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HEAT-TREATMENT APPARATUS

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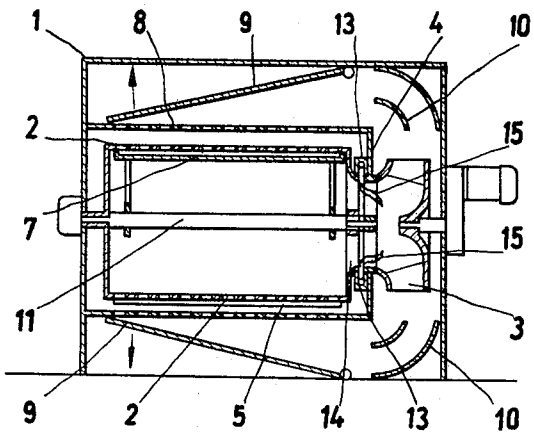

Fig. 1

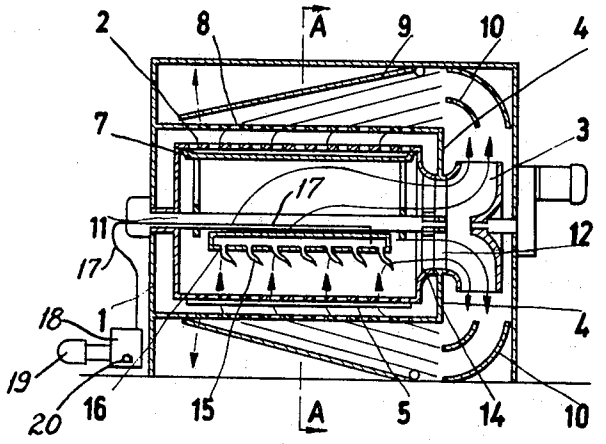

Fig. 2

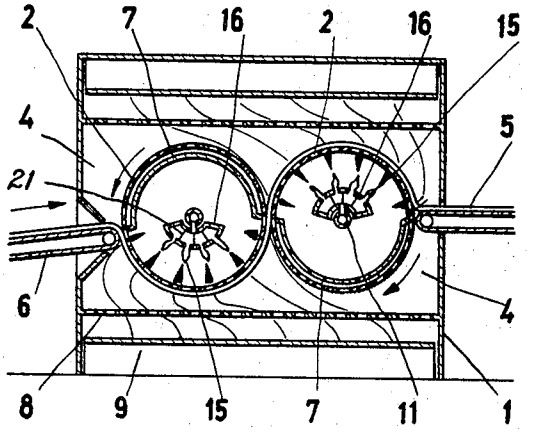

Fig. 3
(A-A)

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HEAT-TREATMENT APPARATUS

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The present invention relates to a device for the heat treatment, for example, for drying, polymerizing, and curing of materials impregnated with synthetic resins and for heat-setting materials of all kinds, preferably natural and synthetic fibrous materials. More particularly, the invention concerns a closed housing in which sieve drums subjected to a suction draft are provided as conveying elements, with fans correlated to the faces of the sieve drums which function to draw a treatment medium out of the sieve drums and return it to the space surrounding the sieve drums. Heating means are also provided for heating the circulated treatment medium.

Sieve drum dryers which are provided with a closed housing which is subdivided by a partition into a treatment chamber, with sieve drums subjected to a suction draft, and into a fan chamber, with radial fans which are correlated to the faces of the sieve drums, are well known. In these devices, heater batteries are provided in the fan chamber above and below the radial fans through which the air discharged by the fans is passed and heated before entering the treatment chamber. The heater batteries generally consist of steam-heated ribbed tubes. However, devices are also known wherein hot combustion gases of an oil burner or of a gas burner are passed through the heater tubes.

Since in a sieve drum dryer the treatment medium, especially the drying air, is circulated at high flow rates, it is generally thought that for this type of dryer only an indirect type of heating is possible. With direct heating there is the danger that the hot combustion gas currents which have not mixed with the cooler treatment medium, and thus will not have had its temperature reduced, will damage the material to be dried or as a result will produce at least some non-uniform drying or over-drying of some of the material. In order to eliminate this danger it has been the practice up until now to utilize the expensive heater batteries of indirect heating.

