

May 9, 1939.

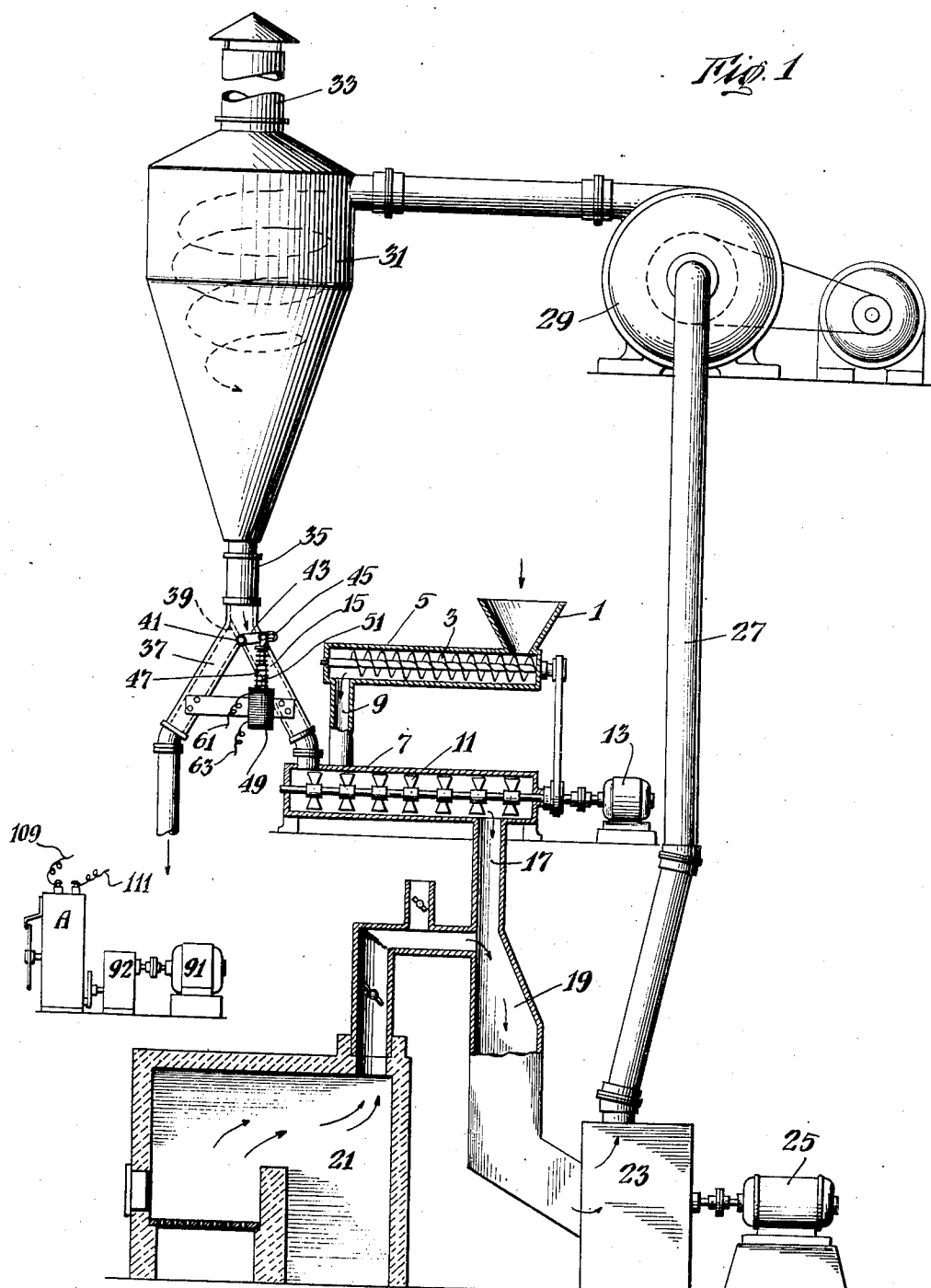
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2,157,775

