April 7, 1959 E. L. WHEELER 2,880,979

FRACTIONAL DISTILLATION APPARATUS

Filed March 5, 1957

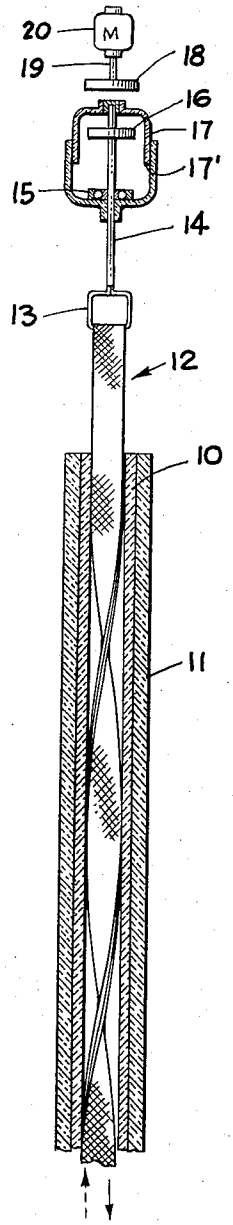


FIG. 1.

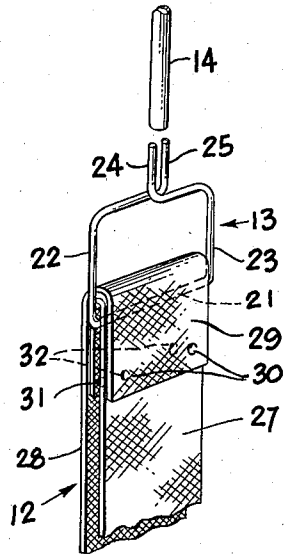


FIG. 2.

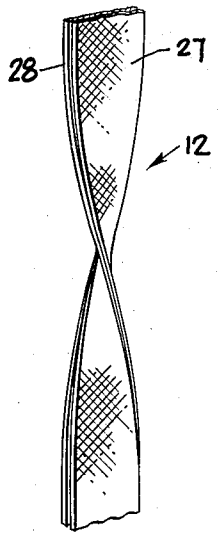


FIG. 3.

INVENTOR.
EDGAR L. WHEELER
BY Elliott & Pastoriza
ATTORNEYS

United States Patent Office

2,880,979

Patented Apr. 7, 1959

2,880,979

FRACTIONAL DISTILLATION APPARATUS

Edgar L. Wheeler, Santa Monica, Calif.

Application March 5, 1957, Serial No. 644,115

5 Claims. (Cl. 261—84)

This invention generally refers to distillation apparatus and more particularly to an improved fractional distillation apparatus enabling more complete rectification or enrichment as well as a resultant higher reflux ratio.

The general object of fractional distillation apparatus is to achieve the closest possible contact between rising vapor and descending liquid or reflux such that only the most volatile vapor will proceed towards the receiver, while the less volatile material returns as a liquid towards the still. When such an object is achieved, it is apparent that liquids may be separated in which the boiling points lie very close to one another.

Various methods have been developed for achieving intimate contact between rising vapor and descending liquid. Towards this end, fractionating columns are usually provided with packing or plates or some other means of achieving the desired contact between vapor and liquid. Some of the more common packings include glass beads, metal chains, rings, saddles, and the like. In addition to such random or stationary packing, other types of devices have been used which rotate within the fractionating column to cause close contact between the passage of the countercurrent liquid and vapor streams. Such devices have included, for example, a rotating cylinder dimensioned to leave a narrow annular space between the tube and itself.

More recently, rotating spinning bands have been employed in the rectifying section. In its most usual form, the spinning band comprises an elongated flat metal band, which may be provided in one embodiment with a spiraling configuration such that the countercurrent flow follows a helical path up and down the length of the fractionating column. Extremely satisfactory contact has been achieved in this manner. A difficulty, however, has arisen in that the band in its frictional engagement with the inner side walls of the tube gradually wears away to such an extent that an annular passage is created between the band and the side walls of the tube enabling the vapor to pass upwardly therethrough without the desired close contact with the descending liquid or reflux. It is primarily towards the overcoming of this problem that the present invention is directed.

