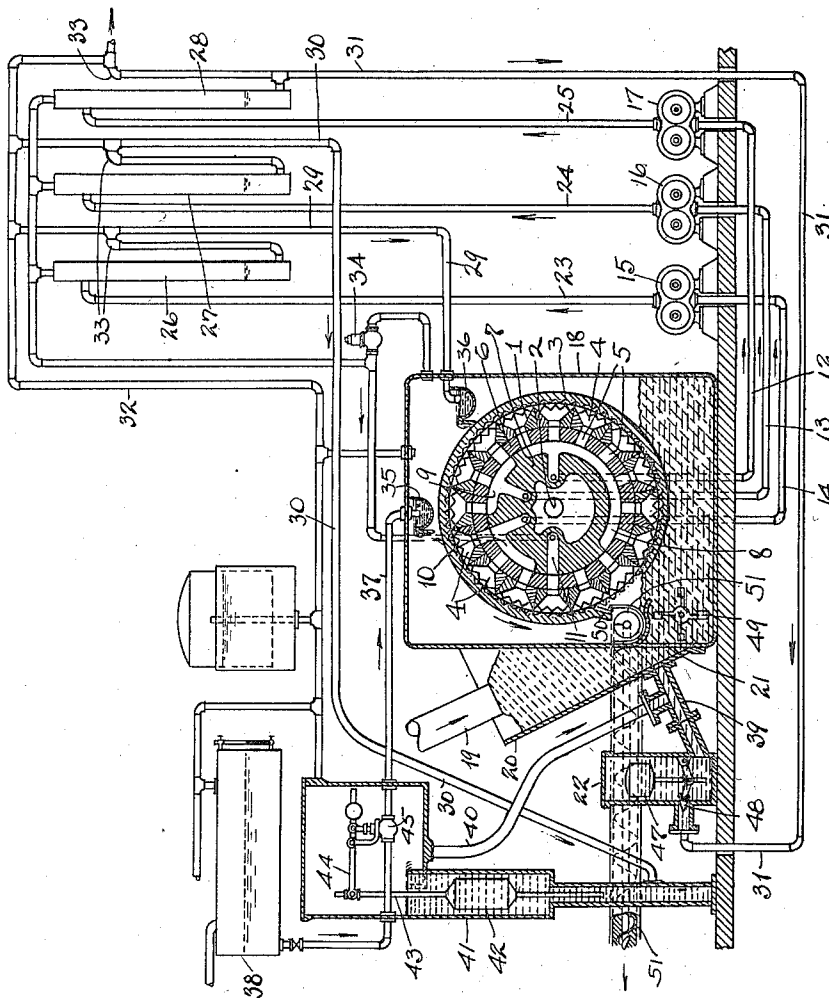


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 METHOD OF AND APPARATUS FOR EXTRACTING OILS AND THE LIKE.
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Patented Aug. 28, 1917.



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METHOD OF AND APPARATUS FOR EXTRACTING OILS AND THE LIKE.

1,238,084.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, EDWIN O. BARSTOW and THOMAS GRISWOLD, Jr., citizens of the United States, and residents of Midland, county of Midland, State of Michigan, have jointly invented a new and useful Improvement in Methods of and Apparatus for Extracting Oils and the like, of which the following is a specification, the principle of the invention being herein explained and the best mode in which we have contemplated applying that principle, so as to distinguish it from other inventions.

In extraction processes, where the more readily soluble constituents of materials are to be separated from their less readily soluble, or insoluble, constituents by the process of washing, it is frequently desirable to use the solvent over and over again. This is particularly the case where the solvent employed is valuable, as in the case of naphtha, carbon tetrachlorid, or the like, the two named solvents being particularly adapted for the extraction of oils and the like from the materials in which they are found. The present improvements relate more especially to a method of and apparatus for carrying on such a general extraction process, wherein the flow of fresh solvent to the extractor is automatically regulated, such regulation being based upon the strength of the extract obtained. To the accomplishment of the foregoing and related ends the invention, then, consists of the steps and means for carrying on the same, hereafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain means and modes of carrying out the invention, such disclosed means and modes illustrating, however, but several of the various ways in which the principle of the invention may be used.

