

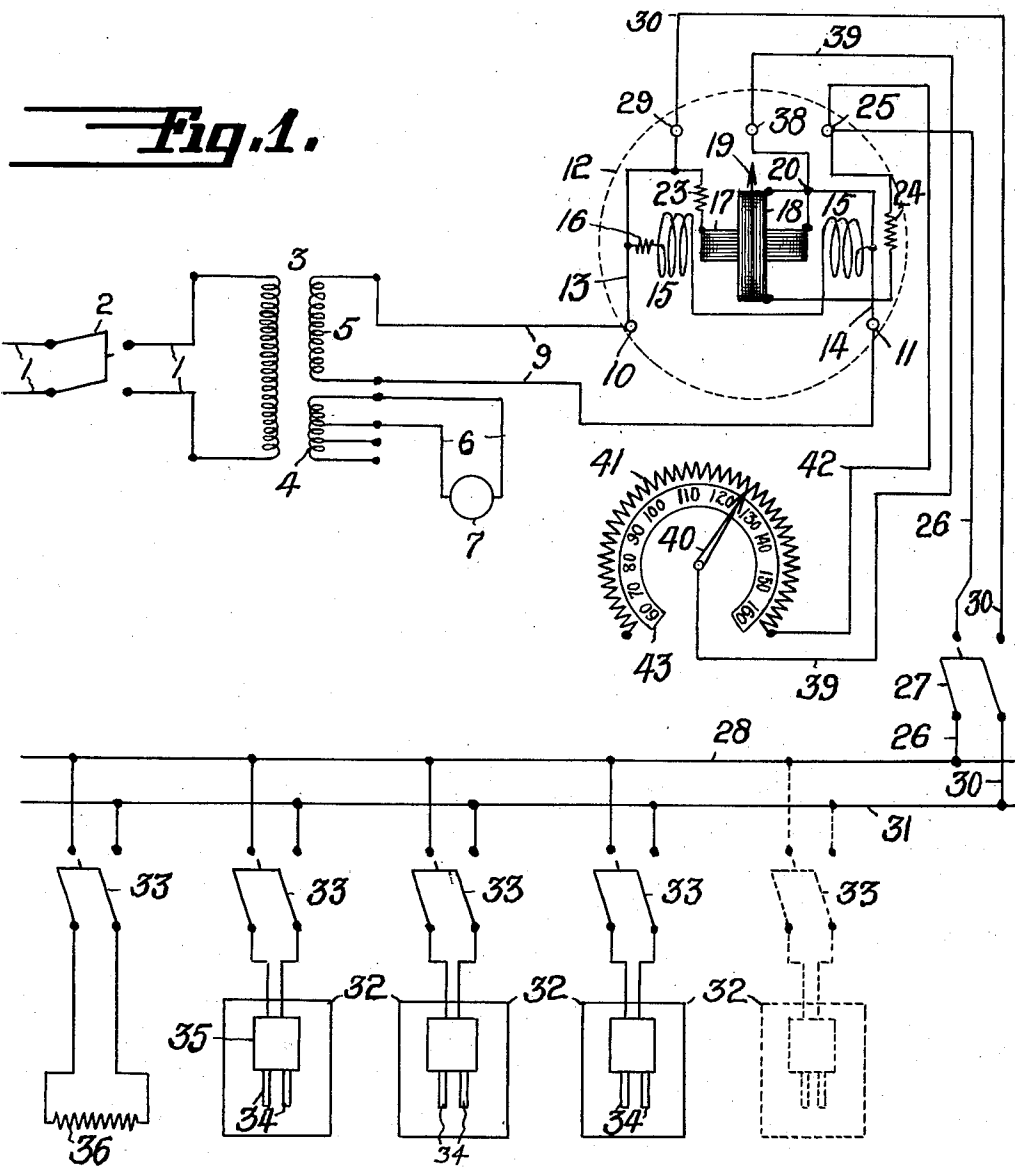
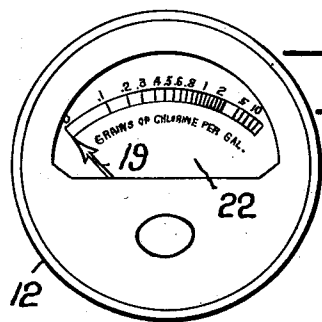
March 7, 1939.

