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OF FINE GRANULAR MASSES
Filed April 20, 1927

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3 Sheets-Sheet 1

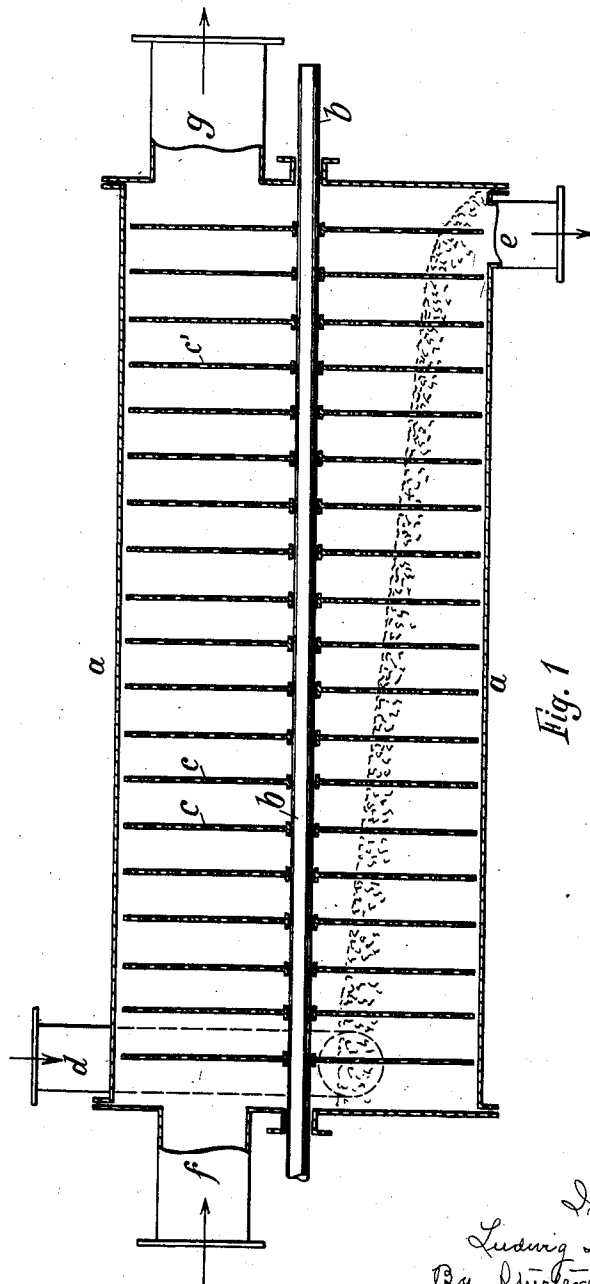


Fig. 1

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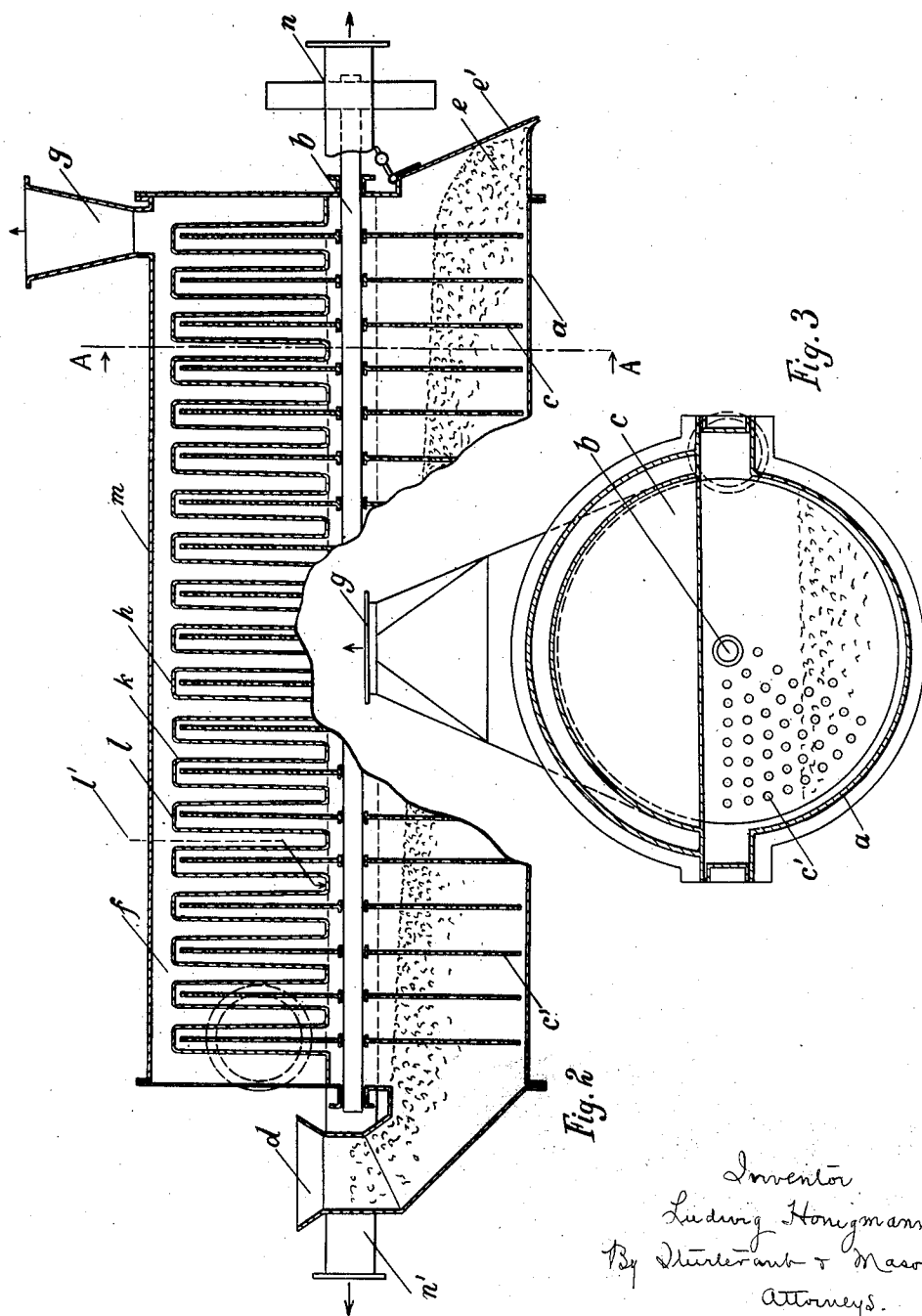
