

Nov. 10, 1936.

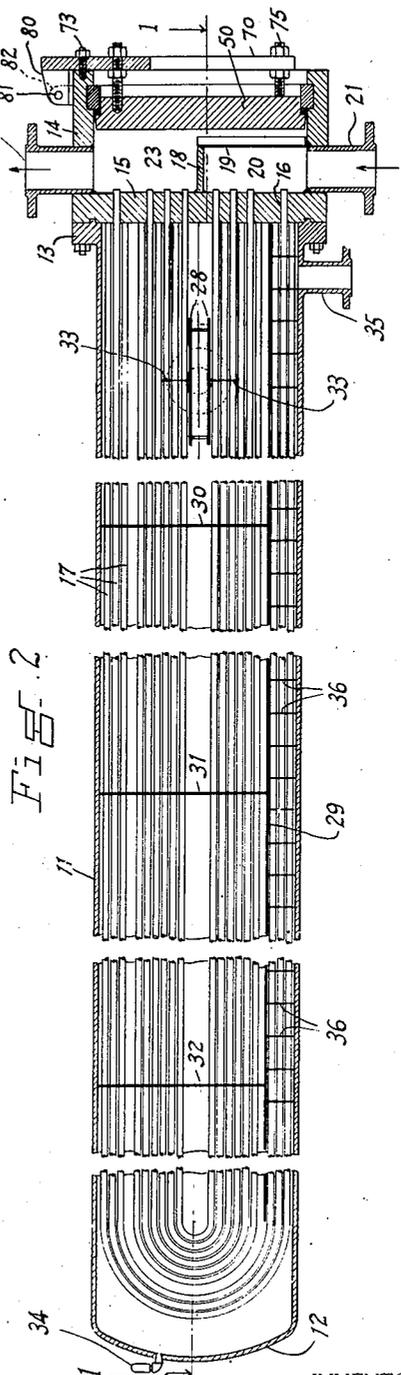
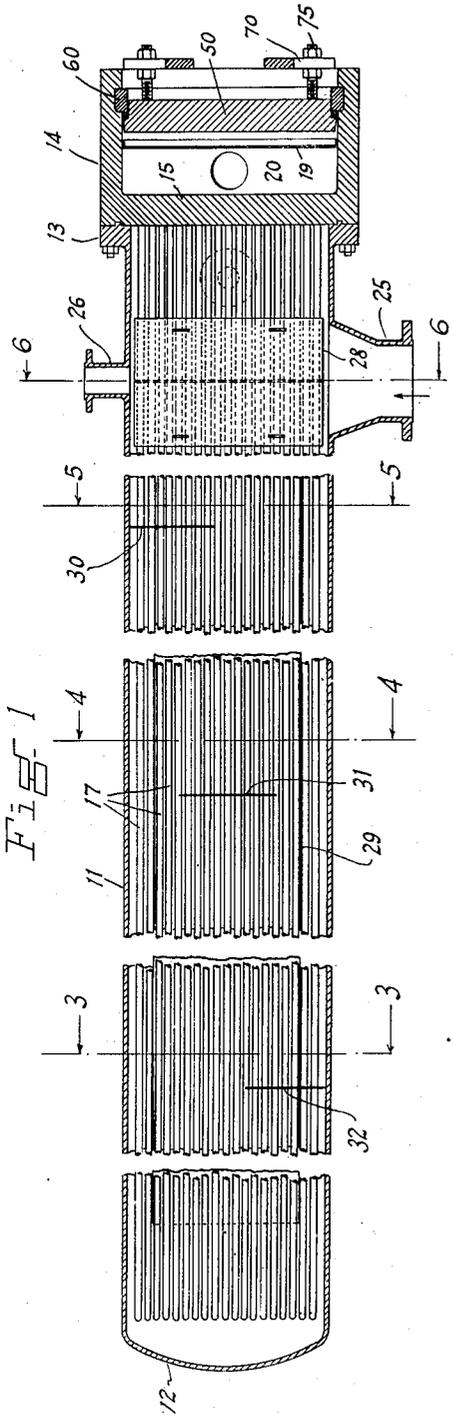
J. C. HOBBS

