March 23, 1926. 1,577,545

O. SODERLUND ET AL

DRYING APPARATUS

Filed June 9, 1924 2 Sheets-Sheet 1

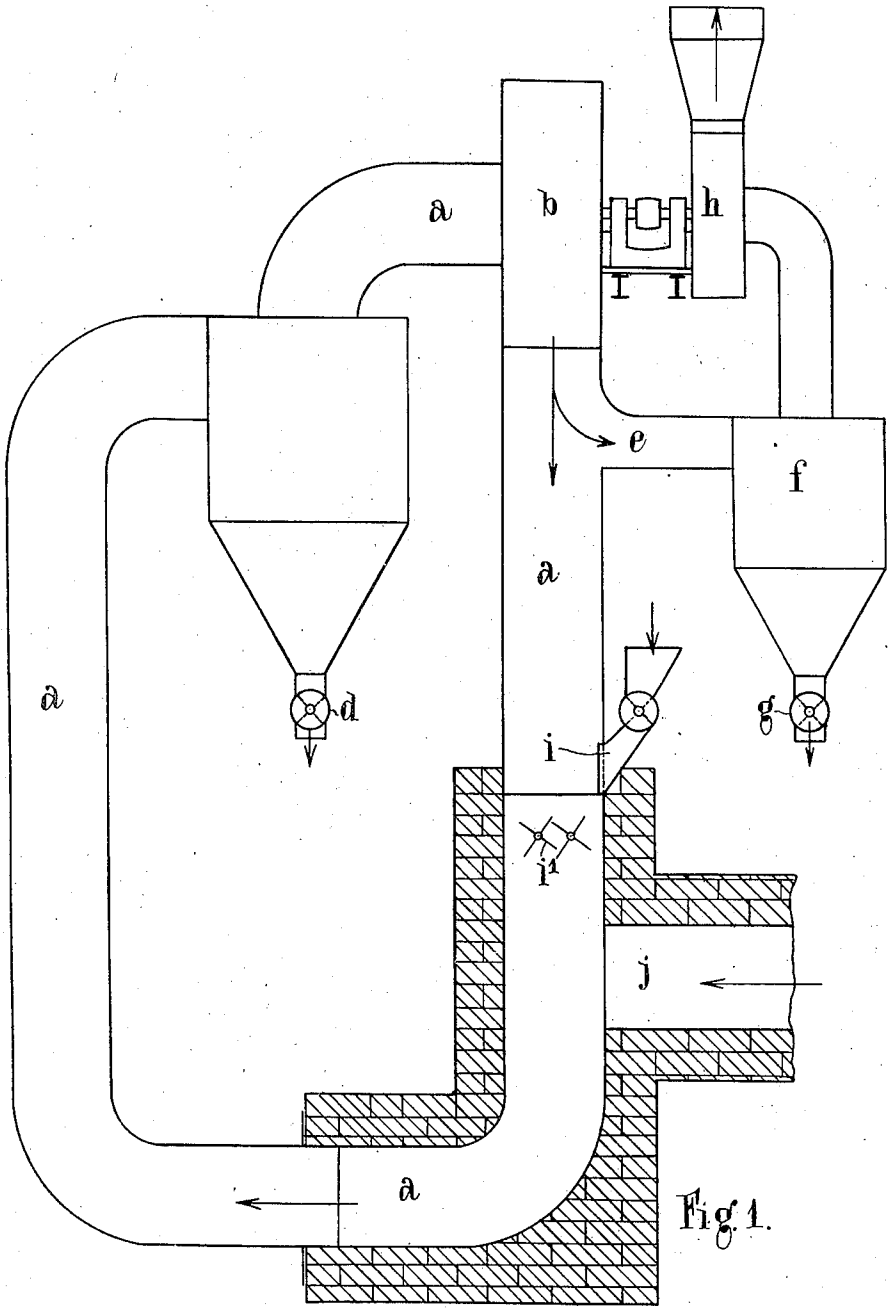


Fig. 1.

