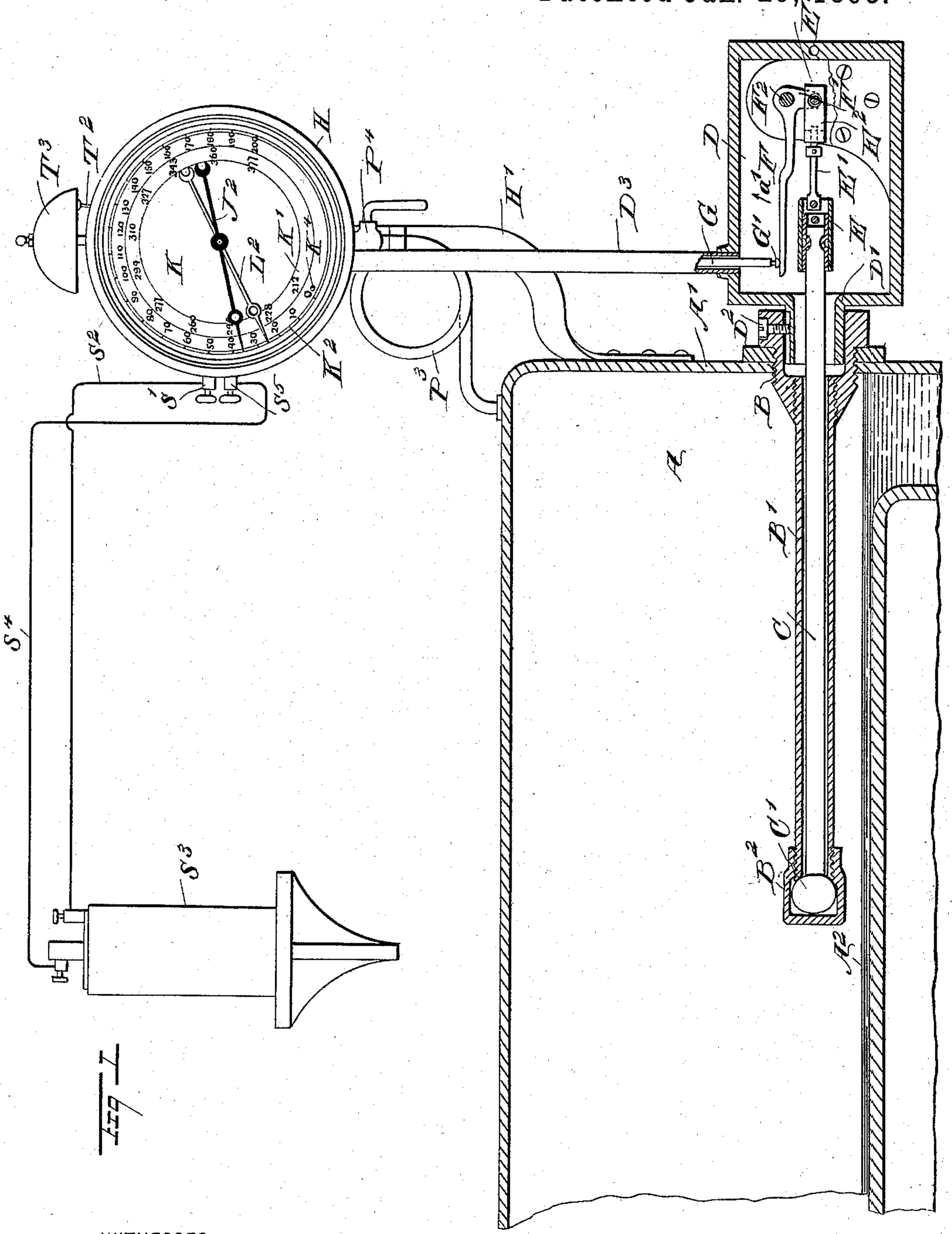
(No Model.)

2 Sheets—Sheet 1.

# A. F. MALLICK.

## BOILER ALARM GAGE.

No. 533,365. Patented Jan. 29, 1895.



