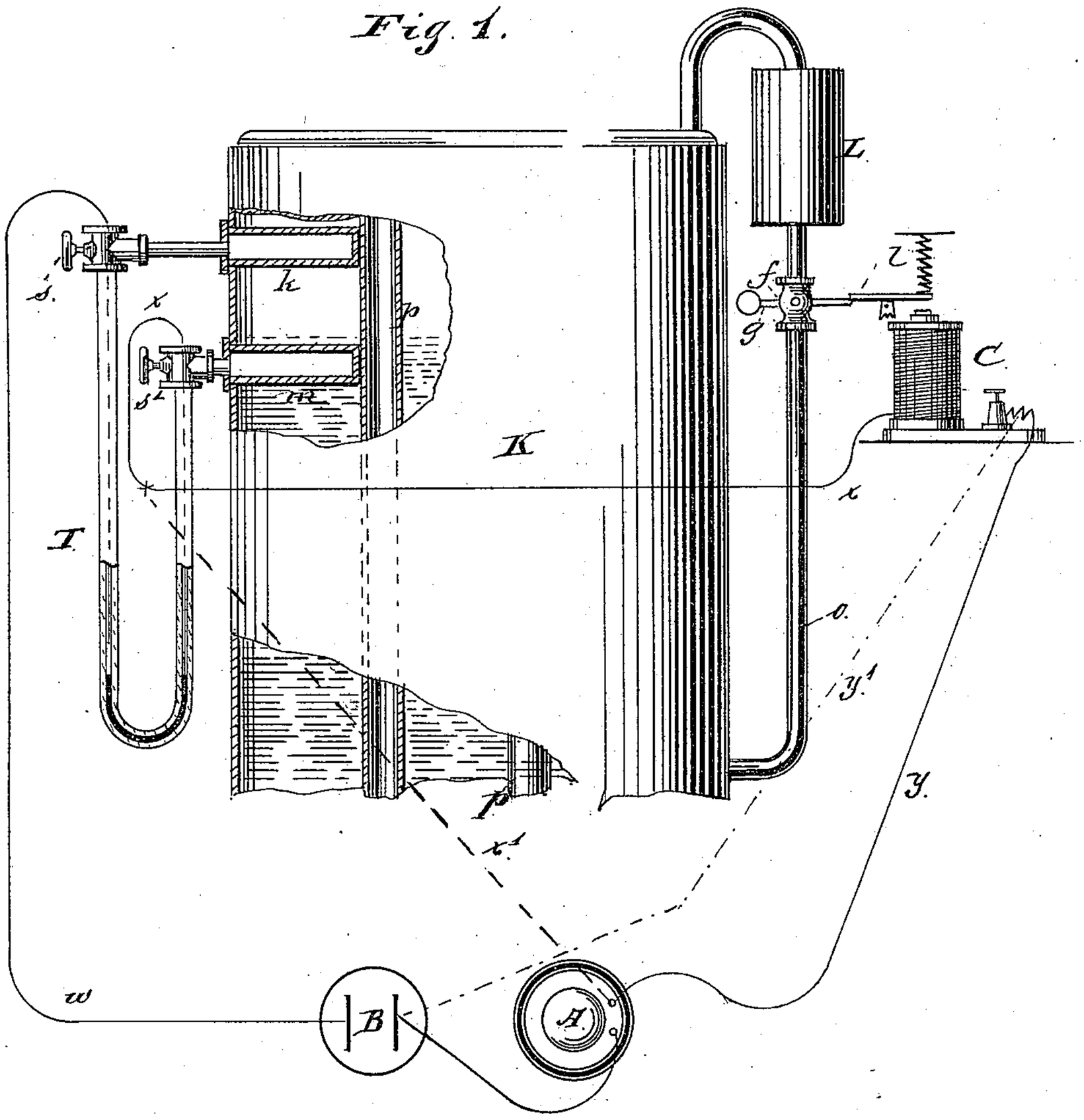
(No Model.) 3 Sheets—Sheet 1.

J. E. SIEBEL.

SAFEGUARD AGAINST BOILER EXPLOSIONS.

