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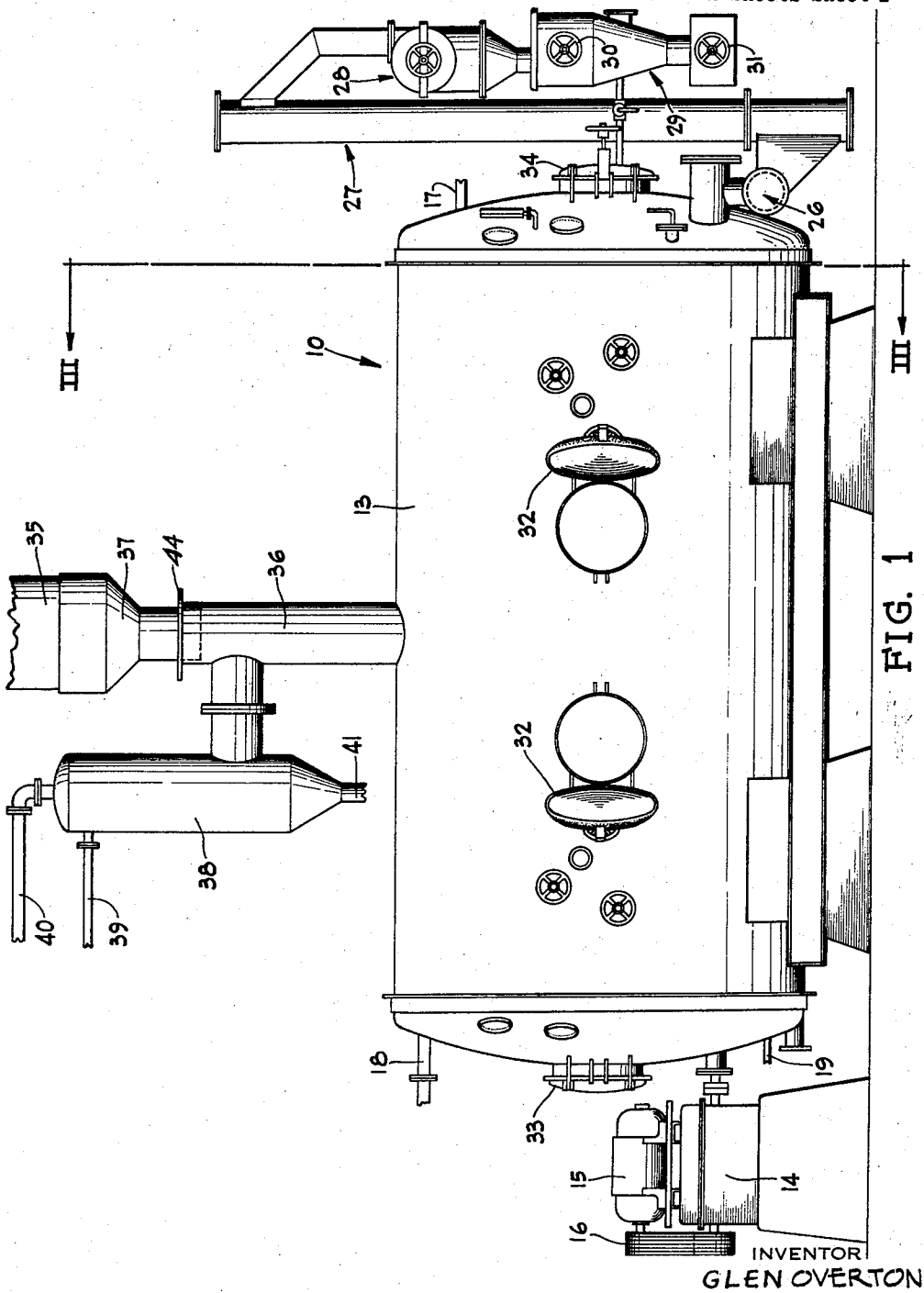
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ATMOSPHERIC AND VACUUM DRUM DRYER

