128,878

# PATENT SPECIFICATION

*Application Date, Mar. 6, 1919. No. 5528/19.*

*Complete Accepted, July 3, 1919.*

COMPLETE SPECIFICATION.

## Apparatus for the Calculation of the Thermal Efficiency, and other Data Involved Therein, of Steam Generating Plant

We, JAMES CROMPTON, of 60, Palmerston Road, Bowes Park, London, N., Engineer, and WILLIAM GALLAGHER, of 81, Taylor Lane, Denton, Manchester, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an apparatus for calculating the thermal efficiency of steam generating plant, and other data incidental to and involved in the process of determining the said thermal efficiency, from the observations and readings commonly taken for that purpose.

The invention as illustrated in the accompanying drawing, Fig. 1, consists of two sliding scales A & C, two fixed scales B & D, and a chart of lines and curves E.

The scales are carried on a flat rectangular frame or stock F, and the chart, mounted on suitable material, passes edgewise through the frame and underneath the scales (Fig. 2) which are arranged in pairs on either side of an opening in the frame or stock in order to expose a suitable section of the chart. The chart is so arranged that it can be moved in a direction at right angles to that in which the slides A & C move. The inner edge of slide A forms one of the boundaries of the opening in the frame, and the marks of the scale which it carries are continued down its inner edge in order to bring them into close proximity to the chart. By these means any point on the edge of scale A can be brought over any point on the chart E.

The chart E, shown separately in Fig. 3, consists of a square or rectangle across which is drawn a series of lines and curves.

The proper position of the various lines on the chart is determined as follows:—

On the righthand boundary of the square or rectangle is marked off a series of points, dividing it into a number of equal parts. From these points is drawn, across the square or rectangle, a series of lines parallel to the top and bottom boundaries.

Along the righthand edge of the rectangle these lines are designated "boiler pressure lbs. per sq. in.," and are numbered accordingly, and along the lefthand edge, each line is numbered according to the temperature of saturated steam at the particular boiler pressure which it represents. In a similar manner a series of lines is drawn from the top to the bottom, and parallel to the right and lefthand boundaries of the square or rectangle. These are

designated "total heat of superheated steam B.T.U.," and are numbered accordingly along the top edge of the rectangle.

Across the rectangle and running from the top to the bottom boundaries is also drawn a series of curves the one on the extreme right being designated "saturation curve," and the others "superheat curves." Their positions are determined by existing formulæ for calculating the total heat of steam, or from existing charts and tables on the properties of steam, and each is numbered according to the degrees of superheat above saturation temperature, which it represents.

A slide A carries on its upper edge a scale of equal divisions designated "feed water temperature °F.," which are numbered accordingly in increasing magnitude from right to left. These divisions are marked off to the same scale as those on the upper and lower edges of the chart, so that the lineal dimension representing a certain number of heat units on the latter, is equal to the lineal dimension representing a similar number of degrees of temperature on the scale A. The lower edge of slide A carries a mark or pointer G.

Below scale A and running parallel to it, is a fixed scale of equal divisions B designated "factors of evaporation."

The scales C & D are independent of the foregoing as regards their position and could form a separate apparatus. They are arranged as shown in drawing for convenience of manipulation.

Slide C carries upon its upper edge a logarithmic scale similar to those used in calculating instruments commonly known as "slide rules"; that is to say, that the distance of each point from the lefthand extremity of the scale represents to some definite scale the logarithm of some number, either whole or decimal.

The marks of the scale are numbered with two rows of figures, except at the extreme right, where there are three rows. Those of the upper row on the lefthand end of the scale, and the middle row on the right are designated "factors of evaporation." Those of the upper row on the righthand end of the scale are designated "efficiency %" and those of the lower row for the whole length of scale are designated "lbs. of water evaporated from and at 212° F. per lb. of fuel."

Above slide C and parallel to it is a fixed scale D which is also a logarithmic scale. At its lefthand end it is designated "calorific value of fuel," the marks on the extreme left of the scale being designated "coal B.T.U." and those a little further to the right being designated "oil B.T.U." From about the centre, and to the extreme right, the marks on scale D are designated "lbs. of water evaporated per lb. of fuel."

The apparatus as herein described and illustrated is graduated in the pound-Fahrenheit system of units, but is not necessarily confined to this system. It may be graduated in the gramme-centigrade or any other system.

The method of using the apparatus is as follows:—The chart E is moved until the edge of slide A lies along the line of the chart representing the observed boiler pressure. Scale A is then moved until the point representing the observed temperature of feed water is over the point on the chart where the curve representing the observed degree of superheat intersects the pressure line; or if the steam is not superheated, over the point of intersection of the saturation curve and the pressure line. The pointer G will then be opposite the point on scale B which represents the factor of evaporation for the conditions under consideration.