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3 Sheets-Sheet 2



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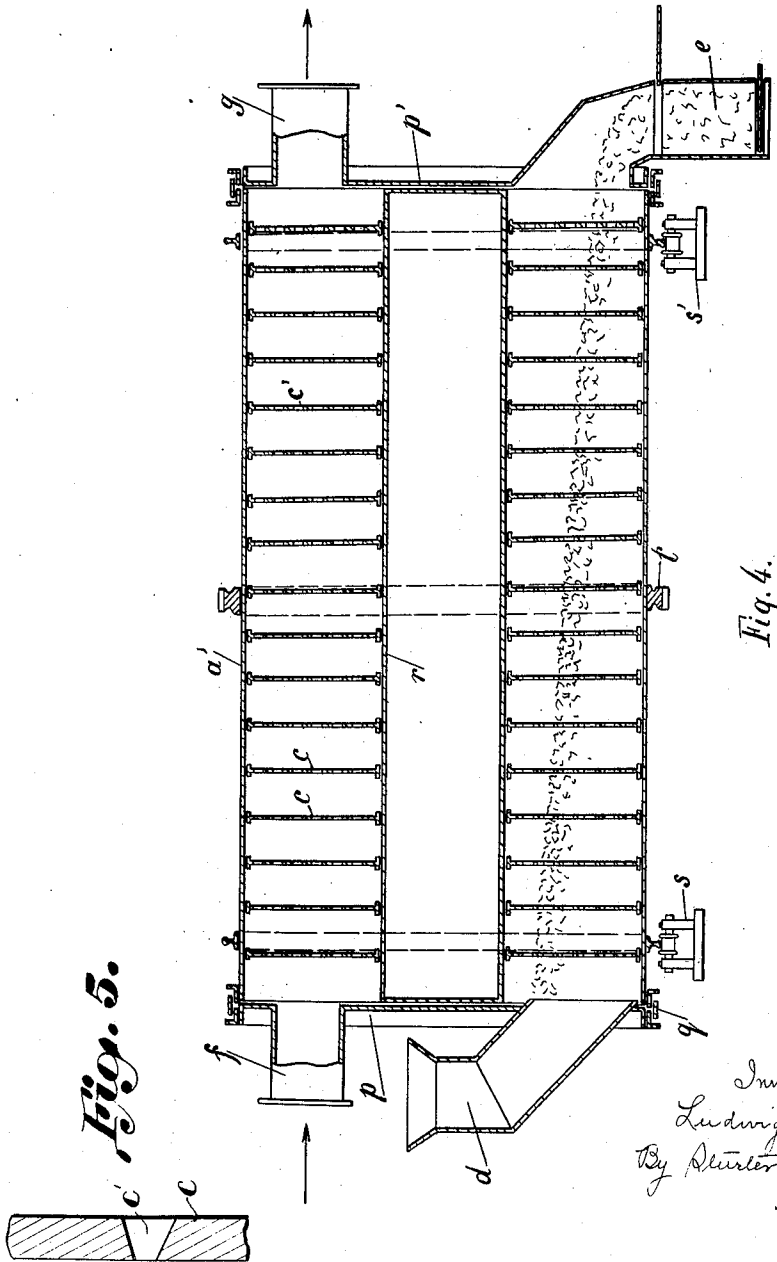
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UNITED STATES PATENT OFFICE.