Filed July 18, 1955

2 Sheets-Sheet 1



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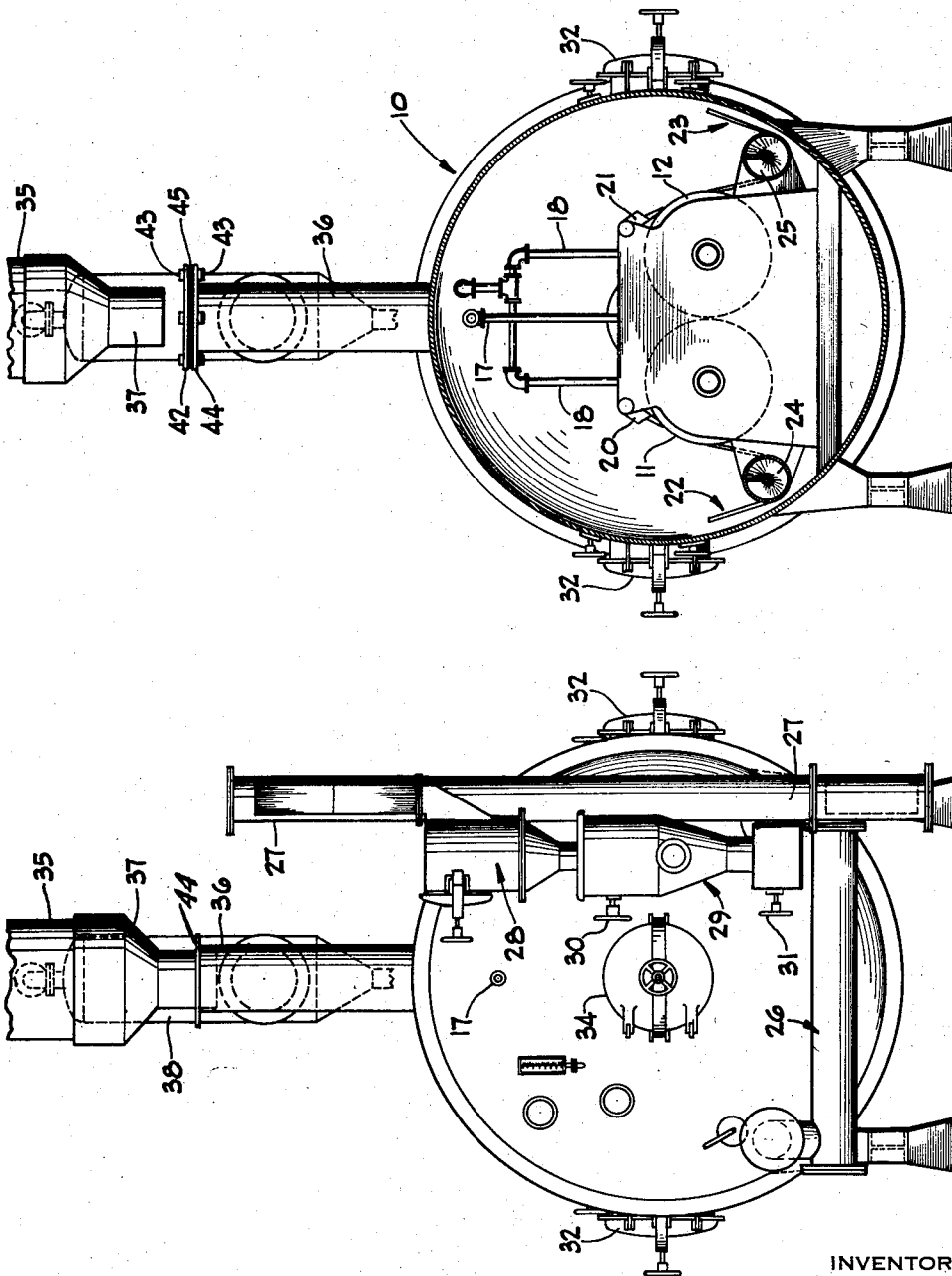


FIG. 3

FIG. 2

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ATMOSPHERIC AND VACUUM DRUM DRYER

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3 Claims. (Cl. 34—92)

This invention relates to a dryer and more particularly to a dryer arranged to dry materials selectively under either atmospheric or vacuum conditions.

It is possible to dry many types of materials either under atmospheric or vacuum conditions with each type of operation having advantages over the other. For example, atmospheric roller process dry milk is preferred by bakers and many other users while vacuum roller process dry milk can be satisfactorily used as a substitute for fluid milk. In large plants, it has been satisfactory to provide separate dryers for each type of operation. For small plants, however, the cost of providing and maintaining two dryers has been relatively great and in many cases prohibitive.

It is the general object of this invention to provide a dryer which will efficiently dry materials under either atmospheric or vacuum conditions and which can be readily changed over from one type of operation to the other.

This invention may be applied to any type of dryer that could be operated under either vacuum or atmospheric conditions but is particularly advantageous when applied to a drum dryer of the type in which a rotatable drum is disposed in a housing for contacting material to be dried with means for heating the drum to form a film of dehydrated material on the surface thereof and with means for scraping the dehydrated material from such a surface. Conveyor means may be provided for carrying the dehydrated material to a point outside the housing and, to permit operation under vacuum conditions, suitable sealing means are provided in the conveyor means for preventing venting of the housing to the atmosphere through the conveyor. Such a dryer may be used for dairy products, chemicals, distillery and brewery waste, and for many other materials and uses.