No. 355,793. Patented Jan. 11, 1887.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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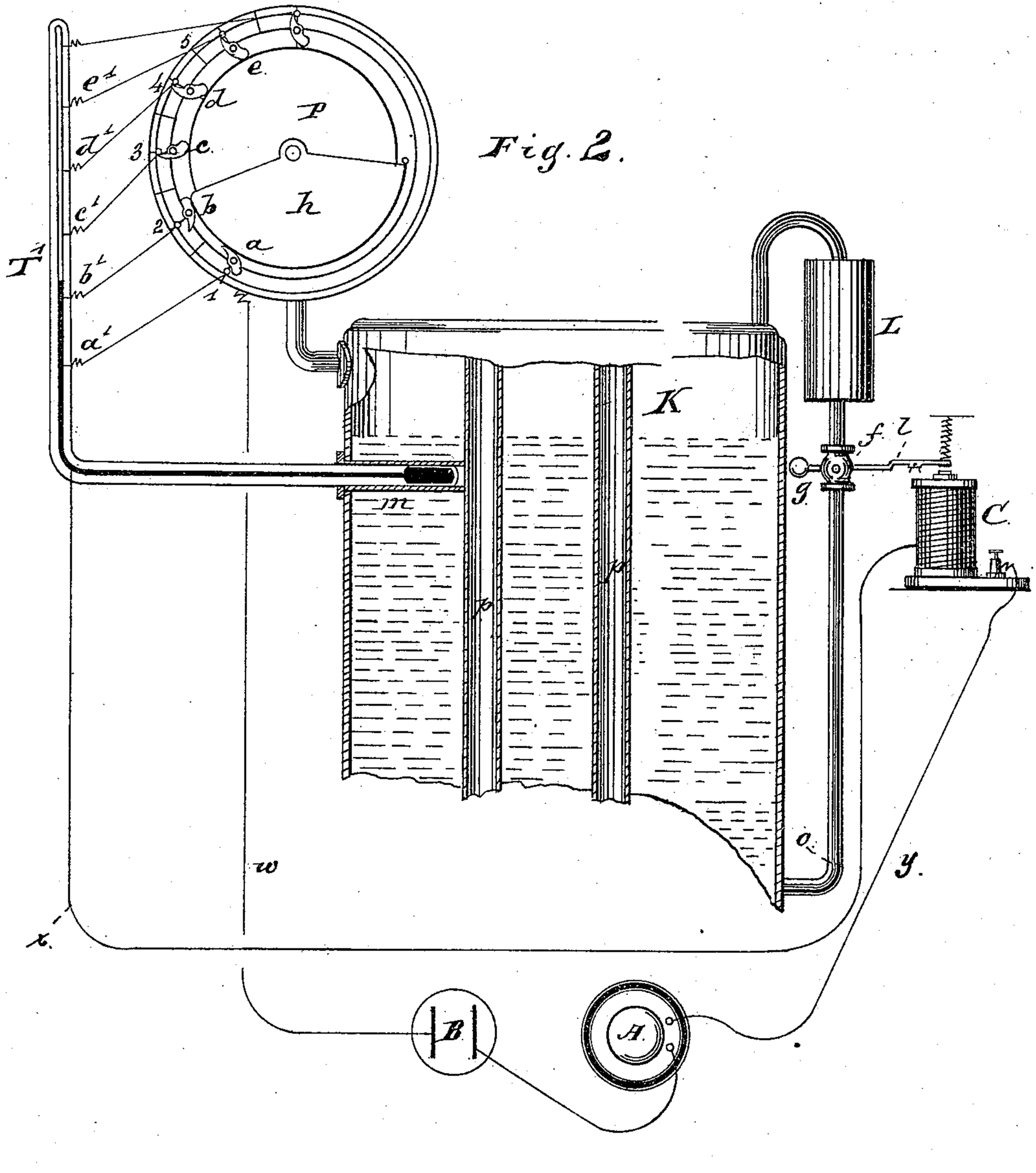

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(No Model.) 3 Sheets—Sheet 3.

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SAFEGUARD AGAINST BOILER EXPLOSIONS.