Scale C is now moved until the mark upon it denoting the ascertained factor of evaporation is in line with pointer "*a*" or "*b*" on scale D. Then, the number of lbs. of water evaporated per lb. of fuel being known, the point representing this number is found on scale "D", and will be in line with the mark on scale C denoting the lbs. of water evaporated from and at 212° F. per lb. of fuel.

The scale C is again moved until the mark denoting lbs. of water evaporated from and at 212° F. per lb. of fuel, is in line with the mark on scale D denoting the calorific value of the fuel. Either pointer "*a*" or pointer "*b*" on scale D will then be opposite the mark on scale C denoting the required thermal efficiency.

This invention provides a new and novel method of determining the thermal efficiency of steam generating plant from the observations and readings commonly taken for the purpose, by the use of a chart inscribed with lines and curves representing certain physical quantities, and arranged underneath, and capable of being moved at right angles to graduated slides either in the manner described above, or in some similar manner substantially as above, without reference to the precise order or size of the scales.

We are aware that computing apparatus for determining the thermal efficiency of steam generating plant from observed data such as boiler pressure and feed water temperature have been used before, but to these we lay no claim.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In computing apparatus for calculating the thermal efficiency of steam generating plant, the combination of a movable chart and sliding scale at right angles to one another and arranged so that any point on the scale may coincide with any point on the chart, substantially as described.

2. The arrangement claimed in Claim 1, in combination with a fixed scale for the purpose of determining the factor of evaporation on steam-generating plant, substantially as described.

3. An apparatus for the calculation of the thermal efficiency of steam-generating plant, substantially as described and illustrated in the drawing.

Dated the 6th day of March, 1919.

J. CROMPTON.
W. GALLAGHER.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1919.

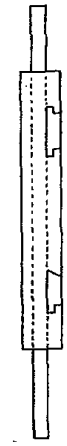

FIG.2

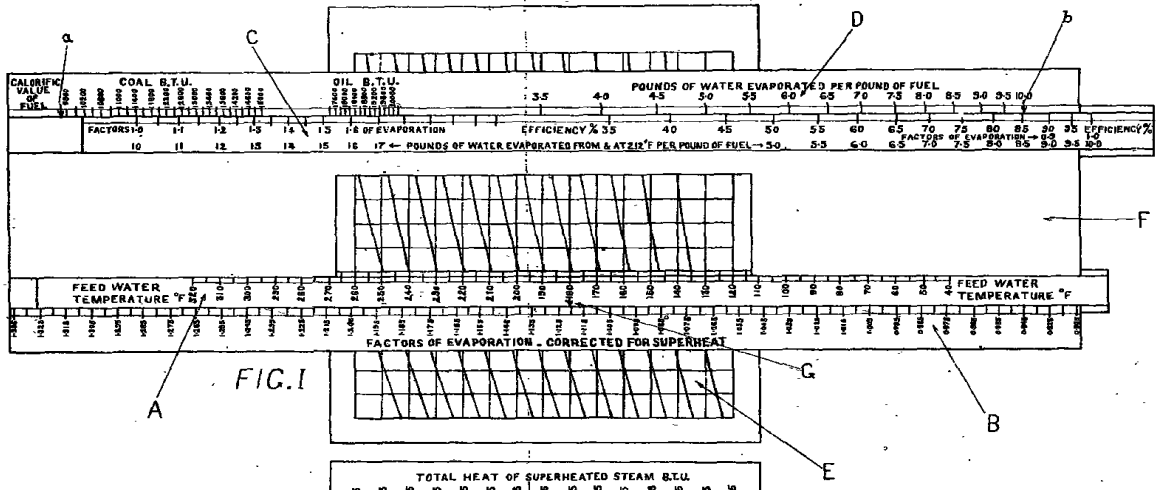


FIG.1

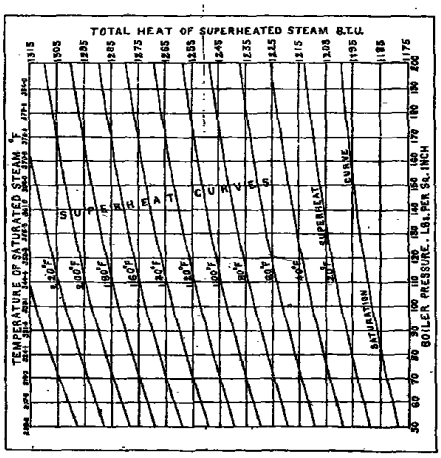


FIG.3

[This Drawing is a reproduction of the Original on a reduced scale.]

