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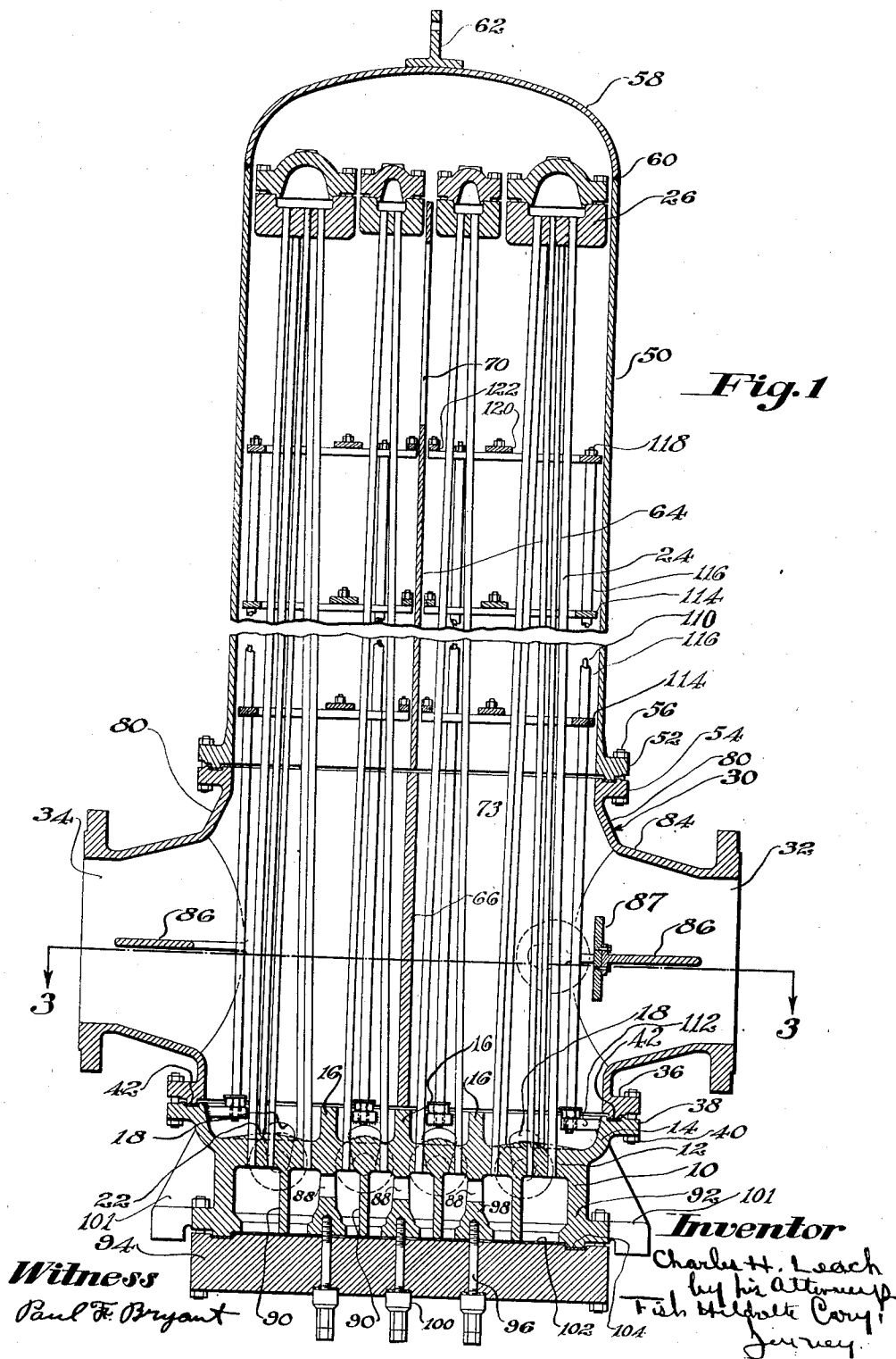
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2,059,967

