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PROCESS FOR REDUCING THE LIQUID CONTENTS OF MATERIALS WHICH HAVE MANY CAPILLARY SPACES

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Fig. 1.

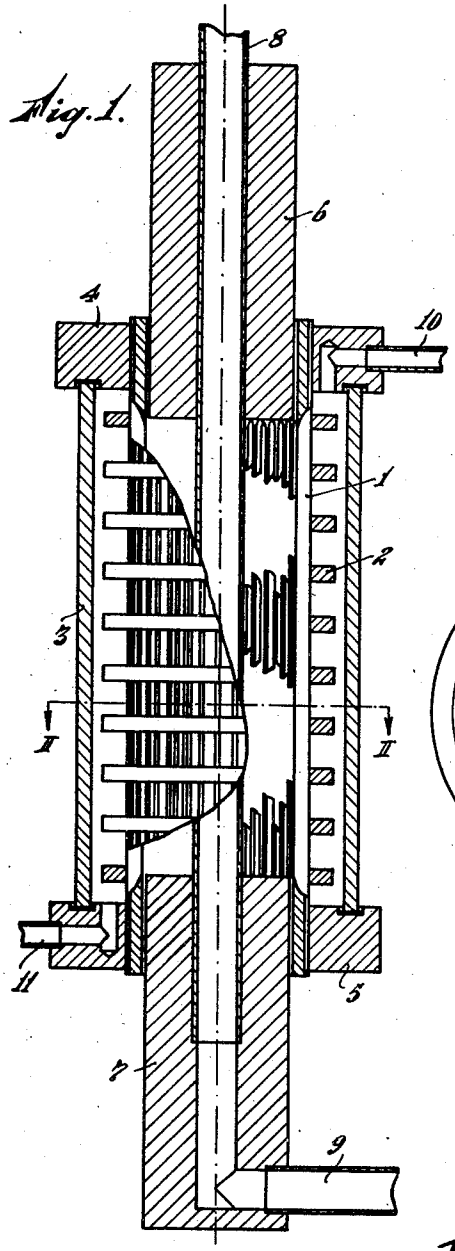
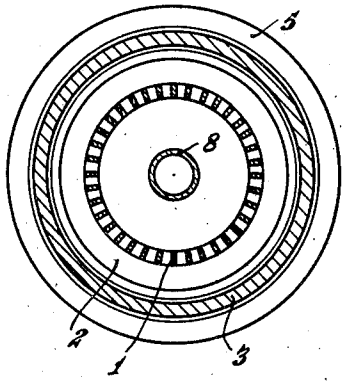


Fig. 2.



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PROCESS FOR REDUCING THE LIQUID CONTENTS OF MATERIALS WHICH HAVE MANY CAPILLARY SPACES

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3 Claims. (Cl. 34—24)

The invention relates to a process for reducing the liquid contents of materials having a plurality of capillary channels such as for example, pressing water out of materials similar to peat and coal mud, pressing oil from oil seeds and the like. There are various materials in which the water or other liquids are present in a condition similar to the water in peat. For the sake of convenience however, the invention will be explained by describing how the water can be removed from peat in a simple and economical manner.

Peat consists of more or less decayed vegetable materials and water. The water which is contained in natural peat is usually in a quantity amounting to 85–94% of the total weight of the peat, and is enclosed inside the walls of the former plant cells or inside the capillary spaces between the cells, while there is also water present in the free spaces occurring in the peat mass itself.

It is known that only a small portion of the water can be removed from natural peat by applying moderate pressure, and that this is only possible if this pressure is exerted throughout a period of many hours.

The present invention is based upon the principle that the water can be removed for instance from peat, in an economical way by correcting in the peat mass a condition causing the water enclosed in the peat to flow towards the surface thereof under the influence of forces other than the pressing forces.

From the law of Van der Waals it follows that in liquids and gases being in equilibrio the kinetic pressure at a given point is equal in all directions.

The kinetic pressure consists of the sum of the external pressure p and the molecular pressure (molecular attraction) M so that in each point the kinetic pressures in two directions $p1+M1$ and $p2+M2$ are equal.