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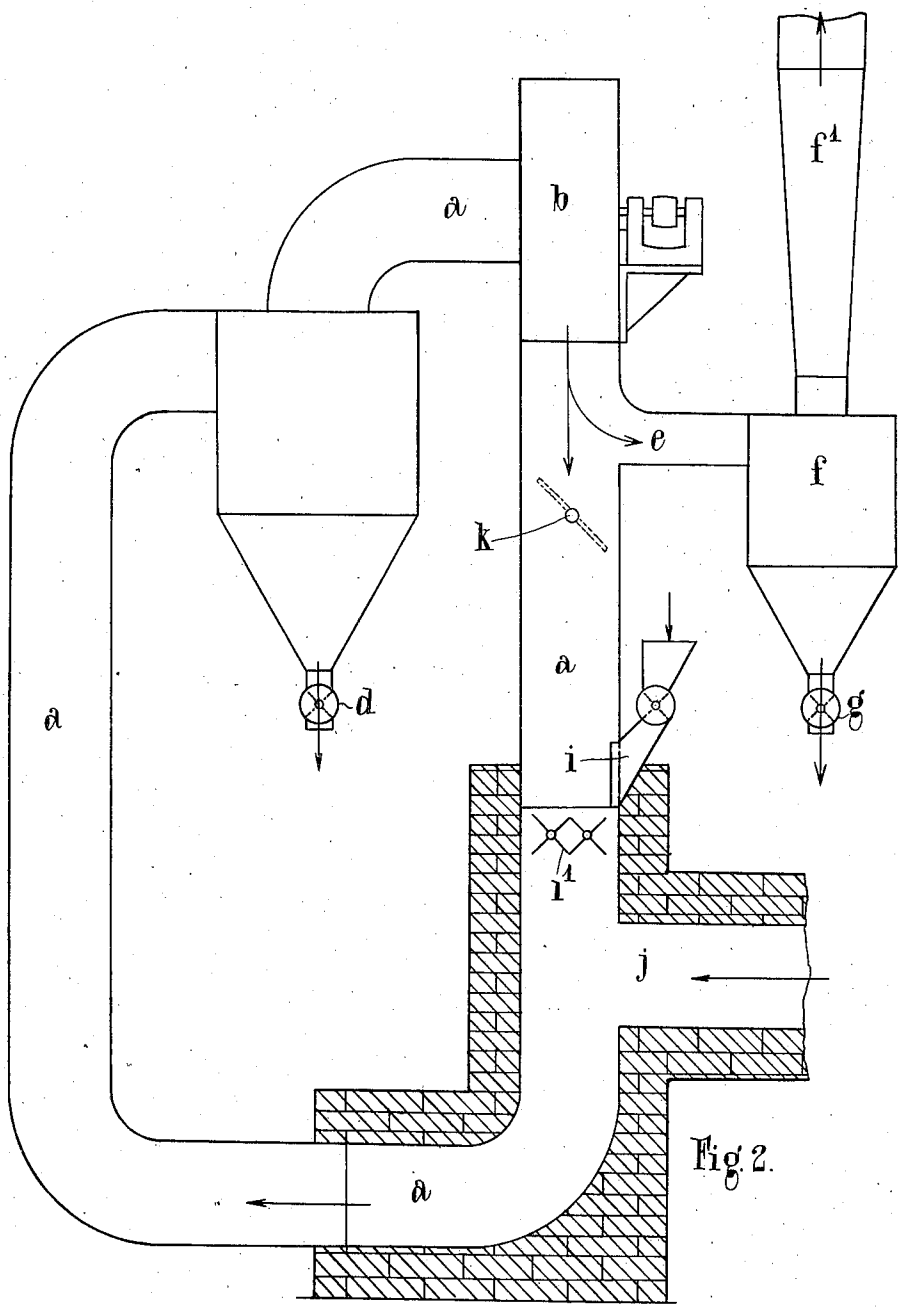


Fig. 2.

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UNITED STATES PATENT OFFICE.

OLOF SÖDERLUND, TEOFRON BOBERG, AND NILS TESTRUP, OF LONDON, ENGLAND, ASSIGNORS TO TECHNO-CHEMICAL LABORATORIES, LIMITED, OF LONDON, ENGLAND.

DRYING APPARATUS.

Application filed June 9, 1924. Serial No. 719,001.

To all whom it may concern:

Be it known that we, OLOF SÖDERLUND and TEOFRON BOBERG, both subjects of the King of Sweden, and both residing at "Fairlawn," Clarence Road, Clapham Park, London, S. W. 4, England, and NILS TESTRUP, a British subject, and residing at 47, Victoria Street, Westminster, London, S. W. 1, England, have invented certain new and useful Improvements in and Relating to Drying Apparatus, of which the following is a specification.

This invention relates to the drying of moist substances which are in such a divided condition that they may be carried in a travelling gaseous medium by the heat of which the drying is effected during conveyance of the substance.

If a high temperature is maintained in a gaseous medium circulated for drying purposes the size of apparatus and power for circulating may be reduced and when the substance is carried by the medium as above indicated separation of the dried material is also simplified. Further, when the temperature is kept up by the direct admixture with the gaseous medium of continuous additions of hot fluid and a corresponding quantity of the cooler medium is rejected to balance, the quantity added and rejected should in view of the heat necessarily carried away in the rejected portion be as small as possible and must consequently to keep up the temperature of the circulating medium itself be at the highest possible temperature.

