Oct. 22, 1929. A. W. KOON 1,733,022

APPARATUS FOR DRYING HAY, GRAIN, AND THE LIKE

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Fig. 1.

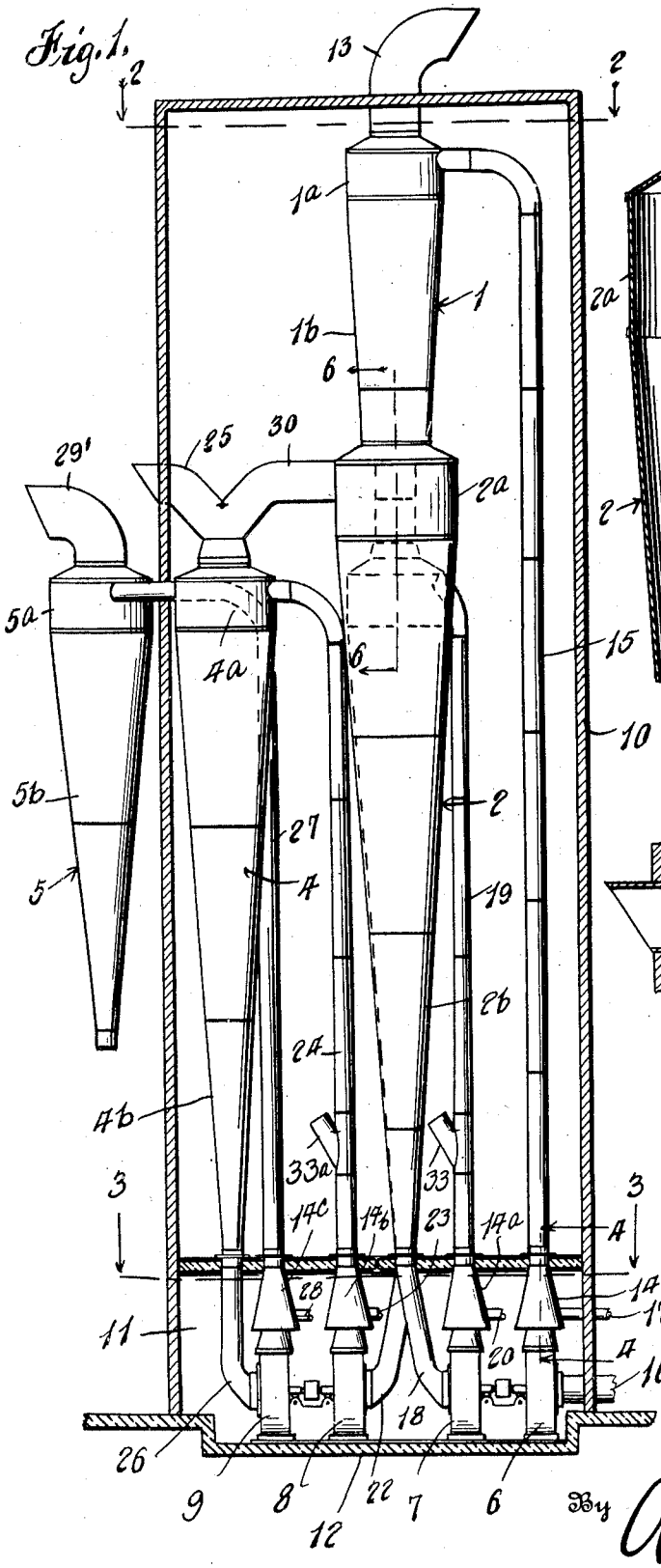


Fig. 6.