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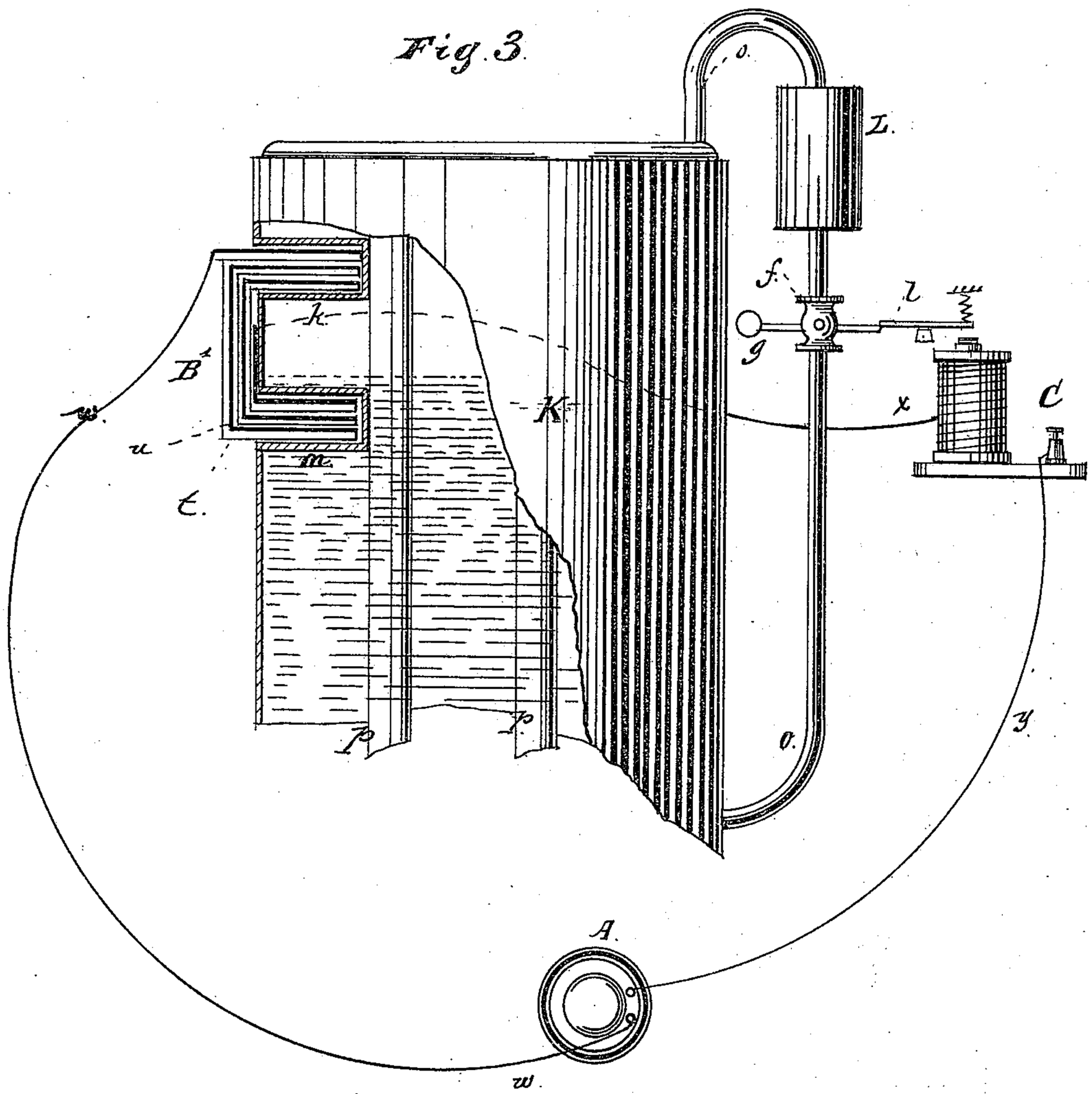
Fig. 3.



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SAFEGUARD AGAINST BOILER EXPLOSIONS.

SPECIFICATION forming part of Letters Patent No. 355,793, dated January 11, 1887.

Application filed October 17, 1885. Serial No. 180,176. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. SIEBEL, of Chicago, in the county of Cook and State of Illinois, have invented new and Improved Safeguards Against the Explosion of Boilers, Cookers, and Similar Appliances, of which the following is a specification.