According to this invention, means are provided for selectively operating the dryer under either atmospheric or vacuum conditions. In particular, evacuating means are provided for coupling the interior of the housing to a vacuum source and vent means are provided defining a vapor flow path from the housing to an atmospheric stack, such vent means being selectively controllable between an operative position in which the vapor flow path is opened and an inoperative position in which the vapor path is sealingly closed, so that the machine may be operated as a vacuum dryer.

When operating under atmospheric conditions, it is desirable to provide an air inlet to the housing and for this purpose a suitable door may be provided to the housing below the vent means, the door being selectively movable between a sealingly closed position with the vent means in its inoperative position and an open position with the vent means in its operative position.

According to a specific feature of the invention, a common pipe is used in coupling both the evacuating means and the vent means to the housing, so that there need be only one pipe connection to the housing.

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Another specific feature of the invention is in an arrangement by which a vacuum seal is achieved in the vent path, to achieve efficient vacuum operation, but with the path, at the same time, being readily opened for atmospheric operation. In particular, closure means are arranged to be sealingly secured to the terminal end of a pipe coupled to the housing and vent means are movable between inoperative position for venting such terminal end of the pipe to an atmospheric stack with the closure means removed and in inoperative position away from such terminal end of the pipe to permit ready installation and removal of the closure means.

Preferably, the closure means comprises a cover arranged to be bolted to an annular flange about the terminal end of the pipe with a gasket disposed between such cover and the pipe. It is possible with this arrangement to achieve a highly efficient vacuum seal. It might be noted that conventional valves could be used for opening and closing the vent path but such valves are very expensive especially when a vacuum seal is required.

According to a still further feature of the invention, the terminal end of the pipe coupled to the housing in space registering relation to one of a stack and a sleeve is provided having a length greater than the distance between the adjacent ends of the pipe and the stack, the sleeve being arranged for telescopic connection with both the terminal end of the pipe and the end of the stack. With this arrangement, the sleeve may be moved away from the pipe to permit installation of the closure means for vacuum operation and, for atmospheric operation, the closure means may be removed without interference from the sleeve and the sleeve may then be moved back into telescopic engagement with the pipe.

This invention contemplates other objects, features and advantages which will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings which illustrate a preferred embodiment and in which:

Figure 1 is a side elevational view of a dryer constructed according to the principles of this invention and in condition for atmospheric drying of materials;

Figure 2 is an end elevational view of the dryer of Figure 1; and

Figure 3 is a sectional view taken substantially along line III—III of Figure 1, but illustrating the dryer in condition for vacuum operation.

Reference numeral 10 designates drying apparatus constructed according to the principles of this invention. The apparatus 10 comprises a pair of dryer drums 11 and 12 disposed in side-by-side inter-engaged relation in a generally cylindrical housing 13. The drums 11 and 12 are respectively rotated in clockwise and counter-clockwise directions as viewed in Figure 3 from a variable speed drive mechanism 14 outside the housing 13, the mechanism 14 being driven from an electric motor 15 through a belt 16.

Liquid material to be dehydrated is introduced through piping 17 into the trough defined by the drums 11 and 12 which are internally heated from steam introduced through piping 18 to form films of dehydrated material on the surfaces thereof. The condensate from the steam used to heat the drums 11 and 12 is returned through piping 19.

To remove the dehydrated material from the surface of the drums 11 and 12, a pair of blades 20 and 21 are positioned for scraping the dehydrated material from the surfaces of the drums 11 and 12, with the material falling into troughs 22 and 23. Screw conveyors 24 and 25 carry the material to a collecting screw conveyor 26 which, in turn, carries the material to the bottom of a bucket elevator 27. From the top of the bucket elevator 27, the material is dropped into a hammer mill 28 which

reduces the collected dehydrated material to fine powdery form. From the hammer mill 28, the material drops into a hopper and gate assembly 29 which includes an upper vacuum-sealable gate under control of handle 30 and a lower vacuum-sealable gate under control of handle 31. When operating under vacuum conditions, both gates may be closed and the space therebetween evacuated. The upper gate may then be opened to allow material to drop onto lower gate and the upper gate may then be closed, after which the space between the gates is vented to the atmosphere and the lower gate is opened to deposit the material in a container to be carried away. Thereafter, the lower gate is again closed and the space between the gates is again evacuated.

