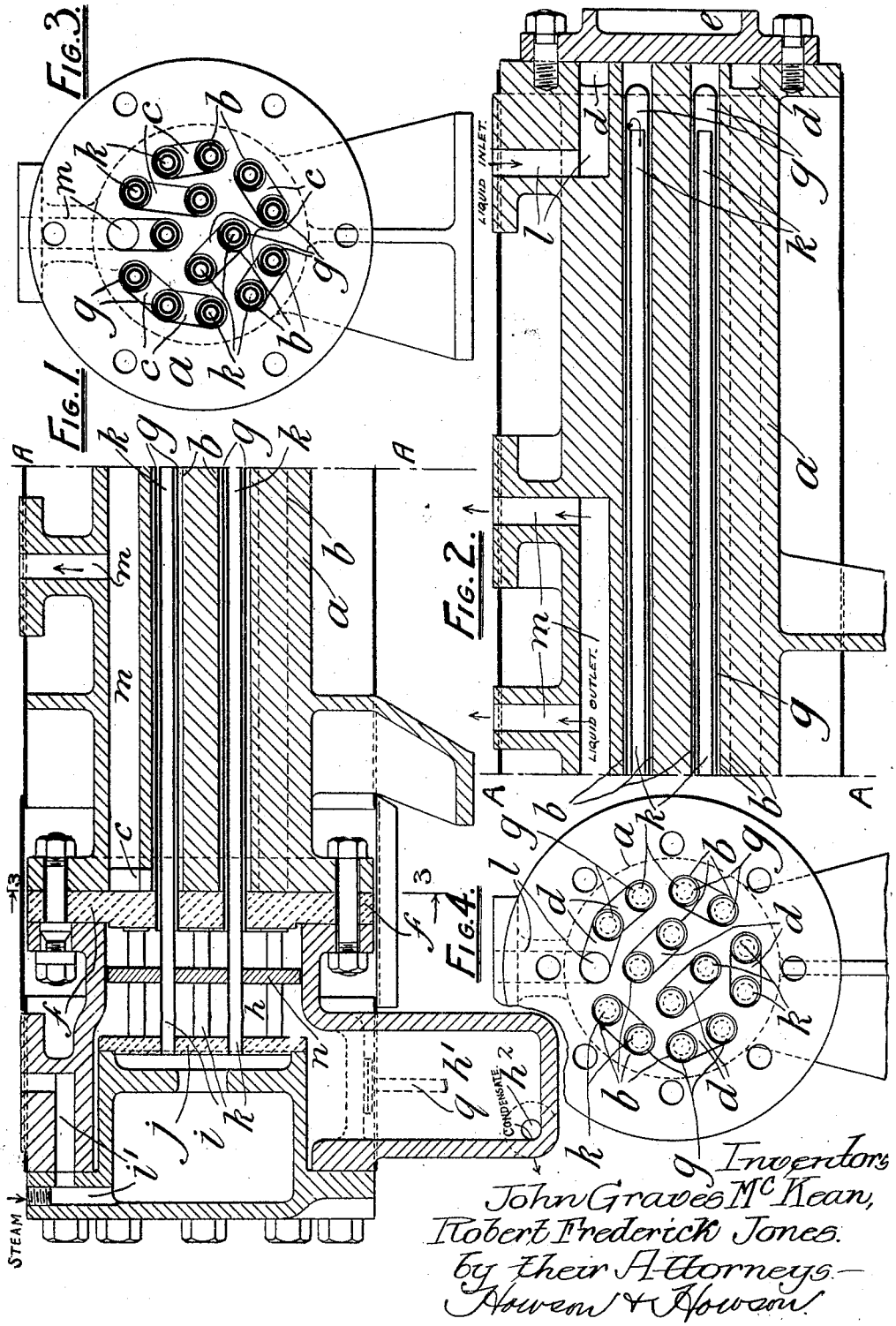
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HEAT EXCHANGE APPARATUS

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HEAT-EXCHANGE APPARATUS.