2,060,078

HEAT EXCHANGER

Filed Feb. 7, 1936

3 Sheets-Sheet 1



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2,060,078

HEAT EXCHANGER

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3 Sheets-Sheet 2

Fig. 3

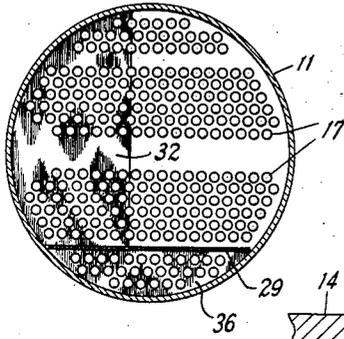


Fig. 4

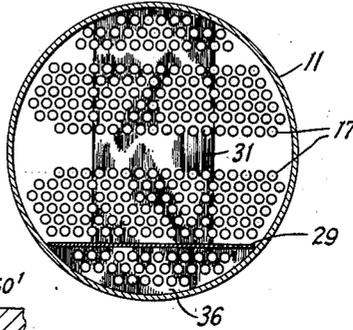


Fig. 13

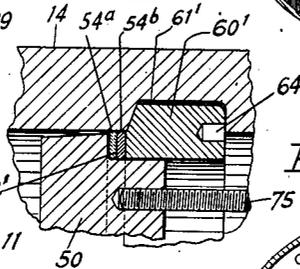


Fig. 5

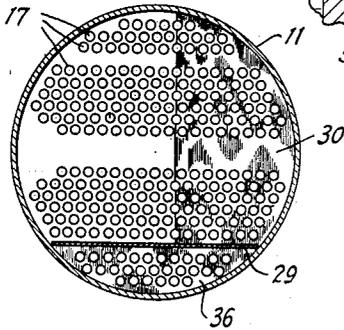


Fig. 6

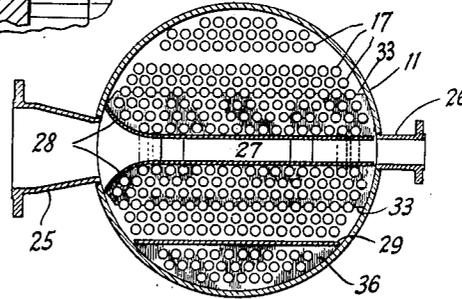


Fig. 7

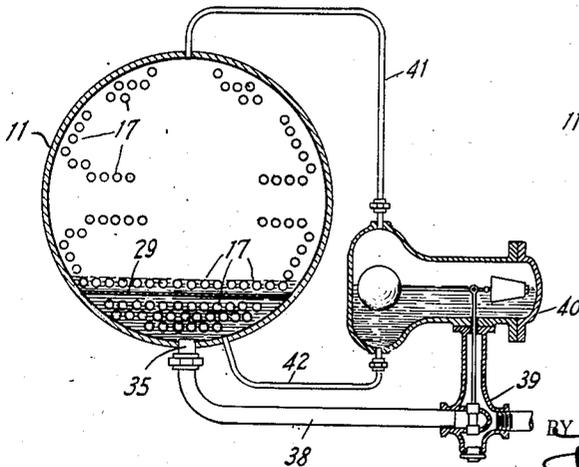
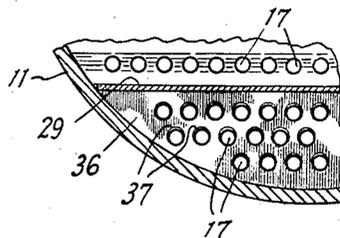