LUDWIG HONIGMANN, OF BICHLERHOF, GERMANY.

MEANS FOR THE CONTINUOUS DRYING OR DISTILLATION OF FINE GRANULAR MASSES.

Application filed April 20, 1927, Serial No. 185,323, and in Germany November 5, 1925.

This invention relates to means for the continuous drying or distillation of fine granular masses and has particular reference to apparatus comprising a container through which the heating agent and the material under treatment are both caused to flow. In apparatus of this kind, it has hitherto been customary to employ a drum-shaped container which was rotated about its longitudinal axis in order to effect rapid and thorough heat transmission by insuring intimate contact between the material under treatment and the heating gases. This arrangement has the disadvantage that the heavy container has to be mounted rotatably and it is further inconvenient inasmuch as the inlet and outlet connections to the moving drum for the heating agent and the material under treatment are difficult to make and are only rendered possible by adopting special means. A further drawback resides in the fact that particles of dust, which are contained in large quantities in the fine granular material, are roused up in eddies by the agitation of the mass and entrained by the exhaust gases, from which they have to be separated out again in apparatus provided specially for this purpose.

The apparatus of the present invention has for its object to avoid these disadvantages. To this end, according to the invention, the container is provided with bodies adapted to be easily heated and such bodies are caused, either by rotating or by oscillating them, firstly to travel through a chamber of the container which is traversed by hot gas, wherefrom they take up heat, and, secondly to dip into the mass of material to be treated, wherein they give up their heat again.

In one preferred constructional form of apparatus according to this invention, there may be employed a series of perforated discs arranged in a row upon a common driving shaft, or the like, and in baffle fashion in the container (of which the upper part is traversed by heating gases and the lower part by the material under treatment) in such a way that the gases and the material both are constrained to flow through the perforations in said discs. If now these sheet metal discs be either continuously rotated or oscillated to and fro, they take up heat during their passage through the space which is filled with hot gases and give up this heat to the charge of material by dipping into the latter where it is filled up in the lower part of the con-

tainer. By reason of the continually repeated movement of the heating surfaces between the heating chamber and the chamber containing the material to be heated, overheating of the thin metallic sheets is avoided, since these are constantly giving up to the charge the heat which they acquire. Feed of material through the container takes place in a very simple manner. The material first of all tends to pile up at the inlet end of the container but, being kept in motion by the dipping metal discs, it flows towards the outlet end by reason of its own weight. It will be observed that the perforated sheet metal discs do not themselves exert a feeding action but the fact of keeping the material in motion suffices to enable the same to flow, of its own accord, downhill, as it were, through the holes in the metal discs, to the outlet end of the container. This action can be accelerated by adapting the known expedient of mounting the drum so that it inclines from the inlet towards the outlet end. The discs are kept as smooth as possible, so as to prevent eddies of dust from being set up and, as a further precaution in this direction, the perforations may be given a conical form which minimizes the adhesion of dust as the plate emerges from the granular material.

If desired, the perforations may be so formed as to facilitate feed of the material from the inlet to the outlet end of the container. According to requirements, the flow of gas and the flow of charging material may take place in the same direction or in opposite directions. The heating gases may be conducted in a circuit through the drum and through a reheating apparatus.

In many cases the gases are vapors and gases arising from the material in the heat treatment of granular masses contain valuable constituents, which it may be very profitable to recover.

In the coking and distillation of bituminous masses, such, for instance, as brown coal or the like, the oily vapors form a product which in value may far exceed that of the coke or semi-coke which is obtained.

