A modular air cooled condenser apparatus having an elongated tubular manifold serving as a backbone principal support for other elements of the apparatus, a plurality of condenser cores supported on the manifold at an angle to the horizontal to provide gravity drainage back into the manifold, a fan shroud and fan supported between the cores, a motor drive structure mounted on the manifold and connected to the fan and a rigid frame interconnecting the manifold, cores and shroud in a self-supporting module unit joinable at the manifold to other such units to provide any desired condensing capacity. Each modular unit is preferably of a size that can be constructed in the factory and shipped as on a flatcar to its destination so as to require a minimum of erection in the field.

9 Claims, 6 Drawing Figures
3,707,185

MODULAR AIR COOLED CONDENSER

SUMMARY OF THE INVENTION

One of the features of this invention is to provide a modular air cooled condenser in which a tubular manifold not only functions as a distributor for the gases to be condensed and a collector for the resulting condensate but also as a support in the nature of a backbone for the condenser cores and air circulating fan structure.

Other features and advantages of the invention will be apparent from the following description of one embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a modular air cooled condenser apparatus or unit embodying the invention.

FIG. 2 is an end view of the unit of FIG. 1.

FIG. 3 is a perspective view illustrating an assembly of modular units to provide a field erected condenser apparatus in which steam is condensed by air cooling.

FIG. 4 is a view similar to FIG. 3 but illustrating another manner of assembling the units in a condenser apparatus.

FIG. 5 is a perspective view of the tubular manifold backbone of the condenser apparatus.

FIG. 6 is a fragmentary sectional view illustrating the mounting of a condenser core on the manifold.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the apparatus illustrated in the drawings there is provided an elongated tubular manifold backbone 10 which functions to direct the fluid in their respective passages and also as a support for other elements of the apparatus. The manifold 10 as illustrated in FIG. 5 comprises an elongated cylinder 11 having connecting flanges 12 at each end and a bottom baffle 13 extending substantially the full length of the cylinder and a small distance above the bottom thereof. Arranged along the length of cylinder 11 are two pairs of elongated flanges 14 that provide elongated access passages 15 to the interior 16 of the cylinder 11.

As can be seen from FIG. 5 each pair of flanges 14 is arranged at a flaring angle to each other from the horizontal and each flange is used to mount a tubular condenser core 17 of conventional spaced tube and interconnected fin construction which is of course air permeable around the tubes and between the fins. The angular arrangement of these condenser cores is illustrated in FIG. 2. As can be seen there, the condenser cores 17 are supported on the manifold 10 at an angle to the horizontal and to each other to provide gravity drainage of condensate into the manifold as illustrated in FIG. 6. Thus in the illustrated embodiment steam flows through the tubular manifold 11 and into the interior 18 of the condenser cores 17 as illustrated at 19 in FIG. 6 and the resulting liquid condensate formed in the core 17 flows back into the cylinder 11 by gravity flow as illustrated at 20 also in FIG. 6.

The cores 17 have their upper ends 21 spaced apart in V-shape as illustrated in FIG. 2 and supported between the cores at these upper ends 21 is a fan shroud 22 which is circular and concentric with the axis of rotation of a rotatable fan 23. For clarity of illustration the fan is omitted in FIG. 1.

The air cooled condenser apparatus or module unit also includes a motor drive structure 24 mounted on the top of the manifold 10. As is illustrated in FIG. 1 this motor drive includes an electric motor 25, a gear reducer 26 and a vertical shaft 27 connected to the hub 28 of the fan 23 for rotating the fan within its shroud 22.

For further support there is also provided a rigid frame including a pair of horizontal frame members 29 beneath the manifold 10 with one being located at each end of the unit. The rigid frame also includes a pair of upwardly extending substantially parallel frame members 30 connected to each of the horizontal members 29 so as to provide an essentially box-like frame. The upper ends of the four vertical frame members 30 are located adjacent the upper ends 21 of the cores 17 and are further strengthened by diagonal frame members 31 at the undersides of the cores 17 and connecting the upper ends of the frame members 30 and the manifold 10. The rigid frame also includes second horizontal frame members 32 interconnecting the upper ends 21 of the condenser cores 17 for supporting the fan shroud 22 and further strengthening the supporting frame 33 which comprises the frame members 29-32.

The upper ends of the two pairs of side frame members 30 are interconnected by horizontal members 34 on which is supported a solid sheet of metal or the like 35 that surrounds the circular fan shroud 22. This sheet 35 aids in directing all of the air flow through the shroud 22.

In the preferred arrangement the fan 23 is rotated so as to draw air into the pair of condenser cores 17 as illustrated by the arrows 36, up into the rotating fan 23 and then exhausted upwardly as shown by the arrows 37. In order to further insulate the air flow the ends of the units are sealed in the areas between the inclined condenser cores 17 by sheets such as metal sheets 38.

FIGS. 3 and 4 illustrate two embodiments of assembled condenser modules embodying the invention in steam condensation apparatus. In FIG. 3 the condenser modules 39 have their manifolds 10 connected in a series of three and each series of three is connected to a steam inlet pipe 40 so that the steam is fed into the assembled manifold 10. The condensate that is formed on the inclined cores 17 then flows by gravity back into the manifold, as previously described and as illustrated in FIG. 6, and the condensate collects in the space 41 beneath the horizontal baffle 13 where it is drained away by condensate drains 42 (FIG. 5) for flow into condensate return manifolds 43 as for return of the condensate to the steam generating system.