In said annexed drawing, the single figure there appearing represents in more or less diagrammatic form, an arrangement of apparatus for the carrying out of our improved process.

The subject matter of the present case, it should be explained, has been required to be divided out of our co-pending application

filed October 12, 1912, Serial No. 724,785, (now issued into Patent No. 1,125,920, dated January 19, 1915), to which reference may be had for an understanding of the more general aspects of the process involved. It also will be understood that while a particular form of extracting apparatus is illustrated and described, in order to explain the construction and mode of operation of the improved regulating apparatus which forms the subject matter of present interest, such apparatus, as well as the method of regulation exemplified in the operation of the same, may be used in conjunction with various forms of extracting apparatus, proper; also that the adjuncts to such extracting apparatus herein shown and described may be differently arranged, or in part entirely omitted, without affecting the desired regulation.

In the illustrated apparatus the extractor will be seen to consist of a cylindrical drum 1 which is diagrammatically shown in cross section at right angles to its axis. This drum is rotatable on a shaft 2, suitable means (not shown) being provided for the purpose of rotating the same. The cylindrical periphery of the drum is corrugated and covered with a pervious filter 3 of suitable material, that forms a continuous band around the drum over the corrugations. The surface of the drum is further divided off into a plurality of similar transverse sections 4, sixteen being shown for the purpose of illustration. Each of these sections is provided with a port 5, such ports opening in the surface of a commutating valve 6, against which is slidably held a suitable take-off valve 7, provided in the present instance with four ports, 8, 9, 10 and 11, the first three of which are respectively connected by means of pipes 12, 13 and 14, with pumps 17, 16 and 15. These pumps are adapted to create a suction through the corresponding pipes and ports and thus through the several sections of the filter cover that happen to be in communication with the respective ports.

The filter drum 1 is inclosed within a tight casing or chamber 18, the lower portion of which constitutes a receptacle for the reception of a mixture of the material to

be treated and the solvent used in the extraction process. The material to be treated is fed into the chamber near its bottom by way of a spout 19 and a hopper 20, the latter being attached to the side wall of the chamber, with which it communicates through an opening 21 that preferably lies below the level of the liquid mixture within the chamber. Such level is determined by means of an automatic regulator 22, by which the supply of the solvent to the chamber is controlled, the construction and operation of such regulator being reserved for future description. The level of the mixture, within the chamber, however, is such as to cause the drum 1 to be partially submerged therein, as clearly shown in Fig. 1.

The respective discharge lines 23, 24 and 25, from the pumps 15, 16 and 17 lead to separators 26, 27 and 28 which are adapted to receive the mixed air and solvent (such air and solvent being drawn through the pumps, as will be presently described), and separate the same by gravity, the solvent passing off by way of separate pipes 29, 30 and 31 and the air by way of a common branched pipe 32. The air in such pipe 32 will be under pressure, due to the hydrostatic head measured from the level of the liquid in the several separators (such level being indicated by dotted lines) to the outlet level of said reservoirs which is the same in each being indicated by numeral 33 in each case. Such hydrostatic head is controlled at will by means of an adjustable relief valve 34 connected to pipe 32 and venting into the housing 18.

Located above and parallel with the axis of the extractor drum within the casing 17 that houses the same, are two troughs, or feed boxes 35 and 36, the first of which is supplied with fresh solvent by way of pipe 37 from a storage tank 38; the second of which is supplied by a pipe 29 leading from the overflow of separator 26. The overflow of separator 27 is carried to a liquid inlet pipe 39 at the base of the chamber 18 by way of pipes 30 and 40, a hydrostatic device, which controls the supply of fresh solvent through pipe 37, being interposed between said two pipes 30 and 40.