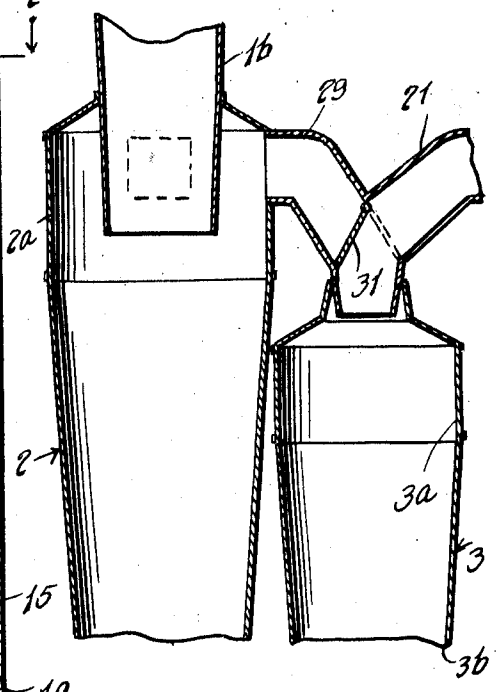
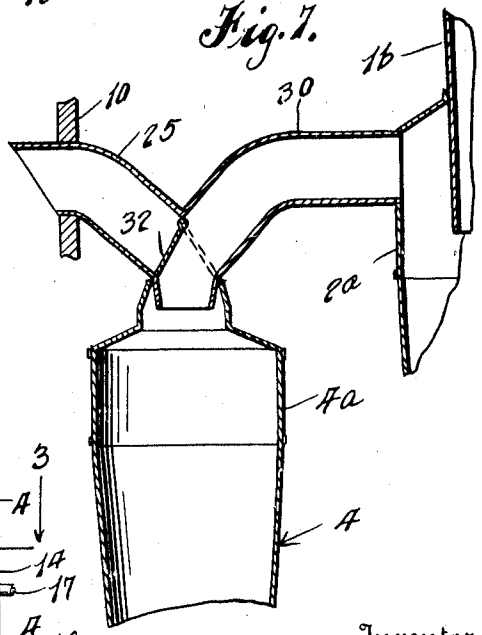


Fig. 7.



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Fig. 2.

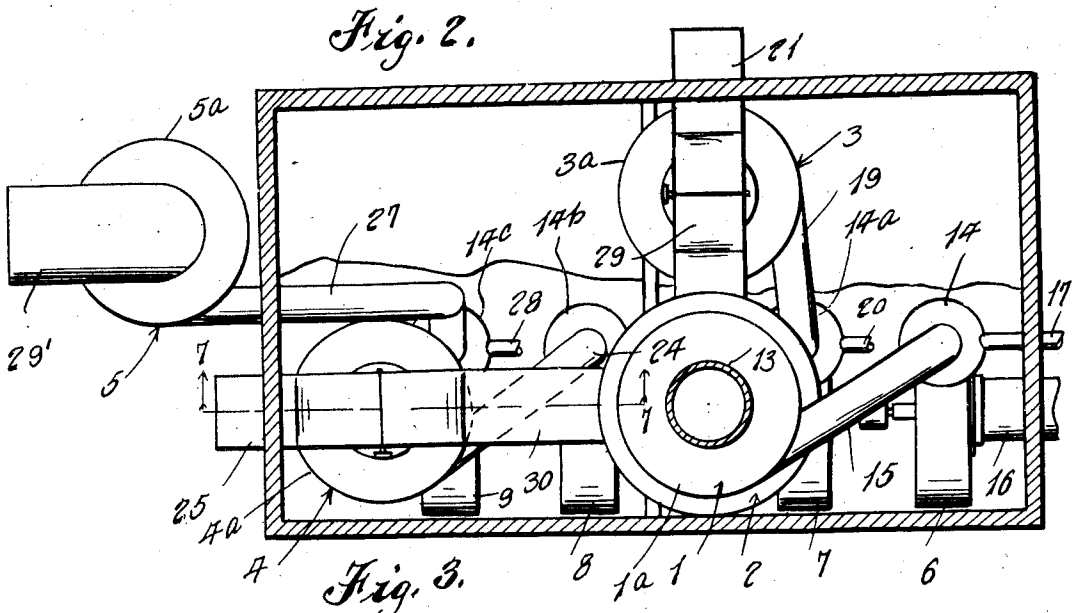


Fig. 3.