Fig. 11



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2,060,078

HEAT EXCHANGER

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3 Sheets-Sheet 3

Fig. 8

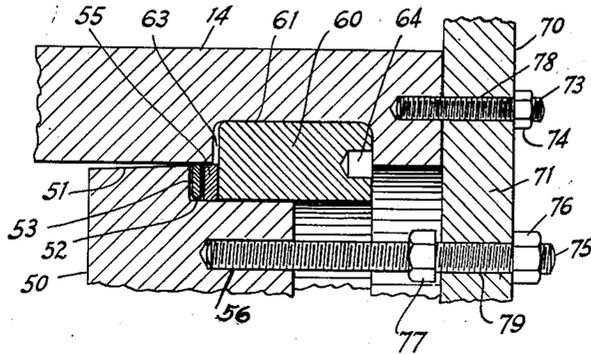


Fig. 9

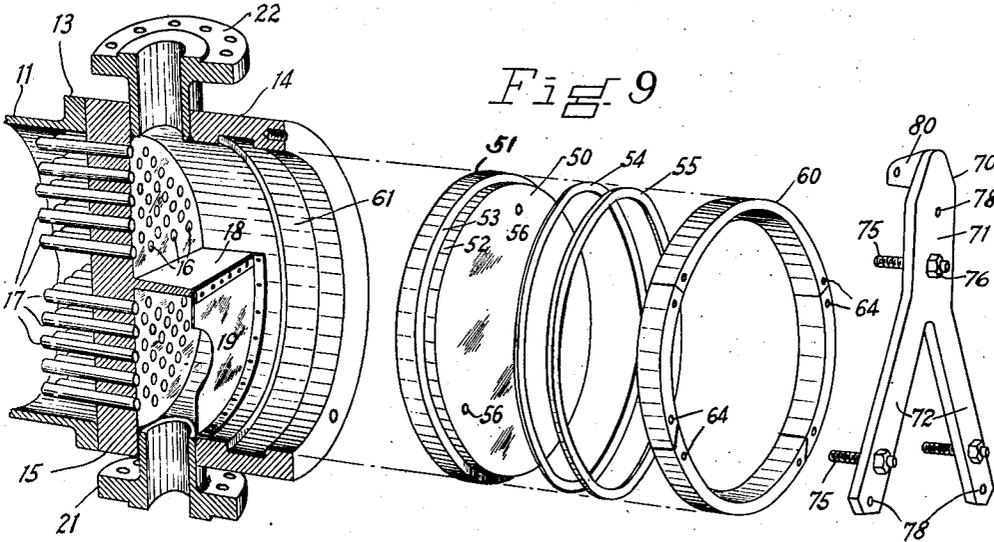


Fig. 10

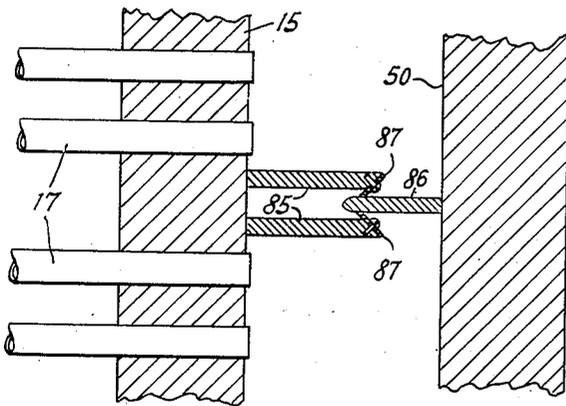
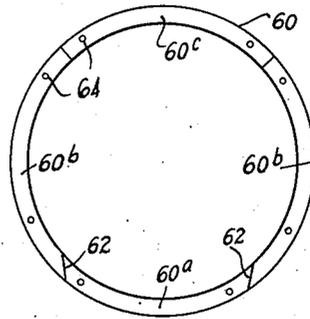


Fig. 12

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UNITED STATES PATENT OFFICE

2,060,078

HEAT EXCHANGER

James C. Hobbs, Painesville, Ohio

Application February 7, 1936, Serial No. 62,733

19 Claims. (Cl. 257—239)

The present invention relates in general to the construction and operation of fluid heat exchangers, and more particularly to heat exchangers having heat transfer surface formed by a bundle of tubes enclosed by a shell connected to a pressure head in which the internal fluid pressure is utilized in maintaining the closure parts of the head in fluid-tight condition irrespective of relative expansion of the parts.

One of the main objects of my invention is the provision of a fluid heat exchanger of the type described which is characterized in operation by its effective utilization of a condensible heating fluid, low temperature and vibration stresses on the tube bundle, and high rate of heat transfer maintained. Another object is the provision of a pressure head construction having closure parts characterized by their ease of assembly and removal, compactness, safeness, simplicity, and relatively low cost of construction and maintenance.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is a longitudinal section taken on the line 1—1 of Fig. 2 of a high pressure steam boiler feed water heater constructed in accordance with my invention;

Fig. 2 is a longitudinal section taken at right angles to Fig. 1;

Figs. 3, 4, 5, and 6 are transverse sections taken on the lines 3—3, 4—4, 5—5, and 6—6 respectively of Fig. 1;

Fig. 7 is a somewhat diagrammatic view partly in section of the condensate level control mechanism;

Fig. 8 is an enlarged fragmentary section of a portion of the pressure head shown in Fig. 2;

Fig. 9 is an exploded view of the pressure head parts;

Fig. 10 is an end view of the segmental holding ring;

Fig. 11 is an enlarged view illustrating the condensate baffle passages;

Fig. 12 is a fragmentary section illustrating a modified form of pressure head partition; and

Fig. 13 is a fragmentary sectional view of a modified head construction.