WITNESSES:

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C. Sedgwick

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(No Model.) 2 Sheets—Sheet 2.

# A. F. MALLICK.

## BOILER ALARM GAGE.

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Fig 2

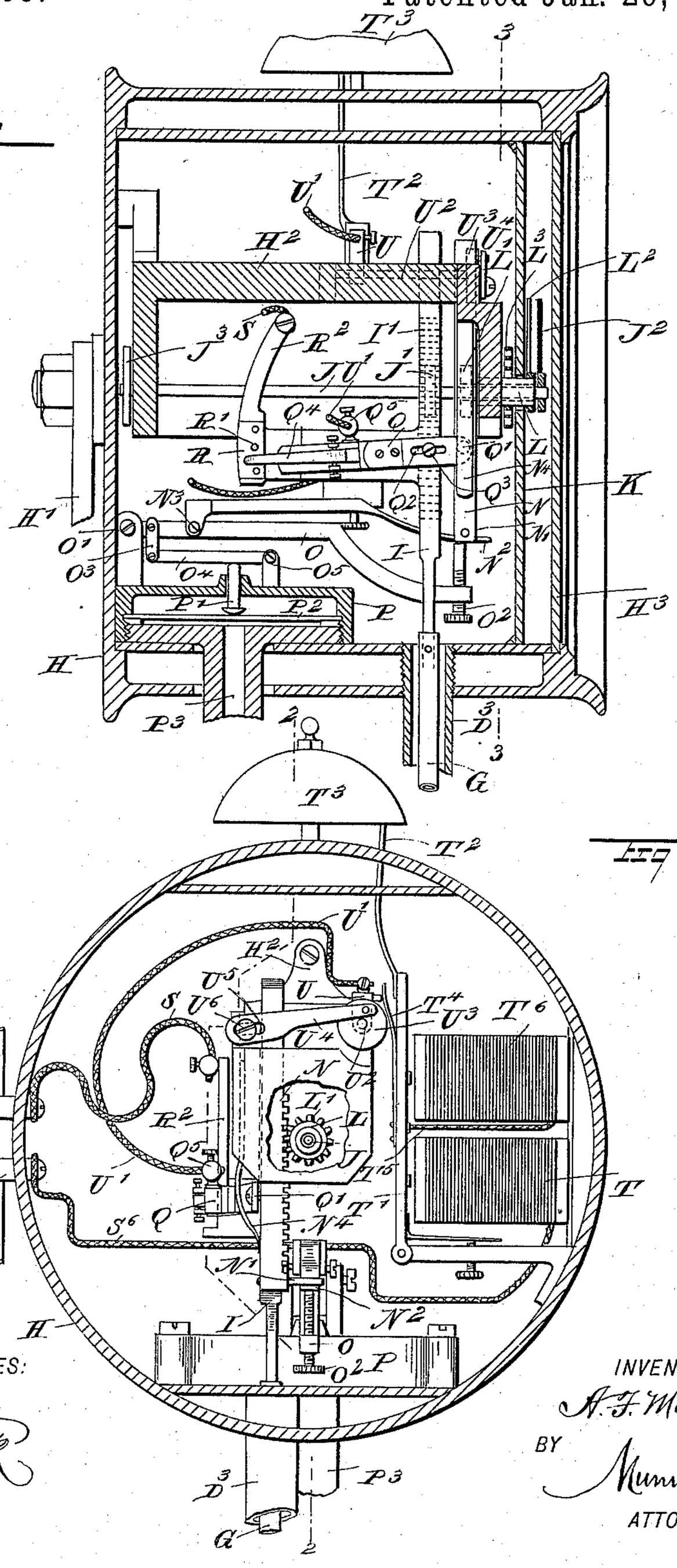


Fig 3

WITNESSES:

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# UNITED STATES PATENT OFFICE.

ALBERT F. MALLICK, OF JAMESTOWN, NORTH DAKOTA.

## BOILER ALARM-GAGE.

SPECIFICATION forming part of Letters Patent No. 533,365, dated January 29, 1895.

