July 11, 1933. O. SODERLUND 1,917,467

DRYING OF YOUNG GRASS, FODDER, AND THE LIKE

Filed Oct. 27, 1930 2 Sheets-Sheet 1

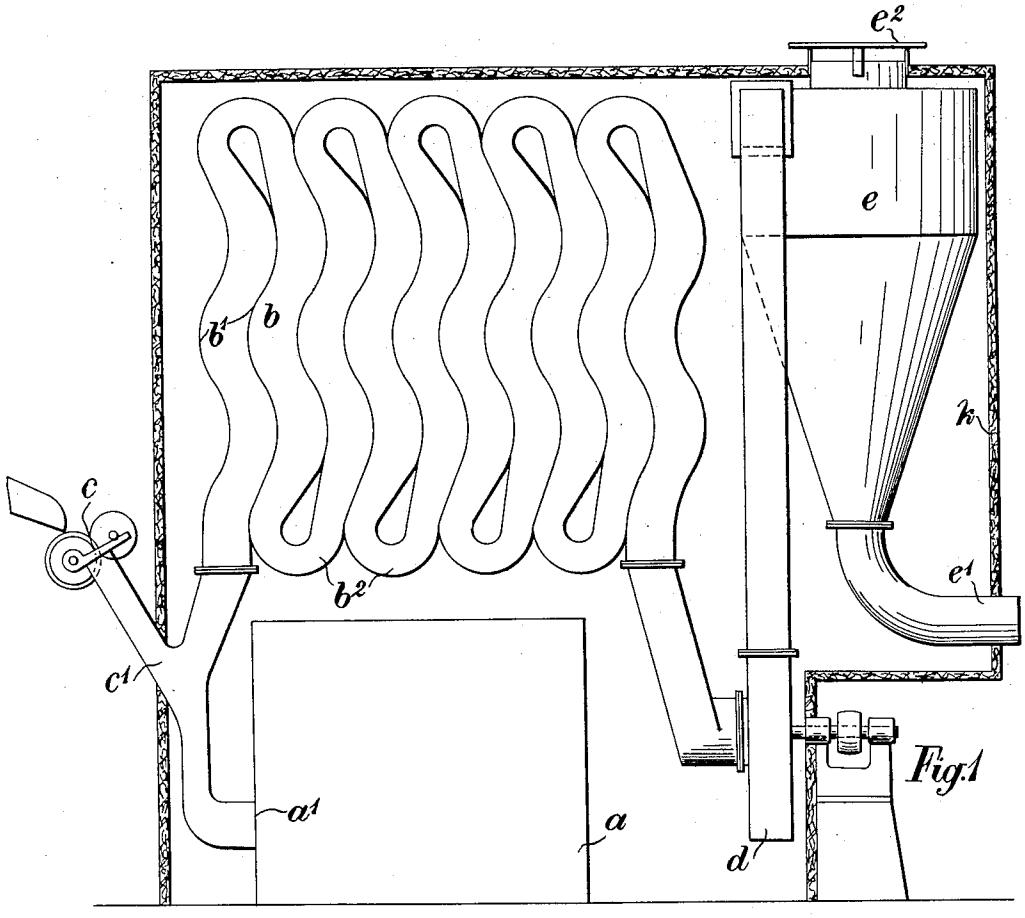

Fig.1

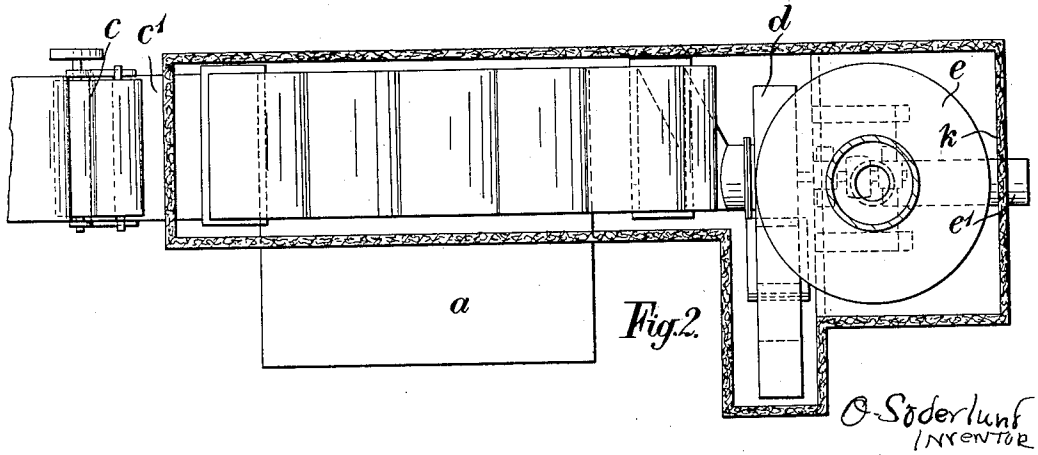

Fig.2.

