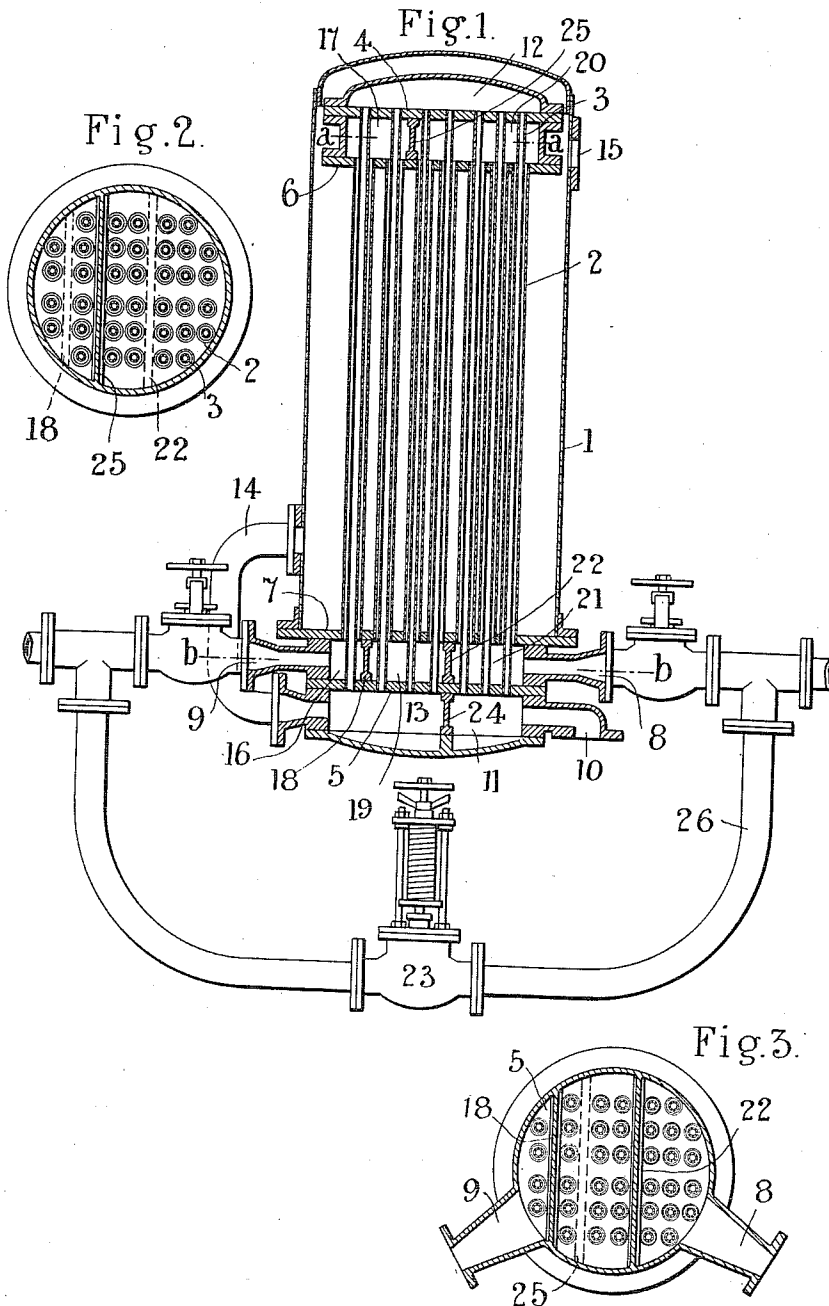


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 APPARATUS FOR HEATING OR COOLING OIL OR OTHER VISCOUS LIQUIDS.
 APPLICATION FILED JUNE 4, 1910.

979,618.

Patented Dec. 27, 1910.



WITNESSES
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UNITED STATES PATENT OFFICE.

JAMES GEORGE WEIR, OF GLASGOW, SCOTLAND.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JAMES GEORGE WEIR, a subject of the King of Great Britain and Ireland, residing at Glasgow, Scotland, have invented a new and useful Improvement in Apparatus for Heating or Cooling Oil or other Viscous Liquids, of which the following is a specification.