This hydrostatic device comprises a vertical stand pipe 41 enlarged at its upper portion to form a chamber, the latter overflowing into the pipe 40 that leads to the liquid inlet pipe 39 at the bottom of the extractor chamber. In the chamber of the device is located a float 42 connected by means of a rod 43 to the lever 44 of a valve 45 in the feed pipe 37 for the fresh solvent. This float, being immersed in the extract in the chamber, will obviously rise and fall as the latter varies in density. Assuming the hydrostatic device to be arranged for dealing with carbon tetrachlorid in extracting an

oil lighter than such tetrachlorid, should the extract become poorer in oil and hence heavier, the float will rise, thereby actuating the valve 45 to decrease the flow of fresh solvent into the extractor; should, on the contrary, the extract become richer in oil and hence lighter, the float will sink and actuate the valve to increase the flow of fresh solvent to the extractor. The connection between the rod 43 and the lever 44 is adjustable, so that the float can be set to respond to any desired density or strength of extract in chamber 41, and when so set it will automatically regulate the flow of fresh solvent to the extractor, such regulation being based on the strength of the extract obtained.

The separator 28 into which pump 17 discharges, is designed normally to overflow into a stationary filter (not shown), but the overflow from said separator is also connected by means of the pipe 31 with the regulator 22, previously referred to, and thence with the extractor chamber by way of inlet pipe 39. The action of this regulator is normally to close the connection of the pipe 31 therewith, so long as the mixture in said chamber is maintained at a predetermined level. Should, however, this level fall, a float 47 in the regulator will drop correspondingly and thereby open a valve 48 and permit a portion, or all, of the extract overflowing from the separator 28 to be diverted from the filter 46 through pipe 31 to the extractor chamber 18. Such lowering of the level obviously will occur only when the supply of extract overflowing from separator 27 and passing thence through pipe 30, hydrostatic device 41, and pipe 40 to the extractor chamber, is insufficient to maintain the predetermined level in said chamber.

The normal course of flow of the solvent may be, for the purposes of the description, taken to be from the last extraction to the filter 46 although in actual operation the volume of this flow is less than that returned to the extractor in order to maintain a uniform and constant level in same. In normal operation the valve 48 is always open and a continuous flow is passing forward to the filter 46, the valve serving merely to automatically divide the total flow into two portions, one to the filter, the other to the extractor.

The extract as it enters the chamber, whether supplied through pipe 40 or pipe 31, is mixed with the untreated material as the latter is drawn away from hopper 20 into the base of the extractor by the action of paddles 49 suitably rotated, as need not be explained. The opening from the hopper 20 into the extractor chamber, being below the liquor level therein, such liquor traps the opening and prevents escape of air and sol-

vent vapor from the chamber 18, and the downwardly moving mass of material within the hopper forms a stopper which further retards or prevents the vaporization of the solvent which wets the material in the base of the hopper.

The operation of the extractor apparatus as a whole, may now be advantageously reviewed, in order that the function of the regulating device, which is of principal interest herein, may be better understood. It will be noted, then, that the material, as it is fed through the hopper into the extractor chamber 18 by the action of the paddle, 49, is mixed with the extract flowing in through the pipe 39, such extract being in the main supplied through pipe 31, there being a larger flow of extract returned through such pipe 31 and valve 48 than through pipe 40, since there is a considerably larger volume drawn in through the surface of the rotary filter in producing a layer thereon than there is drawn through the same in washing such layer, and the portion divided out and sent forward to the stationary filter 46 is relatively small. It will be understood that whenever the level of the mixture in the chamber falls below a predetermined point, the deficiency is made up by diverting the overflow from separator 28, through pipe 31.

The mixture of extract and material, thus produced in the bottom of the extractor chamber, being in contact with the submerged portion of the filter drum 1, a quantity of the fluid extract is drawn from such mixture in the base of the chamber through the submerged sections 4 of the drum's cylindrical surface by pump 17 acting through pipe 12 and port 8. A layer of the material is thus caused to deposit on the surface of the drum, such layer forming continuously to approximately uniform thickness as the drum rotates.

