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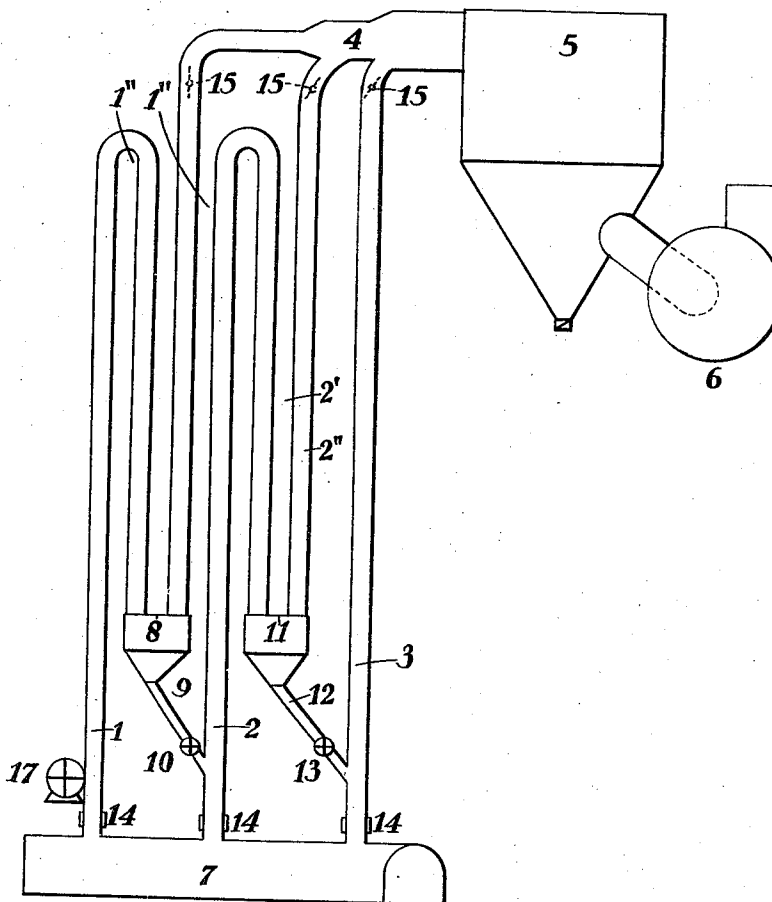
P. ROSIN ET AL
PNEUMATIC DRYING DEVICE

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Fig. 1.



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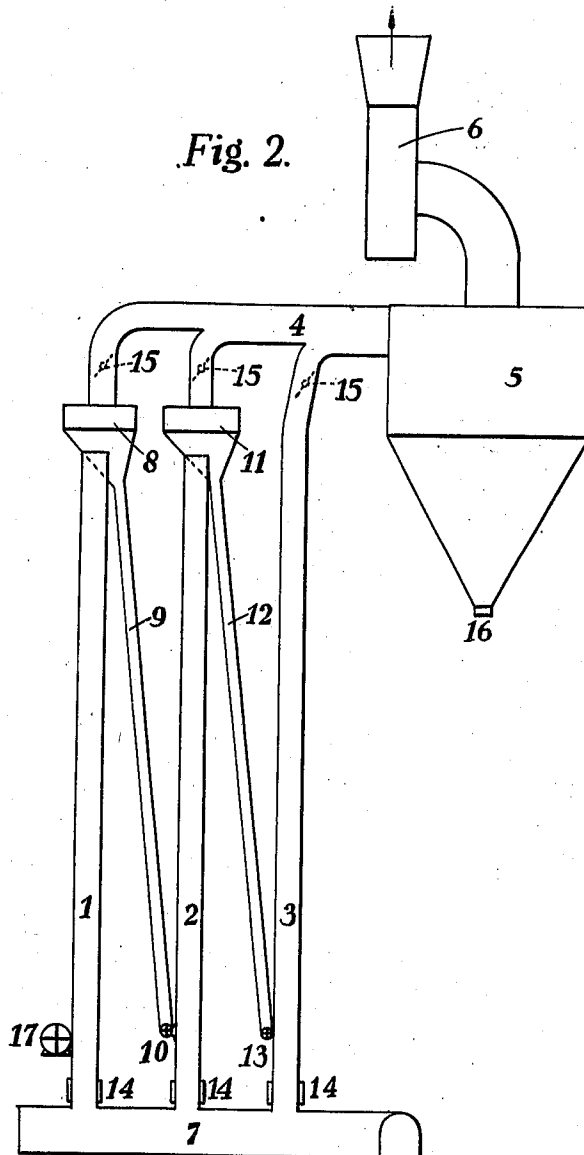
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Fig. 2.