This invention relates to improvements in apparatus for the cooling or heating of oil or other viscous liquids, and relates more particularly to tubular apparatus for the cooling of oil for use in the bearings of marine or other steam turbines or prime movers, and for the heating of oil or liquid fuel for combustion in marine or other steam generators.

It relates to apparatus of the tubular type, in which the liquid to be heated or cooled is passed through tubes or the annular spaces between concentric tubes, on the other side of which the cooling or heating medium is caused to flow.

Apparatus of this class has hitherto been designed in such a manner that the fluid to be heated or cooled flows through the apparatus in a passage of uniform total cross sectional area and consequently with uniform velocity. It has been found that in such an apparatus the rate of transmission of heat between the fluid in the tubes or annular spaces, and the heating or cooling medium on the other side thereof varies with the velocity of the fluid relative to the tube surface. It has also been found that in cases where the viscosity of the fluid changes during its passage through the apparatus, that the pressure necessary to maintain a fixed velocity through a unit length of the path of the fluid also changes.

Apparatus to carry out this invention, may consist of a tubular cooler or heater as the case may be, comprising a series of tube elements, each consisting of say two concentric tubes attached at both ends to separate tube plates, and having an outer removable casing inclosing the whole of the tubes. As the fluid to be heated or cooled is circulated through the annular spaces between the tubes, the chamber at the inner end between the tube plates is provided with inlet and outlet branches, while the chambers outside the outer tube plates are provided with

branches for the cooling or heating medium, so that the cooling or heating medium may be circulated through the inner tubes, and then pass into the outer casing, thus enabling it to pass over the surface of the outer tubes. In the chambers through which the fluid to be cooled or heated passes, at each end I arrange division plates in such a manner that the fluid may be circulated through a gradually increasing number of annular spaces or a space of increased area in the case of the cooling apparatus, and conversely through a gradually decreasing number of annular spaces or a space of decreased area for a heating apparatus. It is obvious that when starting the apparatus the oil will ordinarily be cold and not require any further cooling. It is also obvious that the viscosity will then be at a maximum, and the requisite pressure to force the oil through the cooler will be very high. I accordingly arrange on the inlet oil branch, a spring loaded by-pass valve adjusted to suit a given condition of working, the condition representing the pressure required to force hot oil into the cooler. This spring loaded valve is also connected to the outlet of the cooler, so that when starting the oil will by-pass the cooler altogether and the by-pass valve will remain open until the oil temperature rises and the oil requires cooling.

To enable the invention to be fully understood it will now be described by reference to the accompanying drawings in which:—

Figure 1 is a sectional elevation of an apparatus constructed according to the invention and adapted for both heating and cooling oil or other viscous liquid. Figs. 2 and 3 are transverse sections on the lines *a, a*, and *b, b*, Fig. 1, respectively.

As shown, the apparatus consists of a cylindrical shell 1, containing a series of tube elements each consisting of two concentric tubes 2, 3, the inner tubes 3 being attached at their ends to the tube-plates 4, 5, while the outer tubes 2 are attached to tube plates 6, 7. Inlet and outlet branches 8, 9, for the liquid to be heated or cooled are provided between the tube plates 5, 7. The heating or cooling medium enters the apparatus at 10 and passes into chamber 11, whence by reason of the division plate 24 it is caused

to pass up through the inner tubes 3 into chamber 12, whence it flows down the remaining tubes 3 into chamber 13, then through the pipe 14 into the outer casing 1, across the outside of the outer tubes 2, leaving the casing at 15.

The outer tubes 2, through which the liquid to be cooled or heated passes, are divided into a series of groups by means of division plates 18, 22, placed between the tube plates 5, 7, and by a division plate 25 placed between the tube plates 4 and 6, so that liquid entering the apparatus at 9, will be caused to flow through a gradually increasing number of annular spaces for cooling effect and conversely liquid entering at 8, will flow through a gradually decreasing number of such spaces for heating effect as will be clearly seen by reference to Figs. 2 and 3.