In this case it is advantageous to prevent the gaseous or vaporous products of the treatment, which emanate from the material under the influence of the applied heat, from being carried off in the hot gases. To this end means are preferably provided for preventing these gaseous or vaporous products arising from the charge from mixing with

the gaseous heating medium and for causing them to be conducted away separately or recovered. For this purpose a modified form of apparatus according to the invention is employed, the characteristic feature being that, in addition to the heat exchange bodies which either by rotary or by alternating oscillatory motion, traverse the heating space and dip into the mass of the charge, other and fixed heating bodies are provided in the heating space and are located between the movable heat exchange bodies. By means of these heating bodies the necessary radiant heat is transmitted to the heat exchange bodies whereby it is conveyed and transferred to the material of the charge. That part of the container which, in the form of construction herein first described, was traversed by heating gases can now be utilized for the accumulation of gaseous distillation products which can thence be conducted away freely and uncontaminated and utilized if required.

Although, as above mentioned, an important advantage of the new apparatus resides in the fact that rotation of the container wall itself is avoided, the rotating heat exchange bodies according to the invention may also be used in conjunction with rotating drum shells.

This form of construction may be employed in special cases and is generally useful in the drying treatment of such substances as show little tendency to form dust or stick to the wall of the drum. If the drum be rotated only slowly it is possible to avoid mutual eddying to any harmful extent between the material to be dried and the heating medium. Such an arrangement may generally be employed with economy and advantage when it is desired to obtain the advantages afforded by heat exchange bodies according to the invention while utilizing existing rotary drums and thereby saving the much greater cost of an entirely new container installation.

In this form of construction the heat exchange bodies of an apparatus according to the invention should be rigidly fixed in the rotatably mounted drum shell.

The difficulties attendant upon the separate introduction of the heating medium and the charge may be avoided, according to the invention by uniting the heat exchange bodies, the drum shell and a centrally disposed displacement body (which fills up space in the middle of the drum) into one rigid rotary element which rotates on its axis between fixed end walls.

The accompanying drawings illustrate diagrammatically three examples of constructions according to the invention.

In these drawings:—

Fig. 1 shows one form of construction in longitudinal section,

Fig. 2 is a similar view of a second form of construction.

Fig. 3 is a cross section on the line A—A of Fig. 2.

Fig. 4 a third form of construction, also shown in longitudinal section.

Fig. 5 is a cross section on an enlarged scale through one of the disks, showing the conical shape of the perforations.

In the form of construction shown in Fig. 1 a plurality of circular, perforated sheet metal discs *c* are fastened in a row on a shaft *b* arranged axially in a drum *a*, these discs having a diameter substantially equal to the internal diameter of the drum. At one end, nearly at mid-height of the vessel is an inlet passage *d* for the material to be dried while at the opposite end, and at the bottom of the drum is located the outlet passage *e*. Above the level of the shaft and at opposite ends of the drum are arranged, respectively, the inlet and outlet openings *f* and *g* for the heating gas.

The operation of the device is as follows:—

Heating gas is conducted into the drum through the inlet passage *f* and serves to heat the perforated metal discs. The charging material is fed in through the pipe *d*. The shaft carrying the perforated discs is now continuously rocked back and forth by at least half a turn in each direction. In this way the metal discs convey to the charge the heat which they have picked up from the hot gases in the upper part of the drum. Repeated change of the direction of rotation has the advantage of ensuring uniform heating of the charge.

The feed or progression of the charge through the container from the inlet to the outlet end thereof takes place under the action of gravity, the material fed in tending first of all to fill up at the inlet end. This tendency of the material to feed by its own weight may be enhanced by arranging the drum on the slant from the inlet to the outlet end. The sheet metal discs dipping into the charge do not in this case perform the function of a feed screw; on the contrary it is quite sufficient for them slightly to agitate the granules of the charge. Under the influence of gravity the slight movement thus produced extend from the inlet end, through the perforations in the discs, right away to the outlet end of the container. In this way a very gentle and uniform continuous feed of the charging material is secured, the eddying up of dust being thus entirely avoided.

In the form of construction illustrated in Figs. 2 and 3, as in the example already described in connection with Fig. 1, a preferably cylindrical container *a* is provided, the bottom thereof being appropriately inclined from the inlet to the outlet end. A shaft *b* extends longitudinally through the container and, as before, carries a number of circular

plates *c*, suitably spaced apart and preferably furnished with perforation *c'*. A feed pipe *d* at one end of the container serves to supply material for the charge which flows gradually along, through the perforations in the discs *c* to the outlet neck *e* which is adapted to be closed by a flap *e'*.

