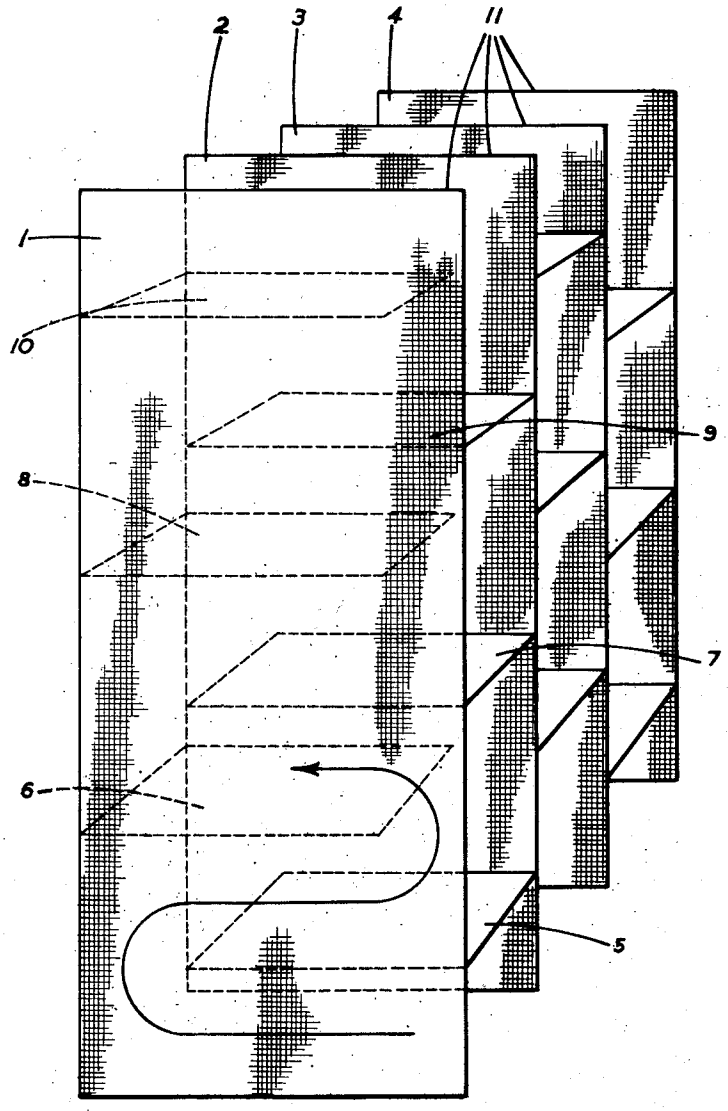
Oct. 28, 1952 O. G. DIXON 2,615,700

APPARATUS FOR CONTACTING LIQUIDS WITH GASES OR VAPORS

Filed Feb. 25, 1947 3 Sheets-Sheet 1

FIG. 1.



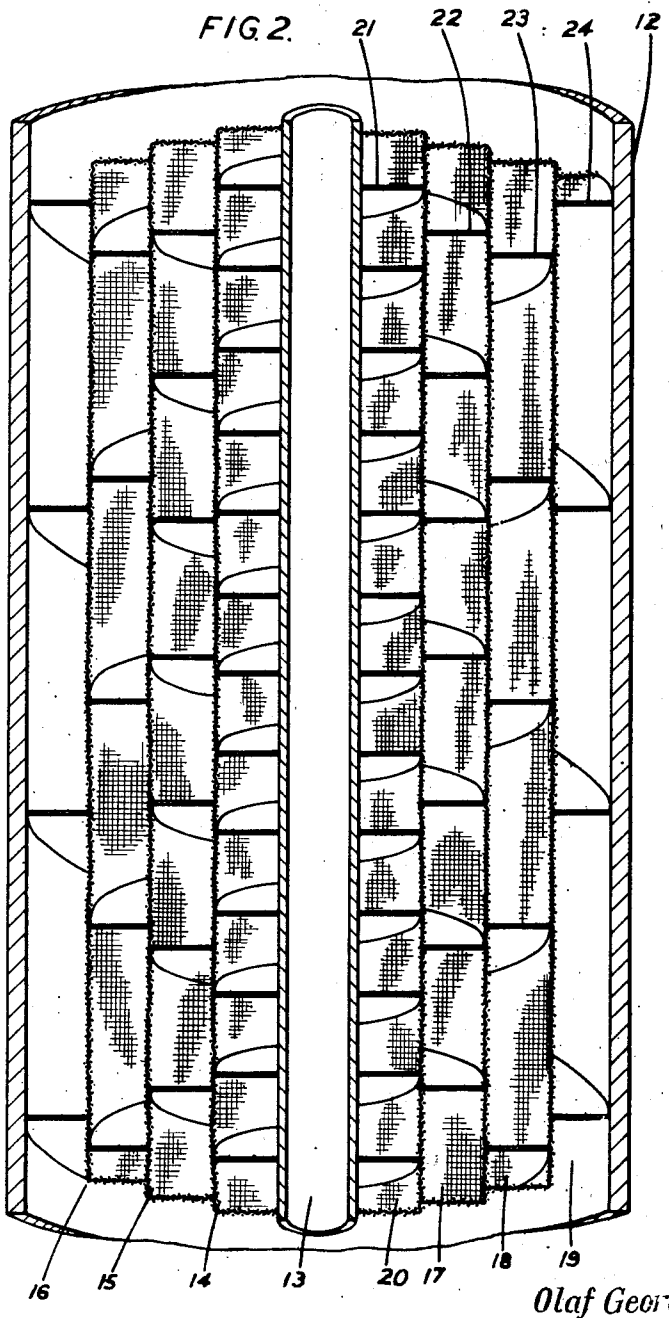
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APPARATUS FOR CONTACTING LIQUIDS WITH GASES OR VAPORS