In the case of textile materials and similar goods, it is furthermore feared that with direct heating and the circulation of large quantities of air, the flames in such devices will begin to flicker or to soot. Soiling of the textile material or other similar materials by flue gases must definitely be avoided. For this reason, it was up to now thought impossible or inadvisable to use a direct heating system in a sieve drum dryer of the afore-described kind.

An object of the present invention is to reduce the manufacturing and operating cost of a heat-treatment and drying device of the kind previously described, and to increase the capacity of this device. This is possible because the space in which the heater batteries can be effectively accommodated is limited and since this space is in general already completely occupied by heater batteries, an increase of the heater's capacity by providing further heater batteries is only possible by enlarging the heating device, thus rendering it more expensive.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of

the invention will become apparent to those skilled in the art from this detailed description.

In accordance with the present invention, it has been found that a substantial increase in the capacity of a heat treatment apparatus, and a simultaneous reduction in its manufacturing and operating cost can be achieved by providing direct heating in the circulation of the treatment medium. The disadvantages and dangers generally encountered in direct heating can be substantially avoided if, in accordance with the present invention, the direct heating is provided in the suction part of the apparatus. In this manner, good mixing of the combustion gases with the circulated treatment medium by the fans can be effected. Furthermore, the long flow pass insures that fiber particles carried away and other contaminants will burn and that their sparks will be extinguished before the treatment medium flows back into the treatment chamber. The apparatus of the present invention also offers the further advantage that the oxygen of the air is substantially replaced by combustion gases, so that fiber damage and/or yellowing of the fibers caused by the influence of oxygen at high temperature treatments, also often experienced by present day heating devices, is eliminated or at least substantially reduced.

In one embodiment of the present invention, the direct heating means is provided, for example, by burners which are arranged annularly between the exhaust sockets of the sieve drum and the exhaust socket of the fan. This arrangement offers the advantage of an intimate mixing and uniform heating of the treatment medium with the combustion flue gases. Furthermore, it offers the advantage that the fuel and compressed air feed lines can be connected to the stationary burner body without an essential modification of the existing apparatus.

In a further embodiment of the present invention the drum cross which supports the sieve drum can be designed as a burner body. It has also been found to be advantageous to mount burner bodies to the drum cross.

In order to prevent the flames from being extinguished by the treatment medium, which is drawn by the suction of the fan wheel out of the sieve drum transversely to the flames, it is desirable to screen the flames, preferably within the range of the flame cone, from the suction of the treatment medium, which is directed transversely to the plane of the flame. This can be achieved by arranging the burners annularly at a predetermined distance from the suction duct so that the flames may burn in a space in which no suction prevails and where only the points of the flames extend into the suction draft. The heating of the circulated treatment medium is effected by mixing it with combustion flue gases and by the radiation heat of the flames.

In still another embodiment of the present invention the burner body or burner bodies is/are mounted to the wall between the treatment chamber and the fan chamber. It is advantageous to arrange the burners between the drum cross and the exhaust socket of the fan in the fan chamber so that the partition between the fan chamber and the treatment chamber screens of the radiation heat from the treatment chamber. This arrangement is of particular advantage for very large burner assemblies and thus for high-capacity devices.

In still a further embodiment of the present invention the burners are arranged in the sieve drum and are mounted to the stationary sieve drum axis. Also the stationary sieve drum axis itself may be designed as a burner body and the burner nozzles may be accommodated in appropriate drillings. Another manner in which the burners may be arranged in the sieve drum is to mount the burners to a stationary baffle, so that a greater distance between the burners and the material adhering to the sieve drum can be obtained.

If the burners are arranged in the rotating sieve drum, provision must be made to introduce the fuel and compressed air feed lines into the sieve drum without providing openings in the apparatus for sucking in the off-air. In accordance with another feature of the present invention this may be achieved by designing the sieve drum axis as a hollow axis and by arranging the fuel and compressed air feed lines in the hollow space of the stationary sieve drum axis.

Another manner for introducing the fuel and compressed air feed lines into the drum is to provide drillings in the drum cross and to introduce the feed lines into the sieve drum through these drillings. In such a case the feed lines are introduced into the sieve drum on the suction side, i.e., on the fan side, whereas in the case of the first-mentioned situation they are introduced into the sieve drum on the drive side.

