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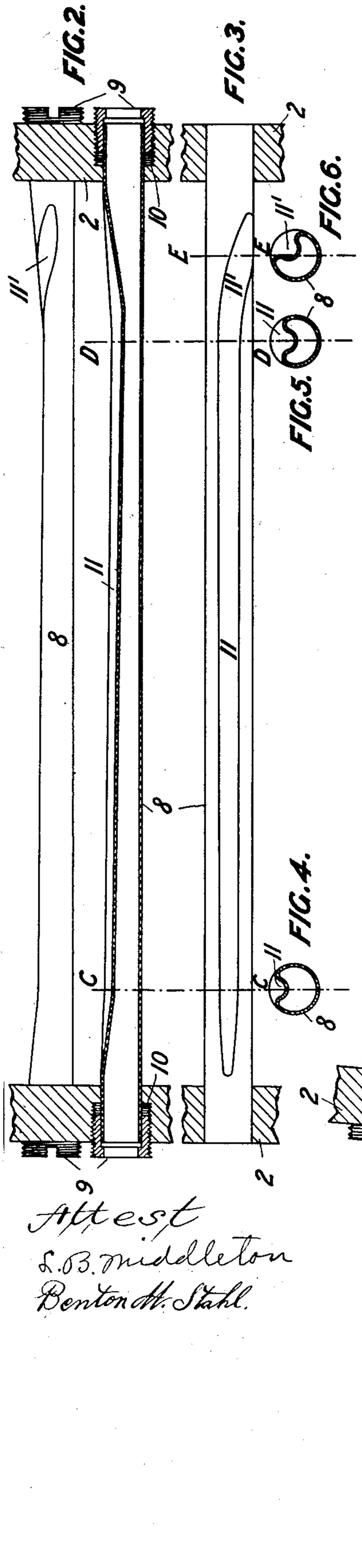
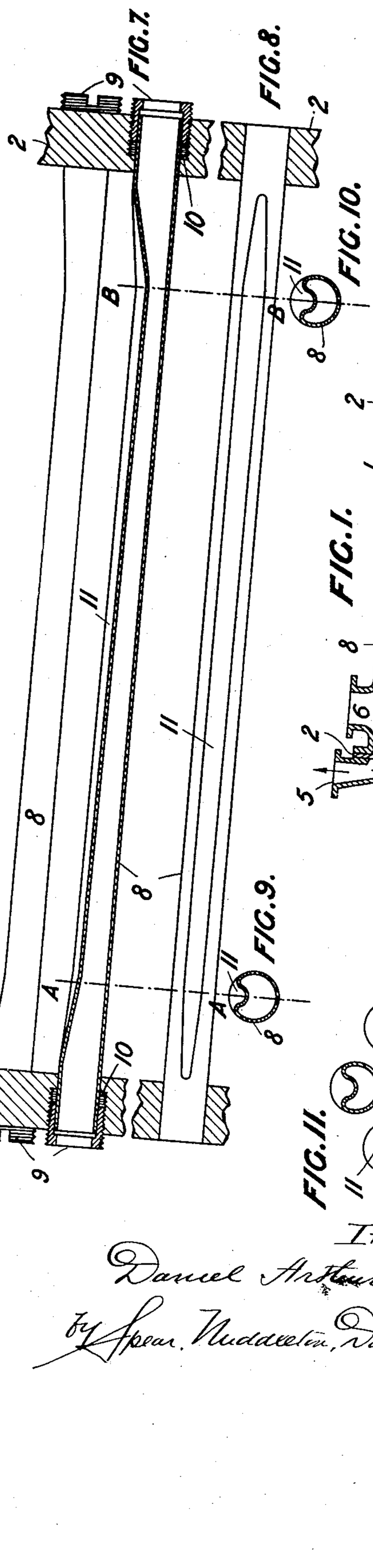
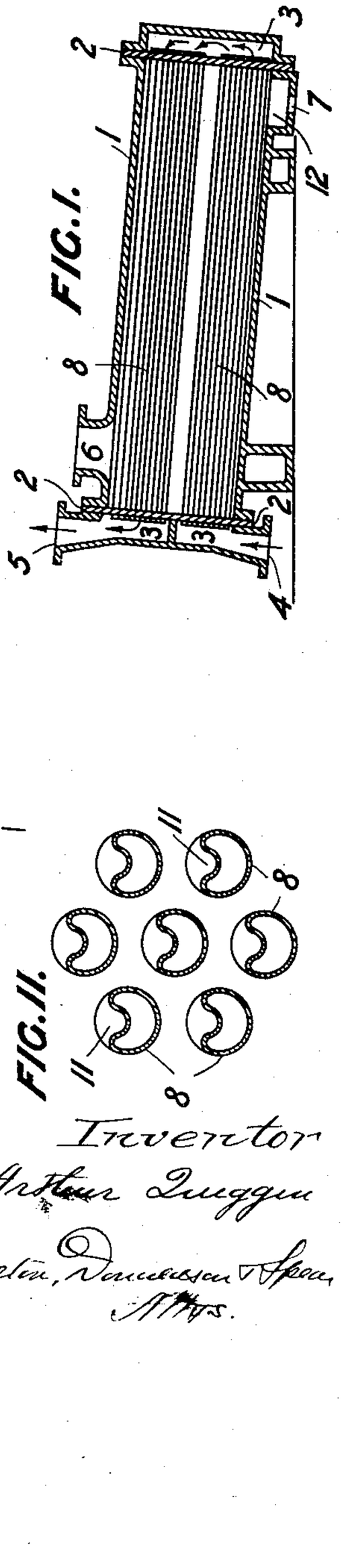
APPARATUS FOR CONDENSING STEAM.

