The improvements of the present invention more particularly relate to a dephlegmator or fractionating column provided with spaced decks on which are positioned ejector nozzles so constructed that the vapors passing through therefrom in liquid and elevate it to the top of the nozzles, thereby effecting intimate contact between the liquid and vapors and creating circulation in the body of liquid on each deck.

It is of the utmost importance in the fractionation or dephlegmation of hydrocarbon oil vapors, particularly that a maximum intimate contact take place between the oil and vapors for the purpose of securing efficient fractionation. The present invention has been designed to accomplish this in a very effective manner.

In the drawings, Fig. 1 is a diagrammatic vertical sectional view of a fractionating tower equipped with ejector devices according to the present invention.

Fig. 2 is a fragmentary enlarged vertical sectional view of a section of a deck illustrating the construction of one type of ejector nozzle in combination with the liquid overflow pipe.

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 2 illustrating a slightly different form of ejector nozzle.

Fig. 5 is another view similar to Fig. 3 illustrating an ejector nozzle having a spaced cap portion.

Referring more in detail to the drawings, 1 designates the shell of a dephlegmator or fractionating column which in the present instance, is illustrated as disposed in a vertical plane. This shell 1 is preferably made of metal, and depending upon the capacity of the plant with which it is used, may be from two to five feet in diameter more or less, and from twenty to thirty feet high more or less. Its upper end is closed by a removable top cap 2 in which cap is disposed a vapor outlet pipe 3 which may be controlled by a throttle valve (not shown). A vapor inlet pipe 4 in which may be interposed a throttle valve (not shown) is shown in the lower portion of the shell 1, as is also a reflux condensate or liquid drawoff pipe 5 in which is interposed the valve 6.

Referring now more particularly to the structure comprising part of the present invention, throughout the height of the dephlegmator there are provided superposed spaced decks or trays 7 supported in any obvious manner, for instance by lugs projecting from the inside wall of the shell. Each of these plates is provided with holes to receive the base of the ejector nozzles designated as a whole 8, which ejector nozzles project upwardly from said plate and are supported thereby. Each ejector nozzle comprises an inner vapor conduit or passageway 9 defined by the walls 10, which at their lower edge are provided with the flange or shoulder portions 11 for the purpose of being supported on the deck 7. Adjacent to and spaced from the exterior walls of the walls 10 are walls 12 which define liquid passageways 13. These liquid passageways 13 and the walls 12 as well as the walls 10 sweep or flare inwardly to the upper edge of conduit 9 where they meet in the space 14. The upper edge of each ejector nozzle is preferably broadened out or provided with an enlarged surface for the purpose of permitting a gradual overflow in the form of films and the like, rather than an abrupt overflow.

The operation of the ejector nozzle should be apparent from the description and the illustration shown in the drawings. Cooling liquid or reflux condensate, or both, is permitted to build up in a substantial body as indicated by the letter A. (Fig. 2) on each deck 7. As the vapors sweep upwardly through the conduit 9 and exit into the space 14 the force of these vapors will create in effect a suction action in the liquid passageways 13, thus elevating liquid from the body A. through the passageways 13 and 14 to the top of the nozzle thereby effecting an intimate contact between the liquid and vapors and also creating circulation in the body of liquid on the plate. A liquid overflow pipe 15 is provided for each deck 7. The upper edge of this overflow pipe 16 is preferably maintained below the upper edge of the ejector nozzles 8 for the purpose of preventing the
liquid in body A. overflowing the top of the ejector nozzles and defeating the purpose of the invention. At the entrance to each overflow pipe 16 is a shield or baffle 17 disposed in spaced apart relation relative to the pipes 16 by the spiders or other supporting element 18. This baffle or shield 17 is provided to keep the liquid from splashing over into the overflow pipe 16 and also to draw off liquid from the lower section of the liquid body. The bottom of these overflow pipes 16 preferably extends below the liquid level A. on the deck below in order to form a liquid seal. Perforated plates 19 may be provided between each deck above the ejector nozzles, the perforations being so arranged that perforate portions are disposed immediately above the outlet from the ejector nozzles to divert the vapors and prevent channeling.

Cooling liquid may be introduced through either or both of the lines 20 and 21 in which are interposed valves 23. The arrangement is such that vapors ascend only through the ejector nozzles. It is obvious that there may be any number of these nozzles on a deck, and that there may be one or more overflow pipes of desired size.