The feed water heater illustrated comprises an elongated cylindrical steel shell 11 closed at one end by a rounded head 12 and terminating at its opposite open end in an external annular flange 13. The flange 13 is connected in a fluid tight engagement with the integral base of a short cylindrical pressure head 14 open at its outer end. The base of the pressure head closes the end of the shell and forms a circular tube sheet 15 having a multiplicity of tube seat openings 16 therein, arranged in upper and lower segmental groups, as shown in Figs. 3-6. A bundle of U-tubes 17 is arranged to extend substantially the full length of the shell 11 with their opposite ends expanded into corresponding openings 16 in the tube sheet upper and lower groups. The pressure head is divided into two separate chambers by a diametrical partition plate 18 extending transversely of the tube sheet 15 intermediate the two groups of tube openings and connected at its outer end to the upper edge of a semi-circular vertical plate 19, the curved edge of which has a fluid tight connection with the inner circumferential wall of the pressure head, to form a closed chamber 20 communicating with all of the lower tube legs in the tube bundle. A flanged pipe 21 opens into the bottom of the chamber 20 and provides an inlet for the feed water to be heated. At the opposite side of the pressure head from the inlet 21 a second pipe 22 opens to a chamber 23 defined by the remaining space in the pressure head and communicating with the ends of the upper tube legs in the tube bundle.

As shown in Figs. 1, 2, and 6, the heating fluid is supplied to the shell adjacent the tube sheet end thereof through nozzle connections 25 and 26 respectively communicating with opposite sides of a narrow space 27 formed by two vertically spaced horizontal plates 28 extending across the shell intermediate the upper and lower tube leg groups. The plates 28 are flared at the side adjacent the nozzle 25 and the space 27 opens at both its ends to the space between the closest upper and lower tube legs. This construction and arrangement is particularly advantageous when the heating fluid is wet steam entering through the tapering inlet 25 or condensed heating fluid at a higher pressure entering through the inlet 26 in preventing erosion and vibration of the tubes due to the impingement of a high velocity fluid without restricting its flow. Such incoming condensate will impinge on the plates causing some of its velocity to be dissipated and its excess heat content is used in flashing a portion of the condensate into steam.

Baffling is provided for directing the flow of

heating fluid along and in intimate surface contact with the tube bundle including a lower horizontal baffle 29 extending from the tube sheet to a point adjacent the opposite end of the tube bundle, and longitudinally spaced transverse vertical baffles 30, 31, and 32 extending from the horizontal baffle 29 to the top of the shell. As shown in Figs. 1 and 5, the baffle 30 is arranged wholly at one side of the shell center line; as shown in Figs. 1 and 4, the baffle 31 is symmetrically arranged relative to the shell center line, but spaced from the sides of the shell; and as shown in Figs. 1 and 3 the baffle 32 is wholly at the opposite side of the shell center line from the baffle 30. The heating fluid issuing from the tube sheet end of the space 27 contacts with the adjacent tube end portions and tube sheet and is then directed upwardly and downwardly longitudinally of the tube bundle by short transverse baffles 33 on the plates 28. With this arrangement the heating fluid will flow longitudinally of the tube bundle through the shell space above the baffle 29 in a sinuous flow path defined by the baffles 30, 31, and 32. The described heating fluid flow will thus be counter to the flow of heated fluid in the upper legs of the tubes and in the same direction as the flow in the lower tube legs above the baffle 29. A vent valve 34 is provided in the end of the shell for the outflow of non-condensable gases.

The shell space below the horizontal baffle 29 is sealed against steam flow therein and insulated from heating by the steam in the shell above the baffle by normally maintaining a condensate level just above the first row of tube legs above the baffle. This condensate level also prevents the steam from directly contacting with the baffle 29 and damaging the same. The space below the horizontal baffle 29 is baffled to provide a relatively rapid counterflow of condensate over the tube legs in that space towards a bottom outlet 35 at the tube sheet end of the shell. This baffling system consists of a large number of segmental baffles 36, as shown in Figs. 3 to 6, having tube openings 37 therein of larger diameter than the outside diameter of the tubes, as shown in Fig. 11, so that a relatively high velocity of the condensate and intimate heat transfer contact with the tube legs will be assured at the baffles.

As shown in Fig. 7, a drain pipe 38 is connected to the condensate outlet 35 and the condensate flow therethrough controlled by a float controlled valve 39 operated from a float chamber 40. As shown in Fig. 7, the float chamber 40 is connected to the steam and condensate space of the shell by pipes 41 and 42. The pipe 42 is used in lieu of the drain pipe 40 to eliminate the effect of velocity in the drain pipe.