APPLICATION FILED OCT. 28, 1907.

925,506. Patented June 22, 1909.







Attest

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CONDENSING STEAM.

No. 925,506. Specification of Letters Patent. Patented June 22, 1909.

Application filed October 28, 1907. Serial No. 399,564.

To all whom it may concern:

Be it known that I, DANIEL ARTHUR QUIGGIN, a subject of the King of Great Britain, and residing in Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in Apparatus for Condensing Steam or for Heating or Evaporating Water by Steam, of which the following is a specification.

This invention has reference to apparatus for transferring heat from steam to water without admixture, such as surface condensers, feed heaters and evaporators. Such apparatus usually consists of a casing containing a stack of tubes forming heat transmitting surfaces; the tubes pass through a diaphragm or tube plate at each end and open into chambers beyond the tube plates. Generally the steam surrounds the tubes and the water is passed through the tubes from the one chamber to the other. It is found in such apparatus that the water deposited on the tubes by the condensation of the steam seriously interferes with their heat transmitting capability, and one of the objects of my invention is to overcome this difficulty. I accordingly construct such apparatus,—say for example a condenser,—as follows:—reference being made to the accompanying drawings in which—

Figure 1 shows a condenser in sectional elevation; Figs. 2 to 6 are detail views to larger scale showing one form of the heat transmitting tubes, Figs. 7 to 10 are similar views of a modified form of tube, Fig. 11 shows the way in which the tubes are generally arranged and Fig. 12 shows modifications in the cross section of the tubes.

The condenser shown in Fig. 1 comprises the usual body or casing 1, tube plates 2, water chambers 3, water inlet 4 and outlet 5, steam inlet 6, and outlet 7 for condensed steam. These parts are shown of ordinary form as being typical of such apparatus. The tubes 8, which are of special form, pass through the tube plates 2 in the usual manner. Details of the tubes are shown in Figs. 7 to 10, Fig. 7 being an elevation with the lower tube in section, Fig. 8 being a plan, and Figs. 9 and 10 being cross-sections on the respective lines A, A, and B, B. The tubes 8 are made with circular ends adapted to be secured in the tube plates 2 in any ordinary manner such as by screwed ferrules 9 and compressible packing 10. Between the circular ends the tubes are of crescent-like cross section, that is to say, one side of the tube is pressed inwardly by a suitable tool so as to form a longitudinal groove or trough 11. This trough is made of increasing depth toward one end of the tube, as indicated in the cross-sectional views Figs. 9 and 10. The tube being placed with its groove or trough 11 uppermost, it will be seen that any water resulting from the condensation of the steam and lodging or dropping on the upper side of the tube will run into and along the trough and will run off at the lowermost end, so being conducted to one end of the condenser and prevented from dripping on to the tubes below, excepting possibly just at their ends. Usually the water runs along the trough with sufficient velocity to reach the tube plate, down which it runs. The tubes are arranged in the condenser so that each tube slopes down toward one of the tube plates; preferably they all slope down to the same tube plate. Where the tubes are grooved so that the trough is deeper at one end than at the other and is at the deep end deflected spirally, such configuration will provide a sloping trough even with horizontal tubes; as however the chief function of these channels is to drain off the water, I find it necessary generally to slope the tubes so that one end of each tube is lower than the other. This is one of the chief distinguishing features of my invention, and I have found it to be of great advantage in increasing the efficiency of a given area of heat transmitting surface. With the ordinary arrangement, the various tubes receive not only the water condensed by themselves but the drippings from those above them, which as already stated seriously impairs their heat transmitting capability. The drainage being collected as described by the tubes and conveyed to one end of the condenser, it may be there collected in a sump 12 so as to expose comparatively little free surface for reëvaporation.