As another feature of the present invention, the overflow or down pipe 24 from the lower deck 7 extends downward to the reflux leg, and may discharge into an inverted cap 25 in order to convey the liquid out of the zone of incoming vapors which enter through the pipe 4. It is desirable that the liquid from the bottom may be carried into the reflux leg without coming in direct contact with the incoming hot vapors, as it has been found that frequently the continuous rain of reflux and cooling liquid coming in contact with the incoming vapors causes an entrainment in said rain of lighter fractions of the vapors which necessarily have to be either removed before the reflux is returned for retreatment, or retreated. It is to be understood of course, that the openings 18 may be placed either below the liquid level as illustrated, at the liquid level, or at any position under the liquid level.

The ejector nozzle illustrated in Fig. 4 is similar in appearance to ejector nozzle 8 illustrated in Figs. 1 and 2, except that it is higher and causes the liquid to be carried to a higher elevation. In addition, the outside surface of the nozzle is corrugated as illustrated at 26 in order to expose the overflowing liquid to more surface to assist in liberating the light ends.

The ejector nozzle illustrated in Fig. 5 is of similar design to the nozzle illustrated in Figs. 1 and 2, and in addition the spaced portion 27 is placed over the outlet in order to accomplish the same purpose as the perforate portions of the plate 19. Where a nozzle of the type illustrated in Fig. 5 is used, it may be found desirable to dispense with plates 19. The cap 27 functions to break the impact of the rising vapors and throw the liquid particles which might be carried upwardly back into the body of liquid.

It is to be understood that the dephlegmator of the present invention is adapted for use either under atmospheric, superatmospheric or sub-atmospheric pressure. It may be found desirable as illustrated in the drawings, to position the overflow pipes 16 alternately on each side of alternate decks.

I claim as my invention:

1. A dephlegmator comprising in combination a shell having a vapor and a vapor outlet, a liquid inlet and a liquid outlet, spaced superimposed decks mounted in said shell, liquid overflow pipes for each deck having vapors projecting above the deck to permit the accumulation of bodies of liquid on each deck, vapor passageways mounted on each deck, said vapor passageways including a centrally positioned vapor conduit and a surrounding liquid conduit, said conduits merging into a common passageway at the upper part thereof, the lower end of said vapor conduit projecting through the associated deck, the lower end of the surrounding liquid conduit terminating above the deck but below the level of the liquid accumulated thereon.

2. A dephlegmator comprising in combination a shell having a vapor inlet and a vapor outlet, a liquid inlet and a liquid outlet, spaced superimposed decks mounted in said shell, liquid overflow pipes for each deck having portions projecting above the deck to permit the accumulation of bodies of liquid on each deck, vapor passageways mounted on each deck, said vapor passageways including a centrally positioned vapor conduit and a surrounding liquid conduit, said conduits merging into a common passageway at the upper part thereof, said common passageway terminating above the level of the body of liquid accumulated on the deck, the lower end of said vapor conduit projecting through the associated deck, the lower end of the surrounding liquid conduit terminating above the deck but below the level of the liquid accumulated thereon.

3. A dephlegmator comprising in combination a shell having a vapor inlet and outlet openings, a liquid outlet from the lower portion of the shell, spaced superimposed decks mounted in said shell, liquid overflow pipes for each deck, said pipes being so arranged that a body of liquid is permitted to accumulate on each deck, a vapor conduit extending through and projecting above each deck, an annular liquid conduit surrounding said vapor conduit, said annular conduit and said vapor conduit merging at their upper portions into a single passageway, said single passageway projecting above the body of the liquid on the associated deck, the lower end
of said annular liquid conduit terminating above said deck but below the level of the body of liquid thereon.

4. A dephlegmator comprising in combination a shell having a vapor inlet and outlet and a liquid inlet and outlet, spaced superimposed decks mounted in said shell, liquid overflow pipes for each deck having a portion projecting above the deck to permit accumulation of liquid thereon, vapor passageways in each deck comprising ejector elements forming separate vapor and liquid passageways merging in a common passageway, the upper edge of each ejector being broadened out to provide an enlarged surface for permitting a gradual overflow in the form of a film.

LYMAN C. HUFF.