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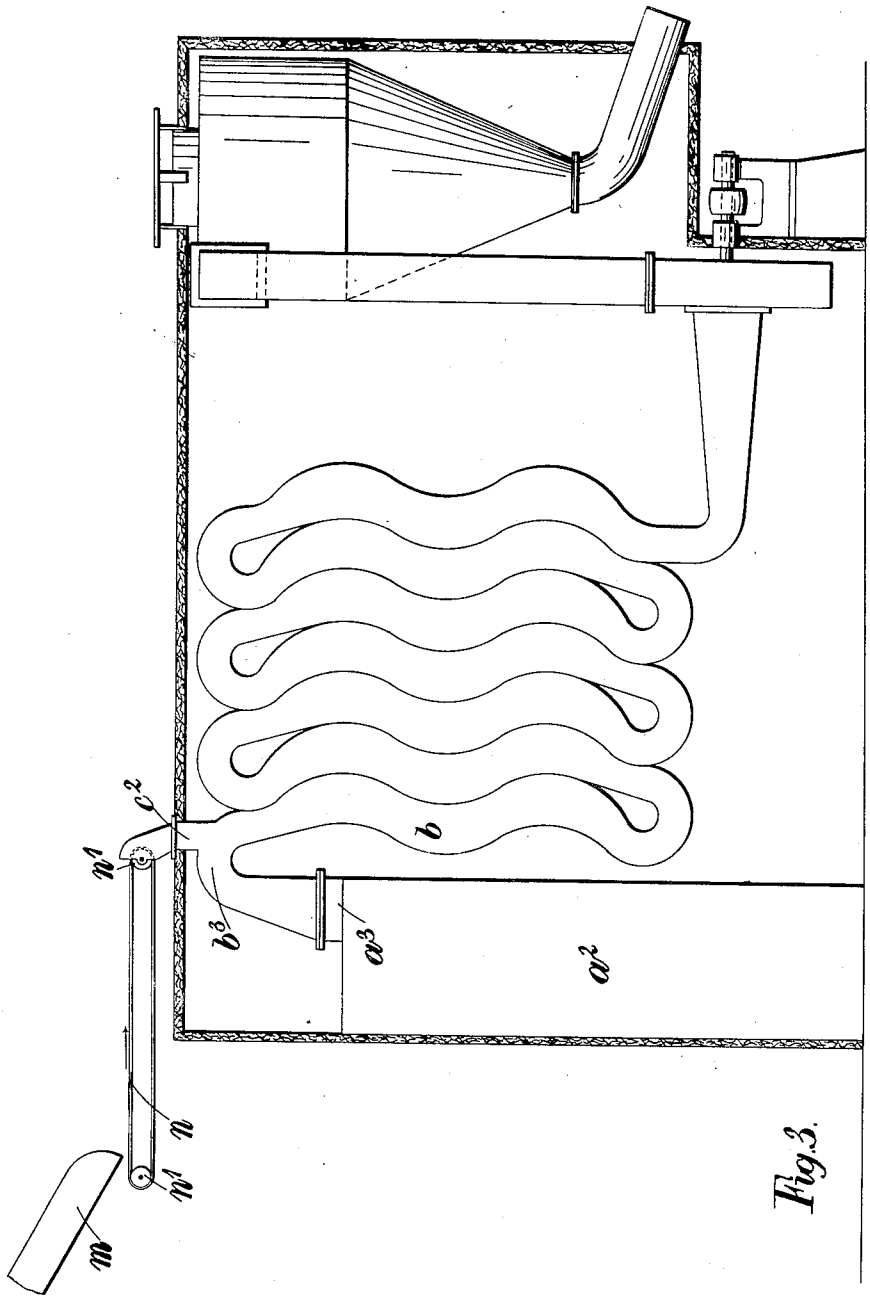

Fig. 3.