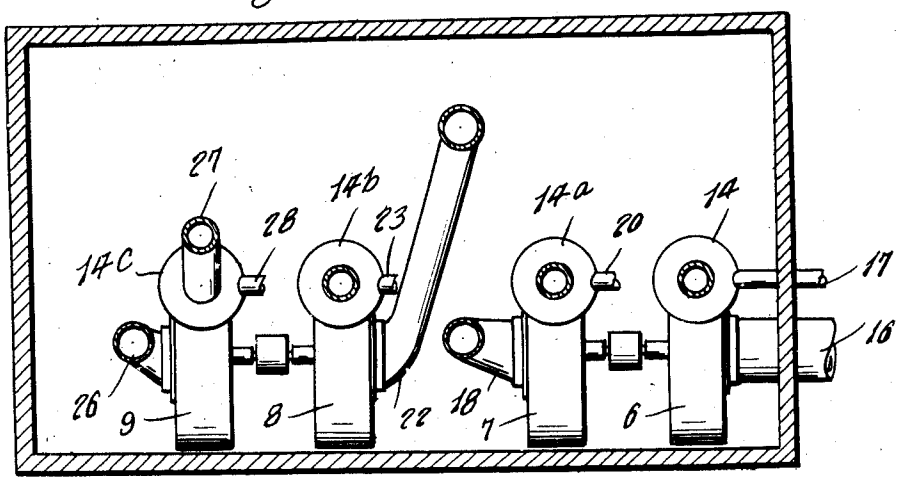


Fig. 4.

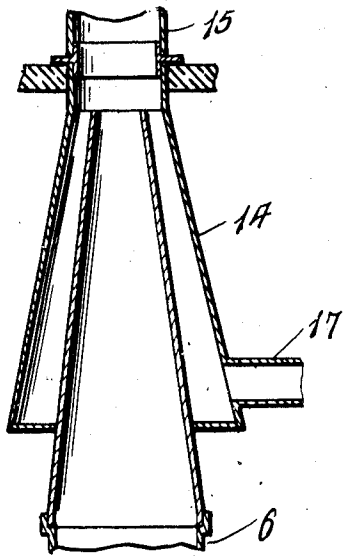
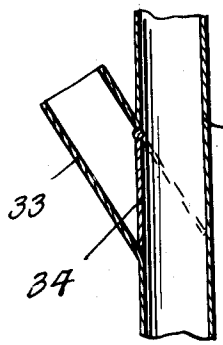


Fig. 5



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UNITED STATES PATENT OFFICE

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APPARATUS FOR DRYING HAY, GRAIN, AND THE LIKE

Application filed April 12, 1928. Serial No. 269,538.

This invention relates to an apparatus for drying vegetables, hay, grain and the like materials, and has for one of its objects the provision of apparatus whereby to effect the drying of the materials through the medium of a heated inert drying gas.

A further object of the invention is to effect the drying of the materials while they are in motion and while they are in suspension in a current of gaseous drying medium, imparting motion to the materials through the medium of the drying agent, and subjecting the materials to an equal degree of heat during each phase of the motion thereof or subjecting the materials during the first phase of their motion to a degree of heat higher than that to which they will be subjected during the remaining phases of their motion.

The invention has further objects in view, which will hereinafter appear, and it is hereinafter fully described and claimed, the apparatus being illustrated in the accompanying drawings, wherein:

Figure 1 is an elevational view of a drying apparatus constructed in accordance with my invention,

Figure 2 is a horizontal sectional view taken on the plane indicated by the line 2—2 of Figure 1,

Figure 3 is a similar view taken on the plane indicated by the line 3—3 of Figure 1,

Figure 4 is a detail sectional view taken on the vertical plane indicated by the line 4—4 of Figure 1,

Figure 5 is a detail sectional view illustrating one of the dampers of the apparatus,

Figure 6 is a detail sectional view taken on the vertical plane indicated by the line 6—6 of Figure 1, and

Figure 7 is a similar view taken on the plane indicated by the line 7—7 of Figure 2.