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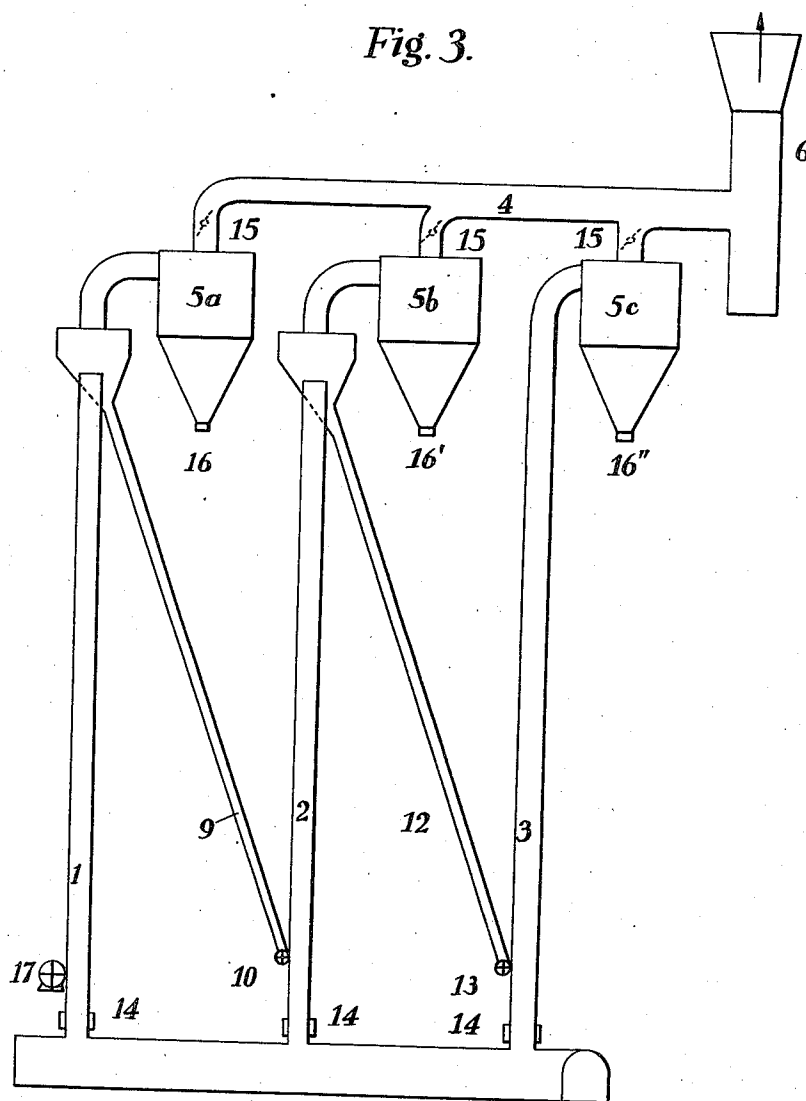
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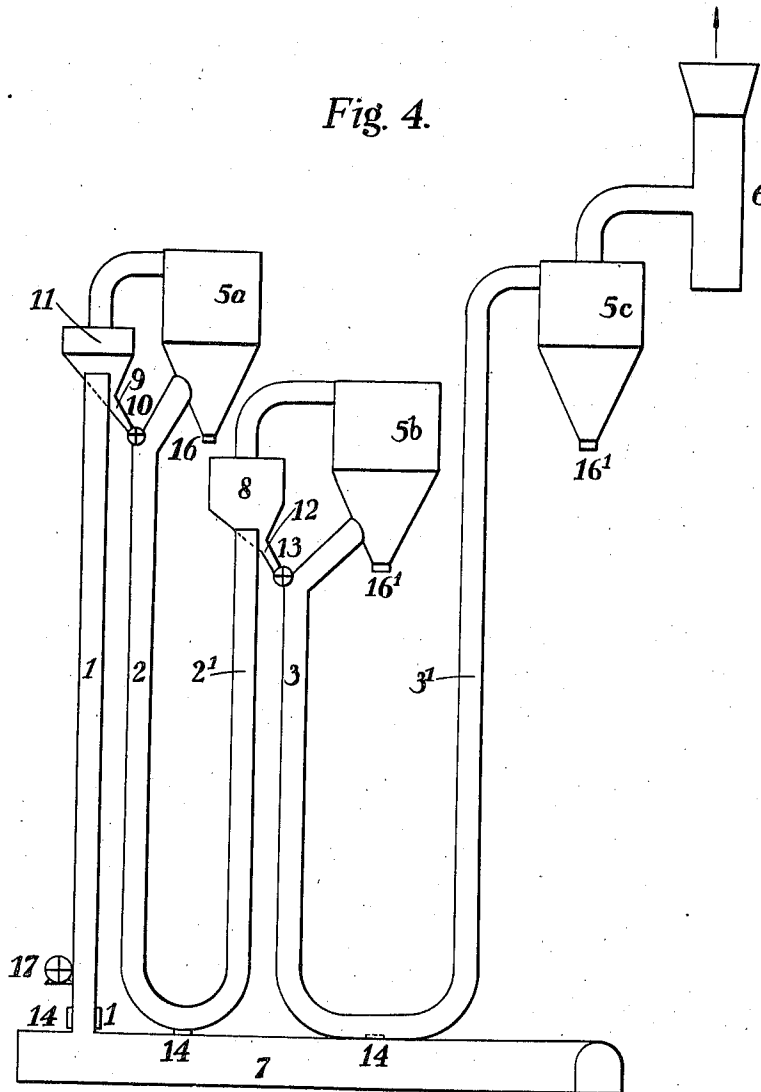
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Fig. 3.