With the described heat exchanger construction, most of the feed water is subjected to two successive stages of heating in each of which the most desirable heat transfer conditions are maintained. In the first stage, a counterflow of condensate at a relatively high velocity contacts with the tubes, while in the second stage a uni-directional flow of a condensable vapor serves as the heating medium. The two heating stages are thermally insulated sufficiently to permit sub-cooling of the condensate below the condensation temperature of the steam to as near the temperature of the incoming feed water as may be desired. The uni-directional flow of steam in the heater assists in displacing the non-condensable gases towards the vent 34. The use of the condensate as heating fluid in the lower section re-

duces the steam supply required by an amount corresponding to the heat absorbed by the feed water from the condensate.

The detailed construction of the pressure head 14 as shown in Figs. 8 to 10, comprises closure parts for the outer end thereof including a heavy forged steel disc-shaped cover 50 arranged to fit within the circular opening in the head. The circumferential surface of the cover has an inner portion 51 tapering slightly towards its inner end, to facilitate its movement within the head and an outer portion 52 of reduced diameter. The cover is cut away at the outer end of the tapered portion in a plane normal to its axis to form an annular pressure surface 53 and a reduced diameter outer portion 52. A gasket ring 54 of substantially rectangular cross-section fits around the cover portion 52 with its flat inner surface in contact with the pressure surface 53. A one-piece sealing ring 55 also of rectangular cross-section has an inner flat surface contacting with the flat outer side of the gasket ring 54, with both the gasket and sealing ring extending radially between the reduced cover portion 52 and the cylindrical wall of the head. With this arrangement, any fluid pressure on the inner side of the cover will compress the gasket ring to cause it to spread radially when axial movement outwardly is prevented by the sealing ring and thus provide a fluid tight seal between the cover and the cylindrical wall of the head.

While various provisions may be used for holding the sealing ring in position, I prefer to employ the segmental retaining ring 60 shown. A relatively shallow annular recess 61 is formed in the inner wall surface of the head adjacent the outer end thereof for receiving the segmental ring. The ring 60 is made in four segments of substantially equal arcuate lengths, as shown in Fig. 10. The ends of the bottom segment 60^a and the corresponding ends of the side segments 60^b are cut to provide centrally diverging lines of contact, indicated at 62, at angles of about 5° to the mid-radius of the bottom segment to facilitate the installation and removal of the bottom segment from the assembled ring, while the remaining end portions of the side segments and top segment 60^c are radial. The recess 61 and the segmental ring are relatively proportioned to provide an annular clearance space, indicated at 63, between the inner wall of the recess and the inner side of the ring when in position, which facilitates assembly and removal of the segmental ring. The sealing ring 55 bridges the cuts in the segmental ring to protect the gasket and closes the side of the clearance space 63 to prevent the gasket from being forced therein in use. Holes 64 are formed in the outer side of each ring segment to facilitate their handling. With the described parts assembled, the forces due to fluid pressure will be transmitted through the cover, gasket, sealing ring, and segmental ring to the cylindrical wall of the head, without any wedging of the gasket ring and resultant difficulty in its removal, and so that the metallic parts involved are subjected to compression and shear in resisting the axially outward acting force of the fluid pressure on the cover while being free to expand radially.

At the outer end of the head is mounted a swingable yoke or spider 70 having a vertical body portion 71 and two diverging leg portions 72. Bolt holes 78 near the ends of the yoke body and legs are used for detachably connecting the yoke to the outer end of the head by stud bolts 73 and

nuts 74. Additional bolt holes 79 are located in the body and legs in positions corresponding with tapped holes 56 in the outer side of the cover 50. Stud bolts 75 having adjusting nuts 76 and 77 thereon at opposite sides of the corresponding yoke portions support the cover in an upright position from the yoke. At the inner side of the upper end of the yoke body is welded a bar 80 having an opening therein for a pivot pin 81 for mounting the yoke on brackets 82 carried by the head, as shown in Fig. 2.

With this arrangement of the parts the yoke can be advantageously used for swinging and axially adjusting the cover 50 during the assembly and removal of the closure parts, and also to put an initial pressure on the gasket ring to prevent leakage at low pressures in the head, especially at starting-up periods. In assembling the pressure head, the cover with the gasket and sealing rings in position thereon is first inserted and held in upright position inwardly of the head wall recess 61 by adjusting the nuts 76 and 77. The segments of the ring 60 are then inserted, with the bottom segment 60^a last to be inserted. The nuts 74 are then tightened and the nuts 77 loosened and nuts 76 adjusted to cause the cover to move outwardly until the sealing ring 55 contacts with the segmental ring. The nuts 76 are further adjusted to cause an initial pressure to be impressed on the gasket ring. In operation the nuts 77 are left loose so that the internal fluid pressure on the cover will increase the pressure on the gasket ring with a consequent further side flow of the gasket material to maintain a fluid tight joint between the cover and the inner circumferential wall of the head.