Application filed March 9, 1894. Serial No. 503,011. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT F. MALLICK, of Jamestown, in the county of Stutsman and State of North Dakota, have invented a new and Improved Boiler Alarm-Gage, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved boiler alarm-gage, which is comparatively simple and durable in construction, and arranged to accurately indicate both the steam pressure and the degree of heat in the boiler, so as to enable the attendant to see at a glance, whether the boiler is in a safe condition or not.

The invention consists principally of a heat indicator and a pressure indicator, both arranged in such a manner that the hand or pointer of the heat indicator moves in unison with the pointer of the pressure gage, as long as the boiler is working under normal conditions, the said heat indicator hand traveling faster than the pressure gage hand whenever an abnormal increase of heat in the boiler takes place.

The invention also consists of certain parts and details, and combinations of the same, as will be hereinafter described and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of the improvement as applied. Fig. 2 is an enlarged transverse section of the gage proper and on the line 2—2 of Fig. 3; and Fig. 3 is a sectional side elevation of the same on the line 3—3 of Fig. 2.

As is well known, the steam pressure and the heat in the boiler have a uniform and proper ratio, so that on an increase of boiler pressure an increase of heat takes place as long as the boiler is in proper condition. The boiler is in the said condition whenever it contains a sufficient amount of water to cover parts exposed to heat, the water having the necessary amount of air at least one cubic inch in one hundred cubic inches of water at 60° Fahrenheit, and the boiler being built sufficiently strong to stand a luke warm water test of at least one hundred and sixty pounds.

A boiler is in a dangerous condition when it does not have a sufficient amount of water to cover the parts exposed to heat, when the air is almost completely boiled out of the water, and when the boiler is not strong enough to hold a working pressure of at least one hundred and sixty pounds, as above described. A boiler being in this dangerous condition is liable to explode at any time. Now, with my invention hereinafter more fully described in detail, I indicate the condition of the boiler, that is, whether it is in a safe or unsafe condition.

It is further a well known fact that the heat generated in the fire box of a steam boiler is for the purpose of raising the temperature of water to its boiling point, and the rise of pressure in the boiler elevates the boiling point while a reduction of pressure lowers the boiling point. Now, if a boiler is fired up without any water over the crown sheet, then the temperature rises and an alarm is sounded as hereinafter more fully described.

If the air is boiled out of water, then the boiling will stop, the water will then get superheated, and the boiler will explode if only 25° hotter than it should be under pressure. The boiler will explode if the pump or injector is applied to refill the boiler or if the engine is reversed, causing the pistons to pump air into the boiler. The water which passes through the pump or the injector contains according to its density about three cubic inches of air in one hundred cubic inches of water, and as soon as that water enters the boiler, the air is mixed with and absorbed by the superheated water, so as to cause the volume of superheated water to boil at 25° lower temperature, thereby causing the boiler to explode.

If air is pumped into the boiler, as in the case of reversing the engine, the momentum of the moving parts of the engine overcomes the boiler pressure and air is forced into the boiler through the dry pipe or throttle, thus causing an explosion in an instant, if the water is superheated. Further if the water is only superheated 20°, and the steam pressure reduced five pounds, as by opening the throttle to start the engine, then the reduction of pressure causes the water to boil at 5° or 6° lower temperature, which has the

same effect as superheating the water 25°. If the pressure is reduced in a boiler suddenly, as in blowing out safety or whistle valves, this reduces or lowers the temperature of the water so as to cause an explosion. By continual boiling, parts of the oxygen that water naturally contains enters into combustion with the iron, so as to form an oxide of iron, while the other parts of oxygen with the nitrogen are mixed with the steam and exhausted to the atmosphere. Now, by the improvement presently to be described, all these abnormal conditions of the boiler are at once indicated and an alarm is sounded, so that the attendant can apply the proper remedy to avoid or prevent an explosion.

The improved alarm gage consists principally of a heat indicator or heat indicator and a steam pressure indicator, both working in unison as long as the conditions in the boiler are normal, but as soon as an abnormal heat is produced in the boiler, then the thermostat actuates an alarm and at the same time indicates the degree of temperature within the boiler.