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FIG. 2.



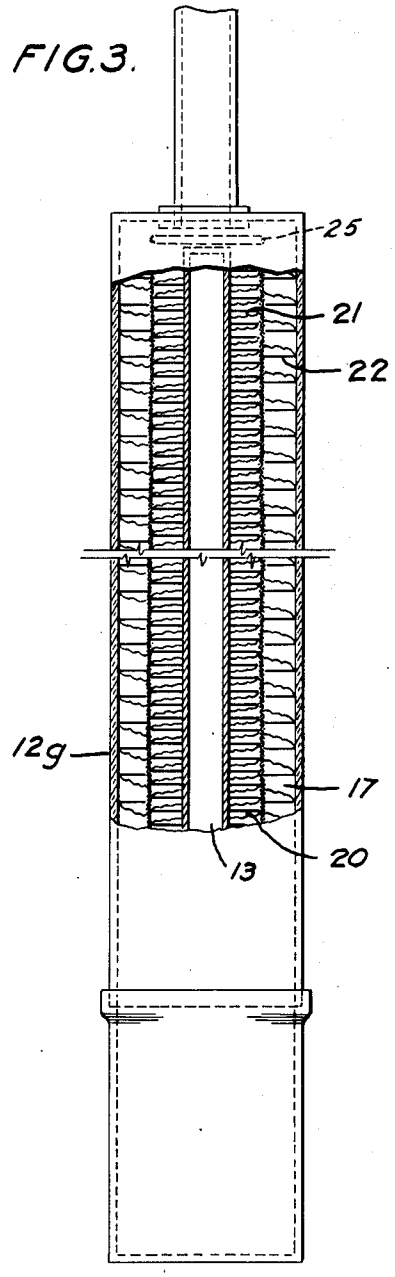
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FIG. 3.



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Patented Oct. 28, 1952 2,615,700

UNITED STATES PATENT OFFICE

2,615,700

APPARATUS FOR CONTACTING LIQUIDS WITH GASES OR VAPORS

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Application February 25, 1947, Serial No. 730,677
In Great Britain February 28, 1946

1 Claim. (Cl. 261—102)

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This invention relates to contacting gases or vapours with liquids.

According to the present invention there is provided a novel form of packing suitable for use in the treatment of gases or vapours with liquids which comprises one or more filamentous sheets which can be irrigated with the liquid, said sheet or sheets being arranged in conjunction with a baffle or baffles to provide one or more tortuous passages for the flow of gas or vapour.

The filamentous sheet or sheets may be made from woven materials such as wire, glass wool, slag wool or filaments of synthetic resins, but it should be understood that sheets made from filaments assembled by methods other than weaving are suitable for use according to the present invention. For example a suitable sheet may be obtained by assembling a series of wires into a grid and spot welding the intersections of the wires. It is convenient however to use wire gauze which may be made from any suitable metal such as copper, brass, phosphor bronze, cupro-nickel or stainless steel. When the filamentous sheets are made from woven material the weave may be any desired pattern, but we have found it preferable to use woven material in the form of galloon netting, that is netting in which the warp threads are substantially straight instead of being bent as in the case of normal weaving, while the weft threads are arranged closely against one another. The number of weft threads in galloon netting is therefore always greater than the number of warp threads. Moreover, the warp threads are generally, but not necessarily, thicker and/or stronger, than the weft threads. A twilled galloon netting may be used but it is preferred to employ galloon netting of normal weave. It is desirable with all woven filamentous materials to arrange the packing so that in use the warp threads are substantially vertical, and this is particularly desirable when galloon netting is used. The sheets of filamentous material may have substantially plain surfaces, or they can be provided with indentations or they can have corrugations in a direction substantially parallel to or transverse to the direction of flow of the gas or vapours. The sheets may be in the form of rectangles arranged at suitable distances apart and with their corresponding edges substantially parallel, or they may be arranged in the form of a series of concentric prisms or cylinders.