FIG. 4 shows another type field erection arrangement of this construction. Here the modular units 39 are elevated on elongated supports 44 at the corners of the modular units 39.

The air cooled condenser apparatus of this invention permits assembling from preassembled units the required amount of condensing capacity. Such air cooled condensers are becoming popular in the power and chemical industries not only because of their efficiency of operation but also because of the growing shortage of available cooling water. These air cooled condensers also avoid the problem of thermal pollution of the water in streams. Although some air cooled condensers have been used in power generating plants, these are of small capacity. With this invention any
capacity required may be quickly assembled by assembling the desired number of modular units.

Another very important advantage of the condenser apparatus of this invention is that the modular units may be manufactured in the factory with dimensional limits so that the units can be easily shipped by rail to any part of the United States. Generally, the limits to the apparatus that can be shipped by rail require structures that are not greater than 11 feet wide by 15 feet high by 30 to 40 feet long. Such structures can be shipped on a standard railroad flatcar.

The manifold 10 which is illustrated in detail in FIG. 5 is commonly identified as a strong back manifold because of its function of not only serving as a manifold to provide fluid flow of both liquid and gas separated by the baffle 13 which may be provided with spaced openings 45 but also as a strengthening and supporting element in the complete assembly. As illustrated in FIG. 5, end flanges 12 are provided for connecting to adjacent equipment such as the next succeeding manifold of the next modular unit. Instead of being of the flanges 12 arrangement, as illustrated in FIG. 5, the cylinder 11 can have plane ends chamfered for butt welding and this is actually preferred because vacuum systems of welded construction are more reliable than those using flanges and the necessary sealing gaskets. The upper ends 21 of the condenser cores 17 function as manifolds for non-condensable gases which are easily vented through vent valves 46. The core 17 comprises tubes 47 with fins 48.

By utilizing the manifold as a part of the strengthening structure on which the other elements of the unit are mounted a simple yet very strong unit can be constructed. In addition, the arrangement as described herein minimized field welding and erection, thereby greatly reducing the overall cost. In the illustrated embodiment, the actual field welding would be substantially limited to the joints connecting adjacent manifolds.

Having described our invention as related to the embodiment shown in the accompanying drawings, it is our intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the appended claims.

We claim:

1. A modular air cooled condenser apparatus for condensing condensable gases to liquid condensate, comprising: an elongated hollow manifold backbone for containing both gas and liquid means for supplying said gas to the manifold; means for reporting said liquid from the manifold; a plurality of air pervious hollow condenser cores supported on said manifold at an angle to the horizontal with their lower ends attached to said manifold, said manifold and cores having their interiors connected for passage of said gas from the manifold into the cores and the gravity flow of said liquid from the cores to the manifold; means for spacing the upper ends of said cores apart; a fan shroud between said spaced cores above the manifold; a fan within said shroud; a motor drive structure mounted on said manifold and connected to said fan for driving the same; and a rigid frame interconnecting said manifold, cores and shroud in a self-supporting module unit of which the tubular manifold is the supporting backbone, said unit being joinable at the manifold to other said module units.

2. The apparatus of claim 1 wherein said manifold backbone is positioned substantially horizontally and the condenser cores are substantially radially arranged around the manifold.

3. The apparatus of claim 2 wherein said motor drive structure comprises an electric motor positioned on the top of the manifold backbone, a gear reducer means also positioned on said manifold backbone and a vertically extending drive shaft connecting the gear reducer means and the fan for rotation thereof.

4. The apparatus of claim 2 wherein said rigid frame comprises a horizontal frame member beneath and connected to the manifold backbone, a pair of spaced frame members on opposite sides of the manifold joining the horizontal member and the cores, and second horizontal frame members adjacent the upper ends of the cores and supporting the fan shroud and fan.

5. The apparatus of claim 4 wherein said shroud is circular and said second frame member is solid between the shroud and said upper ends of the cores to aid in directing the cooling air flow created by the fan in series through the shroud and cores.

6. The apparatus of claim 4 wherein said pair of spaced frame members are substantially vertical and join said cores at the core upper ends, and said second horizontal frame members extend between said core upper ends.

7. The apparatus of claim 1 wherein said manifold backbone is positioned substantially horizontally and the condenser cores are substantially radially arranged around the manifold, said fan shroud and fan are arranged generally horizontally adjacent the upper ends of said cores and have diameters substantially equal to the horizontal distance between the upper ends of said cores, said motor drive structure comprises an electric motor positioned on the top of the manifold backbone, a gear reducer means also positioned on said manifold backbone and a vertically extending drive shaft connecting the gear reducer means and the fan for rotation thereof, and said rigid frame comprises a horizontal frame member beneath the manifold backbone, a pair of spaced frame members on opposite sides of the manifold joining the horizontal member and the cores, and second horizontal frame members adjacent the upper ends of the cores and supporting the fan shroud and fan.

8. The apparatus of claim 7 wherein said shroud is circular and said second frame member is solid between the shroud and said upper ends of the cores to aid in directing the cooling air flow created by the fan in series through the shroud and said pair of spaced frame members are substantially vertical and join said cores at the core upper ends, and said second horizontal frame members extend between said core upper ends.

9. The apparatus of claim 1 wherein there is provided a strengthening and fluid separating baffle means within said manifold interior between the top and bottom thereof extending substantially the full length of said manifold and dividing said interior into a gas space above the baffle means and a liquid space beneath the baffle means.

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