HEAT EXCHANGE APPARATUS

Filed Aug. 5, 1933

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Fig. 2

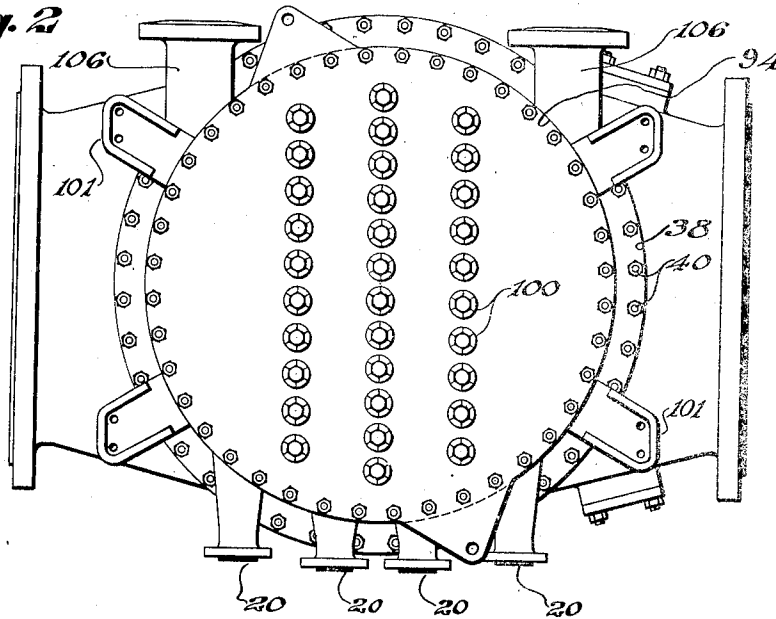
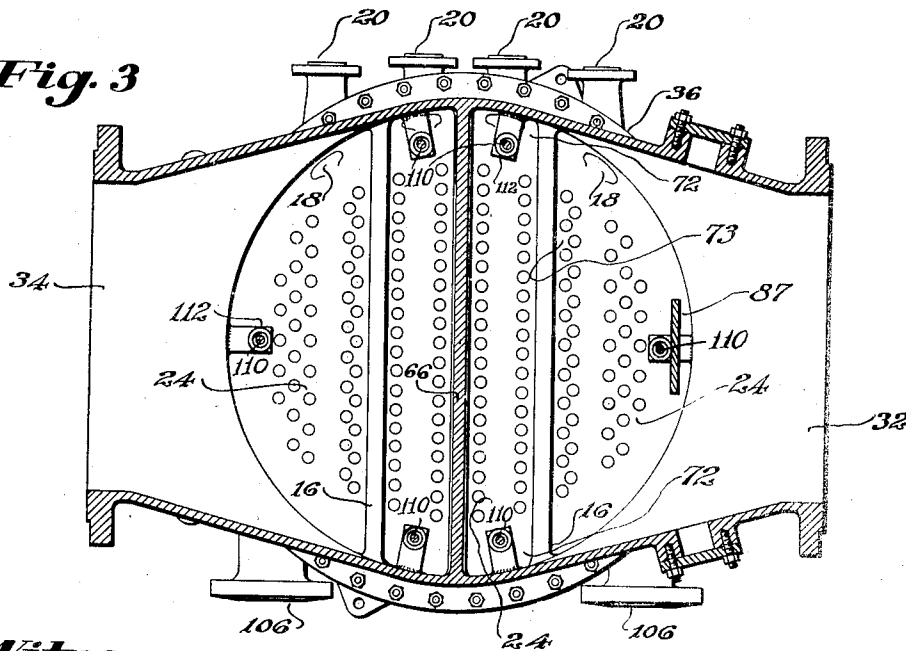