The device, as shown in the drawings, is applied to a boiler A of any approved construction, having in its front or head plate A′ a bushing B carrying on its inner end a pipe B′ extending within the boiler A and a short distance above the crown sheet $A^2$ of the said boiler. On the inner end of the pipe B′ is secured a cap $B^2$ containing the head C′ of a rod C extending loosely through the pipe B′ and into a casing D provided with a neck D′ secured in the outer end of the bushing B by means of a set screw $D^2$ as plainly shown in said Fig. 1. The outer end of the rod C carries a metallic head E provided with a rod E′ supporting a plate $E^2$ pivotally connected with the short arm F′ of a bell crank lever F fulcrumed at $F^2$ within the casing D. By the arrangement of the head E, the rod may be adjusted relative to the bell crank lever F, so as to properly set the apparatus. It is understood that the rod C is preferably made of glass, but any other suitable material may be employed that expands and contracts less than the pipe B′, and likewise the pipe B′ can be made of any material that will expand and contract more than rod C. On the free end of the long arm of the said bell crank lever F rests the head of a screw G′ screwing in the lower end of a vertically-disposed rod G extending loosely through a pipe $D^3$ secured on the casing D and connected with the indicator casing H preferably supported by a bracket H′ from the boiler. See Fig. 1. Now, it will be seen that by an increase of temperature within the boiler A, the pipe B′ will expand so that the cap $B^2$ of the said pipe in moving inwardly, pulls on the head C′ of the rod C made of glass or other non-conductor of heat, whereby the outer end of the said rod moves the head E to the left, whereby a pull is exerted on the short arm of the bell crank lever F to impart a swinging motion to the latter in the direction of the arrow $a'$, so as to lift the rod G, it being understood that the distance the rod is lifted is in proportion to the expansion of the pipe B′ within the boiler A. The upper end of this rod G supports a rack I, the teeth I′ of which are in mesh with a pinion J′ secured on a transversely-extending shaft J mounted to turn in suitable bearings in a frame $H^2$ secured within the casing H. On the outer end of this shaft J is fastened a hand or pointer $J^2$ indicating on a scale K′ representing degrees and sub-divisions of heat and formed on a dial K secured within the casing H in the rear of the glass front $H^3$ of the said casing. On the rear end of the shaft J is fastened the inner end of a coil spring $J^3$ attached with its outer end to the frame $H^2$ so that the heat indicator hand is kept steady and prevented from vibrating. Now, it is understood that when the rod G is lifted on an increase of temperature in the boiler A, then its rack I engaging the pinion J′ turns the latter and consequently the shaft J, so that the pointer $J^2$ is carried forward by the movement of the shaft to indicate the degree of heat within the boiler, on the graduation K′ of the dial K. On the same dial K is indicated the pressure of the steam in the boiler, and for this purpose I provide a hub L through which passes the shaft J and which carries a pinion L′ in mesh with a rack N having a vertical movement according to the increase or decrease of the boiler pressure, as hereinafter more fully described. On the front end of this hub L is secured a hand or pointer $L^2$ directly in the rear of the pointer $J^2$ and indicating on a graduation $K^2$ formed on the dial K, the said graduation $K^2$ representing pounds and subdivisions of steam pressure. The two graduations K′ and $K^2$ are arranged in such a manner that the corresponding pounds and degrees are those of the steam pressure in the boiler and the heat contained therein, under normal conditions of the boiler—that is to say, when the pressure within the boiler is eighty pounds then the degree of heat therein is 277°, the said 80 pounds and 277° being arranged directly along-side each other on the graduations K′ and $K^2$.