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2,150,015

SALINITY INDICATOR SYSTEM

Filed April 23, 1935



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2,150,015

SALINITY INDICATOR SYSTEM

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Application April 23, 1935, Serial No. 17,807

3 Claims. (Cl. 175—183)

This invention relates, generally, to means for detecting and indicating harmful impurities in boiler or evaporator water and the invention has reference, more particularly, to a novel salinity indicator system for disclosing the saline content of boiler or other water in which the presence of impurities is undesirable.

Boiler and evaporator water should be kept as clean and pure as possible in order to obtain efficient boiler operation and to prevent injury to boilers and to operating equipment, such as turbines and engines. In some parts of the country and especially on steam vessels, the water used in boilers either contains or tends to become contaminated with injurious salts, such as magnesium chloride and calcium sulphate, that precipitate out as the boiler water is heated, causing the scaling of heating surfaces and resulting in the overheating and failure of such surfaces, while other salt impurities tend to produce priming, thereby resulting in injury or destruction of turbines, engines, etc. On steam vessels, sea water is generally used in condensers, with the result that any leakage of condenser tubes causes contamination of the boiler feed water.

The principal object of the present invention is to provide a novel salinity indicator system that serves to visually indicate the saline content of boiler water as well as further indicating immediately any change therein, so that steps can be promptly taken, when necessary, to make the required repairs or to otherwise correct for such salinity.

Another object of the present invention lies in the provision of a novel salinity indicator system having parts so arranged as to enable the user thereof to know at what point in the boiler water circulating system a leak or influx of salt-containing water occurs.

A third object of the present invention lies in the provision of a novel salinity indicator system of the above character that utilizes variations in the electrical conductivity of water, corresponding to changes in the percentage of electrolytic impurities, to determine the saline content of the water, the said system employing one or more pairs of electrodes immersed in the boiler water, there being applied a voltage across the electrodes of any selected pair, which voltage produces a current flow in the event that the water has a saline content, the said system having means for utilizing such current flow to determine the percentage of salt present.

Still another object of the present invention is to provide a novel salinity indicator system of

the above character that is so constructed and arranged as to give a substantially true indication of the salt content of the boiler water regardless of variations in the water temperature and of the frequency and/or voltage of the A. C. utilized by the system.

Other objects and advantages will become apparent from the specification, taken in connection with the accompanying drawing wherein one embodiment of the invention is illustrated.

In the drawing,

Fig. 1 is a wiring diagram of the novel salinity indicator system of this invention, and

Fig. 2 is a view, in front elevation, of the indicating meter used in the system.

Referring now to the said drawing, leads 1 are connected to a suitable single phase A. C. supply, such as a 60 cycle, 115 volt source. Leads 1 have a double pole switch 2 included therein for controlling the supply of operating current to the salinity indicator system. Leads 1 are shown connected to the ends of the primary winding of a step down transformer 3, illustrated as having two secondary windings 4 and 5. It is to be understood that the transformer 3 may be omitted in instances where the supply voltage is suitable for direct connection to the system of this invention. Secondary winding 4 is shown as having a number of taps, to two of which are connected leads 6 serving to supply a pilot lamp 7, or the pilot lamp may be connected across the primary of the transformer 3, if desired.

The terminals of secondary winding 5 are connected by leads 9 to terminals 10 and 11 of an indicating means or meter 12. Connected between posts 10 and 11, as by means of leads 13 and 14, is a fixed field coil 15 in series with a resistance 16. A holding coil 17 and a deflecting coil 18 cross one another substantially at right angles and are rigidly secured together to form the movable element of the indicating meter or means 12, the said movable element carrying a pointer 19. These coils 17 and 18 are mounted on a spindle for free rotation, there being no mechanical spring or other similar means for biasing the pointer 19 to zero position on scale 22 (see Fig. 2).

Each of the windings 17 and 18 has one of its ends connected to a common point 20 and this point is connected by lead 14 to terminal 11. The other end of the holding coil or winding 17 is connected through a resistance 23 to lead 13, whereas the other end of the deflecting coil or winding 18 is connected through a resistance 24 to a terminal 25 of meter 12. Terminal 25 is

connected by a lead 26 through a double pole switch 27 to a lead 28. Another terminal 29 of meter 12 is connected within this meter to lead 13 and this terminal is also connected by an out-

side lead 30 through switch 27 to a lead 31. Any one of a plurality of conductivity cells 32 is adapted to be selectively connected across the leads 28 and 31 by means of double pole switches 33. Each of the conductivity cells 32 consists of a pair of spaced electrodes 34 that are electrically insulated from one another within base plug 35 and are respectively connected to the respective poles of one of the switches 33. The cells 32 are located at selected points in the boiler water circulating system, such as in condensers, feed water mains, etc., the electrodes 34 being immersed in the flowing water. Although ordinarily a plurality of these cells 32 would be employed, yet in some installations only one of these cells need be used.