The baffles, arranged in conjunction with the filamentous sheets to provide one or more tortuous passages, may be disposed in various ways. For example when in conjunction with parallel

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rectangular sheets, it is preferred for the baffles to be horizontal; when in conjunction with sheets arranged in the form of concentric prisms the baffles are desirably constructed in continuous strips in a manner analogous to an open well staircase and when in conjunction with sheets arranged in the form of concentric cylinders, the baffles are desirably constructed as continuous helices.

It should be understood that when a single filamentous sheet is used the baffles may be suitably disposed on either side of it to provide, in conjunction with the wall or walls of the containing vessels, the tortuous passages for the flow of gas or vapour. Similarly when more than one filamentous sheet is used, baffles are preferably arranged between the wall or walls of the containing vessel and the next adjacent sheet.

The baffles may also be made from filamentous material, but it is preferred to make them from substantially impervious material such as sheet metal. Thus in addition to providing the tortuous passages, the baffles serve also to stiffen the filamentous sheet or sheets and to maintain the sheets at the desired spacings.

When using sheets arranged in the form of concentric cylinders it has been found convenient to make the baffles from crimped or corrugated metal sheet or tape.

Figure 1 is a diagrammatical showing of a series of vertically parallel filamentous sheets of this invention with horizontal baffles;

Figure 2 is a vertical section of a cylindrical casing fitted with a series of upright cylindrical filamentous sheetings having helices within the annular spaces therebetween; and,

Figure 3 is a side elevational view of a distillation column having another form of the packing of this invention.

Examples of the packing of the present invention will now be described by reference to the accompanying drawing.

Figure 1 shows diagrammatically a series of parallel sheets of copper gauze **1**, **2**, **3**, and **4**, in which, for the sake of clarity the individual wires are not represented. Between the sheets **1** and **2** a series of baffles of sheet copper **5**, **6**, **7**, **8**, **9** and **10** are arranged to provide a tortuous passage through which gas or vapour can pass as indicated by the arrow. A series of similar baffles is fitted between the pairs of sheets **2**—**3** and **3**—**4**, those between sheets **2** and **3** being arranged so that at any given height from the bottom of the arrangement gases or vapours flowing in a transverse direction between sheets **2** and **3** are moy-

ing in a direction opposite to gases or vapours flowing between sheets 1 and 2, and between 3 and 4. This form of packing may be fitted into a rectangular vessel provided with means for irrigating the upper edges 11 of the copper gauze sheets with the liquid to be used, while the gas or vapour to be treated may be introduced at the top or bottom of the vessel as desired to give co-current or countercurrent flow.

Figure 2 illustrates a vertical section of a cylindrical casing 12 fitted with a central tube 13 and a series of concentric cylinders of copper gauze 14, 15 and 16 forming passages of annular cross section 17, 18, 19 and 20. Helices of strip copper 21, 22, 23 and 24 are fitted into the annular passages, the helices being wound alternately in a clockwise and anti-clockwise direction.

Fig. 3 is a side elevational view of a distillation column in which the numeral 12*g* refers to a mild steel shell, numeral 25 represents a conventional means for irrigating the filamentous sheet-form partitions of the packing of this invention and as shown, is a spray ring distributor, and the other numerals thereof refer to like parts of Figs. 1 and 2.

The packing of the present invention is suitable for use in a wide variety of processes where it is desirable to present a large surface area of liquid to a gas or vapour, for example in gas-washing and absorption processes and particularly in distillation.

The following examples illustrate the use of the novel packing of the invention. Example 1 is for a packing of rectangular sheets of filamentous material without baffles, and is given to indicate by comparison with Examples 2 and 3 the improved efficiency which may be achieved in distillation apparatus employing packings of filamentous sheets with baffles as described in this specification.