It is, therefore, an object of the present invention to provide a spinning band means of effecting intimate contact or rectification in a fractionating column, wherein such contact will be maintained to the fullest extent over an extended period of time regardless of deterioration or or wearing away of the spinning band means employed.

Another object of the present invention is to provide an improved spinning band means for use in fractionating columns of distillation apparatus conforming with the aforesaid object, in which said spinning band means may be simply constructed without appreciable increase in manufacturing costs, and yet which is susceptible of incorporation into conventional fractionating columns without any modification thereof.

These and other objects and advantages of the present

invention are generally attained by providing in fractional distillation apparatus including a fractionating column or tube, a first elongated spinning band extending axially therethrough in combination with a second elongated spinning band extending axially therethrough in juxtapositioned relationship with the first spinning band. Coupling means are provided to secure together one pair of adjacent ends of the first band and the second band, and means are provided for rotating the coupling means to in turn effect rotation of the two spinning bands.

With such a construction, the first band and the second band are urged radially apart by centrifugal force to frictionally engage the side walls of the tube. It will be appreciated, however, that as wearing occurs throughout the length of the bands, the result will only be that the bands will move radially outward a distance compensating for the wear that has occurred so that the bands are always continuously in contact with the side walls of the tube, thus assuring that a countercurrent flow of vapor and liquid must always take a path causing contact with the bands within the tubes.

A better understanding of the present invention will be had by reference to the drawings, showing an illustrative embodiment of the present invention, and in which:

Figure 1 is a view of the improved spinning band means of the present invention, shown in partial schematic relationship incorporated with fractional distillation apparatus;

Figure 2 is an enlarged isometric view of the coupling means employed in conjunction with the improved spinning band means of the present invention shown in Figure 1; and,

Figure 3 is an enlarged view of a short length of the spinning band means of Figure 1, illustrating a preferred construction thereof.

Referring now to the drawings in detail, there is shown in Figure 1 a section of a fractionating column or tube **10** surrounded by insulating material **11**, for example. It will be appreciated that the insulating material **11** may take various forms and might be replaced by vacuum jacketing, or the like. The ascending vapor is indicated by the dotted line arrow and the descending liquid or reflux by the solid line arrow.

The spinning band means for effecting the necessary enrichment or rectification of the countercurrent streams of vapor and liquid is generally designated by the numeral **12** and extends throughout the length of the fractionating column **10**. This spinning band means **12** is secured to a stirrup or coupling member **13** for rotative movement therewith. The coupling member **13** in turn is joined to a shaft **14** which passes upwardly (as viewed in Figure 1) through a bearing means **15**. The shaft **14** has rigidly secured to it near its upper end a magnetic core **16**.

The magnetic core member **16** is adapted to be rotated by means provided exterior of a glass cap **17** surrounding the core and adapted to form an airtight seal with a head **17'** and in turn with the column or tube **10**. For purposes of the description of the present invention, the glass cap **17'** has been shown as cut off in Figure 1, although it will be appreciated that depending on the construction of the fractionating distillation apparatus, it would finally be sealably joined to the column **10**.

The core **16** is shown as being driven by a magnet **18**, which is in turn coupled through a shaft **19** to a small motor **20**.

The co-operative relationship between the coupling member **13** and the spinning band means **12** as well as the manner in which the shaft **14**, coupling member **13**, and spinning band **12** are connected together may be more clearly described by reference to Figure 2.

It will be noted in Figure 2 that the coupling member

13 includes a base member 21 integrally formed with two upright members 22 and 23. The upright member 23 terminates in a free end 24, and the upright member 22 terminates in a free end 25. The ends 24 and 25 are adapted to be welded or otherwise rigidly secured to the shaft 14.