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Fig. 4.



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UNITED STATES PATENT OFFICE

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PNEUMATIC DRYING DEVICE

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3 Claims. (Cl. 34—34)

This invention relates to pneumatic drying devices.

It is known that when material with granules of various sizes is dried the finer granules are dried faster than the coarser ones, so that granules of different size leave the drying device with a correspondingly different degree of remaining moisture. This disconformity in the degree of drying is the greater, the more the granules differ in size, the smaller their heat conductivity and the higher their resistance to diffusion. This disconformity is often very detrimental to the use of the material for its intended purposes, and occurs, as is well known, for instance, in steam drying devices used in the manufacture of brown-coal briquettes. It occurs, however, even more in pneumatic drying devices, due to the drying being restricted to a period of a few seconds only.

If the drying operation is carried out in a circulation system, a grading and crushing device can be inserted, and the larger particles can thus be crushed several times and kept in circulation until they are dried to the same degree as the finer fractions, owing to the extension of the drying period and to the reduction in size combined therewith.

Such intermediate crushing, however, is not in all cases possible. It is, therefore, an object of the invention to provide for the drying of all granule sizes to the same extent even in those pneumatic drying devices wherein no intermediate crushing is provided. This is achieved, according to the invention, by resolving the conduit to a system of parallel or series-connected branches, each of which has a grading device, such as an air sifter, inserted, wherein the insufficiently dried larger particles are separated out and conveyed to the next following pipe branch for further drying, whilst the smaller particles of each stage are conveyed by the shortest way from their conduit branch to a cyclone separator. This can be one separator common to all branches so that eventually also the largest particles are brought into it from the last conduit branch, and the whole material is thus again re-united in the cyclone device. A single fan only is then required to suck or force the heating gases through the system. Or alternatively, if it is desired to obtain the individual granule sizes separately, a separate cyclone device is arranged behind the air sifter of each branch, the waste gases coming from the individual branches being removed either by one common fan or by several fans. If the

branches are not interconnected in parallel but in series, only the last mentioned arrangement is possible. If, in this case, it is not desired to obtain the fractions separately, a helical collecting conveyer or other suitable conveying device can be provided underneath the cyclone devices.