In contradistinction to the arrangement first described, the upper part of the cylindrical container is double walled. The inner wall, designated generally by *h*, of this double walled part is traversed by rib-like walls *h* in such wise that each disc *c* is encased by the parallel walls *h* extending nearly to the middle of the container. These walls are united, in pairs, alternately at their outer and their inner edges, by transverse wall sections *h'*, so that the upper part of each disc is enclosed in a sort of pocket open at the bottom, the free spaces between the pockets being open at the top. The structure thus formed, resembling, as it does, half of a ribbed tube, is surrounded by the drum shell or casing *m*, into which is introduced, through a pipe *f*, a mainly gaseous heating medium which, after flowing through the heating jacket, escapes therefrom at *g*. The inner chamber of the container is connected to outlets *n*, *n'* for the gases and vapors given off by the charge under treatment.

The manner in which this device operates is similar to that described in connection with Fig. 1, with the exception that the discs *c* do not come into direct contact with heating gases in the upper part of the container but, instead, are heated by radiant heat from the fixed heating bodies interspersed between them.

The perforations in the plates *c* may be conically shaped (Fig. 5) so that dust-like constituents of the charge may not remain sticking in them and thereby get entrained by the current of gas. Furthermore the form given to these holes may be such as to facilitate the feeding movement of the charge. The shaft may conveniently be made hollow and, if necessary, water may be circulated through it.

In the form of construction according to Fig. 4 the drum *a'*, is, as is usual with rotary drum, mounted on bearing rollers *s*, *s'* so as to be rotatable about its axis. It may be driven, in the usual manner, through the medium of a toothed ring *t*. The cylindrical drum shell is not rigidly attached to the end walls *p*, *p'* these latter being, however, fitted to the shell with the interposition of suitable packing. Suitable means are provided for preventing these end walls from participating in the rotary movement of the drum shell. Thus they can, as in the arrangements illustrated in Figs. 1 to 3, be fitted in the upper half, with an inlet *f* and an outlet *g* for the heating medium and in the lower half, with

an inlet *d* and an outlet *e* for the material to be treated.

The heat exchange bodies, in the form of perforated circular plates *c* are fixed to the drum shell *a'* the cross-section of which they occupy completely, excepting that middle of the container is occupied by a displacement body *r* to which the discs *c* are also firmly attached, and which is made of a size sufficient to reduce material that dead space about the axis of the drum which cannot be utilized for heat exchange purposes.

Claims.

1. An apparatus of the class described comprising a drum mounted with its axis substantially horizontal, means adapted to supply material in particles at one end of the drum and to permit the removal of said material at the other end of the drum, so that the bottom of said drum may contain a layer of said material, conduits adapted to lead a current of heating gas to said drum at one end thereof and to remove gas therefrom at the other end thereof, a shaft mounted axially in said drum, a plurality of solid heat exchange bodies of sheet metal fixed on said shaft within said drum and extending substantially radially from said shaft and having perforations therein serving to permit the passage of the current of gas from end to end of the drum, the area of each of said bodies being substantially equal to twice the cross-sectional area of the drum to form baffles therein, said shaft and bodies being movable about the shaft axis so that portions of each body may alternately be brought above the layer of material in the bottom of the drum so that they may be heated by said gas current and thereafter be moved into contact with the material to give off absorbed heat thereto, and means to move said shaft and bodies.

2. Apparatus as in claim 1, in which the said heat exchange bodies are of smooth sheet metal and the perforations therein serving to permit the passage of the current of gas from end to end of said drum have conical mouths so that the bodies may move through the material without carrying portions thereof along into the current of gas.

3. Apparatus as in claim 1, in which the drum and bodies are circular, and the bodies are movable through at least a half rotation so that each part of the bodies may be in succession and alternately heated and employed for heating.

4. An apparatus of the class described comprising a drum mounted with its axis substantially horizontal, a horizontal partition above said axis and dividing said drum into upper and lower chambers, downwardly open pockets on said partition and extending upwardly therefrom, means adapted to supply material in particles into the lower chamber at one end of the drum, and to permit the removal of said

material at the other end of the drum so that the bottom of said drum may contain a layer of said material, conduits adapted to lead a current of heating gas to the upper chamber
5 of said drum at one end thereof and to remove gas therefrom at the other end thereof, a shaft mouted axially in said drum below said partition, a plurality of solid heat exchange bodies fixed on said shaft within the lower compartment and extending upward into said pockets
10 respectively so that the bodies may be heated from the walls of said pockets, said shaft and

bodies being movable about the shaft axis so that portions of each body may alternately be brought above a layer of material in the
15 bottom of the drum so that they will be heated by heat from said gas current as radiated by the walls of said pockets and thereafter be moved into contact with the material to give off absorbed heat thereto, and means adapted
20 to move said shaft and bodies.

In testimony whereof I have signed my name to this specification.

LUDWIG HONIGMANN.