DRYING APPARATUS

Filed Aug. 4, 1936

2 Sheets-Sheet 1



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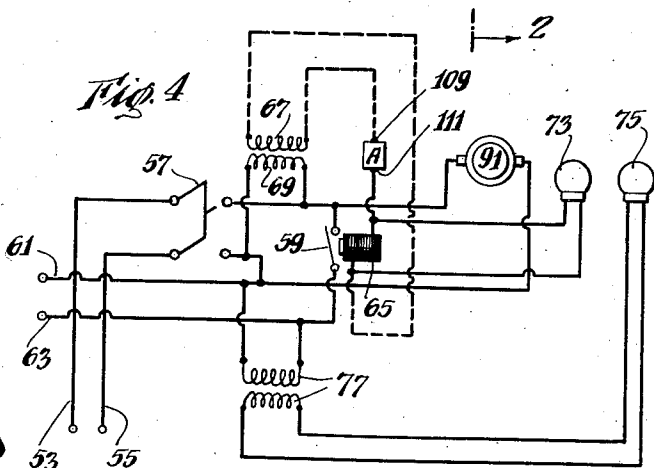
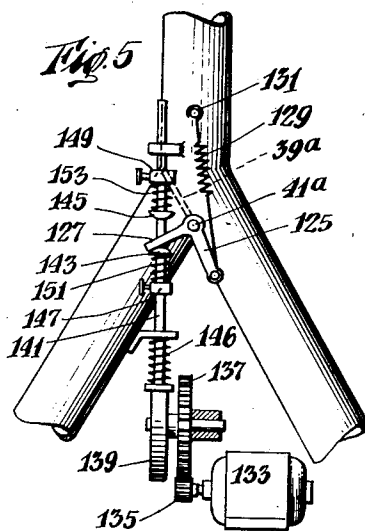
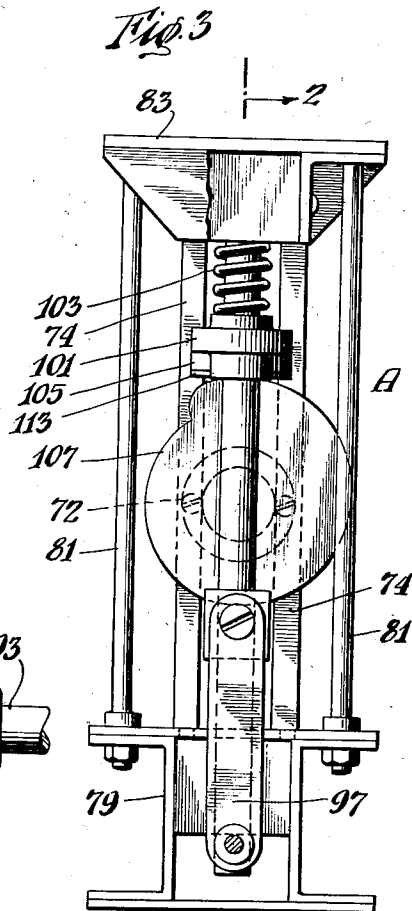
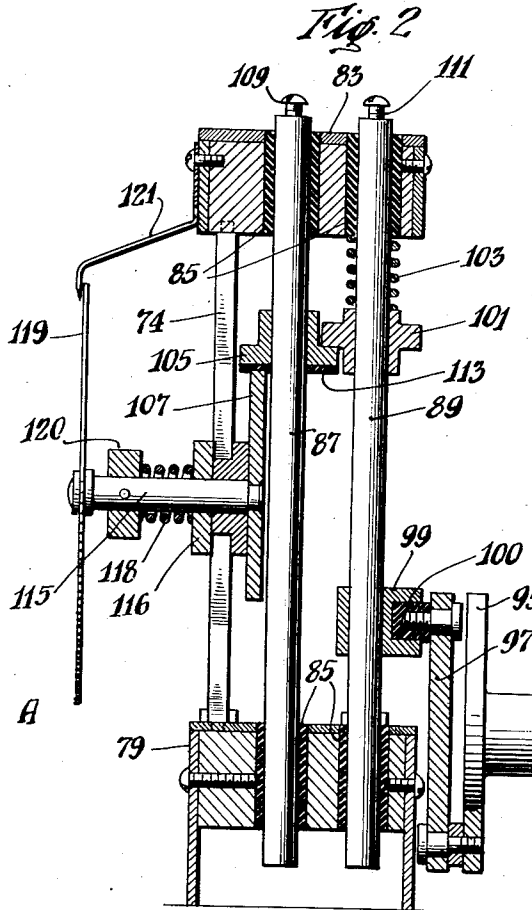
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DRYING APPARATUS

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2 Sheets-Sheet 2



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2,157,775

DRYING APPARATUS

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Application August 4, 1936, Serial No. 94,183

1 Claim. (Cl. 34—34)

The invention is of utility in connection with and will be described as applied to certain systems for drying very wet materials such for example as distillers' pressed grains. It will be apparent, however, from a reading of the specification, that the use of the invention is not limited to this particular field.