In this way, the drying period for the larger particles can be increased according to their size, to a multiple as compared with the smaller particles, by arranging a corresponding number of drying stages. If, for instance, material of, say, 0 to 10 mms. size is to be dried, the whole material first passes through the first branch, and the wind sifter arranged in the latter may separate out, for instance, particles of 2 to 10 mms. and pass them on to the second drying branch whilst the particles of 0 to 2 mms. are conveyed directly to the cyclone separator. The particles of 2 to 10 mms. are then dried further by fresh heating gases; in the second branch is arranged another air sifter for separating out the granules of, say, 5 to 10 mms. which are passed to the third drying branch, whilst the particles of 2 to 5 mms. are conveyed to the cyclone device. After passing through the third drying branch in which they are again brought into contact with fresh heating gases, the particles of more than 5 mms. size eventually also reach the cyclone device. Thus, whilst the particles of 0 to 2 mms. only pass the first drying stage, those of 2 to 5 mms. are treated in two, and those of 5 to 10 mms. even in three drying stages.

Owing to the great difference in temperature between the fresh heating gases and the material to be treated, the drying process is carried out very fast and in a comparatively short conduit system. The distribution of the material to the branches, both as regards quantity and granule size, can be made variable with the aid of control members in the air sifters.

The drying process can also be influenced by introducing the heating gases at variable temperatures into the several drying branches, for instance, by the addition of controllable quantities of cold air or waste gases in the individual parallel conduit branches; this is of special value in the treatment of material which is sensitive to temperature. On the other hand, fresh heating gases can be added in each branch in the case of series-connection to raise the temperature.

The invention will be best understood by ref-

erence to the accompanying drawings forming a part of this specification and in which

Fig. 1 is a diagrammatic view of one form of apparatus embodying the invention;

Fig. 2 a similar view of another form of the same;

Fig. 3 a similar view of another form of the same; and

Fig. 4 a similar view of still another form of the same.

In Fig. 1, the heating gases are sucked, by means of a fan 6 arranged at the end of the system from a heating gas channel 7, through three parallel drying branches consisting of serpentine, 1, 2 and 3, and are then conveyed in common through the conduit 4 to a separator 5 such as a cyclone separator, from where they are forced into the open air by the fan 6, if necessary, through a dust separator. The material to be dried is fed into the upward portion 1 of the first drying serpentine by means of a suitable feeding device 17 and passes through the tubes 1, 1' and 1'' forming the serpentine. An air sifter 8 is arranged at the lowest point of this serpentine, i. e., between the pipes 1' and 1''. In this air sifter the larger particles which are still wet are separated out in well known manner, for instance, by change of cross section and direction, and then fall through a short pipe 9 and over a further feeding device such as a rotary chamber drum 10, to the drying serpentine 2, whilst the heating gases escape with the finer particles through the pipe 1''.

The remaining material then passes through the pipes 2, 2' and 2''; another air sifter 11 is interposed between 2' and 2'' which separates the largest particles and feeds them through a tube 12 and a feeding device 13 to the final drying serpentine 3, whilst the medium products are carried off through the pipe 2''.

In cases where the nature of the material allows of moderate crushing, the feeding means 10 and 13 can be replaced by crushing devices, with a view to accelerating the drying process by enlarging the surface of the material.

The heating gas temperature in the individual branch conduit can be controlled by means of circular sets of adjustable slots 14 or the like through which cold air or the waste gases, returned from the cyclone or dust separator, enter the pipes.