The material thus deposited on the drum's surface as it rises above the level of the mixture is, of course, wet, that is, it includes a considerable content of the extract; however, the suction of the pump 17 continues to be exerted upon said layer after it has thus passed out of the body of mixture in the bottom of the extractor chamber until the upper limit of the port 8 has been passed by the ports 5 in the commutating valve member 6 that rotates with the drum.

Immediately following the breaking of connection with port 8 and pump 17 just described, the sections 4 are successively brought into communication with the port 9 that is connected with pump 16, such port being normally in register with but three of the sections of the drum's surface at a time, whereas the first port was more extensive, as shown in Fig. 1. The trough or feed box 36, which receives the overflow from separator 26, is disposed to discharge the weaker

extract received from said separator on the surface of the drum along a line just safely above that which the sections of said drum's surface must reach in order to be in communication with said port 9. The additional flow of solvent thus run onto the material from the feed box is drawn through the material by the pump 16 and by it conveyed to the next separator in the series, viz., separator 27.

The sections 4 of the drum's surface are next brought into communication in succession with port 10 connected with pump 15, the second trough, or feed box 35, being disposed so as to discharge the fresh solvent received from the reservoir 38 onto the layer of material covering the drum's surface along a line just beyond that which the sections must reach in order to first come into such communication with such port 10.

Finally the sections, one by one in the illustrated construction, come into register with the port 11, this port being connected with the air line 32 through which the air that is drawn by the several pumps and then separated from the solvent in the separators is returned to the extractor chamber. This air blows through the filter membrane that forms the outer surface of the drum and thus assists in loosening the layer of material thereon so that the latter may be easily removed by means of a scraper 50, which delivers the extracted material onto a conveyer 51 that serves to continually convey the same outside of the housing, as fast as it is received from the revolving extractor drum.

It should be noted at this point that the rate of rotation and degree of suction are intended to be such that not only will the extract or solvent be sucked through the layer of material, but air from within the housing will also be drawn through the layer, thus mechanically displacing in a measure the residual solvent or extract between the particles of material in such layer. Both air and extract, or solvent, of course, are drawn into the several pumps and are then delivered into their corresponding separators. This same air, after separation, is available for loosening the layer of exhausted material, no outside air being required to be introduced at any state of the operation.

It will be further noted that after the extract is separated from the material picked up by the rotating extractor, the solid material remaining on the drum's surface is washed one or more times by weaker extract, and finally by entirely fresh solvent, as the extractor drum rotates; also that the extract from each extraction, as such drum rotates, is kept separate from the extract of all the other extractions and the fresh solvent fed into the box or trough 35 is next fed into the box or trough 36 and is later mixed with the fresh, incoming material at the base of

the extractor chamber. Such incoming material, it will accordingly be seen, moves in a general direction substantially opposite to that in which the current of solvent, freshly received at the feed box 35, is caused to move as it is brought intermittently into contact with the material as the latter is picked up and carried around the drum.

Counting the extractions as Nos. 1, 2, 3, etc., beginning with the fresh solvent wash, and the last extraction, viz., that obtained through the submerged portion of the drum, it will be noted that we have placed the regulator 42, so that it will regulate according to the density of extract from the next to the last extraction. It should be understood, however, that this regulator can be placed in any portion of the circulation so as to regulate according to the density of extract at the preceding extraction; preferably, however, we place it as shown near the final extraction, at which point the extract is nearly full strength.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any one of the following claims or their equivalents be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. In a method of the character described, wherein a supply of the material to be treated and a fluid solvent are continuously mixed and thereupon separated, the step which consists in maintaining the bulk of the mixture substantially constant by returning thereto solvent that has been separated from such material, and automatically regulating the supply of fresh solvent by the proportion of extract in such separated solvent.