The liquid in a capillary tube is, depending on the width of the capillary tube, to a greater or less extent, under the influence of the attraction of the wall of the capillary tube. It may therefore be said that in a capillary space the liquid has a surface layer which is retained by the wall, whereas the liquid which is not subjected to the influence of the attraction of the wall may be called the homogeneous phase. The part of the liquid which is subjected to the influence of the attraction of the wall, has also various molecular attractions in different directions, because in the direction perpendicular to the wall the molecular attraction may be larger or smaller than in the direction parallel to the wall.

Generally speaking the value of M in the direction perpendicular to the wall will be another one than in the direction along the wall, and it follows from this that also the pressure $p2$ in the direction along the wall which has obtained from Van der Waals the name of "tangential pressure" has another value than the pressure $p1$ which is directed perpendicularly on the wall.

For further details about the "tangential pressure" reference may be made to a publication by Hulshof in the "zietschrift fur Physikalische Chemie", 1927 Heft I and II.

According to the invention the outflow of liquids from capillary spaces is promoted by creating a difference between the tangential pressure in the capillary spaces at the spot at which the liquid must flow from the mass, and in the interior of the mass. If in this way in the liquid present in the capillary spaces a fall in the tangential pressure from the interior to the outside is created, a power will act on the liquid which tries to displace it from the interior to the outside.

If at the same time an external pressure is exerted on the mass the liquid flowing from the surface layers will immediately be substituted by the liquid from the homogeneous phase and in this way it is possible to remove the greater part of the liquid from a capillary mass by using the energy present in capillary liquids in latent form, the amount of the energy necessary for this purpose being very small.

According to the invention this fall in tangential pressure from the interior to the outside is effected by causing and maintaining a difference in temperature between the interior of the mass and the outflow openings, the said difference in temperature being obtained by bringing the draining surface into contact with liquids or gases having a higher temperature than the interior of the mass. The inventor has found that by so doing the value of the molecular forces in the capillary liquid is so changed that the tangential pressure at the outflow opening will be smaller than the tangential pressure in the mass. When applying a difference in temperature, the extent of the fall of the tangential pressure depends upon the value of the said difference, the average level of the temperature also playing a part. By means of this fall of pressure, obtained by the difference in temperature, more water can be removed from the peat with a predetermined pressure and suitably chosen temperatures than is possible without the application of the invention. A comparatively small amount of energy is necessary for maintaining the difference of

temperature required, so that in this way, a much greater extraction of water may be obtained.

If a vessel, which possesses a wall provided with openings to allow the water to pass, is filled with natural, still better with finely divided, peat, which has e. g. a temperature of 10° C., and the perforated wall is heated to e. g. 100° C. by passing hot water or steam along the same, the water will flow out from the peat, if pressure is put on the peat mass, through the openings in the wall of the vessel under the influence of the fall in the tangential pressure caused by the heating of the exterior layers of the mass. The maintaining of a temperature difference is caused by simultaneously cooling the interior of the mass.

Furthermore, the speed of draining of the mass may be increased by simultaneously producing difference of temperature in many parts of the mass. For instance, in a wide vessel, with a perforated wall and at a certain distance from the wall, a plurality of closed little tubes or a tube, can be arranged through which a cool liquid flows while at the same time the outside of the vessel is heated. Furthermore, tubes can be placed alternately in a large vessel in which case one tube is heated and the other one cooled.

The surface at which the water is drained off can be heated in several ways by means of fluid gases, steam, hot liquids, hot air or other heated gases.

It need also be mentioned that any troublesome obstruction of the openings of the draining surfaces need not occur as long as the liquid flows out under the influence of the differences in pressure in tangential direction, and as long as the external pressure which is put on at a predetermined moment remains below a limit determined by the consistency and the further properties of the mass.

In the drawing a construction capable of carrying out the process is illustrated, but it must be remembered that such construction is merely illustrative and is not to be construed in any way as limiting applicant's process.

Figure 1 is an elevational view with the major portion broken away to show a vertical sectional view of an apparatus for carrying out the process, and

Figure 2 is a horizontal sectional view along the line II—II.