In order to return the pointer or hand $L^2$ whenever the pressure decreases in the boiler, I provide a coil spring $L^3$ connected at its inner end with the said hub L and fastened at its outer end to a part of the frame $H^2$. On the lower end of the rack N is secured a pin N′ resting on the free end of a lever $N^2$ pivoted at $N^3$ to a lever O fulcrumed at O′ on a bracket attached to the top of the diaphragm casing P arranged within the casing H. See Fig. 2. The free end of the lever O carries a vertically-disposed screw $O^2$ engaging the underside of the lever $N^2$, so that the said two levers $N^2$ and O can be adjusted relative to each other by screwing the said set screw $O^2$ either upward or downward. The lever O between its fulcrum point O′ and the fulcrum

$N^3$ for the lever $N^2$ is connected by a link $O^3$ with a lever $O^4$ fulcrumed at $O^5$ to a bracket on the casing P. This lever $O^4$ rests on the upper end of a pin P′ fitted to slide in the top of the casing P and resting with its head on a diaphragm $P^2$ secured within the casing P. A pipe $P^3$ connects with the steam compartment of the boiler A and with the under side of the said diaphragm $P^2$, so that the latter is subjected to the pressure of the steam within the boiler A. A valve $P^4$ is preferably arranged in the pipe $P^3$ to shut off the steam pressure from the diaphragm whenever desired. Now, it will be seen that the steam pressure on the diaphragm $P^2$ actuates the latter so that the pin P′ actuates the lever $O^4$ which, by the link $O^3$ actuates the lever O and consequently the lever $N^2$, whereby the free end of the lever in pressing on the pin N′ of the rack N causes the latter to slide up or down according to the increase of the pressure in the boiler or a decrease. This movement of the rack N causes a rotating of the pinion L′, and its hub L, whereby the pointer or hand $L^2$ is moved on the graduation $K^2$ to indicate the boiler pressure. Now, as long as the boiler is in a normal condition the two hands $J^2$ and $L^2$ will move together, the one indicating the temperature in the boiler, and the other the pressure therein. On the rack N is pivoted at Q′ the lever Q formed with a longitudinally-extending slot $Q^2$ through which passes a screw $Q^3$ screwing in the other rack I, so that the lever Q is carried upwardly or downwardly on the simultaneous movement of the said racks N and I, as long as the boiler is in a normal condition, but when the temperature in the boiler increases abnormally and the said rack I moves up faster than the rack N, as before explained, then a swinging motion is given to the said lever Q by the action of the rack I.

On the free end of the lever Q is held a spring plate $Q^4$ engaging normally at its outer end an insulated plate R in which are arranged a number of contact points R′ so that on the swinging motion of the said lever Q, the free end of the spring plate $Q^4$ will move in contact successively with the contact pins R′. The said insulated plate R, and the contact pins R′ are held on an arm $R^2$ secured to and moves with an arm I′ extending from the rack I so that when the spring plate $Q^4$ has finally passed the uppermost contact pin R′ it finally passes onto the arm $R^2$ so as to make a continuous connection with the latter. The arm $R^2$ is connected by a wire S with a binding post S′ held in the wall of the casing H and the said binding post S′ is connected by a wire $S^2$ with one pole of the battery $S^3$ of any approved construction, and as plainly shown in Fig. 1. This battery $S^3$ is connected at its other pole with a wire $S^4$ leading to a second binding post $S^5$ likewise held in the wall of the casing H and this binding post $S^5$ is connected inside of the casing H with a wire $S^6$ leading to an electro magnet T arranged within the casing H. The armature lever T′ for this electro magnet T carries at its upper end a striker $T^2$ extending through the wall of the casing H to act on a bell $T^3$ supported from the said casing H. Thus, when an electric current passes through the said electro magnet T, the armature lever T′ is attracted and the striker $T^2$ sounds the bell $T^3$. The armature lever T′ is provided near its free end with a spring plate $T^4$ normally in contact with a contact point U made in the shape of an arm and connected by a wire U′ with a binding post $Q^5$ secured on the lever Q previously mentioned.