Corresponding and like parts are referred to in the following description, and designated in the several views of the accompanying drawings, by similar reference numerals.

The apparatus comprises towers 1, 2, 3 and 4, a cooling chamber 5, and blowers 6, 7, 8 and 9. The towers 1—4 are suitably supported within a building 10 which is insulated to prevent them from being affected by atmospheric changes. The cooling chamber 5 is suitably supported outside of the building 10. The blowers 6—9 are located in the uninsulated lower portion or cellar 11 of the building 10, and are suitably secured to the base 12 of the building. The towers 1—4 and the cooling chamber 5 are of similar construction. Each has a cylindrical upper portion and a conical lower portion of which the conical portion is considerably greater in vertical extent than the cylindrical portion.

The cylindrical upper portion 1^a of the tower 1 constitutes a cyclone chamber into which the material to be dried and the drying agent are first delivered and from which the moisture separated out of the material together with the drying agent escapes by way of a flue 13. The flue 13 extends from the top of the cyclone chamber 1^a to and through the roof of the building 10. The material and the drying agent, which latter consists preferably of nitrogen gas free of oxgen and heated to a high degree, are delivered to the cyclone chamber 1^a through the medium of the blower 6, an ejector 14 and a pipe 15. The ejector 14 communicates with the discharge port of the blower 6. The pipe 15 communicates with the discharge end of the ejector 14 and with the cyclone chamber 1^a, and is adapted to deliver the material and the drying agent in a tangential manner to the cyclone chamber. The material is delivered to the blower 6 through the medium of a pipe 16 which communicates with the intake port of the blower. The drying agent is delivered to the ejector 14 through the medium of a pipe 17 which communicates with the ejector and with a suitable apparatus, not shown, for generating the drying agent.

The tower 1 is located directly above the tower 2, and the lower end of the conical portion 1^b thereof extends into the cylindrical portion 2^a of the tower 2. The lower end of the conical portion 2^b of the tower 2 communicates with the intake port of the blower 7, and this communication is established by a pipe 18. An ejector 14^a communicates with the discharge port of the blower 7, a pipe 19 communicates with the ejector and with the cyclone chamber 3^a of the tower 3, and

a pipe 20 communicates with the ejector and with the drying agent generating apparatus, whereby to effect the delivery of the material from the lower end of the tower 2, together with a fresh supply of the drying agent, to the cyclone chamber 3^a of the tower 3. The material and drying agent are delivered tangentially to the cyclone chamber 3^a, and the moisture now separated out of the material together with the drying agent flow from this chamber to the atmosphere by way of a flue 21 which extends from the top of the chamber to and through a side of the building 10. The material flowing downwardly through the conical portion 3^b of the tower 3 is conveyed by a pipe 22 to the intake port of the blower 8, and is delivered, together with a fresh supply of the drying agent, tangentially to the cyclone chamber 4^a of the tower 4. The delivery of the material from the lower end of the tower 2 and the drying agent to the cyclone chamber 4^a of the tower 4, is affected through the medium of the blower 8, an ejector 14^b in communication with the discharge portion of the blower and in communication with the drying agent generating apparatus by way of a pipe 23, and a pipe 24 communicating with the ejector and with the cyclone chamber 4^a. The moisture now separated out of the material and drying agent flow from the cyclone chamber 4^a to the atmosphere by way of a flue 25 which extends from the top of the chamber to and through a side of the building 10. The material flowing down the conical portion 4^b of the tower 4 is conveyed by a pipe 26 to the intake port of the blower 9, and the material, together with a fresh supply of the drying agent, is delivered tangentially to the cyclone chamber 5 of the cooling chamber 5 by the blower 9, an ejector 14^c and a pipe 27. The ejector 14^c communicates with the discharge port of the blower 9, and a pipe 28 establishes communication between the ejector and the drying agent generating apparatus. The pipe 27 communicates with the ejector 14^c and with the cyclone chamber 5^a. The moisture now separated out of the material and the drying agent pass out of the cyclone chamber 5^a by way of a flue 29 which is in communication with the top side of this chamber. The material flows downwardly through the conical portion 5^b of the cooling chamber 5 into any suitable receptacle or conveyor, not shown.