A system of this sort is shown and described in United States Patent 2,023,247 granted on December 3, 1935, to W. B. Senseman. The system is especially adapted for drying very wet materials such as distillers' grain, sewage sludge, etc., one of the distinguishing features being that a portion of the dried material or partly dried material is returned to be mixed with the incoming raw material, the remainder being discharged from the system and carried to the point of use or disposal. This general idea is applicable not only to the particular form of drier disclosed in the patent but also to other forms of driers.

More particularly, the present invention relates to the means for dividing the dried material in the desired ratio, one portion to be returned and the other portion to be discharged from the system, and has for its object the provision of improved means for this purpose.

The invention is illustrated in and will be described in connection with the accompanying drawings. In these drawings a system with the invention applied is illustrated more or less diagrammatically and partly in section in Fig. 1;

Fig. 2 shows a vertical section of the preferred form of one of the essential elements in the apparatus for carrying out the invention, this section being on line 2—2 of Fig. 3;

Fig. 3 is a view of this part of the apparatus looked at from the right of Fig. 2;

Fig. 4 is a diagrammatic showing of the wiring system used; and

Fig. 5 is a fragmentary view showing a variation.

Referring first to Fig. 1, the general system to which my invention is shown applied may be briefly described as follows.

Raw wet material is fed into the hopper 1 and delivered by it to the feeding screw 3 located in the housing 5. This screw 3 forces the raw material into the mixer 7 through the vertical passage 9. In this mixer 7 is the mixing screw 11. This as well as the screw is driven by means such as the motor 13. The dry return referred to above is fed to the mixer through the pipe 15 and the raw material and dry return are together moved along by the mixing screw 11 toward the right, as viewed in the figure, and during their

progress through the mixing chamber become intimately mixed. By the time the mixture reaches the outlet 17 it consists of a mass of small discrete particles. This mass of separate particles is fed through 17 to the drying tower 19 where it enters a current of hot gases which in the particular form shown is a current of products of combustion from the furnace 21. The current of hot gases causes a portion of the moisture in the particles to flash into steam. This evaporating or drying process is continued in the drying mill 23, in which there is a rotor driven by motor 25, the rotor being equipped with blades to beat up the particles during the drying process in the known way more fully described in the patent referred to. The mixture of gases, evaporated moisture and dried particles leaves the mill 23 and passes through duct 27 to the exhaust fan 29 which forces the current of gases and solids in suspension to the separator 31. The gases leave this separator at 33, the particles separated being delivered at the bottom of the separator to pipe 35. This pipe 35 divides into the two branches 37 and 15, the latter of which delivers dried material to the mixing chamber 7 as described above. The finished product which is to be removed from the system passes out through 37.

The invention relates to the means for regulating the relative amount of material flowing respectively through 15 and 37. A specific form of the apparatus for this purpose will be described below.

In the prior art the simplest and most usual way for attempting to distribute the dried material in the desired ratio between the return pipe 15 and the pipe 37 consists in a damper dividing the passage and manually adjustable so that it divides the stream of gas-borne particles into two parts in the required ratio. There is a serious objection to this arrangement which is that the concentration of the particles carried by the gas current is usually not uniform throughout the cross-sectional area of the current. In other words, there may be more of the material carried by one portion or thread of the current than by another. Moreover the point in the cross section of the current where the material is more concentrated may shift from time to time. This makes it impossible to set the damper so that the amount of material returned relatively to that removed from the system is constant.

It is this difficulty which my invention is intended to remove. Instead of setting the damper as outlined above, I, while still employing a

damper, alternately completely close one of the two branches, leaving the second one open and then completely close the second branch, leaving the first branch open, and make any changes in the ratio of distribution between the two branches by adjusting the length of time which one of the branches is open relatively to the length of time the other is open. For example, if it is found that for proper operation two thirds of the dried material should be returned and one third discharged, the passage 15 will by my device be kept open two units of the time for each one unit of time that the branch 37 is open. In practice the length of time which the damper is in one position or the other may be a matter of seconds. For example, to effect the distribution just spoken of, the damper may be in the position to leave passage 15 open for ten seconds and then be in the position leaving passage 37 open for five seconds. These details are obviously subject to choice, depending upon circumstances.