With the above described arrangement the fluid to be cooled enters the chamber 16, passes up through the outer tubes 2, connected to said chamber, in this example four in number, (see Fig. 3) into chamber 17 whence it passes down the six tubes connected thereto into chamber 19, then up through a series of twelve tubes 2, into chamber 20, down again through a series of sixteen tubes and flows out through the outlet 8. The cooling medium, water for example, enters at 10, and passes through the apparatus as previously described. When the apparatus is employed, for example, for cooling oil, in a continuous lubricating system, the oil will ordinarily be cold at the start and will not require any further cooling. Accordingly a by-pass connection 26 is provided between the oil inlet 9 and the outlet 8 having a spring loaded valve 23 adjusted to lift when the resistance due to the viscosity of the oil passing through the cooler is greater than that exerted by the valve spring, so that when starting, the oil will by-pass the cooler, the valve 23 remaining open until the temperature of the oil rises and it requires cooling, when said valve closes and the oil passes through the cooler.

If it is desired to employ the apparatus for heating liquids, steam or other heating medium is introduced at 10, and the liquid to be heated enters at 8, flowing through the apparatus in the reverse direction to that previously described with reference to a liquid to be cooled, thus passing through a gradually decreasing number of annular spaces.

It will be obvious that this invention may be carried out in various types of apparatus, but the essential feature consists in the variation of the area of path for the liquid to be cooled or heated in proportion to its

viscosity with consequent variation in its velocity of flow.

What I claim is:—

1. In apparatus of the class described, the combination with an outer casing of concentric tube elements, means for passing cooling medium through the inner tube elements, means for causing the liquid to be cooled to flow through a gradually increasing number of outer tube elements.

2. In apparatus of the class described the combination with an outer casing, of concentric tube elements, inner tube plates for the inner tube elements, outer tube plates for the outer tube elements, chambers between the inner and outer tube plates, an inlet and an outlet for the liquid to be cooled in one of said chambers, baffle plates arranged in said chambers in such a manner as to cause the liquid to be cooled to flow through a gradually increasing number of outer tube elements and means for passing a cooling medium through the inner tube elements.

3. In apparatus of the class described the combination with an outer casing, of concentric tube elements, inner tube plates for the inner tube elements, outer tube plates for the outer tube elements, chambers between the inner and outer tube plates, an inlet and an outlet for the liquid to be cooled in one of said chambers, baffle plates arranged in said chambers in such a manner as to cause the liquid to be cooled to flow through a gradually increasing number of outer tube elements, an inlet chamber for the cooling medium surrounding the lower ends of the inner tube elements, a baffle plate dividing said chamber and forming a second chamber, a third chamber surrounding the upper ends of the inner tube elements into which the cooling liquid flows before passing down the inner tube elements into said second chamber, a pipe connecting the second chamber to the outer casing and an outlet in the outer casing.

4. In apparatus of the class described the combination with an outer casing, of concentric tube elements, inner tube plates for the inner tube elements, outer tube plates for the outer tube elements, chambers between the inner and outer tube plates, an inlet and an outlet for the liquid to be cooled in one of said chambers, baffle plates arranged in said chambers in such a manner as to cause the liquid to be cooled to flow through a gradually increasing number of outer tube elements, an inlet chamber for the cooling medium surrounding the lower ends of the inner tube elements, a baffle plate dividing said chamber and forming a second chamber, a third chamber surrounding the upper ends of the inner tube elements into which the cooling liquid flows before passing down

the inner tube elements into said second chamber, a pipe connecting the second chamber to the outer casing an outlet in the outer casing, a by-pass pipe connecting the inlet
5 and outlet of the fluid to be cooled, and a loaded valve in said by-pass pipe.

In witness whereof I have hereunto set my

hand in the presence of two subscribing witnesses.

JAMES GEORGE WEIR.

Witnesses:

JAMES DAYTON IRWIN,
GEORGE MORTON DALZIEL.