In removing the closure parts of the pressure head, the outer nuts 76 are first loosened and the inner nuts 77 adjusted to force the cover inwardly and allow the ring segments to be removed. The nuts 74 are then removed and the nuts 76 and 77 adjusted to cause the cover and gasket and sealing rings to move outwardly to a position in which the cover may be swung about the yoke pivot and render the heater accessible for tube cleaning or renewal or repair of the pressure head parts.

In lieu of forming the water inlet chamber 20 by the partition plates 18 and 19, the partition construction shown in Fig. 12 may be used. In this modification, a pair of spaced partition plates 85 extend horizontally across the outer side of the tube sheet to the cylindrical wall of the head and between which slidably fits a transverse plate 86 carried on the inner face of the cover 50, and extending but unconnected to the circumferential wall. Flexible seal members 87 mounted on the plates 85 provide a fluid tight seal between the plates while permitting the necessary relative movements of the cover plate 86 in inserting and removing the head closure parts.

Under certain conditions the sealing ring 55 may be omitted as by making the gasket ring 54 so that it will have the desired capacity for radial expansion to seal the joint between the cover 50 and the head wall, while sufficiently rigid to prevent the flow of the gasket material into the joint between the segmental ring and head wall, or by forming the segmental ring so as to fit tightly into the recess 61. In Fig. 13, I have illustrated a modified head construction incorporating both of the above features for dispensing with the sealing ring. In this form, the gasket ring 54^a is made with an inner rubber face 54^a with a reinforced base 54^b of fabric or other suitable

material. A segmental ring 60^a is tapered to fit tightly into the seat provided by a similarly shaped recess 61^a in the inner circumferential wall of the head 14. With these parts so constructed a sealing ring is no longer required.

The pressure head constructions described are particularly adapted for the heating of a fluid at high pressure. As compared with prior head constructions employing bolts and flanges, the present constructions avoid the dangerous possibilities of unequal bolt stresses, minimize the load on the holding parts, and provide a head that cannot be opened as long as pressure exists in the heater. Fewer closure parts are required and the higher the fluid pressure, the tighter will be the seal, without deformation of the gasket ring in a manner which would hinder its easy removal. The size and weight of the pressure head parts are substantially reduced and the cover stresses transmitted to the head wall in a more direct manner, reducing the bending stresses and the amount of metal required to withstand the stresses. The reduction in number, size and weight of the closure parts lowers the cost of construction, and the ease of installing and removing these parts substantially lessens the labor maintenance costs.

While in accordance with the provisions of the statutes I have illustrated and described herein the best forms of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

I claim:

1. A heat exchanger comprising a shell, a bundle of fluid heating tubes enclosed by said shell and having a plurality of serial flow paths in opposite directions therethrough, means for supplying a fluid to be heated to a portion of said tube bundle, an inlet in said shell for a condensible heating fluid, and an outlet in said shell for condensed heating fluid, said inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction over one portion of said tube bundle and a flow of condensate in the opposite direction over another portion of said tube bundle.

2. A heat exchanger comprising a shell, a bundle of fluid heating U-tubes enclosed by said shell and arranged to provide a serial flow of fluid in opposite directions through said tube bundle, an inlet in said shell for a condensible heating fluid, and an outlet in said shell for condensed heating fluid, said inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid over the upper tube legs of said tube bundle and a flow of condensate in a countercurrent direction over the lower tube legs of said tube bundle.

3. A heat exchanger comprising a shell, a bundle of fluid heating tubes enclosed by said shell and arranged to provide a serial flow of fluid in opposite directions therethrough, means for supplying a fluid to be heated to a portion of said tube bundle, an inlet in said shell for a condensible heating fluid, an outlet in said shell for condensed heating fluid, said inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid over one portion of said tube bundle and a flow of condensate

in a countercurrent direction over another portion of said tube bundle, and means for maintaining a predetermined level of condensate in said shell.

5 4. A heat exchanger comprising a horizontally elongated shell, a bundle of U-tubes enclosed by said shell and arranged to provide a serial flow of fluid horizontally in opposite directions through said tube bundle, means for supplying a fluid to be heated to the lower legs of said U-tubes, an inlet in said shell for a condensible fluid, an outlet in said shell for condensed heating fluid, said inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction over the upper tube legs of said tube bundle and a counterflow of condensate in the opposite direction over the lower tube legs of said bundle, and means for maintaining a predetermined level of condensate in said shell.