Fig. 3



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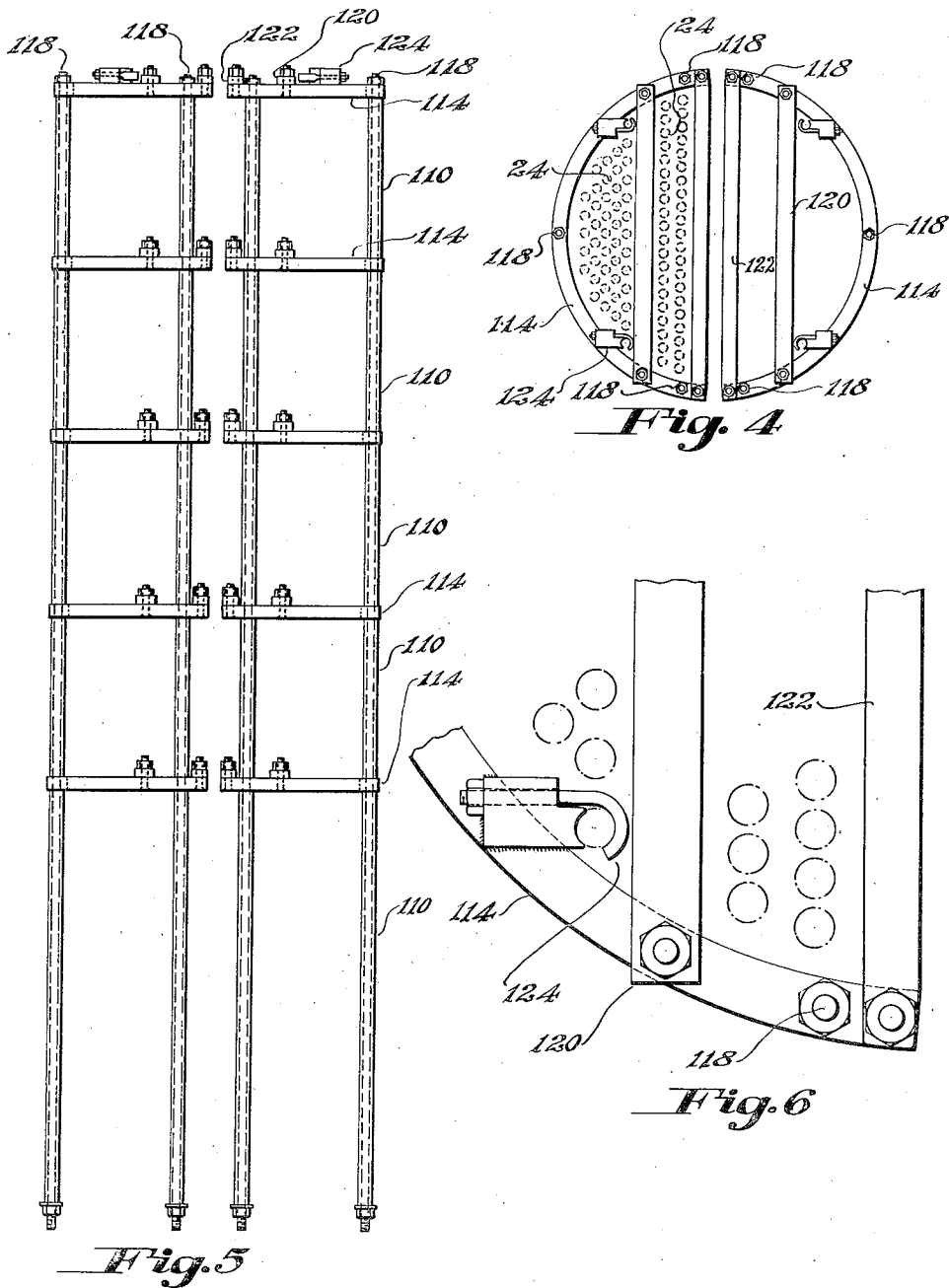
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UNITED STATES PATENT OFFICE

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HEAT EXCHANGE APPARATUS

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Application August 5, 1933, Serial No. 683,817

21 Claims. (Cl. 257-223)

The present invention relates to heat exchange apparatus employed for the interchange of heat between a vapor and liquid, and is more particularly adapted for use in oil refining operations where heat is transferred from a hot vapor to a cooling liquid, the latter being circulated within a system of cooling tubes or the like.

The cooling and partial condensing of oil vapors presents many problems not encountered in the handling of other vapors. These problems in part are due to the corrosive nature of the condensate derived from the vapor and the solid residuum which is progressively formed during the continuance of operation, and in part due to the comparatively high velocity of flow of the vapor to meet the needs of the industry and secure a satisfactory transfer of heat without utilizing excessive tube surfaces.

The purpose of the present invention is to design a heat exchanger particularly adapted for the cooling and condensation of oil vapors which operates efficiently and with a maximum of tube life even though the corrosive content of the vapors may be high.

A further object of the invention is to design a heat exchanger for this purpose which is capable of partial dismantling with a minimum of time and labor for the purpose of cleaning out the tube surfaces and removing from the exterior thereof certain solid residuum which inevitably occurs.

With the above objects in view, I have discovered that I can effectively increase tube life by equalizing tube wear due to erosion throughout the tube length, and that by thus equalizing tube wear and avoiding localized erosion due to impact of the rapidly moving vapor, I not only vastly increase the effective life of the apparatus before tube replacement, but enable the effective tube life to be predicted under any given set of conditions. I accomplish this result in major part by causing the entering vapor to flow about the tube bundle or bank in the entering region through the provision of relatively free and unobstructed channels or lanes and the design of the conduit walls to promote vapor flow within these free channels. By so doing I avoid direct impingement or impact of entering vapor upon the adjacent tube walls due to the vapor flow at high velocities transversely to the tube length. By proper design and location of the unobstructed channels I am enabled to introduce the vapor completely about the tube bank or bundle without substantial loss of pressure head, and thereafter to diffuse the vapor into and through the

tube bank, thence causing it to be directed upwardly in the general direction of the length of the tubes. By introducing the vapor in this fashion, I avoid undue erosion throughout the entering region, and I have demonstrated by actual experience that the erosion and tube wear throughout the entering region is no greater than the normal wear throughout the remainder of the tube length.