To effect the alternation of the position of the damper I prefer the construction which will now be described.

The damper is shown at 39. A simple means for actuating it is shown by way of example. The damper is mounted on a shaft 41 which extends outward through the casing and has fixed to it the arm 43. This arm is pivotally connected to the link 45 whose opposite end is connected to the armature 47. This armature is reciprocable in the solenoid 49, being pulled into it when the electric current flows through the coil and being pushed upward out of the coil by the spring 51 when the current is interrupted. The damper 39 will thus be in a position indicated in the drawing to return dry material to the system and shut off the discharge when the current is interrupted and in a position to discharge all of the material and return none when the circuit is closed.

In Fig. 4 I show the preferred wiring system for the apparatus. The two wires 53, 55 furnish the current controlled by the switch 57. When normally closed relay switch 59 is closed, the two leads 61 and 63 which are connected to the ends of the coil 49 Fig. 1 supply current to energize the coil and draw the armature 47 into the coil. The opening and closing of the relay switch 59 is effected by closing and opening the circuit which includes coil 65. Current for this circuit is induced in the secondary coil 67 by the primary coil 69 when timing switch A, whose terminals are 109 and 111, is closed. The windings 69 and 67 are such that current through the secondary coil 67 is a low potential current. 73 and 75 are lights indicating respectively when coils 65 and 49 are energized. In the case of the latter the current for the light 75 is stepped down by the transformer 77. These lights furnish visible signals for use in connection with making or checking adjustments for distributing the time between the two damper positions and to give a visual idea of the proportional division of the material.

91 is a motor supplied with current from wires 61—63 and serving to actuate an element of timing switch A. This timing switch is located in the pilot circuit and is, in accordance with this form of my invention, the one which, by its periodical closing and opening, indirectly effects the distribution of the dry material between the two branches. The particular form of this switch is illustrated in Figs. 2 and 3.

On the base 79, which may be a casting or a built-up structure, are mounted posts 81—81 sup-

porting an upper block 83, which may also be built up as shown or consist of a single piece. Mounted in the base 79 and top 83 but insulated from them by the insulating bushings 85—85 are the two rods 87 and 89. On rod 89 is reciprocably mounted a cross-head 99 which is driven by means of the constant-speed motor 91 (see Fig. 1) through gearing 92, shaft 93, crank plate 95, and connecting rod 97. Between the screw securing the connecting rod 97 to the cross-head 99 there is interposed the insulating bushing 100. Also slidably fitted on the rod 89 is the contact collar 101 which is urged downwardly by the spring 103 into engagement with collar 105 slidably mounted on rod 87. The downward movement of collar 105 and consequently also the downward movement of collars 101, are prevented by a cam 107 which is insulated from the collar by insulating washer 113. Binding posts 109 and 111 serve for connecting the rods 87 and 89 into the low potential circuit of coils 65 and 67. In the position indicated, with collars 101 and 105 in contact, it will be noted that a circuit from 109 to 111 is completed through rods 87, 89 and the two collars. As the shaft 93, driven by motor 91, rotates and raises cross-head 99 on rod 89, the cross-head comes into contact with collar 101 and raises it from contact with collar 105 thereby interrupting the current through coil 65. Evidently the length of time for which the two collars 101 and 105 are out of contact with each other and the current therefore interrupted can be varied by altering the position of collar 105. This is effected by rotating the cam 107. The rotation of cam 107 is effected by turning the shaft 115 on which it is rigidly mounted.

It will be convenient in practice to indicate the position of the cam. This can readily be done on the dial 119 mounted on the shaft 115 and serving to rotate the cam, the various positions being indicated on the dial by a fixed pointer 121.

The shaft 115 is rotatably mounted in block 116. To prevent rotation of the shaft when cam 107 has been set to the desired position, a spring 118 is employed which at one end bears against collar 120, fixed to the shaft, and at the other end against block 116, thereby holding the cam in frictional engagement with the block 116.

Block 116 is mounted rigidly in any desired way relatively to the stationary parts of the timing switch. In the form shown it is secured by screws 72 to the bars 74, these bars being fixed by any desired means to the base 79 and top 83.

The mechanism described above makes it possible to control the division of material from a point remote from that at which the division is actually effected. The timing switch A can for example be arranged so that the indicating dial 121 and control pointer 119 are on the panel with other controls.

The operation of the device has been more or less completely stated above in connection with the description of the apparatus and will be obvious.