In the drawing, in which similar reference characters refer to like parts throughout, the apparatus consists of a pressing chamber 1 which is surrounded by a jacket 3 through which a hot liquid or gas may be passed. The wall of the pressing chamber comprises the vertical ribs, parts of which are shown in the section broken away upon the right hand side of Figure 1, and which are arranged so as to leave spaces of approximately 0.2 mm. between them. The ribs are held together by the strengthening rings 2 shown particularly in the left part of Fig. 1 showing an apparatus without the jacket.

The material to be pressed is enclosed by the pistons 6 and 7. Both pistons are perforated. A tube 8—9 passes through the holes and serves for cooling the material in the pressing chamber by means of a cooling liquid flowing through the tube. The piston 7 is fixed in the position shown in the drawing and the piston 6 can be operated by hand or mechanically while sliding along the tube 8.

The chamber for the heating liquid or gas is closed at the top and bottom by the covers 4 and 5 which are firmly connected both with the wall of the pressing chamber and the jacket. The hot liquid is introduced by the inlet 10 and removed by the outlet 11.

For carrying out the process according to the invention, the material e. g. wet peat with a temperature of about 10° C., is introduced into the pressing chamber. Water at a temperature of 100° C. is passed through the jacket and at the same time water of about a temperature of 15° C. is caused to flow through the tube 8. The piston 6 is now moved downwardly so as to exert a pressure upon the material in the pressing chamber. The pressure is increased from 2 atmospheres at the start to about 60 atmospheres at the end of the pressing operation. The peat can be pressed without any difficulty to a water percentage of about 30% or even lower.

The time for the process will depend entirely upon the size of the apparatus, the pressure used, etc. Good results may be obtained in a time varying from ten minutes in laboratory apparatus, to about one hour when carrying out the process upon a large scale. The invention is particularly adapted to be used in continuously operating presses in which case the time during which the material is exposed to the pressing conditions is relatively short.

The following test shows what can be accomplished from the application of the process to peat: 100 g. finely divided peat of about 90% liquid content is put into a vessel with walls provided with slots and steam is passed along the same. If a gradual rising external pressure is put upon the peat mass, a quantity of water up to 80% of the total weight of peat can be pressed out, the water flowing out into the surrounding space filled with steam and being removed together with the condensed steam.

The de-watering of peat has only been described by way of an example, but the invention can also be applied in removing other liquids.

I claim:—

1. A process for pressing liquid in the liquid phase from materials having a plurality of capillary spaces comprising causing a fall of the tangential pressure of the capillarily bound mass to be treated towards the places of outflow of the liquid by bringing about and maintaining a a difference of temperature between the interior of the mass and the places of outflow of the liquid, the said difference of temperature being obtained by bringing the draining surface of the said mass into the contact with fluids having a higher temperature than the interior of the mass and at the same time cooling the interior of the mass sufficiently to cause a fall of tangential pressure towards the draining surface and simultaneously exerting pressure upon said mass.

2. A process for pressing liquid in the liquid phase from materials having a plurality of capillary spaces comprising causing a fall of the tangential pressure of the capillarily bound liquid of the mass to be treated towards the places of outflow of the liquid by bringing about and maintaining a difference of temperature between the interior of the mass and the places of outflow of the liquid, the said difference of temperature obtained by bringing the draining surface of the said mass into contact with liquids having a higher temperature than the interior of the mass and at the same time cooling the interior of the mass sufficiently to cause a fall of tangential pressure towards the draining surface and

simultaneously exerting a mechanical pressure on said mass.

3. A process for pressing liquid in the liquid phase from materials containing a plurality of capillary spaces comprising causing a fall of the tangential pressure of the capillarily bound liquid of the mass to be treated towards the places of outflow of the liquid by bringing about and maintaining a difference of temperature between the interior of the mass and the places of outflow of the liquid, the said difference of temperature being obtained by bringing the draining surface of the said mass into contact with fluids having a higher temperature than the interior of the mass and at the same time cooling the interior of the mass so as to establish a difference in temperature between the exterior of the mass and the interior of the mass of substantially 85° C. and simultaneously exerting a mechanical pressure on said mass.

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