Having introduced the vapor about and within the tube bundle without serious erosive effects due to impact, I thereafter conduct the vapor throughout the length of the tubes and I prefer during this traverse to increase the velocity of the vapor and introduce turbulence thereto. Vapor velocity is increased by restricting the space within and about the tube bundle above the nozzle or entering region, and turbulence is provided by a system of baffling which compels a tortuous or undulating path of vapor for avoiding and preventing the flow of vapor in straight lines through unobstructed channels which would otherwise occur.

Although the essential aim of my invention looking toward a measurably increased tube life can be accomplished by precluding and avoiding vapor impact during the entering region, nevertheless it is important from the point of view of efficiency that the rate of heat transfer through the tubes above the entering region be maintained at as high a point as possible. This I accomplish through the system of baffling hereinafter indicated. This baffle system is particularly advantageous, furthermore, from the point of view of oil refining, as it may be readily removed as a unit regardless of collections of solid residuum which may occur, and permits free access to the exterior of the tubes after such removal. Furthermore, the baffling is so designed as to promote turbulence without at the same time causing vapor impact in localized regions of the tube surface at any point throughout its length. In addition, the baffling or baffle units provide a permanent clearance with adjacent tube walls sufficient to avoid build-up of solid residue on the tube walls in operation, or bridging of such residue between the baffles and the adjacent tube walls themselves. This is an important adjunct of the baffling system both from the standpoint of operation and of maintenance.

Although the present invention is particularly adapted and designed for the cooling and condensing of oil vapors, nevertheless certain features of this invention are well adapted for the interchange of heat between any vapor and liquid,

and unless specifically limited by the claims it is understood that the present invention is not to be construed as inevitably confined in all its aspects to the oil refining art.

5 In the accompanying drawings illustrating the preferred form of the invention, Fig. 1 represents a sectional elevation of a heat exchanger embodying the features of the invention; Fig. 2 is a bottom plan view of the exchanger shown in Fig. 1; 10 Fig. 3 is a section of the entering vapor region and intertubular space upon the line 3—3 of Fig. 1; Figs. 4 and 5 are details illustrating a top plan view and elevation, respectively, of the baffle assembly; and Fig. 6 is an enlarged view of a portion 15 of Fig. 4.

The heat exchanger shown in the illustrated embodiment of the invention in its general aspects comprises a supporting member 10, which may be made as a steel casting or equivalent material, having a tube sheet and partition 12 surrounded by an upper rim 14 which forms one or more condensate basins and serves for supporting an upper nozzle ring. Projecting upwardly from the surface of the tube sheet are a series of partitions 16 which separate the space above the tube sheet into a series of separate and independent condensate basins, the partitions extending completely across the surface of the tube sheet and joining the rim 14 at opposite ends. These basins 25 are individually drained by discharge passages 18 of which there is one for each basin, each discharge passage being located in a nozzle member 20 for connection to a pipe line. As indicated, the passages slope downwardly and in addition, the surfaces of the outer basins are crowned at 22 to shed condensate into the passages from about the lower ends of the tube and avoid the formation of pools of stagnant condensate which, in the case of an active corrosive element, would otherwise tend to promote localized corrosion of the tube ends immersed therein. 40

The apparatus is provided with a series of tubes 24 preferably arranged in banks and all mounted at their lower ends in the fixed tube sheet 12, 45 each bank of tubes being individually connected at its upper end with a floating head 26 which serves to reverse liquid flow through the banks and to permit independent expansion and contraction of individual banks. Surmounting the support 10 and connected to the upper rim 14 is a vapor nozzle annulus or ring indicated generally at 30 and having formed therein inlet and outlet nozzles 32 and 34. The vapor nozzle annulus, which may be in the form of a casting or equivalent construction, is provided with a bolting flange 36 by virtue of which it is attached to a similar flange 38 formed on the rim 14 through securing bolts 40. A ring gasket 42 serves to seal the space between the flanges. Surmounting 60 the vapor nozzle annulus is the shell proper indicated at 50 which is detachably connected at its lower end through a bolting flange 52 cooperating with a similar flange 54 formed on the annulus, the bolts 56 serving to secure the two members in assembled detachable relation. The shell 50 is integrally closed at its upper end by a domed cap 58 which may be welded to the shell at 60. This method of construction produces an integrally closed end shell free from joints at the 70 upper end which would otherwise promote leakage.