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Patented July 11, 1933 1,917,467

UNITED STATES PATENT OFFICE

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DRYING OF YOUNG GRASS, FODDER, AND THE LIKE

Application filed October 27, 1930, Serial No. 491,572, and in Great Britain November 1, 1929.

This invention relates to the drying by direct contact with hot gases of subdivided materials which can be carried by a rapidly flowing elastic gaseous fluid stream in a conduit.

To obtain high thermal efficiency when drying with hot gases it is important to utilize gases of the highest obtainable temperature and by extraction of heat for the drying process to cool these gases down to as low a temperature as possible while employing simple apparatus of small dimensions so as to minimize radiation losses.

Gases of the highest temperature ordinarily obtainable from furnaces or other combustion appliances when brought into direct contact with material to be dried are very liable to cause injury by overheating particles which have already been dried and this is difficult to avoid because the conditions vary from place to place throughout the mass of material which is suspended in the gases and homogeneous mingling of the material and the gases is difficult. Furthermore, when employing high temperature gases for the drying of materials which are combustible, fire danger will occur unless great care to exclude any supporter of combustion is exercised or the gases are very rapidly and evenly cooled down to comparatively low temperatures.

It is known that it is difficult to satisfactorily dry young grass, fodder and similar materials. Various methods have been suggested for drying these materials with hot gases but it has always been found to be very difficult if not impossible to obtain uniform drying and to avoid destructive overheating of part of the material. These difficulties limit the suggested methods to materials which are not so sensitive as young grass to destruction by overheating or long exposure to higher temperatures. The drying time employed is frequently in the neighbourhood of 15 to 30 minutes or even longer and the necessary apparatus is often cumbersome and costly.

An object of the present invention is to overcome difficulties such as the foregoing and to provide for the utilization of higher temperatures than are now ordinarily employed for drying material suspended in a gaseous medium.

Another object of the invention is to provide a method of drying materials which are sensitive to destruction, such as young grass, in a simple and inexpensive apparatus and so as to obtain an evenly dried product while avoiding any risk of damage by overheating.

The invention consists in feeding the subdivided material in an evenly distributed condition and in thin layers and predetermined quantity directly into flue gases of high temperature while such gases are in sufficiently rapid motion to carry forward with them the injected material through a tortuous conduit having sinuous walls continually changing the direction of flow to retain homogeneous mingling and having no pockets or the like in which the solid matter can be deposited from the moving stream.

The invention further consists in proceeding in accordance with the preceding paragraph by exposing young fresh-cut grass, fodder or like materials to the action of a gaseous medium having a temperature of up to 800° C. to 1000° C. for exceedingly short time intervals which may be in the neighbourhood of one second or less.

The invention further consists in drying such materials as last referred to by bringing them in intimate and controllable contact with hot gases by suspending and carrying the materials in the hot gases in such a manner as to create continuous turbulence and subsequently separating the gases from the material.

The invention further consists in drying young grass, fodder and other similar materials by feeding them in thin layers into and blowing them with gases of high temperature at high speed through passages suitably shaped so that the relative position of the material to be dried and the hot gases is continually being changed.

The invention further consists in employing for the above-described drying processes rectangular- or oblong-shaped passages which are disposed in a tortuous path by making their sides corrugated.

The invention also consists in the processes and apparatus hereinafter described.

Referring now to the accompanying more or less diagrammatic drawings:—

Figures 1 and 2 illustrate a single stage drier, and

Figure 3 is a side view showing an alternative way of feeding in the material to the drier.

When carrying the invention into effect in one way, given as example only, I distribute fresh-cut grass in a thin layer and pass it by means of gasses of a temperature of say 800° C. from a furnace and travelling at an average speed of from 10 to 15 meters per second through a passage consisting of two thin metal plates, fixed in a frame, so as to form a tortuous passage for the gases and material. A fan is employed to carry the gases and material through the apparatus and from the apparatus to a cyclone or other separation device.

The hot gases required for the operation of the invention can be obtained from any suitable source.

The invention may also be applied to the drying of peat, lignite or any other material which is suitable, the passage or conduit employed being of long and narrow cross section with sinuous walls. The conduit is conveniently formed of two corrugated sheets placed near to one another; the closing end plates need not be sinuous. The conduit is preferably disposed vertically and provides a suitable length of path to effect the drying required. The lower end of the conduit is provided on one side with a feeding device which may comprise a pair of rollers extending across the width of the conduit and delivering from between them in suitably predetermined quantity the subdivided material which is evenly distributed by the rollers along the whole width of the conduit on to an inclined plate terminating at the inner surface of the conduit. On the opposite side and just below the plate is a long narrow slit communicating with a combustion chamber, e. g. a coke or powder fuel or gas furnace or other source of supply of a hot gaseous medium incapable of supporting combustion. The lower end of the conduit opens into a closed receptacle or trap into which any powder not carried upwards by the gaseous stream can freely fall.