In order to adjust the arm carrying the contact point U relative to the spring plate $T^4$, I fasten the said contact point U on a transversely-extending shaft $U^2$; see Fig. 2, journaled in suitable bearings arranged on the frame $H^2$. On the front end of this shaft $U^2$ is secured a crank disk $U^3$ connected at its wrist pin with an arm $U^4$ formed at its rear end with a longitudinally-extending slot $U^5$ engaged by a screw $U^6$ screwing in the frame $H^2$. See Fig. 3. Now, by loosening the screw $U^6$, the arm $U^4$ can be shifted from the left to the right or right to the left, so as to turn the shaft $U^2$ and consequently impart a swinging motion to the arm carrying the contact point U, to adjust the latter relative to the spring plate $T^4$ so as to make the proper connection with the latter. After the adjustment is made, the screw $U^6$ is screwed up so as to securely fasten the arm $U^4$ in place, so as to securely hold the point U in proper position relative to the spring plate $T^4$. The armature lever T′ is connected by a wire $T^5$ with a second electro magnet $T^6$ also adapted to attract the armature lever T′ whenever the temperature in the boiler rises abnormally, so as to sound an alarm on the bell $T^3$ at the time the said abnormal rise of temperature in the boiler takes place.

Now, it will be seen that if the boiler A is fired up and without any water over the crown sheet $A^2$, then the temperature will increase abnormally within the boiler and consequently the thermostat will act independently of the steam indicator, so that the rack I will move upward faster than the rack N and consequently a swinging motion is imparted to the lever Q. At the same time the pointer $J^2$ will move in advance of the pointer $L^2$ actuated by the steam pressure indicator. The swinging motion imparted to the lever Q causes the spring plate $Q^4$ to make connection with the next uppermost contact pin R′ so that the circuit is closed between the wires U′ and S, by way of the arm U, electro magnet $T^6$, wire $T^5$ and armature T′ connected by electro magnet T and wires $S^6$ and $S^4$ with the battery $S^3$ to which leads the wire $S^2$ connected with the previously mentioned wire S. Thus, an alarm is sounded by the striker $T^2$ on the bell $T^3$. A first call is thus sounded, and the circuit is again broken as soon as the spring plate $Q^4$ on the upward swinging motion of the lever Q leaves the contact pin R′ to pass onto

the insulated plate R, and then on the further upward movement of the lever Q to pass to the next following contact pin R′ to again complete the circuit and make a second call and so on until finally the spring plate $Q^4$ passes onto the arm $R^2$ so as to ring the alarm continuously, the spring plate $Q^4$ then remaining in contact with the said arm $R^2$ on any further upward movement of the lever Q, until further upward swinging motion of the said lever is arrested by the pointer $J^2$ having made a complete revolution and stops in contact with the pin $K^4$ corresponding to about 800° of heat.

It will be seen that the above mentioned circuit is completed whenever water is superheated only 5°, as the spring plate $Q^4$ will then make connection with the first contact pin R′ to sound the first call and so on. If the pressure is reduced in the boiler suddenly, as by blowing out the safety valve or other device, then the rack N will slide downward faster than the rack I so that again a swinging motion is given to the lever Q and consequently the spring plate $Q^4$ will again move in contact with the contact points R′ to sound successively first, second, third and continuous calls in the manner above described. Thus, it will be seen that any abnormal condition of the boiler will cause a swinging movement of the lever Q, either by the rack I or by the rack N, so that an alarm is sounded in the manner above described.

The spring $Q^4$ moves upward only when steam pressure is reduced, and heat not withdrawn from the water, or when the temperature is increased, and steam pressure remains the same, at the same time completing a circuit which gives the alarm. When water is foaming within a boiler the foam with the water often falls below the crown sheet, when steam is shut off; the intense heat within the fire box softens the parts not covered by water, and as a result the steam pressure within the boiler caves or bulges in the side sheets, or the crown plate. With my boiler alarm gage all this is prevented because when the water or foam leaves the crown sheet, the iron pipe which composes part of my indicator is surrounded by steam, and steam being hotter than water will instantly turn the heat pointer ahead of the steam pointer, and give an alarm in time to prevent the sheets from caving in.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. A boiler alarm gage, comprising a heat indicator and a pressure indicator, operating in unison as long as the boiler is in a normal condition, and operating differentially when the boiler is in an abnormal condition, substantially as shown and described.