From the foregoing and accompanying drawings, it will be apparent that the material is subjected to a uniform temperature during its passage from the blower 6 to the tower 1, during its passage from the tower 2 to the tower 3, during its passage from the tower 3 to the tower 4, and during its passage from the tower 4 to the cooling chamber 5, that moisture is separated from the material during each phase of its travel through the apparatus, and that the moisture separated from the material during each phase of its travel is conveyed at the end of each phase to the atmosphere. It will also be apparent that, as the drying agent causes the expansion and bursting of the moisture cells of the material, and as the material is treated with a fresh supply of the drying agent during each phase of its travel through the apparatus, the material will be thoroughly dried before being discharged into the cooling chamber 5.

A flue 29′ extends from the flue 21 to the cylindrical portion 2^a of the tower 2, and a flue 30 extends from the flue 25 to said portion of the tower. A damper 31 is pivotally mounted at the juncture of the flues 21 and 29, and a damper 32 is similarly mounted at the juncture of the flues 25 and 30. The dampers 31 and 32 permit the heating agent to be directed from the cyclone chambers 3^a and 4^a to the atmosphere by way of the flues 21 and 25 or into the cylindrical portion 2^a of the tower 2 by way of the flues 29 and 30, and the heating agent is directed into said portion of the tower whenever it is desired to subject the material to a higher temperature during its passage from the tower 1 into the tower 2. The pipes 19 and 24 are provided with by-pass spouts 33 and 33^a which are under the control of dampers 34. The by-pass spout 33 permits the material to be discharged from the apparatus after it has passed through the towers 1 and 2, and the by-pass spout 33^a permits the discharge of the material after it has passed through the towers 1, 2 and 3. The ejectors 14—14^c are similar and of the construction shown in detail in Figure 4.

If the material to be dried is grain, hay or the like, it is fed to the blower 6 in a comminuted form. During the passage of the material through the pipe 15 and tower 1 it is heated to such a high degree as to prevent the resaturation thereof. By "oxygen-free gas" in the appended claims I mean a drying gas substantially free of uncombined oxygen or oxygen, as such.

What is claimed is:—

1. A drying apparatus including towers arranged one above the other and of which the upper one extends into the lower one, means for supplying material to the upper tower and heating it during its passage thereto, a third tower, means conveying the material from the lower tower to the third tower and heating it during its passage thereto, and means by which the heat from the third tower may be directed into the lower tower at the juncture thereof with the upper tower.

2. A drying apparatus comprising upper and lower communicating towers, other towers, means for supplying material to the upper tower and heating it during its pas-

sage thereto, means for conveying the material from the lower tower to one of the other towers and heating it during its passage thereto, means for conveying the material from said other tower to the remaining other tower and heating it during its passage thereto, and means by which the heat from the other towers may be directed into the lower tower at the juncture thereof with the upper tower, and means by which the heat from the other towers may be directed to the lower tower at its point of juncture with the upper tower or to the atmosphere.

3. A drying apparatus comprising towers provided with cyclone chambers, blowers, ejectors communicating with the discharge ports of the blowers, gas supply pipes communicating with the ejectors, pipes communicating with the ejectors and the cyclone chambers of the towers, and pipes communicating with the lower ends of the towers and the intake ports of certain of the blowers.

4. A drying apparatus comprising towers provided with cyclone chambers, flues communicating with the cyclone chambers, dampers in certain of said flues, means conveying the material to one of the cyclone chambers, and means for causing the material to circulate through the towers and heated during its circulation therethrough.

In testimony whereof I affix my signature.

ARTHUR W. KOON.