My invention relates to safeguards against explosions of boilers which are due to a superheating of the water in the boiler or to a retardation of the boiling of the same. I find that under such circumstances a surplus of heat accumulates in the water, which, after having reached its maximum, suddenly disengages itself, causing the generation of an enormous amount of steam and consequent explosion. Therefore, whenever these dangers are approaching, the temperature in the water-space of the boiler increases at a quicker ratio than the temperture and the pressure in the steam-space of the boiler. These abnormal differences, whenever they occur, are utilized in my invention by being converted into motive force, so as to establish or close an electric circuit which automatically and simultaneously opens a valve to allow a fluid to enter the boiler and gives an alarm of the occurrence. The fluid which so enters the boiler causes a commotion in the boiler, thereby insuring the boiling of the water and preventing a further dangerous retardation of the boiling.

Several devices may be constructed which involve the principle above referred to. I attain the object mentioned by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 shows a vertical elevation, partly in section, of the mechanism as applied to an upright steam-boiler. Fig. 2 shows a vertical elevation, partly in section, of a modification of this mechanism as applied to an upright steam-boiler. Fig. 3 shows a vertical elevation, partly in section, of another modification of this mechanism as applied to an upright steam-boiler.

Similar letters refer to similar parts throughout the several views.

K represents a steam-boiler with flues *p*; *m* and *k*, receptacles in the steam and water spaces of the boiler, respectively.

L is a vessel containing a fluid to pass into the boiler through the pipe *o* on the opening of the valve *f*.

C is an electro-magnetic coil with armature *l*.

A represents an electric alarm, and B a battery.

g is a weight, which opens the valve *f*, if released; and *x*, *w*, and *y* are conducting-wires.

s s' are small air-vents.

The air-chambers *m* and *k* are connected by means of a U-shaped glass tube, T, the lower portion of which contains a thread of mercury, at one end of which is inserted an iron wire, forming a portion of a galvanic circuit. The other end of the conducting-wire *w* of this circuit terminates near the other end of the mercurial thread, but does not touch the same under normal conditions within the boiler.

Whenever the water in the boiler should have a tendency to become superheated, the water becomes comparatively much hotter than the steam above, in consequence of which the air contained in the chamber *m* is more expanded than in the chamber *k*, and the mercury-thread will move toward *w*, and, touching the same, establishes connection between the wires *x* and *w*, thus closing the galvanic circuit. As soon as this takes place the soft iron in the electro-magnet C becomes magnetic and attracts the armature *l*, thereby releasing the weight *g*, which, in falling downward, opens the valve *f*, thereby allowing a fluid contained in the vessel L to flow into the boiler. At the same time the circuit being now established the electric bell or other alarm, A, will sound or ring, thus notifying the engineer or attendant to refill the vessel L and to place the weight *g* and valve *f* in proper position again. The fluid contained in the vessel L must be of such a character as to produce a commotion in the water of the boiler. For this purpose it may be an aeriform fluid, such as atmospheric air in a highly-compressed state, or a liquid fluid which will generate gas when entering the boiler. In using the latter I prefer a solution of bicarbonate of soda or potash, which is filled into the vessel L. This being

connected with the water and steam space of boiler allows the liquid to flow into the boiler by its own weight whenever the valve is opened, and, owing to the generation of carbonic-acid gas, causes ebullition.

Fig. 2 shows a modification of this apparatus, in which T′ represents a mercurial thermometer inserted in the boiler at *m*, and the mercury of which is connected with one pole of the battery B. The wire issuing from the other pole passes around the electric bell A, and thence to the metallic pins *a*, *b*, *c*, *d*, and *e*, fixed in an isolated position at different degrees of the pressure-gage P. These points serve as fulcrums for small levers, which are so weighted, shaped, and balanced that one end of them will rest against the metallic points 1, 2, 3, 4, and 5. These points are the termini of the platinum wires melted into the tube of the thermometer at points indicating temperature *a′ b′ c′ d′ e′* corresponding to the pressure indicated by *a*, *b*, *c*, *d*, and *e*.

h is a segment of a circle, which serves as indicator, and which in passing the points *a b c d e* lifts the respective levers leaning against the points 1, 2, 3, 4, and 5 and interrupts the electric circuit, which otherwise would have been established.

Whenever the mercury in the thermometer reaches any one of the points *a′ b′ c′ d′ e′* before the indicator on the pressure-gage reaches the corresponding points, the electric circuit will be closed, and in consequence the valve *f* will be opened and the fluid contained in L will flow into the boiler, while the alarm ringing at the same time notifies the attendant of the occurrence and of necessity of refilling the vessel and of raising the weight *g* into position again.