10 5. A heat exchanger comprising a shell, a tube bundle extending longitudinally in said shell and comprising spaced groups of tubes with corresponding tubes in said group connected to provide a serial flow of fluid in opposite directions through said tube bundle, means for supplying a fluid to be heated to the tubes in one of said groups, means forming a heating fluid inlet nozzle extending transversely of said tube bundle in the space between said tube groups and having a discharge opening directed longitudinally of said space.

15 6. A heat exchanger comprising a horizontally elongated shell, a bundle of parallel U-tubes extending longitudinally in said shell with their tube legs arranged in vertical planes to provide a serial flow of fluid in opposite directions through the tubes of said tube bundle, means for supplying a fluid to be heated to one end of said U-tubes, means forming a flattened nozzle extending transversely of one end of said tube bundle in the space between the upper and lower legs of said U-tubes, and means for supplying a heating fluid to said flattened nozzle.

20 7. A heat exchanger comprising an elongated shell closed at one end, a tube sheet closing the open end of said shell, a bundle of U-tubes in said shell having opposite ends connected to two spaced portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, and said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid through said upper shell space and a flow of condensate in a countercurrent direction through said lower shell space.

25 8. A heat exchanger comprising an elongated shell closed at one end, a tube sheet closing the open end of said shell, a bundle of U-tubes in said shell having opposite ends connected to two spaced portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed

heating fluid, said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell space and a flow of condensate in the opposite direction through said lower shell space, and means for maintaining a level of condensate in said shell above said horizontal baffle.

5 9. A heat exchanger comprising an elongated shell closed at one end, a tube sheet closing the open end of said shell, a bundle of U-tubes in said shell having opposite ends connected to two spaced portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell space and a flow of condensate in the opposite direction through said lower shell space, baffling arranged to provide a sinuous flow of heating fluid over the tube portions in said upper shell space, baffling in said lower shell space for increasing the condensate velocity therethrough, and means for maintaining a level of condensate in said shell above said horizontal baffle.

10 10. A heat exchanger comprising a horizontally elongated cylindrical shell closed at one end, a tube sheet closing the open end of said shell, a bundle of parallel U-tubes in said shell having opposite ends connected to spaced upper and lower portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell space and a flow of condensate in the opposite direction through said lower shell space, baffling arranged to provide a sinuous flow of heating fluid over the tube portions in said upper shell space, baffling in said lower shell space for increasing the condensate velocity therethrough, means for maintaining a level of condensate in said shell above said horizontal baffle, and a vent for non-condensable gases in said upper shell space.

15 11. A heat exchanger comprising an elongated shell closed at one end, a pressure head connected to said shell and having a tube sheet closing the open end of said shell, a bundle of U-tubes in said shell having opposite ends connected to two spaced portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, said shell inlet and outlet being arranged rela-

tive to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell and a flow of condensate in the opposite direction through said lower shell space, an opening in said pressure head to said outlet chamber, a cover adapted to fit into said opening and having an annular pressure surface at the outer side thereof, a gasket ring contacting with said pressure surface, and means for holding said gasket ring in position and transmitting the fluid pressure on said gasket ring to said head.

12. A heat exchanger comprising a shell closed at one end, a pressure head connected to said shell and having a tube sheet closing the open end of said shell, a bundle of fluid heating tubes in said shell connected to said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell space and a flow of condensate in the opposite direction through said lower shell space, an opening in said pressure head to one of said chambers, a cover adapted to fit into said opening and having an annular pressure surface at the outer side thereof, a gasket ring contacting with said pressure surface, a sealing ring contacting with said gasket ring, means for holding said sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing rings to said head, and a pivoted yoke having means for supporting and axially moving said cover relative to said head.

13. A heat exchanger comprising an elongated cylindrical shell closed at one end, a pressure head connected to said shell and having a tube sheet closing the open end of said shell, a bundle of U-tubes in said shell having opposite ends connected to two spaced portions of said tube sheet, means dividing said pressure head into inlet and outlet chambers, an inlet to said inlet chamber for a fluid to be heated, a horizontal baffle extending longitudinally of said tube bundle and dividing said shell into upper and lower spaces connected at the closed end of said shell, an inlet to said upper shell space for a condensible heating fluid, an outlet from said lower shell space for condensed heating fluid, said shell inlet and outlet being arranged relative to said tube bundle to effect a flow of condensing heating fluid in one direction through said upper shell space and a flow of condensate in the opposite direction through said lower shell space, baffling arranged to provide a sinuous flow of heating fluid over the tube portions in said upper shell space, baffling in said lower shell space for increasing the condensate velocity therethrough, means for maintaining a level of condensate in said shell above said horizontal baffle, a vent for non-condensable gases in said upper shell space, an opening in said pressure head to said outlet chamber, a cover adapted to fit into said opening and having an annular pressure surface at the outer side thereof, a flat gasket ring contacting with said pressure surface, a sealing ring contacting with the outer side of said gasket ring, means for holding said sealing ring in position and transmitting