From an inspection of the drawings, and more particularly Fig. 3, it will be observed that the entering path for the vapor as provided by the 75 inlet nozzle 32 flares outwardly without abrupt

curvature or angles merging with the exterior of the shell at a tangent, as shown in Fig. 3, and causing the natural expansion of the incoming vapor to cause the bulk of the vapor to flow about the space adjacent the shell in the free and unobstructed lanes or channels at 72 provided between the outer tube row and the surrounding shell wall. In addition, a wide lane 73 communicating at opposite ends with the lanes 72 is provided intermediate the bundle to facilitate diffusion of vapor into intimate contact with all of the tubes in the bundle. The proper design of the entering nozzle with its outwardly flaring walls merging into the wall of the shell and the provision of the unobstructed lanes or channels extending peripherally of the shell in the entering region both combine to avoid vapor impact upon the tube walls with consequent freedom from erosion and tube wear. Furthermore, the provision of the relatively wide and unobstructed communicating lanes facilitates diffusion of vapor throughout the bundle or bank as a whole. 10 15 20

In addition to the nozzle flare in a section normal to the length of the tubes, it will be observed from an inspection of Fig. 1 that the nozzle may also be flared in a vertical plane to promote introduction of vapor throughout the entire length or height of the nozzle ring and vapor belt enclosed thereby. As shown in the drawings the nozzle ring from the bottom thereof to a point above the nozzles 32 and 34 is of greater cross sectional area or diameter than the shell 50 and it will be evident that this construction provides essentially an enlarged peripheral vapor belt extending about and communicating interiorly with the tube bundle throughout the entering region. As shown in the drawings, the nozzle may be formed integrally with the annulus or ring being outwardly flared and the nozzle ring tapers inwardly above the nozzles as shown at 80 merging smoothly with the adjoining walls of the shell. 35 40

For the purpose of further improving the flow and augmenting the directional effect of the incoming vapor, I provide a flat vane or partition 86 located within the nozzle as indicated and a target 87 which aids in spreading or dividing the flow of incoming vapor with a consequent diversion of this vapor into the surrounding unobstructed channels. 45

Having this secured the introduction of the vapor with a minimum of pressure drop and a minimum of vapor impact upon the tubes in the entering region, I cause the vapor to flow upwardly throughout the length of the tubes and impart thereto a tortuous path both to increase velocity adjacent to the tube surfaces through restriction and to produce turbulence due to the undulation and change of direction of the vapor flow. This baffle assembly is conveniently made as a divisible unit in two or more sections which surround the tube bundles within the shell and which are removable from the bundles after the shell has been detached. Each section of the baffle unit consists essentially of curved members extending about the bundles in the space within the shell surrounding the bundles and having transverse members secured thereto which extend through the interior of the bundles. 50 55 60 65

Referring more particularly to the drawings, the two complementary and semi-circular sections are individually supported by longitudinal rods 110 which are inserted in holes in lugs 112 forming a part of the main support 10. Each section is provided with two or more rods, pref- 75

erably three, having secured thereto semi-circular baffles and bracing members 114. These semi-circular members are preferably secured upon the rods in spaced relation through the provision of hollow sleeves or bushings 116 which surround the rods between the members and serve as spacers, the assembly being held in fixed relation by nuts 118. Secured to the semi-circular members or baffles 114 are transverse baffles 120 and 122, respectively. These baffles are detachably bolted to the semi-circular supports and are removed prior to dis-assembly of the baffle unit from about the tube bundles. From an inspection of the drawings, it will be observed that these assemblies completely baffle the longitudinal lanes or channels both about and between the tube bundles, but in each case a definite clearance is preserved between both the semi-circular baffles and the transverse baffles and the adjoining tube surfaces to avoid building up of solid residue on the adjoining tube walls, with a resultant holding of corrosive condensate in contact with the walls. Furthermore, the baffles are so designed that although a tortuous path with resulting turbulence is introduced into the vapor flow, there is no sharp reversal of direction nor any tendency to cause violent vapor impact in the region of baffles, with consequent erosion. The baffle assembly may be steadied and supported at its upper end by hook-shaped connectors 124, securing the baffle assembly to the adjacent tubes, as indicated more particularly in Figs. 4, 5 and 6.

To this end, the lowermost baffle ring is located substantially above the entering vapor region and the entire baffle system is disposed between the entering vapor region and the passage between vapor passes indicated at 70 in the mid-partition. Upon removal of the shell and nozzle ring assembly and unbolting of the transverse baffles 120 and 122, the sections may be readily removed from about the bundles by merely lifting the sections until the lower ends of the supporting rods clear the lugs. This may be accomplished even though a considerable collection of coke or other solid residue has built up during the operation of the exchanger.

With this type of construction, not only is undue erosion and wear in the entering region avoided, but an efficient operation is maintained through the high rate of heat transfer accomplished throughout the length of the tube. If so desired, the outlet nozzle may partake of the same general conformation as the entering nozzle, as indicated in the drawings.