To allow selective operation of the machine under either vacuum or atmospheric conditions, and for servicing and cleaning of the machine, a pair of doors 32 is provided on each side of the housing 13 and doors 33 and 34 are provided on the ends of the housing 13, the doors 32, 33 and 34 all being of the type which can be sealingly closed. For operation of the dryer 10 under atmospheric conditions, the interior of the housing 13 is vented to an atmospheric stack 35 by means of a pipe 36 connected to the housing 13, the upper terminal end of the pipe 36 being disposed in spaced registering relation to the lower end of the stack 35 with a sleeve 7 coupling the upper end of the pipe 36 to the lower end of the stack 35. The doors 32-34 are opened for operation under atmospheric conditions and air entering therethrough combines with vapors from the drying operation and passes out through the stack. This operation is facilitated by the fact that the doors are not substantially above the tops of the drums.

For operation under vacuum conditions, the pipe 36 is coupled to a condenser 38 arranged to be connected to a pump or other vacuum source through a piping 39. The purpose of the condenser 38 is to condense moisture from the vapor flowing from the dryer and for this purpose, water is introduced through an inlet 40 to contact the vapor with the water and condensed vapor being removed through an outlet 41.

When operating under vacuum conditions, it is necessary to sealingly close the path from the pipe 36 to the stack 35. For this purpose, the sleeve 37 is telescopically connected to the upper end of the pipe 36 and the lower end of the stack 35, to allow the sleeve 37 to be moved between the position such as illustrated in Figures 1 and 2 in which the lower end thereof is disposed within the pipe 36 and an upper position illustrated in Figure 3 in which the lower end of the sleeve 37 is spaced above the upper end of the pipe 36. In this upper position of the sleeve 37, closure means may be readily installed on the upper end of the pipe 36. Such closure means preferably comprises a cover plate 42 arranged to be secured by a plurality of bolts 43 to an annular flange 44 about the upper end of the pipe 36, with a sealing gasket 45 between the cover 42 and the flange 44.

It will, accordingly, be appreciated that this invention provides a dryer which will efficiently dry materials under either atmospheric or vacuum conditions and which can be readily changed over from one type of operation to another.

When operated under atmospheric conditions the housing or casing acts as a hood connected to a stack thereby inducing a draft which removes vapors and moisture to expedite the drying operation. When operated under vacuum conditions the same housing or casing serves the dual function of sealing the dryer from the atmosphere and directing the moisture and vapors to the stack. The housing or casing thus actually enhances the drying capacity of the dryer when in closed or opened positions.

It will be understood that modifications and variations may be effected without departing from the spirit and the scope of the novel concepts of this invention.

I claim as my invention:

1. In a drying machine, a housing arranged to receive material to be dried, a rotatable drum in said housing for contacting the material to be dried, means for heating said drum and forming a film of dehydrated material on the surface thereof, means for scraping dehydrated material from said surface, conveyor means for carrying the dehydrated material to a point outside said housing, sealing means in said conveyor means for preventing venting of the housing to the atmosphere therethrough, a pipe coupled to said housing independently of said conveyor means, an annular flange about the terminal end of said pipe, a gasket arranged to be disposed on said flange, a cover arranged to be secured to said flange with said gasket therebetween to seal said terminal end of said pipe, and vent means movable between an operative position for venting said terminal end of said pipe to an atmospheric stack with said cover removed and an inoperative position away from said terminal end of said pipe to permit installation and removal of said cover.

2. In a drying machine, a housing arranged to receive material to be dried, a rotatable drum in said housing for contacting the material to be dried, means for heating said drum and forming a film of dehydrated material on the surface thereof, means for scraping dehydrated material from said surface, conveyor means for carrying the dehydrated material to a point outside said housing, sealing means in said conveyor means for preventing venting of the housing to the atmosphere therethrough, a pipe coupled to said housing independently of said conveyor means and arranged for disposition in register with one end of an atmospheric stack with a terminal end of said pipe spaced a certain distance from said one end of said stack, closure means for sealingly closing said terminal end of said pipe, and a sleeve having a length greater than said certain distance and arranged for telescoping connection with both said terminal end of said pipe and said one end of said stack to permit installation and removal of said closure means.

3. In a drying machine, a housing arranged to receive material to be dried, a rotatable drum in said housing for contacting the material to be dried, means for heating said drum and forming a film of dehydrated material on the surface thereof, means for scraping dehydrated material from said surface, conveyor means for carrying the dehydrated material to a point outside said housing, sealing means in said conveyor means for preventing venting of the housing to the atmosphere therethrough, a pipe coupled to said housing independently of said conveyor means and arranged for disposition with the terminal end thereof and spaced registering relation to one end of an atmospheric stack, an annular flange about the terminal end of said pipe, a gasket arranged to be disposed on said flange, a cover arranged to be secured to said flange with said gasket therebetween to seal said terminal end of said pipe, and a sleeve having a length greater than the distance between said terminal end of said pipe and said one end of the stack and arranged for telescoping connection with said one end of the stack to permit installation and removal of said cover and for telescoping relation with said terminal end of said sleeve with said cover removed to vent said housing to the stack.

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