It will be further noted that the spinning band means 12 is actually comprised of two spinning bands 27 and 28. The spinning band 28 includes an end 29 turned back upon itself over the base member 21 and joined as by spot welding 30 to the spinning band 27. Similarly, the spinning band 27 is provided with an end turned back upon itself and passing over the member 21 underneath the end 29 to thereafter be joined by spot welding 32 to the spinning band 28. It will be appreciated with such a construction that the spinning bands 27 and 28 are in such coupled relationship with the member 13 and with respect to each other that any rotative movement of the member 13 will cause a similar and simultaneous in-phase rotative movement of the spinning bands 27 and 28.

In a preferred construction, the spinning bands 27 and 28 are each constructed in a similar spiraling shape and lapped together as shown in Figure 3. It is further usually desirable that the spinning band means 12 have a maximum diameter just slightly less than the inner diameter of the columnar tube 10, whereby the band means 12 may be slid down into the column 10 to contact the side walls thereof. In the form illustrated in the drawings, the spinning band means 12, as heretofore mentioned, is provided with multiple turn helices which are (as determined from tests) best provided approximately every six to eight inches of length.

With such a construction, upon energization of the motor 20, the shaft 19 will rotate to in turn cause rotative movement of the magnet 18. In consequence, the magnetic core 16 will be caused to rotate and effect rotative movement of the lower shaft 14 and the coupling member 13 secured thereto. In turn, the spinning band means 12 will be rotated throughout its length. Because of the relatively small difference in dimension between the diameter of the band means 12 and the inner diameter of the tube 10, the band means 12 will be forced into frictional engagement with the side walls of the tube 10 throughout its entire length. This engagement will continue despite wearing away of the edges of the spinning band 12 and 28, since as this wearing away occurs the spinning bands 27 and 28 will through centrifugal force be separated a small distance apart and brought into contact again with the inner side walls of the tube 10. Thus, regardless of the amount of decrease in the overall diameter of the spiraling spinning bands 27 and 28, they will always be contacting side walls of the tube 10, assuming sufficient rotative speed of the motor 20. With such a construction, it has been found through practice that an intimate contact may be maintained between

the ascending vapor and the descending reflux liquid over a long period of operation.

Although the improved spinning band means of the present invention has been described in one illustrative form, it will be appreciated that various changes and modifications may be made, as defined by the scope of the following claims.

What is claimed is:

1. In fractional distillation apparatus, the combination comprising: a tube; a first elongated spinning band extending axially through said tube; a second spinning band extending axially through said tube, said second spinning band being normally juxtaposed in face-to-face relationship with respect to said first spinning band; coupling means securing together one pair of adjacent ends of said first band and said second band; and, means for rotating said coupling means to in turn effect rotation of said first band and said second band, whereby said first band and said second band are urged laterally apart by centrifugal force to frictionally engage the sidewalls of said tube.

2. The combination according to claim 1, in which said first band and said second band are flat in cross section and formed of screen material.

3. The combination according to claim 1, in which said first band and said second band are spiraled axially throughout their lengths.

4. The combination according to claim 1, in which said first band and said second band each have a maximum width slightly less than the inner diameter of said tube, whereby said bands may be readily inserted into said tube.

5. In fractional distillation apparatus, the combination comprising: a tube; a first elongated spinning band extending axially through said tube; a second spinning band extending axially through said tube, said second spinning band being juxtaposed with respect to said first spinning band; a stirrup for coupling one end of said first band and an adjacent end of said second band, said stirrup including a base member and two integrally formed upright members; said one end being turned back on itself over said base member and secured to said second band, and said adjacent end being turned back on itself over said base member and secured to said first band; a shaft coupled to said upright members; and, means for rotating said shaft to in turn effect rotation of said first band and said second band, whereby said first band and said second band are urged laterally apart by centrifugal force to frictionally engage the sidewalls of said tube.

References Cited in the file of this patent

UNITED STATES PATENTS

2,608,528	Piros et al.	Aug. 26, 1952
2,712,520	Nester	July 5, 1955
2,764,534	Nerheim	Sept. 25, 1956