The cooling liquid is caused to flow within the tubes 24, and is directed by a series of liquid passes 88 formed below the partition 12 through integral partition members 98 forming a part of the casting 10. The casting is also provided with a depending circular rim 92 bounding the exterior of the liquid passages. The passages are closed by a flat cover member 94 of substantial thickness in order to resist distortion strains due to the high pressure of liquid there-within. The cover member is secured in place by an intermediate series of bolts 96, which are threaded within enlarged portions 98 of certain partitions as indicated, the bolts being provided with cap nuts 100 at their lower ends. The seal is augmented by a sealing disk 102 comprising essentially an asbestos sheet covered on opposite sides and preferably completely enveloped by metal sheets formed thereover to provide a metal covered asbestos disk capable of withstanding

high tension strains, but nevertheless being sufficiently yielding to cushion and seal the parts at contacting points. The disk also provides an ideal insulating medium for avoiding transfer of heat from the charge oil within the chambers downwardly through the cover member. An additional seal ring 104 lies within the channel formed in the head, the combination of the two members serving to effectually prevent leakage of high pressure liquid. Cooling liquid is conveyed to and from the head by the liquid nozzles 106, which communicate with liquid passages at opposite ends.

As previously described, the interior of the enclosing shell 50 is divided into two vapor passes by a longitudinal partition consisting of a complementary series of baffle or partition members. The shell section 50 is provided with a longitudinal partition 64, which in assembled relation of the shell, projects at its upper end between adjacent floating heads. This partition has an opening or passage 70 for communication between the passes. The partition is secured to the shell section at its margin in any convenient manner for removal therewith. The nozzle ring is provided with a second partition section 66 which may be formed integrally therewith, and is so located in assembled relation that it registers and is co-extensive with the partition 64, the two cooperating with the rib 16 to completely divide the interior of the exchanger as indicated.

It will be evident that because of the integrally closed shell end, access cannot be obtained to the upper portion of the heat exchanger without removal of the shell. By the same token, there is no provision for centering or locating the tube bundles except through the medium of the shell itself. From this standpoint the partition section 64 extending upwardly between the floating heads when the shell is assembled, not only properly locates the tube bundles with respect to the shell, but in addition serves for partially guiding the shell and tube bundles during the withdrawal or replacement of the shell. This guiding action is complemented by the independently mounted baffle assembly which is supported from the base of the unit and which guides and prevents the free edge of the shell from injurious contact with the tube banks or floating heads mounted thereon.

In actual dismantling of the apparatus, the normal and usual inspection and clean-out may be accomplished by removal of the shell section and cleaning of the upper portion of the tubes. If so desired for this purpose the baffle assembly may be normally removed without dismantling the nozzle section. If unusual collection of coke is present, however, particularly if it requires clean-out of the nozzle section, this must be accomplished by removing the baffle assembly and disconnecting the nozzle section, which then may be lifted bodily, the partition section 66 passing upwardly between the heads. During this disassembly, the tube bundles themselves with the unitary support and the liquid connections are not interfered with, due to the support of the unit as a whole on off-set lugs 101 which project from the support or base casting, as shown in Fig. 1. In a like manner the flat cover member may be removed from the under portion of the unit without disconnecting from the support.

The capacity in a unit having an integrally closed end shell for disconnecting either the

shell from the nozzle section, or disconnecting both the shell and nozzle section from the support, is important from the point of view of inspection and clean-out. Furthermore, the provision of

- 5 means for guiding the shell during the normal inspection periods and for insuring proper centralization of the tube bundles and floating heads when the shell is in assembled relation, are also important adjuncts of this type of apparatus.
- 10 It will furthermore be noted that the upper rim 14 surrounding and bounding the condensate basins and forming a support for the nozzle ring forms a chamber about the lower tube ends commensurate in area with that of the nozzle
- 15 ring, and providing a free and unobstructed passage surrounding the tube bundle which complements the vapor passage in the nozzle ring to provide for the effective diffusion of vapor within the tube bundles at the lower end. The
- 20 provision of this enlarged space within the channel casting also provides for the disposition and draining of condensate without liability of trapping condensate in the region of the lower tube ends. In addition, this increased space
- 25 facilitates the cleaning of condensate basins in the event that it is found necessary so to do.

What is claimed is:

1. Heat exchange apparatus comprising a unitary support, heat transfer tubes connected to the support extending therefrom, a shell enclosing the tubes to provide a vapor space thereabout, means for admitting vapor to the shell, and a baffle assembly positioned between the tubes and shell and serving to impede flow of
- 30 vapor beyond the region of admission to the shell.