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To all whom it may concern:

Be it known that we, JOHN GRAVES McKEAN and ROBERT FREDERICK JONES, subjects of the King of Great Britain and Ireland and the Isle of Man, residing, respectively, at Westerhill, Mount Vernon, Lanarkshire, Scotland, and 11 Leven Street, Pollokshields, Glasgow, Scotland, have invented new and useful Improvements in Heat-Exchange Apparatus, of which the following is a specification.

This invention has reference to improvements in heat exchange apparatus and the like and particularly relates to apparatus for heating liquid fuel and the like.

According to this invention the apparatus comprises a main heater body, of any suitable shape in cross section, provided with a plurality of longitudinal passages in each of which two steam pipes are arranged; one being located within the other. The diameters of these two steam pipes and of the passages are such that there is an annular space between each inner and outer steam pipe and between the outer pipe and the wall of the passage containing same.

The liquid to be heated flows through the annular space between the outer steam pipe and the wall of the passage.

The steam is discharged from the outer steam pipe into a discharge chamber, suitably drained; the arrangement being such that condensed steam in the outer pipe does not drip on to the pipes at a lower level but falls direct into the discharge chamber.

The inner steam pipe does not extend the full length of the outer pipe and the outer pipe does not extend the full length of the passage so that these pipes may expand without the undesirable consequence of steam leaking into and mixing with the liquid.

In order that others skilled in the art to which this invention relates may properly understand the same we have hereunto appended one sheet of explanatory drawings in which:—

Figure 1 is a longitudinal sectional elevation of the left hand portion, and Figure 2 is a similar sectional elevation of the right hand portion, of a heat exchange apparatus constructed according to this invention. A complete sectional elevation of the apparatus will be seen if these two figures are placed side by side with a line A—A (Figure 1) coinciding with the line A—A (Figure 2).

Figure 3 is a transverse sectional elevation, taken on the line 3—3 of Figure 1, and looking toward the right.

Figure 4 is an end elevation of the right hand end of Figure 2, with the cover plate removed.

Referring to these drawings:—

In carrying this invention into effect or practice a heater body a is provided with a plurality of longitudinal passages b which extend from end to end of same and which are positioned in concentric rows that is, an innermost row of passages b is encircled by an outermost or concentric row, all as shown in the drawing. The passages are connected up to each other by passages c and d at each end in such manner as to form a continuous duct which extends inwardly. One end of the heater a is provided with a cover plate e which closes the passages b and the other end of the heater a is provided with a tube plate f fitted with tubes g which are arranged one within each passage b. These tubes g do not extend the full length of the passage b so that they may expand freely. The ends of the tubes g lying within the passages b are closed, while the other and open ends of the tubes g discharge into a chamber h arranged next to the tube plate f and formed with a "well" h^1 suitably drained through the ports h^2. It will thus be seen that condensed steam in the tubes g does not drip on to other tubes at a lower level but falls direct into the chamber h. A steam supply chamber i provided with a tube plate j is arranged next the chamber h and tubes k fitted to the plate j are arranged one passing into each tube g. These tubes k are open ended and do not extend the full length of the tubes g so that they may expand freely.

The heater a is provided with a liquid inlet passage and port l and a liquid outlet passage and ports m. The steam enters the supply chamber i through the port i^1, passes through the inner tubes k to the closed end of the tubes g, then passes back through the tubes g in the annular space between the tubes k and g and is discharged into the chamber h.