2. In a method of the character described, the steps which consist in treating a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again, fresh solvent being used in such last treatment and the solvent containing a certain amount of extracted substance resulting from such last treatment being used in the preceding treatment; and automatically regulating the supply of fresh solvent by the proportion of extracted substance in such solvent following one of said treatments.

3. In a method of the character described, the steps which consist in treating a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again a plurality of times, fresh solvent being used in the last treatment and the solvent containing a certain amount of extracted

substance resulting from such last treatment being used in the preceding treatment and then, finally, in the first treatment of the material; and automatically regulating the supply of fresh solvent by the proportion of extracted substance in such solvent following one of the foregoing treatments.

4. In a method of the character described, the steps which consist in treating a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again a plurality of times, fresh solvent being used in the last treatment and the solvent containing a certain amount of extracted substance resulting from such last treatment being used in the preceding treatment and then, finally, in the first treatment of the material; and automatically regulating the supply of fresh solvent by the proportion of extracted substance in such solvent following an intermediate treatment.

5. In a method of the character described, the steps which consist in mixing a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again, fresh solvent being used in such treatment and the solvent containing a certain amount of extracted substance resulting from such treatment being mixed with the material in the first-described step; and maintaining the bulk of the mixture in such first step substantially constant by returning thereto solvent from such treatment.

6. In a method of the character described, the steps which consist in mixing a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again a plurality of times, fresh solvent being used in the last treatment and the solvent containing a certain amount of extracted substance resulting from such last treatment being used in the preceding treatment and then, finally, mixed with the material in the first-described step; and maintaining the bulk of the mixture in such first-described step substantially constant by returning thereto solvent from the first treatment.

7. In a method of the character described, the steps which consist in mixing a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again, fresh solvent being used in such treatment and the solvent containing a certain amount of extracted substance resulting from such treatment being mixed with the material in the first-described step; maintaining the bulk of the mixture in such first step substantially constant by returning thereto solvent from such treatment; and automatically regulating the supply of fresh

solvent by the proportion of extracted substance in such solvent following one of said treatments.

8. In a method of the character described, the steps which consist in mixing a supply of the material with a fluid solvent; separating such solvent from the material; then treating such material with such solvent again a plurality of times, fresh solvent being used in the last treatment and the solvent containing a certain amount of extracted substance resulting from such last treatment being used in the preceding treatment and then, finally, mixed with the material in the first-described step; maintaining the bulk of the mixture in such first-described step substantially constant by returning thereto solvent from the first treatment; and automatically regulating the supply of fresh solvent by the proportion of extracted substance in such solvent following one of such treatments.

9. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, and a device affected by the proportion of extracted substance in the solvent following a preceding treatment adapted to regulate said connection.

10. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, and a device affected by the proportion of extracted substance in the solvent following an intermediate treatment adapted to regulate said connection.

11. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, and a hydrostatic device affected by the

proportion of extracted substance in the solvent following a preceding treatment adapted to regulate said connection.

12. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, another connection for returning to said extractor the solvent following one of such treatments to be mixed with the material, and means affected by the bulk of such mixture adapted to regulate said second connection.

13. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, another connection for returning to said extractor the solvent following one of such treatments to be mixed with the material, and a float device affected by the bulk of such mixture adapted to regulate said second connection.

14. In an apparatus of the character described, the combination with an extractor, wherein the material is initially mixed and then successively treated with a suitable solvent a plurality of times; of means adapted to maintain a mixture of such material and solvent in said extractor, said means including a connection for supplying fresh solvent for the last of such treatments, a device affected by the proportion of extracted substance in the solvent following a preceding treatment adapted to regulate said connection, another connection for returning to said extractor the solvent following one of such treatments to be there mixed with the material, and means affected by the bulk of such mixture adapted to regulate said second connection.

Signed by us, this 8th day of December, 1914.

EDWIN O. BARSTOW.
THOMAS GRISWOLD, Jr.

Attested by:
W. R. CRISSEY,
J. H. MCCOY.