2. Heat exchange apparatus comprising a unitary support, heat transfer tubes connected to the support extending therefrom, a shell enclosing the tubes to provide a vapor space thereabout, means for admitting vapor to the shell, and a baffle assembly supported from the tube support and serving to impede flow of vapor beyond the region of admission to the shell.
- 40

3. Heat exchange apparatus comprising a series of heat transfer tubes, a shell surrounding the tubes to provide a vapor space, and a sectional circular baffle assembly located in the vapor space between the tubes and shell and removable therefrom to permit access to the
- 50 tubes.

4. Heat exchange apparatus comprising a series of heat transfer tubes, a shell surrounding the tubes to provide a vapor space, and a sectional circular baffle assembly positioned between the tubes and the shell and affording clearance between adjacent tube and shell surfaces, and removable therefrom to permit access to the
- 55 tubes.

5. Heat exchange apparatus comprising a series of heat exchange tubes arranged in banks with a space between the banks, a shell enclosing the tubes, a sectional circular baffle assembly located in the space between the shell and tubes and removable therefrom, each baffle section
- 60 comprising a transverse member in the space between the tube banks and a semi-circular member to which it is attached, and means for mounting the baffle assembly independently of the
- 70 shell.

6. Heat exchange apparatus comprising a series of heat transfer tubes, an enclosing shell spaced therefrom, a series of sectional baffles located in the space surrounding the tubes, transverse baffles extending between the tubes, and
- 75

means for mounting the baffle assembly independently of the shell.

7. A heat exchanger comprising a support, a series of tubes mounted upon the support, a nozzle section detachably connected to the support, a closed end shell detachably connected
- 5 above the nozzle section and surrounding the tubes, a removable baffle assembly interposed in the space between the shell and tubes, and means for mounting the baffle assembly from the support independent of the shell and nozzle section.
- 10

8. A heat exchanger comprising a support, a series of tubes mounted upon the support, a nozzle section detachably connected to the support, a closed end shell detachably connected
- 15 above the nozzle section and surrounding the tubes, a removable baffle assembly interposed in the space between the shell and tubes, and means for connecting the baffle assembly at its upper end to an adjacent tube.
- 20

9. Heat exchange apparatus comprising a series of heat transfer tubes arranged so as to provide a longitudinally extending space between some of the tubes, a shell enclosing the tubes and arranged so as to provide a space between the tubes and the shell, means for admitting vapor
- 25 inside the shell, a baffle positioned between the tubes and shell and arranged to impede the flow of vapor through the space between the tubes and shell, and another baffle secured to the first mentioned baffle extending transversely of the
- 30 space between the tubes and serving to impede the flow of vapor through the space.

10. Heat exchange apparatus comprising a series of heat transfer tubes arranged so as to provide a longitudinally extending space between some of the tubes, a shell surrounding the tubes and formed so as to provide a space between the tubes and shell, and a baffle assembly including a segmental baffle located in the space
- 35 between the shell and tubes, and a baffle member secured to the segmental baffle extending transversely of the space between the tubes, the said baffle assembly being removably supported so as to permit access to the tubes.
- 40

11. Heat exchange apparatus comprising a series of heat transfer tubes arranged so as to provide a longitudinally extending space between some of the tubes, a shell surrounding the tubes and formed so as to provide a space between the tubes and shell, and a baffle assembly including a segmental baffle located in the space between the shell and tubes and spaced therefrom, and a baffle member secured to the segmental baffle extending transversely of the space between the
- 45 tubes and spaced therefrom, the said baffle assembly being removably supported so as to permit access to the tubes.
- 50

12. Heat exchange apparatus comprising a series of heat transfer tubes, a shell enclosing the tubes and arranged so as to provide a space between the tubes and shell, means for admitting vapor to the shell, a baffle positioned in the space between the tubes and shell and serving to impede the flow of vapor therethrough, said baffle
- 55 being spaced from the tubes and shell, and means for detachably connecting said baffle to one of the tubes to hold said baffle in fixed position with respect to the tubes and shell.
- 60

13. Heat exchange apparatus comprising a supporting member, a series of heat exchange tubes supported from said member, a shell detachably mounted on said member enclosing said tubes and formed so as to provide a vapor space between the tubes and shell, said shell being re-
- 75

movable so as to expose the tubes, vapor inlet and outlet means communicating with the interior of said shell, and a baffle assembly arranged around the outside of the tubes in the space between the tubes and shell so as to impede the flow of vapors therethrough, said baffle assembly being arranged so as to serve as a guide for the shell and so as to protect the tubes when the shell is being removed from and returned to position.

14. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, vapor inlet means in said casing adjacent one end of the tubes and a baffle arranged in said casing so as to provide a vapor passage longitudinally of the tubes, said casing being of greater cross sectional area adjacent the vapor inlet so as to provide an enlarged vapor space communicating with the inlet, and the casing being of smaller cross sectional area beyond the inlet so as to provide a smaller vapor space communicating with the first mentioned space thereby to increase the velocity of the vapor beyond the inlet.

15. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, vapor inlet means in said casing adjacent one end of the tubes, a baffle arranged in said casing so as to provide a vapor passage longitudinally of the tubes, said casing being of greater cross sectional area adjacent the vapor inlet so as to provide an enlarged vapor space between the casing and tubes communicating with the inlet, and the casing being of smaller cross sectional area beyond the inlet so as to provide a smaller vapor space between the casing and tubes thereby to increase the velocity of the vapor beyond the inlet, and means adjacent said inlet for directing at least a portion of the vapor entering the inlet directly into the enlarged vapor space without contacting the tubes.

16. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, a baffle arrangement in said casing so as to provide a vapor passage longitudinally of the tubes, and means providing a vapor inlet substantially perpendicular to said tubes adjacent one end thereof, said casing being of greater cross sectional area adjacent the vapor inlet providing an enlarged vapor space between the tubes and casing at that point to aid in changing the direction of movement of the vapor and to protect the tubes from excessive erosion, and the casing being of smaller cross sectional area beyond the inlet providing a smaller vapor passage between the casing and the tubes so as to increase the velocity of the vapor beyond the inlet.

17. Heat exchange apparatus comprising a supporting member, a plurality of heat exchange tubes supported thereby having means associated therewith for directing a cooling medium through the interior thereof, a vapor nozzle ring mounted on the supporting member and surrounding one end of the tubes and having an inlet nozzle formed therein, a shell surmounting the vapor nozzle ring and enclosing said tubes, and means inside said shell providing a vapor passage longitudinally of the tubes, said vapor nozzle ring being of greater cross sectional area than said shell so as to provide an enlarged vapor space

between the tubes and vapor nozzle ring adjacent the inlet nozzle and communicating directly therewith and said shell being formed so as to provide a more restricted vapor space between the tubes and shell thereby to increase the velocity of the vapor beyond the inlet.

18. Heat exchange apparatus comprising a supporting member having a fixed header formed on one side thereof, a plurality of heat exchange tubes supported on the opposite side thereof and having connection with said header so that a cooling medium may be directed through the interior thereof, a vapor nozzle ring mounted on the supporting member and surrounding one end of the tubes and having an inlet nozzle formed therein, a shell surmounting the vapor nozzle ring and enclosing said tubes, and means inside said shell providing a vapor passage longitudinally of the tubes, said vapor nozzle ring being of greater cross sectional area than said shell so as to provide an enlarged vapor space between the tubes and ring adjacent the inlet nozzle, said shell being formed so as to provide a more restricted vapor space between the tubes and shell thereby to increase the velocity of the vapor beyond the inlet, and said header portion of the supporting member being of substantially the same cross sectional size as the shell.

19. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, vapor inlet means in said casing adjacent one end of the tubes, a baffle arranged in said casing so as to provide a vapor passage longitudinally of the tubes, said casing being of greater cross sectional area adjacent the vapor inlet so as to provide an enlarged vapor space communicating with the inlet between the tubes and casing, and the casing being of smaller cross sectional area beyond the inlet so as to provide a smaller vapor space between the casing and tubes thereby to increase the velocity of the vapor beyond the inlet, and a baffle arranged in said space between the casing and tubes beyond the vapor inlet so as to impede the flow of vapor through the space.

20. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, vapor inlet means in said casing adjacent one end of the tubes, a baffle arranged in said casing so as to provide a vapor passage longitudinally of the tubes, said casing being of greater cross sectional area adjacent the vapor inlet so as to provide an enlarged vapor space communicating with the inlet between the tubes and casing, and the casing being of smaller cross sectional area beyond the inlet so as to provide a smaller vapor space between the casing and tubes thereby to increase the velocity of the vapor beyond the inlet, and a baffle disposed in the space between the casing and tubes beyond the vapor inlet and spaced from said casing and tubes thereby to impede the flow of vapor through the space.

21. Heat exchange apparatus comprising a plurality of heat exchange tubes having means for directing a cooling medium through the interior thereof, a casing enclosing said tubes, vapor inlet means in said casing adjacent one end of the tubes, a baffle arranged in said casing so as to provide a vapor passage longitudinally of the tubes, said casing being of greater cross sectional

area adjacent the vapor inlet so as to provide an enlarged vapor space communicating with the inlet between the tubes and casing, and the casing being of smaller cross sectional area beyond
5 the inlet so as to provide a smaller vapor space between the casing and tubes thereby to increase

the velocity of the vapor beyond the inlet, and a sectional circular baffle assembly disposed around said tubes beyond the vapor inlet in the space between the casing and tubes and mounted independently of the shell.

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