In Fig. 2, the serpentine pipes are replaced by straight upward pipes and the air sifters are placed above which necessitates, of course, longer connecting tubes 9 and 12. This arrangement has a double advantage; first, the drying is carried out only in a rising air stream so that, owing to the relative velocity between the gases and the material, the drying is accelerated, and second, the serpentine bends of Fig. 1 which incur waste of energy are here dispensed with.

Fig. 3 shows an example of an arrangement with separate cyclone devices. Here again, the heating gas is sucked by the fan 6 from the channel 7, through the pipe branches 1, 2 and 3, the wind sifters 8 and 11 are arranged at the ends of the pipe branches 1 and 2, and the separated material falls through the tubes 9 and 12 and the fans or locks 10 and 13, to the following drying stages 2 and 3 respectively. Instead, however, of one common cyclone device, three separate cyclone devices 5a, 5b, 5c are arranged behind the wind sifters 8, 11 and the conduit 3 respectively, to separate the fine, medium and large particles. These are removed

from their respective cyclone devices through air-locks 16, 16', 16'' and carried off separately. Waste gas conduits provided with throttle valves 15 connect the cyclone separators with a common suction pipe 4 leading to the fan 6.

Fig. 4 shows an arrangement in which the branch conduits are series-connected. The preliminary drying is carried out at the highest stage of temperature. In the sifter 11, the medium and large material is separated and fed into the conduit 2 wherein the drying is continued at a medium temperature by means of the same heating gas stream as before which has, however, meanwhile been freed from the fine dried particles in the cyclone separator 5a. In the sifter 8, the large material is separated and fed into the conduit 3 wherein the drying process is finished at a low temperature by the heating gases which have been freed from the medium material in the cyclone device 5b. The gases now convey the large particles to the cyclone device 5c, wherefrom they reach the dust separator and fan 6. The fractions, separated out, like in Fig. 3, in separate cyclone devices 5a, 5b, and 5c, and ejected by the cell drums 16, 16', 16'', can either be removed separately or re-united by means of a conveyer screw which collects and mixes the material.

If the parts are suitably arranged, the drying device occupies very little room so that all conduits can have one common insulation. Also, the wind sifters can be combined in one casing with separating walls. The pipes 1, 2, and 3 may have different diameters corresponding to the expected distribution of the drying output. The speed of the heating gases in the individual pipe branches can be controlled by throttle valves 15, such as shown in Figs. 1 to 3. The wind sifters 8 and 11 may be constructed in any suitable way, for instance, as boxes with reflecting faces for changing the direction of the stream and with funnels for the escaping gas, or simply as widened parts in the pipes.

We claim:—

1. Drying apparatus comprising two drying conduits; means for causing a current of drying gases through each of said conduits; means for introducing comminuted material into one of said conduits at the beginning of the effective current therein; separating means at the discharge end of said one conduit arranged to separate out and remove from further drying influence the smaller particles which have reached a predetermined degree of dryness; and means for collecting and delivering the larger separated wetter particles to the other conduit.

2. Drying apparatus comprising a plurality of drying conduits; means for causing a current of drying gases through each of said conduits; means for introducing comminuted material into the first of said series of conduits at the beginning of the effective current therein; separating means at the discharge end of each of said conduits except the last of the series arranged to separate out and remove from further drying influence the smaller particles which have reached a predetermined degree of dryness; and means for collecting the separated wetter particles from each conduit except the last and delivering the same to the next conduit of the series.

3. Drying apparatus comprising a series of drying conduits, means for introducing comminuted material of differently sized particles into the first conduit of the series adjacent its

inlet, means for supplying a continuous current of drying gases to the inlet of each drying conduit for conveying the material therethrough and drying it while being conveyed, means at the outlet of each conduit except the last for separating out and discharging all particles above a predetermined size, each of said separating means being progressively capable of passing larger particles of the material, means

for conveying the material discharged at each separator to the inlet end of the respectively successive drying conduit of the series, material collector means at the outlet end of the last conduit of the series, and means separately conveying the material passed through each said separating means to said collector means.

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