The dried material must, of course, be removed from the circulating medium to avoid accumulation, but a somewhat imperfect removal can be effected much more cheaply than a more perfect one. Such a step, however, entails leaving a large quantity of smaller particles or dust in the circulating medium, which dust would in many cases be most injuriously affected by incoming hot medium at the hightest possible temperature as above required.

The object of the present invention is to retain the foregoing advantages while avoiding the drawbacks mentioned.

The invention consists in a drying process of the type indicated or apparatus for carrying the same into effect, in which after removal of dried material from the circulating medium a further supply of the wet substance is added thereto prior to the addition of more hot medium at a comparatively high temperature.

The invention further consists in a process or drying apparatus in accordance with the preceding paragraph, in which the dried matter is removed by separating means to a convenient extent from the circulating gaseous medium prior to the rejection from circulation of a determined proportion of said medium which is subjected to a further separating action.

The invention further consists in a process or apparatus in accordance with either of the preceding paragraphs, according to which the substance is conveyed in gaseous medium travelling in an upward and in a downward direction and the fresh supplies of moist material are added and preferably mechanically mingled with the gaseous medium while it is moving downward to a location at which the supply of hot medium is added thereto.

The invention further consists in drying apparatus comprising in combination a circuitous conduit returning to the point of starting, means for causing a gaseous medium to circulate therein, means for separating from said medium divided dried substance carried thereby, means for introducing finely divided moist substance into said conduit and distributing it in said gaseous medium, means for continually adding to said medium determined proportions of hot medium at a considerable temperature, means for rejecting equivalent proportions of said medium at lower temperature and means for separating from said rejected medium dried substance still carried thereby.

The invention also consists in improvements in or relating to drying processes and apparatus as hereinafter described.

The accompanying diagrammatic drawings show by way of example two ways of carrying the invention into effect:—

Figure 1 being an arrangement in which two blower, exhausting or like fans are employed, and

Figure 2 an arrangement entailing only one fan.

In carrying the invention into effect in one convenient form as illustrated in a diagrammatic manner in Figure 1, a circuitous conduit *a* returning to its starting point is arranged preferably with a considerable pro-

portion of its length disposed in an upward and downward direction, as shown.

Within the more or less closed circuit formed by the conduit a fan *b* or other suitable means for circulating gaseous medium is inserted and prior to the entry to the fan a cyclone *c* is provided for separating from the circulating gaseous medium any divided dried substance carried thereby and discharging the same at the outlet *d*.

The fan *b* is arranged at the top of a downwardly disposed portion of the conduit and more or less closely adjacent to the fan an outlet passage *e* is provided through which a determined portion of the gaseous medium may be rejected; this passage *e* is carried to a cyclone *f* or other separating device for removing from the rejected medium any finely divided solid matter still carried thereby which is discharged at the outlet *g* and the rejected portion of gaseous medium is withdrawn from the circuit by means of a suction fan *h* or a chimney or other suction device drawing the gaseous medium from the cyclone or other separating means may be employed.

In the length of conduit which extends downwards from the outlet of the circulating fan *b* and at a location beyond the outlet passage *e* is an inlet *i* for the divided moist substance which is to be dried and this inlet is, as shown, provided with mechanical distributing means, such as a rotary beater *i'*, for breaking up any lumps of the moist substance and uniformly distributing it in the current of gaseous medium.

Joining the conduit at a location following the inlet *i* for the moist substance is an inlet *j* for hot gaseous medium, said inlet being conveniently arranged near the bottom of this downwardly disposed portion of the conduit.

The hot medium may conveniently be the products of combustion from a semi-producer or other combustion appliance and the supply of hot medium may be drawn into the circuit by means of the before-mentioned suction device *h* which effects the withdrawal of the rejected gaseous medium from the circuit.

Alternatively, hot medium can, if desired, be introduced under a slightly excess pressure over the pressure in the circulating conduit and thus also effect the rejection of the desired quantity of cooler gaseous medium.

In the alternative arrangement shown by way of example in Figure 2, the conduit *a* is provided with a circulating fan *b* which delivers into a downwardly directed portion of the conduit *a*, having an outlet passage *e* leading to a second cyclone or separator *f*.

The conduit is in other respects similar to that described in connection with Figure 1; an inlet *i* being provided for the moist material with distributing means *i'* and an inlet *j* for hot gases.