A checking resistor 36 is adapted to be connected across leads 28 and 31 by a double pole switch 33 for the purpose of checking the reading of meter 12, as will further appear. As indicated in Fig. 2, this meter 12 is graduated in an accepted arbitrary scale of "grains of chlorine per gallon", i. e., per gallon of water. The common point 20 of meter coils 17 and 18 is connected to a terminal 38 of meter 12, which terminal is connected by a lead 39 to the adjustable arm 40 of a temperature compensating rheostat 41. Rheostat 41 is connected by a lead 42 to meter terminal 25.

With the parts of the system as thusly connected, it will be noted that holding coil 17 is connected in series with resistance 23 across leads 9. With switch 27 closed and one of the switches 33 leading to any selected cell 32 closed, it will be noted that deflecting coil 18 is connected in series with resistance 24 and such selected cell 32 across leads 9. This circuit is by way of terminal 11, lead 14, coil 18, resistance 24, terminal 25, leads 26 and 28 to the cell 32, and from thence through leads 31, 30, terminal 29 and lead 13 to terminal 10. The temperature compensating rheostat 41 is connected in parallel with deflecting coil 18 and resistance 24 by leads 39 and 42.

In use, with switch 2 closed, A. C. is supplied to transformer 3 so that pilot light 7 is lighted, showing that the system is in operation. With switches 27 and 33 open, the cells 32 are open circuited and no current flows in deflecting coil 18 or in the temperature compensating rheostat 41. Field coil 15 and holding coil 17, however, are both connected across leads 9 and hence carry current, so that the movable holding coil 17 will turn so as to tend to make its axis coincide with or lie parallel to that of coil 15, thereby also turning coil 18 and causing pointer 19 to overlie the zero position on scale 22, as shown in Fig. 2. If switch 27 is now closed and one of the switches 33 also closed, the pointer 19 will move over the scale 22, provided that the feed water into which the selected conductivity cell is immersed, contains salt and is hence electrically conducting. In such case, current flows through deflecting coil 18 and resistance 24 in parallel with current passing through the temperature compensating rheostat 41; both of these currents combining and passing through the selected cell 32. Thus, flux produced in deflecting coil 18 tends to cause the axis of this coil to move into parallelism with that of field coil 15, whereby coil 18 opposes coil 17 and effects a deflection of pointer 19 towards the right in Fig. 2, the magnitude of such de-

section being a measure of the saline content of the water as indicated by the reading of scale 22.

As the temperature of the feed or evaporator water increases, the degree of ionization of its saline content increases so that the electrical resistance of the feed water correspondingly decreases, and this would ordinarily cause an increase in the current flow through deflecting coil 18, thereby giving a higher and incorrect reading, although the saline content has not actually changed. However, by turning the compensating rheostat arm 40 so as to decrease the compensating rheostat resistance 41 as the feed water temperature rises, the excess current flows through rheostat 41 instead of through deflecting coil 18 so that meter 12 therefore continues to give the correct salinity reading regardless of the change in temperature.

On the other hand, should the temperature of the boiler feed water fall, causing a decrease in the conductivity of the feed water, it is necessary to turn arm 40 so as to increase the resistance of rheostat 41, thereby maintaining a constant current in deflecting coil 18 and a constant reading of the salinity indicator meter 12 for a constant saline content of the feed or evaporator water. Arm 40 of rheostat 41 is adapted to move over a scale 43 on which feed water temperatures are indicated, so that by positioning arm 40 on that reading of scale 43 corresponding to the feed or evaporator water temperature at any time, proper compensation for variation of feed or evaporator water temperature is obtained.