Since the heat consumption varies widely according to the material to be treated, it is necessary to adapt the heat supply to the particular circumstances in order to avoid over heating. This can be accomplished by varying the numbers of burners utilized and by coordinating the burners with a means for multi-stage off-on switching of the burners. At the same time, or instead of the multi-stage switching means, the burners may be designed so that their heat producing capacity are infinitely variable. In general, however, the combination of a multi-stage switching means with an infinitely variable control would be most advantageous.

The burner or burners can also be designed as a stationary part of the exhaust socket with several burner rings, one behind the other. Thus the capacity can be changed in steps by switching on and off one or several burner rings.

The bottom of the sieve drum which is most distant from the stationary fan can also be designed as a burner body or as a burner support and the sieve drum can be mounted to the burner body or the burner support.

The arrangement of the direct heating within the circulation of the treatment medium offers the further advantage that fluffs or other particles which become detached from the material to be treated are burned so that soiling of the device is substantially reduced when compared with the known sieve drum dryers using direct heating.

Since the ribbed heaters are disposed of, the apparatus of the present invention is not only rendered less expensive but also a considerable amount of resistance which the ribbed heaters presented to the circulation of the treatment medium is eliminated so that the amount of circulated air can be considerably increased for the same fan capacity. If desired, a filter may be arranged within the circulation of the treatment medium if a delicate textile material is being processed. In such a case, it is advantageous to provide filters instead of sieve sheets which can be positioned above and below the sieve drums or in the alternative to provide the sieve sheets with thin filter coatings.

The present invention will be more fully understood from the detailed description herein below and the accompanying drawings wherein,

FIGURE 1 is a cross section of the apparatus according to the present invention;

FIGURE 2 is a cross section of another embodiment of the apparatus according to the present invention; and

FIGURE 3 is a longitudinal section of FIGURE 2, taken along line A—A of the apparatus according to the present invention.

Referring now to the drawings wherein like reference numerals are used throughout the various views to designate like parts, reference numeral **1** designates in all figures a closed housing. In the housing, sieve drums **2** are provided as conveying elements which are separated by a partition **4** from fans **3** which are correlated to the faces of the sieve drums. The fans suck the treatment medium

out of the sieve drums in a known way, thereby creating a partial vacuum in the sieve drums which is utilized for holding and drying the material **5** to be treated. At the same time, the partial vacuum causes the treatment medium to be passed through the material into the sieve drums. This has the advantage of an intimate contact between the treatment medium and material **5** and also a rapid and intensive heat transfer between the treatment medium and said material to be treated. For feeding and discharging the material to be treated by the apparatus of the present invention, conveyor belts **6** are used at the intake and the delivery end of the apparatus. In the sieve drum stationary baffles **7** are provided which interrupt the suction draft on that portion of the sieve drum which is not covered by the material being treated. Above and below the sieve drums sieve sheets **8** and oblique bottoms **9** are provided which insure a uniform distribution of the treatment medium discharge by the fans over the whole working width of the sieve drums. Deflector sheets **10** are provided above and below the fan for deflecting the air and/or the treatment medium which is discharged both upwards and downwards.

In referring to FIGURE 1, an annular burner body **13** is provided between the sieve drum and the drum cross **12** for heating the treatment medium. The drum cross functions to support drum axis **11**. Since the free inner ring of the annular burner body **13** has a larger diameter than the free diameter of cast-iron spider **14** and the drum cross, an annular space is created for the flames between the cast-iron spider **14** and the drum cross. This space is free from the transverse current of the treatment medium directed towards the fan, so that flames **15** may develop in this space, with only the tips of the flames being seized by the transverse current of the treatment medium and sucked into the fan. The fan effects an intimate mixing of the hot combustion gases with the treatment medium and thus a uniform heating of the treatment medium is achieved.

FIGURES 2 and 3 illustrate that a dish-shaped burner body **16** can be mounted to drum axis **11** which is hollow in order to provide for the supply of fuel and compressed air therein. Using this arrangement the radiation of flames **15** heats up the sieve drum which in turn transfers its heat to the material to be treated. The apparatus of the present invention can be heated with gas, oil, and other liquid or gaseous fuels.

A stepwise turning-on of the burner is possible when the burner body **16** consists of several mutually separate segments **21** with a proper individual gas supply line and a priming device. As is evident from FIGURE 3, it is then possible to ignite only one segment or any number thereof, in combination.