According to this arrangement the rejected portion of gaseous medium escapes by an outlet *f'* from the top of the cyclone *f* but without the assistance of an exhausting fan and in order to render this possible the conduit is fitted just below the passage *e* with a damper *k* by means of which a sufficiently high pressure is maintained at the region of the passage *e* to ensure the rejection of a sufficient quantity of the hot medium from the circuit.

It is to be understood that the particular disposition of the various parts of the apparatus hereinbefore described and the types of appliances mentioned are given by way of example and that any desired modifications may be introduced without departing from the spirit of this invention.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:—

1. A drying apparatus comprising in combination a closed circuitous conduit, means for circulating a gaseous medium therein, means on the inlet side of said circulating means for separating from said medium divided dried substance carried thereby, means on the delivery side of said circulating means for introducing into the gaseous medium in said conduit finely divided moist substance, means beyond said introducing means for adding determined proportions of high temperature medium to said medium, and means for rejecting equivalent proportions of said circulating medium prior to the addition of moist material to the circuit.

2. A drying apparatus comprising in combination a closed circuitous conduit, means for circulating a gaseous medium therein, means on the inlet side of said circulating means for separating from said medium divided dried substance carried thereby, means on the delivery side of said circulating means for introducing into the gaseous medium in said conduit finely divided moist substance, means beyond said introducing means for adding determined proportions of high temperature medium to said medium, means for rejecting equivalent proportions of said circulating medium prior to the addition of moist material to the circuit, and means for separating from said rejected medium dried substance still carried thereby.

3. A drying apparatus comprising in combination a closed circuitous conduit, a fan for circulating gaseous medium therein, a separating chamber at the entry to said fan, means for rejecting some medium from the circuit after passing said separating chamber, means for introducing fresh substance to be treated after the rejection of the medium from the circuit, and means for add-

ing to said circuit after the introduction of fresh substance high temperature medium to replace the rejected medium and maintain the desired temperature.

4. A drying apparatus comprising in combination a closed circuitous conduit, a fan for circulating gaseous medium therein, a separating chamber at the entry to said fan, means for rejecting some medium from the circuit after passing said separating chamber, means for introducing fresh substance to be treated after the rejection of the medium from the circuit, means for adding to said circuit after the introduction of fresh substance high temperature medium to replace the rejected medium and maintain the desired temperature, and means for separating from said rejected medium dried substance still carried thereby.

5. A drying apparatus comprising in combination an endless conduit forming a circuit, means for circulating a gaseous medium therein, means in said circuit for separating dried substance from said medium, means for rejecting some of said medium after said separation, means for introducing divided substance into the circulating medium after said rejection, and means for adding some high temperature medium after introducing said substance.

6. A drying apparatus comprising in combination an endless conduit forming a circuit, means for circulating a gaseous medium therein, means in said circuit for separating dried substance from said medium, means for rejecting some of said medium after said separation, means for introducing divided substance into the circulating medium after said rejection, means for adding some high temperature medium after introducing said substance, and means for separating from said rejected medium substance still carried thereby.

7. A drying apparatus comprising in combination an endless conduit, a fan for circulating a gaseous medium therein, a separating chamber forming part of said conduit, means beyond said chamber for rejecting some of said medium from said conduit, means for introducing divided substance into said conduit after said rejection, and means for adding hot gases to said circulating medium after introducing said substance.

8. A drying apparatus comprising in combination an endless conduit, a fan for circulating a gaseous medium therein, a separating chamber forming part of said conduit, a second fan beyond said chamber for withdrawing medium from said conduit, means for introducing divided substance into said conduit after said withdrawal, means for adding hot gases to said circulating medium after introducing said substance, and a second chamber for separating substance still carried thereby from said medium withdrawn by said second fan.

9. A drying apparatus comprising in combination an endless conduit, a fan for circulating a gaseous medium therein, a separating chamber preceding said fan as part of said conduit, a second fan beyond said first fan for withdrawing medium from said conduit, means for introducing divided substance into said conduit after said withdrawal, means for adding hot gases to said circulating medium after introducing said substance, and a second separating chamber through which said second fan withdraws said medium.

10. A drying apparatus comprising in combination a circuitous conduit returning to the point of starting, means for causing a gaseous medium to circulate therein, means for separating from said medium divided dried substance carried thereby, means for introducing finely divided moist substance into said conduit and distributing it in said gaseous medium, means for continually adding to said medium determined proportions of hot medium at a considerable temperature, means for rejecting equivalent proportions of said medium at lower temperature and means for separating from said rejected medium dried substance still carried thereby.

In testimony whereof we have signed our names to this specification.

OLOF SÖDERLUND.
TEOFRON BOBERG.
NILS TESTRUP.