With the number of passages b in the apparatus illustrated, the liquid enters through the inlet port l and flows into the first two

passages *b* in the outer row and then through the connecting passages *d* and from these first two passages *b* the liquid flows through the connecting passages *c* at the other end of the heater into the third passage *b* of the series. From this third passage *b* the liquid flows through the other passages *b* and passages *c* and *d* to the outlet passage and ports *m*. By reason of the fact that the passages *b* are so connected as to form a continuous duct extending inwardly from the outer surface of the body *a* to the center thereof, the temperature of the liquid traversing the same is gradually increased, reaching a maximum in the centrally positioned passages *b* just prior to its entrance into the outlet passages and ports *m*. An advantage of such method of flow is the material economies effected in the heat losses by radiation. The flow of the liquid through the passages *b*, *c*, and *d* may be varied to suit different liquids. For viscous liquids the preferred arrangement is as illustrated, but for other liquids which are not so viscous the flow may be from the first to the second passage *b* and from the second to the third and so on instead of through the first and second simultaneously to the third.

If desired the first passage *b* (or the first two passages) may be of greater diameter than the other passages *b*.

As illustrated the heater *a* may be circular in cross section, but, if desired, and to suit any particular installation, the heater may be rectangular or other shape in cross section and the arrangement and number of passages *b* may be varied as desired.

If desired the inlet and discharge passages and ports may be arranged otherwise than as illustrated, that is, these may be arranged in the end cover *e*. A plate *n*, riding loosely on the tubes may be arranged to facilitate the entrance of these tubes *k* into the tubes *g*.

We claim:—

1. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, the said ends of the body member having recesses connecting the ends of the passages, and end plates secured to the body and enclosing the recesses whereby the said passages are made to constitute a continuous duct extending toward the center of said body member.

2. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, the said ends of the body member having recesses connecting the ends of the passages, end plates secured to the body and enclosing the recesses whereby the said passages are made to constitute a continuous duct, and tubes carried by one of the end plates and adapted to enter the passages.

3. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, means at one end of the member for connecting the ends of the passages, recesses in the other end of the member joining the ends of the passages, an end plate secured to the said other end and enclosing said recesses, and tubes carried by the end plate and adapted to enter the passages.

4. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, means at the ends of the body for connecting the ends of the passages to form a continuous duct, a chamber at one end of the body having an exhaust opening, a series of ducts extending from said chamber into the passages, a second chamber, a series of ducts extending from second chamber into the said first series of ducts, and intake means in the second chamber.

5. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, means at one end of the body for connecting the ends of the passages, recesses at the other end of the body joining the ends of the passages, an end piece for the latter end of the body comprising a pair of spaced plates, one adapted to abut the end of the body and to enclose said recesses, a series of apertures in each of said plates, a corresponding series of ducts extending from each series of said apertures into the passages of the body, the ducts of the outer plate extending into the ducts of the inner plate, casing members secured to the end of the body and enclosing the space between the said plates to form thereof a substantially closed chamber, and a second chamber outwardly of the outer plate and communicating with the apertures therein.

6. A heat exchange device comprising a main body member having a plurality of passages extending from end to end thereof, said passages being positioned to form inner and outer rows, and means for so joining said passages as to form a continuous duct extending inwardly of said body member.

7. A heat exchange device comprising a main body member having a plurality of passages extending from end to end thereof, said passages being positioned to form inner and outer rows, heating means positioned in said passages and means for so joining said passages as to form a continuous duct extending inwardly of said body member.

8. A heat exchange device comprising a main body provided with a plurality of passages positioned at different distances from the center thereof, means for so joining said passages as to form a continuous duct extending inwardly of said body member, telescoping tubes individual to each passage and

adapted to form a continuous duct, and enclosures adapted to receive corresponding ends of said telescoping tubes.

9. A heat exchange apparatus comprising a main heater body member having a plurality of passages extending therethrough from end to end, means at the ends of the body for connecting the ends of the passages to form a continuous duct, a chamber at one end of the body having an exhaust opening, a series of ducts extending from said chamber into the passages, a second chamber, a series of ducts extending from said second chamber into the said first series of ducts, a plate having perforations adapted to receive the ducts extending from said second chamber and positioned in said first mentioned chamber and intake means in the second chamber.

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