Thus, by setting rheostat arm 40 over that reading on scale 43 corresponding to the feed water temperature at any time and closing any selected switch 33, the saline content of the water surrounding the particular conductivity cell 32 connected to the closed switch 33 is immediately indicated visually by meter 12, thereby enabling the engineer in charge to know the present saline content of that part of the feed water system into which the particular cell 32 is immersed. Thus, an increasing salinity reading enables the engineer to know at once of a leak occurring in any part of the boiler water circulating system, and by knowing the locations of cells 32 he also knows just where the leak or influx of salt water occurs as, for example, in a condenser having a defective tube.

Inasmuch as the field coil 15 as well as the holding coil 17 and deflecting coil 18 are all connected in series with resistances directly across the leads 9, and as the currents carried by these coils are small, they really operate as voltage coils and hence are similarly affected by changes in line voltage and frequency, with the result that for constant salinity conditions the current differential between the holding coil and the deflecting coil varies substantially uniformly with the current in the field coil, so that the reading of meter 12, determined by the differential flux of coils 17 and 18 and by the flux of field coil 15, is largely unaffected by changes in line voltage or frequency, which is highly desirable, especially on shipboard where the A. C. line voltage and frequency are apt to vary. Thus, the indicator readings of the novel salinity system of this invention are highly accurate at all times, variations in supply voltage and frequency being automatically corrected for, while variations in boiler feed water temperature are corrected for by use of rheostat 41. It is not feasible to use a D. C. supply in this system owing to the creation of large errors in readings resulting from the polar-

ization and rapid deterioration of the cell electrodes 34.

The accuracy of the system may be checked at any time by means of checking resistor 36. This resistor has a resistance corresponding to the resistance between the electrodes of a conductivity cell 32 immersed in water having a definite temperature and salt concentration, for example, 100° F. and a salt concentration equivalent to one grain of chlorine per gallon, respectively. Thus, with the temperature compensating rheostat arm 40 set over the 100° reading of scale 43 and switch 33 leading to checking resistor 36 closed, the meter 12 should read approximately 1 grain.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a salinity indicator system for determining the saline content of boiler water, an A. C. supply, a plurality of differently positioned pairs of spaced electrodes immersed in said boiler water, a checking resistor, meter indicating means having a deflecting coil, switching means for selectively connecting one of said pairs of electrodes in series with said deflecting coil across said A. C. supply, a holding coil connected independently across said A. C. and fixed at right angles with respect to said deflecting coil, a field coil inductively related to said deflecting and holding coils and independently connected across said A. C. supply, an indicator carried by said deflecting coil, and a salinity scale over which said indicator moves, said deflecting and holding coils being relatively movable with respect to said field coil, whereby said indicator is caused to indicate on said scale the conductivity and hence the relative salinity of the boiler water, and substantially independently of voltage and frequency variations, said switching means being also adapted for con-

necting said checking resistor in series with said deflecting coil for checking the readings of said meter indicating means.

2. In a salinity indicator system for determining the saline content of boiler water, an A. C. supply, a plurality of pairs of spaced electrodes immersed in said boiler water, meter indicating means having a salinity scale, a deflecting coil, an indicator carried by said deflecting coil and movable over said scale, a holding coil fixed at right angles to said deflecting coil and connected across said A. C. supply for normally urging said indicator to the zero point of said scale, and a field coil connected across said A. C. supply independently of though inductively coupled to said deflecting and holding coils, switching means for selectively connecting any desired pair of electrodes in series with said deflecting coil across said A. C. supply, and an adjustable temperature compensating resistance connected in shunt with said deflecting coil, whereby variations in the temperature of the boiler water are compensated for so as not to appreciably influence the reading of said meter indicating means, the series nature of said coils rendering the indications of said meter substantially independent of variations in line voltage and frequency.

3. In a salinity measuring and indicating device, an A. C. supply, a pair of spaced electrodes adapted to be immersed in the fluid the salinity of which is to be determined, a meter responsive to the current flow between said electrodes for showing the saline content comprising mutually interacting coils fixed at right angles to each other and together rotatably mounted in a common field, and constituting a holding and a deflecting coil, a variable resistance calibrated in terms of the temperature of the fluid being tested and manually adjustable to compensate for variations in said temperature and a plurality of resistances, said electrodes being connected across the A. C. supply in series with a shunt circuit containing in one leg said variable resistance and in the other leg said deflecting coil and of said other resistances, the holding coil being connected across said supply in series with another resistance, and a stationary field coil for supplying said field also connected across said supply in series with a third resistance.

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