For the sake of convenience it will be given again in a connected statement as follows:

The closing of switch 57 energizes primarily coils 69 and 77 and starts up constant speed motor 91, which drives the timing switch A. The primary coil 69 induces a current in secondary coil 67 whenever and as long as the timing switch A is closed, this secondary current energizing coil 65, thereby closing switch 59. With this switch 59 closed the two leads 61 and 63 energize coil 49 (Fig. 1), which results in putting

damper 39 into its right hand position as viewed in Fig. 1. When timing switch A is opened by the continued rotation of motor 91, coil 65 becomes de-energized, switch 59 opens, leads 61 and 63 no longer supply current to coil 49 and spring 51 places damper 39 into its left hand position.

The proportionate part of time which the damper 49 is in each of its two positions depends upon the position given to cam 107. As this is set to different positions, it raises or lowers the collar 105, thereby varying the time during which collar 101 is in contact with collar 105, which means varying the time during which current is supplied to coil 65. Should the relative lengths of time which damper 39 closes off the two branches 15 and 37 be incorrect for any reason, adjustment is made by means of cam 107. By rotating it the right distance in the proper direction collar 105 is raised or lowered as required thereby shortening or extending the time during which the two collars are in engagement and the damper 39 is in its corresponding position.

It will be noted that the proportional division of the material between the two branches is quite independent of the rate at which raw material is fed to the system. If for example the raw material has been supplied for a time at a certain rate and this rate is then raised, the combined raw and recirculated material will build up until the rate at which material is discharged during the intervals branch 37 is open equals the rate at which raw material is added. In the long run the amount of material added must balance the amount of material discharged. Similarly if the feeding rate is lowered, the combined raw and recirculated material will diminish in amount until the discharge equals the feed.

It will be evident that the invention can be carried out by apparatus quite different from that described. One such varied apparatus is illustrated in Fig. 5. Here the damper 39a is mounted on the shaft 41a, this shaft extending outward from the casing and carrying on it a crank 125 having an arm 127. The end of the crank 125 is connected by a tension spring 129 to a fixed pin 131. The arm 127 is forced alternately upward and downward by mechanism to be described presently. In the figure it is shown in its lower position. When it is forced up the crank 125 will swing toward the left as viewed in the figure until its lower end, to which spring 129 is attached, comes into a position to the left of the line connecting points 131 and 41a. As soon as this happens the spring 129 will snap the damper 39a over the opposite position. From this new position it is changed back to the one shown in the drawing by depressing the arm 127

until the lower end of crank 125 comes to the right of the line connecting points 131 and 41a.

To depress and raise the arm 127 I employ mechanism driven by the motor 133. The motor is geared down by the gears 135 and 137 to a suitable velocity. The rotation of gear 137 causes the cam 139 alternately to raise the rod 141 against spring 145 and to allow this spring to lower the rod. The rod has secured to it collars 147 and 149 and slidably mounted on it the two stops 143 and 145 spaced from collars 147 and 149 by springs 151 and 153, these springs serving to absorb the shocks caused by the snapping over of the damper by spring 129. Evidently an adjustment of the relative lengths of time which the damper is in the two positions can be made by properly setting the collars 147 and 149.

It will be clear that the particular form of drying device used is immaterial as far as my invention is concerned. This drying device might for example be of the rotary drum type. All that is required is that the system be one in which a portion of the dried material is returned to be mixed with the incoming raw material.

More generally than this, it will be understood that the invention has application anywhere where material flowing through a duct, or carried in suspension by a fluid flowing through a duct is to be divided in an adjustable ratio between two branches of the duct.

What I claim is:

In a drying system of the class described having a mixer wherein a portion of the dried material is mixed with raw wet material, the remainder being discharged from the system, the combination of a conduit for the dried material, a second conduit connected to receive dried material from the first conduit and to deliver it to the mixer, a third conduit connected to receive dried material from the first conduit and to deliver it to a point outside of the system, and a damper adapted and arranged to alternately open each of the two last named conduits for delivery from said first conduit while at the same time shutting off the other one against delivery to it, means to place the damper alternately into its two positions for predetermined periods of time thereby effecting a predetermined distribution of material between the second and third conduits, and means to vary the length of the periods of time the damper is in one position relatively to the length of the periods it is in the other position thereby to adjust the amount of dried material returned to be mixed with the incoming raw wet material.

ALFRED R. SMITH.