2. A boiler alarm gage, comprising a heat indicator and a pressure indicator, both arranged in such a manner that the hand of the heat indicator moves in unison with the hand of the pressure gage as long as the boiler is working under normal conditions, and when the boiler is working under abnormal conditions, either by an increase of heat or a sudden decrease of steam pressure, then the said hands move at a different rate of speed, substantially as shown and described.

3. A boiler alarm gage, comprising a heat indicator and a pressure indicator, each provided with a rack, a lever pivoted on one of the racks and engaged by the other rack, and an electric alarm of which the said lever forms the circuit closer, the said lever receiving a swinging motion whenever the racks move at a differential rate of speed, substantially as shown and described.

4. In a boiler alarm gage, the combination with two movable racks, of which one is controlled by a pressure indicator and the other by a heat indicator, of two hands actuated from the said racks, a dial on which indicate the said hands, the said dial being graduated with a degree scale and with a pressure scale, a lever pivoted on one of the said racks and engaged by the other rack, and an electric alarm of which the said lever forms a circuit closer, substantially as shown and described.

5. In a boiler alarm gage, the combination with two racks controlled by a pressure indicator and a heat indicator, of a lever pivoted on one of the said racks and engaged by the other rack, so that when the said racks move at a differential rate of speed then a swinging motion is given to the said lever, and an electric alarm of which the said lever forms the circuit closer, substantially as shown and described.

6. In a boiler alarm gage, the combination with two racks controlled by a pressure indicator and a heat indicator, of a lever pivoted on one of the said racks and engaged by the other rack, so that when the said racks move at a differential rate of speed then a swinging motion is given to the said lever, an arm provided with an insulated plate through which extend contact pins arranged on the said arm, the said insulated plates, contact pins and arms being adapted to be engaged by the free end of said lever, and an electric alarm connected by one wire with the said lever and by its other wire with the said arm, substantially as shown and described.

7. In a boiler alarm gage, the combination with two racks controlled by a pressure indicator and a heat indicator, of a lever pivoted on one of the said racks and engaged by the other rack, so that when the said racks move at a differential rate of speed then a swinging motion is given to the said lever, a spring plate held on the free end of the said lever, an arm provided with an insulated plate through which extend contact pins arranged on the said arm, the said insulated plates, contact pins and arms being adapted to be engaged by the said spring plate, and an electric alarm connected by one wire with the said lever and by its other wire with the said arm, substantially as shown and described.

8. A boiler alarm gage provided with a heat indicator, comprising a pipe adapted to be secured to the boiler and extending over the crown plate, the inner end of the said pipe being provided with a cap, a non-conducting rod held loosely in the said pipe and provided with a head inclosed by the said cap, beyond the end of said pipe and of greater diameter than the pipe so that an expansion of the said pipe draws the said rod inwardly, and a bell crank lever connected with the outer end of the said rod, substantially as shown and described.

9. A boiler alarm gage, provided with a heat indicator, comprising a pipe adapted to be secured to the boiler and extending over the crown plate, the inner end of the said pipe being provided with a cap, a non-conducting rod held loosely in the said pipe and provided with a head inclosed by the said cap, beyond the end of said pipe and of greater diameter than the pipe so that an expansion of the said pipe draws the said rod inwardly, a bell crank lever connected with the outer end of the said rod, and an adjusting mechanism between the said rod and the said bell crank lever, substantially as shown and described.

10. A boiler alarm gage provided with a heat indicator, comprising a pipe adapted to be secured to the boiler and extending over the crown plate, the inner end of the said pipe being provided with a cap, a non-conducting rod held loosely in the said pipe and provided with a head inclosed by the said cap, beyond the end of said pipe and of greater diameter than the pipe so that an expansion of the said pipe draws the said rod inwardly, a bell crank lever connected with the outer end of the said rod, a vertically disposed rod resting on the free end of the said bell crank lever, a rack held on the said second rod, a pinion in mesh with the said rack, a shaft carrying the said pinion, and a hand or a pointer on the said shaft, substantially as shown and described.

ALBERT F. MALLICK.

Witnesses:
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