The outlet end of the sinuous conduit may be coupled to a cyclone or other separating device and an exhauster, which latter is capable of giving the required velocity of flow of products of combustion through the sinuous conduit, while the cyclone separates the gases from the material.

In some cases the sinuous conduit may be turned back down to the inlet level and then upwards again forming a suitable number of zigzag passages where it is not convenient to provide sufficient path for moisture abstraction in one single direction. The whole of the apparatus may be suitably insulated.

Alternatively, a fan may be arranged to deliver air for combustion to the furnace so as to maintain a pressure above that of the atmosphere throughout the apparatus, the conduit forming a plenum system, avoiding air leaks.

In working, the grass moisture-laden powder or other material to be dried in predetermined quantity and in thin layers is delivered directly into the stream of hot gases at a temperature of about 800° C. to 1000° C., flowing into the conduit and is carried therethrough depositing in a practically dry condition in the cyclone.

It is found that drying of lignite or peat powder can be practically accomplished without any risk of fire notwithstanding the very high temperatures used and that it takes place very rapidly so that a large output for the size of apparatus as well as high thermal efficiency can be obtained.

In some cases a plurality of sinuous passages may be utilized in parallel, care being taken to ensure uniform distribution of the flow through them.

The invention provides a simple method and small apparatus for utilizing gases of high temperatures and rapidly cooling the gases by the abstraction of heat to effect evaporation down to the neighbourhood of the saturation temperature of the gases.

In the apparatus shown in Figures 1 and 2, a is a furnace from which gases at a temperature of from 800° C. to 1000° C. issue at the outlet a' and b is an elongated conduit of attenuated or long and narrow cross section having sinuous walls b' and a plurality of return bends b^2 to create continuous turbulence and homogeneous mingling of the material and the gases, c is a feeding device comprising a pair of rollers whose length corresponds with the width of the conduit and by which the material to be dried in predetermined quantities is injected into the hot gases in an evenly distributed thin layer which passes down the inclined plate c' and is carried up by the gaseous stream.

An exhauster d imparts the required high velocity to the gases for carrying the material through the conduit and discharges into the cyclone e from which the dried product is obtained at e' and the spent gases escape at e^2 at a temperature of say 100° C. to 150° C.

As shown at Figure 3 a furnace or heater a^2 is of more upright form and the outlet a^3 is at the upper end.

The feeding connection c^2 enters the bend b^3 in such a manner that the material at entry is moving in the same direction as the hot gas is travelling and the material is disposed as an even layer by being fed by the chute m on to a moving belt or conveyor n

carried by rollers n' and of the same width as the conduit b.

The conveyor deposits the even layer of grass or other material to be dried within the hood c^3 of the connection c^2 at the lower end of which the layer is met and carried forward evenly by the hot gas which at this region may preferably be given a higher velocity by suitably forming the conduit.

The presence of the layer of material prevents the entrance of any undesirable quantity of air at the hood c^3 and if shortage of material at any region should allow more air to enter this air will tend to reduce the temperature locally at the region where the material is deficient and will, therefore, prevent overheating thereof.

A device for feeding in the material in the same direction as the hot gas is travelling may be fitted at any substantially horizontally or downwardly directed region of the conduit, such region being introduced at any position as desirable for the purpose and the dimension of the conduit normal to the width being reduced as may be required to give the proper velocity to the hot gases to evenly carry forward the layer of material.

All the apparatus of the driers is enclosed in an insulating k, k' and the spent gases may be used in such casings or in any other way for insulating.

It is to be understood that the constructions hereinbefore described are by way of example only and that additions and modifications may be introduced without in any way departing from the nature of the invention as set forth in the foregoing statements and the claim.

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

Apparatus for drying finely divided material comprising means for continuously supplying a heated gaseous medium, means for feeding finely divided moist material uniformly into said medium, a conduit having sinuous walls and semi-circular return bends extending without break from the region where said material is fed into said medium and means for moving said medium along said conduit to carry said material without deposit and subject it to reciprocating turbulence by contact with said walls.

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

OLOF SÖDERLUND.