, but is also due to the fact that the centrifugal action which they have in passing through the flues causes them to impinge against the flues. The spiral flanges, as here shown, fit so snugly in the flues that they support the tubes from which they extend. The forward ends of the tubes F pass through a metal diaphragm, G, which is arranged just outside of the rim *a* at the front of the smoke-chamber, against which the hinged door E' of the smoke-chamber shuts. Beyond the diaphragm G springs F² surround the tubes, and are arranged between the diaphragm and collars *b*, pinned or otherwise secured to the tubes. The springs prevent the rattling or play of the tubes. The door E' of the smoke-chamber is provided with bosses S, which, when the door is closed, abut against the front end of the tubes F. These tubes are studded with perforations *c* throughout their length between the convolutions of the spiral flanges. The door E' has openings *d*, which are coincident with the ends of the tubes F, and through which air passes to the tubes. On the outside of the door is fitted a plate, H, having perforations *e*, corresponding to the openings *d* in the door. This plate is provided with slots *f*, through which pass screws *f'*, that secure it to the door. It may be slid by means of a lever, H', fulcrumed to the boiler and connected to the plate by a rod, H², into such position that its perforations *e* may be brought into line with the openings *d* of the door, or may be wholly or partially removed beyond the same. In this way the supply of air to the tubes F may be regulated and cut off. The air entering and passing through the tubes becomes highly heated and continuously issues in small jets from the perforations *c* in the tubes between the convolutions of the spiral flanges. The motion of the locomotive and the partial vacuum produced outside the perforations in the tubes by the passage of the heated gases and products of combustion around the tubes induces the air to pass through the tubes and issue from their perforations. The air may be forced in by mechanical means, if desirable. Mingling with the heated gases and products of combustion passing around the tubes, the heated air produces a very effective combustion, and utilizes a much larger percentage of

the carbon in the fuel than is ordinarily utilized. The combustion is thus extended through the flues.

The collars *b* or the ends of the tubes *F* may be made polygonal, so that after opening the door *E'* a wrench may be applied to them to turn them. By turning them the spiral flanges will be caused to scrape off scales, soot, and other matter which collect on the interior of the flues, and will feed the same into the fire-box or into the smoke-chamber, according to the direction in which the tubes are turned.

I designates a pipe extending from the steam-dome through the forward end of the water and steam space of the boiler into the smoke-chamber. In the smoke-chamber it has a T-shaped coupling, *I'*, connected to it, and from this T-shaped coupling branch pipes *I*² extend close to the interior of the smoke-chamber. These branch pipes extend down to the valve-chests of the cylinders of the locomotive-engines.

From the coupling *I'* a pipe, *J*, extends towards the front of the smoke-chamber and communicates by means of branch pipes *J'* with a number of pipes, *J*², which extend through the tubes *F* into the fire-box. Steam is thus conducted through the tubes *F*, and issues in jets within the fire-box, forming there hydrogen gas which will mix and combine with the oxygen in the flues *D*.

In order to connect the branch pipes *J'* with the pipes *J*² and still afford provision for turning the tubes *F*, I connect the pipes *J'* *J*² beyond the ends of the tubes *F*. As shown in Figs. 1 and 1*, the bosses *S* on the door *E'* are slotted, and the branch pipes *J'* extend downward through the bosses and lie within the faces of the bosses, against which the ends of the tubes *F* abut. The pipes *J'* are not connected in any way with the door, and hence it may be readily opened. The exhaust-pipes *K* lead from the exhaust-ports of the engine-cylinders into the smoke-chambers, and extend up along opposite sides of the interior of the smoke-chamber into the lower portion of the smoke-stack. As shown, they lead into petticoat flues or pipes *L*, through which waste products of combustion pass.

In Figs. 4 and 5 I have shown tubes *F* provided with spiral flanges and fitted in the flues *D* of an upright boiler. The tubes *F* are perforated, as in the other boiler. The tubes *F* are suspended by means of collars at the upper ends. The steam and water chamber of this boiler is connected to an annular superheater, *M*, by pipes *M'*, conducting steam thereto, and by pipes *M*², returning water of condensation from the superheater. In either example of my improvement the wrench for turning the tubes *F* may engage with a cross-pin extending through the tubes, if the tubes are not made externally polygonal at the ends.

The spiral flanges on the tubes *F* serve as

spark-arresters in addition to their other functions.

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

1. In a steam boiler, the combination, with a fire-box, a smoke arch, chamber, or passage, and flues extending between the same, of perforated tubes extending through the flues and serving to conduct air into the same, and spiral flanges between the flues and tubes, substantially as described, whereby the products of combustion are caused to circulate spirally through the flues and air is discharged from the tubes into them.

2. In a steam-boiler, the combination, with a fire-box, a smoke arch, chamber, or passage, and flues extending between the same, of perforated air-tubes extending through the flues, capable of being turned, and having spiral flanges secured upon them within the flues, substantially as herein described, whereby the products of combustion are caused to circulate spirally through the flues and air is discharged from the tubes into them.

3. In a steam-boiler, the combination, with a fire-box, a smoke arch, chamber, or passage, and flues extending between the same, of air-tubes arranged within the flues, spirals between the tubes and flues, and pipes passing through the air-tubes and serving to convey steam to the fire-box, substantially as specified.

4. In a steam-boiler, the combination, with a fire-box, a smoke arch or chamber, and flues extending between the same, of perforated tubes extending into the flues, and a door or cover at the front of the smoke arch or chamber provided with perforations with which the forward ends of the tubes communicate, substantially as specified.

5. In a steam-boiler, the combination, with a fire-box, a smoke arch or chamber, and flues extending between the same, of perforated tubes extending into the flues, spiral flanges secured to those portions of said perforated tubes which extend into said flues, a door or cover at the front of the smoke arch or chamber provided with perforations with which the forward ends of the tubes communicate, and a perforated slide plate or valve, whereby the passage of air through the perforations of the door or cover may be regulated, substantially as specified.

6. In a steam-boiler, the combination of the flues *D*, the tubes *F*, the spiral flanges *F'*, secured to said tubes, the diaphragm *G*, the springs *F'*, pins or their equivalents beyond the springs, and the door or cover *E'*, substantially as specified.

JACOB ROBERTS.

Witnesses:

T. J. KEANE,
JAMES R. BOWEN.