Instead of the dial-gage P and the thermometer T′ any other form of gage and thermometer may be readily adapted to perform the same duties.

The air-chambers *m* and *k* in Fig. 1, the tube connecting them, and the mercury within really constitute two thermometers combined, or what is known as a "differential air-thermometer," and any other device used in its place by physicists may be substituted for the same. As one of these substitutions I will mention the use of a thermo-electric pile made of iron and German silver wire, or of any other material, which may be placed one pole end within the steam-space and the other end within the water-space of a boiler when any differences in temperature at both ends demonstrates itself by an electric current within the circuit connecting the ends of the said thermo-electric pile, which current, as soon as established, opens the valve *f* and causes the alarm to ring. This modification is illustrated in Fig. 3, *m* and *k* being the respective poles of the thermo-electric battery, made from German silver *u* and iron wire *t*, connected by wires *x* and *w* with the coil C and alarm A. Whenever, owing to the difference of temperature in the steam and water space of the boiler, an electric current is generated, the valve *f* will be opened and the alarm will be sounded in the manner and for the purpose described.

Under ordinary circumstances and for obvious reasons I use the alarm together and simultaneously with the vessel L, containing the fluid to cause ebullition. If, under exceptional circumstances, it should become desirable to operate only one automatically, or to use the differential thermometer alone, this can be done by disconnecting the wires *w* and *x* altogether, or by substituting the wire *y* by the wire shown by dotted line *y′*, Fig. 1, in case it is desired to throw out the alarm A, and by substituting the wire *x* by the wire shown by the dotted line *x′*, in case it is desired to disconnect the coil C, and with that the vessel L.

What I claim is—

1. The system for preventing the explosion of boilers, consisting of a vessel, L, with valve *f* and electro-magnet C, permitting an inflow into the boiler of a fluid causing ebullition, of an alarm, and of an electric circuit controlling said inflow and alarm, and a differential thermometer, T, made to form part of the electric circuit, operated by the tendency of the increase of the temperature of the water in the boiler taking place at a faster ratio than the increase of the temperature or pressure in the steam-space of the boiler, and serving to establish said electric circuit, substantially as described.

2. The method of preventing the explosion of steam-boilers, consisting in introducing into the water-space of the boiler a fluid adapted to cause ebullition therein at such times as the increase of the temperature in the water-space of the boiler has a tendency to take place at a faster ratio than the increase in the temperature and pressure in the steam-space of the boiler.

3. The combination, with a boiler, of a differential thermometer, T, indicating and showing whenever the increase of the temperature of the water in the boiler takes place at a faster ratio than the increase of the temperature or pressure in the steam-space of the boiler.

4. The combination, with a boiler, of a differential thermometer, T, forming part of an electric circuit, subject to and controlled by the tendency of the increase of the temperature of the water in the boiler taking place at a faster ratio than the increase of the temperature or pressure in the steam-space of the boiler, and with an inlet-valve controlled by an electric circuit, which is in turn controlled by the said differential thermometer, substantially as described.

5. The combination, with a boiler, of a differential thermometer, T, forming part of an electric circuit, subject to and controlled by the tendency of the increase of the temperature of the water in the boiler taking place at a faster ratio than the increase of the temperature or pressure in the steam-space of the boiler, and with an alarm controlled by said

electric circuit, which is in turn controlled by the said differential thermometer, substantially as described.

6. The combination of a steam-boiler, K, with the air-chambers *m* and *k*, the tube T, partly filled with mercury, the battery B, the alarm A, the coil C, the armature *l*, the vessel L and valve *f*, and the conducting-wires *w*, *x*, and *y*, one end of *x* being inserted into the mercury contained in the tube T′ and the one end of *w* nearly touching the same.

7. The combination of the boiler K with the air-chambers *m* and *k*, the tube T, partly filled with mercury, the battery B, the alarm A, and the connecting-wires *w* and *x*′, for the purpose described.

8. The combination of the boiler K with the air-chambers *m* and *k*, the tube T, partly filled with mercury, the battery B, the coil *x*, the armature *l*, the vessel L, the valve *f*, with the conducting-wires *w*, *x*, and *y*, for the purpose described.

9. The combination of the boiler K with the air-chambers *m* and *k*, and the tube T, partly filled with mercury, for the purpose described.

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