The construction described, in addition to providing for very efficient drainage of the condensed steam, has the further advantage that the circulating water in passing through the tube section of decreasing area and varying form, flows with an accelerating velocity and is very thoroughly intermixed, so that every portion comes into contact with the tube surface. For this reason, the tubes are generally arranged so that the circulating water flows through the tubes

from the larger to the smaller cross section even when, as in Fig. 1, the circulating water has a reversed flow necessitating the shallower end of the groove to be turned toward the drainage end, as the trough at any part of its length is large enough to convey the drainage.

The tubes are generally arranged as in Fig. 11 so that each tube carries its own drainage. Cross slots may be formed in the tube ends so that they may be turned into the proper position by a screw driver. By this means the tubes may be turned with their troughs underneath when "boiling out" to remove grease from the tubes. Or, owing to the unsymmetrical section, the tubes may be turned by a tool of appropriate contour adapted to be inserted at either end. To still further facilitate the drainage, the troughs are preferably deflected spirally around the tube at the deeper end so that the drainage will run off freely and not lodge in the trough; this modification is illustrated at 11^1 in Figs. 2 and 3, which are analogous to Figs. 7 and 8, and in Figs. 4, 5 and 6, which are cross-sections on the respective lines C, C, D, D, and E, E.

The cross-section of the tube may be varied from the crescent-like form described without departing from my invention as shown for instance at 13 and 14 in Fig. 12, or more than one groove may be formed as shown at 15 and 16 in Fig. 12. The cross-section of the tubes may be uniform throughout their troughed part, but for the reasons stated in referring to the action of the circulating water, it is generally preferable to make the cross-section of varying form and diminishing area.

I am aware that tubes with one or more longitudinal grooves have been used in connection with apparatus of the class herein referred to, with the object of giving a large heat transmitting surface relatively to the cross-sectional area, and to such broadly I make no claim.

I find that the greatly increased efficiency of tubes constructed and arranged according to my invention results not from the increase of surface relatively to the cross-sectional area due to the cresent shape, but from the manner in which the groove of the cresent is arranged on the upper part of the tube and upon the mode in which it is disposed to form a drainage trough, as described.

Having now fully described my invention, I declare that what I claim and desire to secure by Letters Patent is;—

1. In apparatus for condensing steam or for heating or evaporating water by steam, a casing, tube plates, heat transmitting surfaces within said casing and connected to the tube plates, comprising straight or substantially straight tubes having each a trough or troughs extending longitudinally thereof on its upper side, the tubes being arranged with a slope so as to collect and convey to one end of the tubes and casing, the drainage resulting from the condensation of the steam on the outer surface of the tubes, substantially as described.

2. An apparatus for condensing steam or for heating and evaporating water by steam, comprising a casing, tube plates, heat transmitting surfaces in the form of substantially straight tubes arranged within said casing having each a longitudinal trough of gradually increasing depth on its upper side and arranged with a slope so as to collect and convey to one end of the tubes and casing the drainage resulting from the condensation of the steam on the outer surface of the tubes, substantially as described.

3. In apparatus of the class described a casing a heat transmitting tube having a trough on its upper side to collect and convey the water of condensation, the end of the said trough being deflected to discharge the water of condensation laterally, substantially as described.

4. In apparatus of the class described a casing a heat transmitting tube having a trough on its upper side for the water of condensation, said trough being deflected at its end spirally of the tube, substantially as described.

5. In apparatus of the class described a casing tube plates, a heat transmitting tube extending within the casing and supported by the tube plates and having a trough in its upper side to collect and convey the water of condensation to the end of the casing, said trough being inclined in respect to the axis of the tube whereby a sloping trough is provided and the cross sectional area of the tube is varied at different points along the same, said trough having a discharge outlet at one end substantially as described

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

DANIEL ARTHUR QUIGGIN

Witnesses:
ROBT. A. SLOAN,
JOSEPH E. HIRST.