Example 1

A mild steel distillation column 2 feet long and having a cross section at right angles to its axis of 1½ inches by 1½ inches was fitted with 6 sheets of phosphor-bronze wire gauze, the sheets being spaced approximately ¼ of an inch apart. The wire gauze had 60 meshes to the inch. The column was fitted with a boiler of 15 litres capacity and a reflux condenser. An adjustable orifice was arranged at the bottom of the column to provide a temporary hold-up of liquid in the column. 5 litres of a mixture containing 20 moles per cent of carbon tetrachloride and 80 moles per cent of benzene were placed in the boiler and heated to give a distillation rate of 4000 gms. per hour, the apparatus being operated with 100% reflux. The adjustable orifice was partially closed so that liquid built up in the column and flooded the packing. Then without altering the rate of distillation the adjustable orifice was gradually opened whereby the liquid flowed from the column into the boiler. When steady conditions prevailed, the refractive indices of the boiler liquid and of the reflux liquid were measured and the mole fractions of carbon tetrachloride and benzene therein were determined from the International Critical Tables, 7, 1930, page 77. From these values, the volatility ratio of the components was determined from the equilibrium data given by Rosanoff and Easley, Journal of the American Chemical Society 1909 pages 953–987 and by substituting the value in the formula given by Fenske in Industrial and Engineering Chemistry 24 (1932) pages 482–5, the number of theoretical plates in the column was found to be 3.75, i. e. 1.88 per foot.

Example 2

The same apparatus was assembled but with 6 sheets of phosphor-bronze wire gauze having 30 meshes to the inch and with sheet metal baffles spaced vertically ¼'' apart in the spaces between the sheets in the manner illustrated in Figure 1 of the accompanying drawing. 5 litres of a mixture containing 18 moles per cent of carbon tetrachloride and 82 moles per cent of benzene were placed in the boiler and heated to give a distillation rate of 2000 gms. per hour. Operating as described in Example 1 with 100% reflux, when steady conditions were attained the number of theoretical plates in the column was determined as above described and was found to be 21.8 i. e. 10.9 per foot.

Example 3

A cylindrical glass distillation column having an internal diameter of approximately 1½'' was fitted with a central copper tube of ⅜'' outside diameter having its upper end sealed and having soldered to its outer curved surface a continuous right-hand helix of ¼'' wide corrugated copper tape with corrugations at ⅛'' centres, the pitch of the helix being 0.2 inch. Concentrically with an enclosing the central tube and the right-hand helix was arranged an open ended cylinder ⅞'' diameter and 12'' long made from phosphor-bronze wire gauze of 40 meshes per inch square weave, and in the annular space between this gauze cylinder and the wall of the glass column there was arranged a left-hand helix of ¼'' wide corrugated copper tape, the pitch of the helix being 0.4 inch; the whole assembly being in the manner of the innermost two annuli illustrated in Figure 2 of the accompanying drawing.

The column was fitted with a boiler of one litre capacity and a reflux condenser, the reflux liquid from the condenser being directed on to the top edge of the gauze cylinder at two points by means of a wire distributor. A mixture containing 20 moles per cent of normal heptane and 80 moles per cent of methyl cyclohexane was placed in the boiler and without making any provision for the preliminary flooding of the packing, the boiler was heated to give a distillation rate of 1050 gms. per hour, the apparatus being operated with 100% reflux. When steady conditions were attained, the number of theoretical plates in the column was determined as above described and was found to be 9.6 per foot.

In many processes, for example gas washing or absorption, particularly at substantially atmospheric pressure, it is convenient to use the novel packing in the form of rectangular sheets with rectangular baffles, contained in suitable vessels of rectangular cross-section. It is preferred however, in processes operating at pressure above or below atmospheric to use the packing in the form of concentric cylinders with helical baffles contained within cylinderical vessels as this construction is simpler and moreover the pressure drop through the cylindrical packing is in general much less than through an equivalent one of rectangular form.

In the appended claim the term "gas," when used, designates both substances which are gaseous under normal conditions of temperature and pressure, and normally liquid substances in vapourised form.

I claim:

Apparatus for contacting gases with liquids which comprises a container, at least one upright filamentous sheet-form partition in said container, said filamentous sheet-form partition being formed from galloon netting, the said galloon netting being positioned with the warp threads thereof substantially upright, a tortuous passage on each side of said partition, said tortuous passage being formed by imperforate partition members arranged step-wise, one above the other, and in staggered relation to each other for permitting the gas to flow around only one end of one imperforate partition and only around the other end of the next one in order, the side edges of said imperforate partitions being attached to the opposite sides of said upright filamentous sheet-form partition and means for irrigating the upright sheet-form partition with liquid.

OLAF GEORGE DIXON.

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