the fluid pressure on said cover through said gasket and sealing ring to said head, and a pivoted yoke having means for supporting and axially moving said cover relative to said head.

14. A pressure vessel having a chamber therein for receiving fluid under pressure and a circular opening for providing access to said chamber, and closure parts for said opening including a disc-shaped cover adapted to fit into said opening and be subjected to fluid pressure on its inner side, said cover having a circumferential wall section of reduced cross-section with an annular pressure surface at its inner end arranged in a plane normal to the axis of said cover, a flat gasket ring fitting around said cover reduced section and having an inner surface contacting with said pressure surface, a sealing ring fitting around said cover reduced section and contacting with the outer surface of said gasket ring, the contacting surfaces of said gasket and sealing rings being arranged parallel to said cover pressure surface, and means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing rings to the wall of said opening.

15. A pressure vessel having a chamber therein for receiving fluid under pressure and a circular opening for providing access to said chamber, and closure parts for said opening including a disc-shaped cover adapted to fit into said opening and be subjected to fluid pressure on its inner side, said cover having an inwardly tapering circumferential wall section and a section of reduced cross-section joined by an annular pressure surface in a plane normal to the axis of said cover, a flat gasket ring fitting around said cover reduced section and having an inner surface contacting with said pressure surface, a sealing ring fitting around said cover reduced section and contacting with the outer surface of said gasket ring, the contacting surfaces of said gasket and sealing rings being arranged parallel to said cover pressure surface, and means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing means to the wall of said opening.

16. A pressure vessel having a chamber therein for receiving fluid under pressure and an opening for providing access to said chamber, and closure parts for said opening including a cover fitting into said opening and adapted to be subjected to fluid pressure on its inner side, said cover having a peripheral wall section of reduced cross-section with an annular pressure surface at its inner end, a gasket ring fitting around said cover reduced section and contacting with said pressure surface, a sealing ring fitting around said cover reduced section and contacting with said gasket ring, means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing ring to the wall of said opening, and means for axially moving said cover to exert an initial pressure on said gasket ring.

17. A pressure vessel having a chamber therein for receiving fluid under pressure and an opening for providing access to said chamber, and closure parts for said opening including a cover fitting into said opening and adapted to be subjected to fluid pressure on its inner side, said cover having a peripheral wall section of reduced cross-section with an annular pressure surface at its inner end, a gasket ring fitting around said cover reduced section and contacting with said pressure surface, a sealing ring fitting

around said cover reduced section and contacting with said gasket ring, means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing ring to the wall of said opening, and means for supporting said cover in an upright position in said opening.

18. A pressure vessel having a chamber therein for receiving fluid under pressure and a circular opening for providing access to said chamber, and closure parts for said opening including a circular cover adapted to fit into said opening and be subjected to fluid pressure on its inner side, said cover having a circumferential wall section of reduced cross-section with an annular pressure surface at its inner end, a gasket ring fitting around said cover reduced section and contacting with said pressure surface, a sealing ring fitting around said cover reduced section and contacting with said gasket ring, means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing ring to the wall of said opening, and means for axially moving said cover in an upright position

in said opening and bodily swinging said cover out of said opening.

19. A pressure vessel having a chamber therein for receiving fluid under pressure and a circular opening for providing access to said chamber, and closure parts for said opening including a circular cover adapted to fit into said opening and be subjected to fluid pressure on its inner side, said cover having a circumferential wall section of reduced cross-section with an annular pressure surface at its inner end, a gasket ring fitting around said cover reduced section and contacting with said pressure surface, a sealing ring fitting around said cover reduced section and contacting with said gasket ring, means for holding the sealing ring in position and transmitting the fluid pressure on said cover through said gasket and sealing ring to the wall of said opening, and a yoke pivotally mounted on said pressure vessel and having means for supporting and axially moving said cover in an upright position in said opening and permitting the bodily swinging of said cover out of said opening to an inoperative position.

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