FIGURE 2 shows a means for infinitely regulating the supply of gas to the burner. The drum axle is provided as a hollow shaft (see FIGURE 3) into which a feed line **17** may be placed. Outside of the dryer, the line **17** is connected with a blower **18** which has an infinitely variable motor **19**. In this blower **18**, the gas which is introduced by way of line **20** is mixed at the same time with the fresh air being drawn in from the room.

Although FIGURES 1, 2 and 3 show the apparatus of the present invention using two sieve drums, it is contemplated that any number of sieve drums including only one can be utilized depending upon the intended use of the apparatus and the material being treated.

While I have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

It is claimed:

1. A heat-treating apparatus which comprises a closed housing, at least one cylindrical sieve drum rotatably dis-

posed within said housing and defining an annular space surrounding said cylindrical sieve drum, the cylindrical surface of said sieve drum serving as a conveying means, vacuum-creating means communicating with the interior of the cylindrical sieve drum for directing a treatment medium from the inside of said drum to the annular space surrounding said drum, direct heating means provided within the circulation of the treatment medium in the vacuum portion of the apparatus between the material being treated and the vacuum-creating means, inlet means for introducing the material to be heat-treated to said conveying means and outlet means for removing said heat-treated material from said conveying means.

2. The apparatus of claim 1 wherein the direct heating means is disposed between the end of the cylindrical sieve drum and the vacuum creating means.

3. The apparatus of claim 1 wherein the direct heating means is disposed annularly between the exhaust socket of the cylindrical sieve drum and the exhaust socket of the vacuum creating means.

4. An apparatus according to claim 1 wherein the heating means is a burner body means mounted to the wall between the treatment chamber and the fan chamber.

5. The apparatus according to claim 1 wherein the heating means is a burner body means disposed between the drum cross and the exhaust socket of the fan in the fan chamber.

6. The apparatus according to claim 1 wherein the heating means is disposed in the sieve drum and mounted to the sieve drum axis.

7. The apparatus of claim 6 wherein the sieve drum axis itself functions as a burner body means.

8. The apparatus of claim 1 wherein a stationary baffle is disposed on the inside of the cylindrical sieve drum and shields that portion of the drum which is not in contact with the material being treated.

9. The apparatus of claim 8 wherein the heating means is mounted to the stationary baffle in said cylindrical sieve drum.

10. The apparatus of claim 1 wherein the sieve drum axis is hollow in order to provide for fuel and compressed air supply lines therein.

11. The apparatus of claim 1 wherein the fuel and compressed air supply lines are introduced into the cylindrical sieve drum through drillings in the stationary drum cross.

12. The apparatus according to claim 1 wherein the sieve drum bottom which is more distant from the fan is stationary and supports the sieve drum.

13. An apparatus according to claim 1 wherein a device for the multi-stage switching of the direct heating means is provided to vary the heating capacity of the apparatus.

14. An apparatus according to claim 1 wherein the heating capacity of the direct heating means is infinitely variable.

15. An apparatus according to claim 1 wherein at least one filter means is provided within the circulation of the treatment medium between the direct heating means and the material to be treated.

16. An apparatus according to claim 1 wherein sieve sheets are disposed between the exhaust of the vacuum means and the outside of the cylindrical sieve drum.

17. An apparatus according to claim 16 wherein the sieve sheets are disposed above and below the cylindrical sieve drum and are designed as a filter means or covered with a filter coating.

18. An apparatus according to claim 1 wherein deflector sheets and oblique baffle are disposed within the circulation of the treatment medium between the exhaust of the vacuum means and the sieve sheets.

19. The apparatus of claim 1, wherein the direct heating means is an annular burner body disposed between the sieve drum and a drum cross, said drum cross providing axial support for the cylindrical sieve drum on its vacuum side.

20. The apparatus of claim 19, wherein the inner diameter of the annular burner body is larger than the inner diameter of the surrounding elements, said burner body thereby being recessed in the apparatus so that the flame is substantially screened off from the suction of the circulating treatment medium which flows transverse to the plane of the flame.

21. The apparatus of claim 19, wherein the drum cross is designed as a burner body means.

22. The apparatus of claim 19, wherein the drum cross supports a burner body means.

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