Malby & Sons, Photo-Litho

FIG. 2

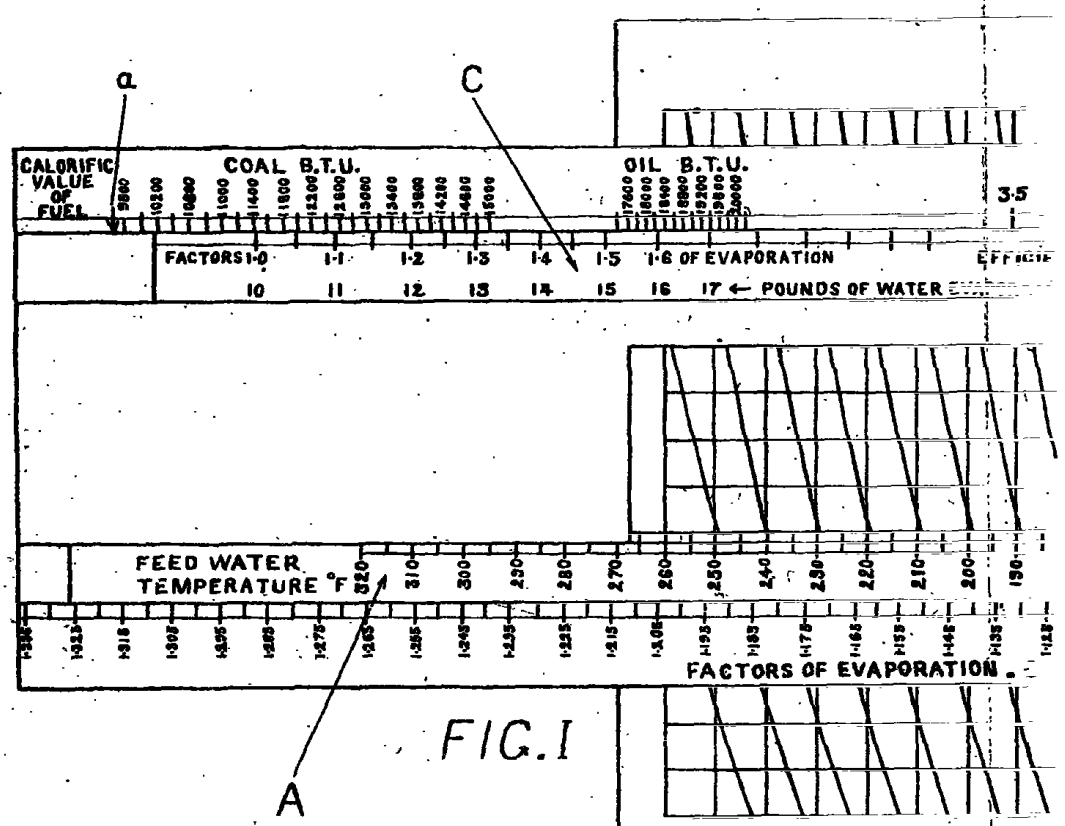


FIG. 1

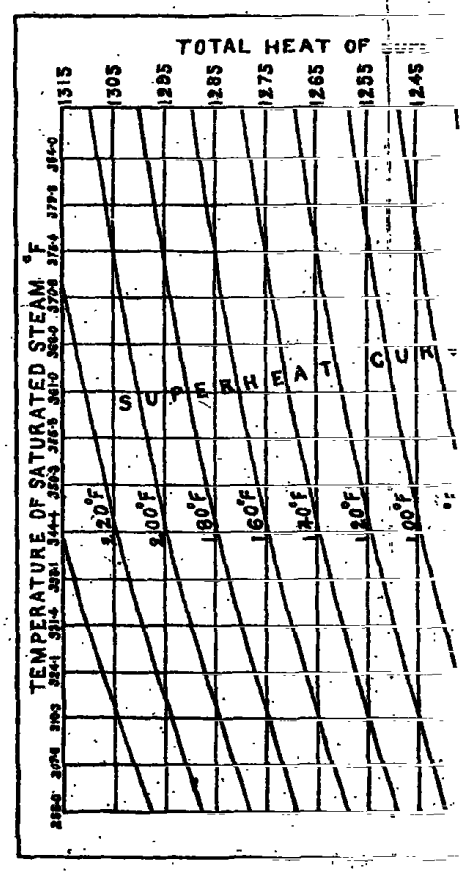


FIG. 3