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BLENDING AND HEAT EXCHANGE MILL

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Fig. 1

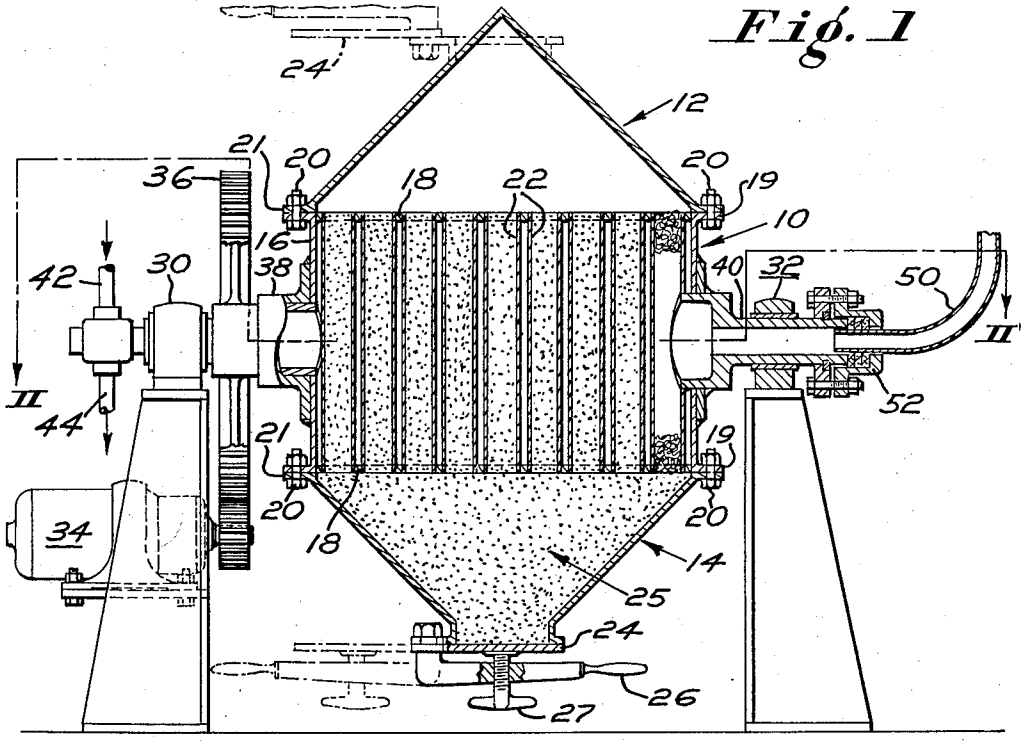
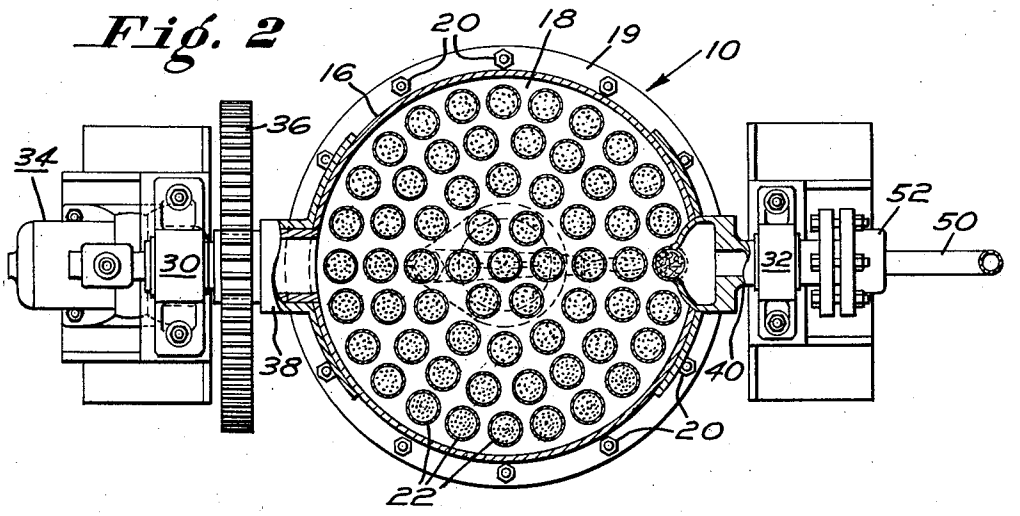


Fig. 2



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BLENDING AND HEAT EXCHANGE MILL

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5 Claims. (Cl. 257—75)

This invention relates to material heating or cooling devices for use in the various industries, and more particularly to an improved device as aforesaid which is also adapted for use as a blender for materials such as are difficult to admix, and wherein the admixture may at the same time be either heated or cooled or dried, as may be required.

It is an object of the invention to provide an improved "tumbler" type combination mixing and heat exchanging mill, adapted to process raw materials of both solid and liquid form requiring to be intimately mixed or blended and at the same time either heated or cooled or dried, as the case may be.

Another object of the invention is to provide a mill for the purposes aforesaid which is of novel structural form to provide highly efficient heat exchange operations.

Another object of the invention is to provide a mill as aforesaid which is of structurally simple and rugged form, and which may be relatively inexpensively fabricated in accord with standard shop practices.

Another object of the invention is to provide a mill as aforesaid which presents to the raw material maximum heat exchange total area in the form of surfaces which are more readily cleanable between "batch" uses of the mill, whereby contaminations of the mill products may be avoided.

Other objects and advantages of the invention will appear in the specification hereinafter.

In the drawing:

Fig. 1 is a vertical sectional view through a mixing or blending and heat exchange mill of the invention; and

Fig. 2 is a sectional view thereof taken along line II—II of Fig. 1.

As shown in the drawing, the mill casing of the invention may be constituted to comprise essentially a three-part construction; comprising a central cylindrical or drum-shaped section **10**, and conical-shaped opposite end sections **12, 14**. The central section **10** includes a cylindrical outside wall portion **16** to which are welded "header" plates **18—18**. The central section **10** may also be provided as shown with peripheral flanges **19—19** for bolted connections as indicated at **20** with corresponding flange portions **21** extending from the conical end portions **12, 14**.

The header plates **18—18** are bored in mutual alignment to receive therebetween a plurality of tubes **22**, as in the manner of conventional steam boiler construction. A removable cover as indicated at **24** is provided at the apex end of one of the conical sections so as to provide a material loading and discharge device. Thus, preparatory to loading the mill with a charge of material as indicated for example at **25**, the door end portion of the mill will be rotated to the top position thereof as shown by broken lines in Fig. 1. The door **24** may then be opened, and the mill charged with the material to be blended and heated or cooled or dried, as the case may be. The mill is then rotated for either heating or cooling the charges; and then upon completion of the material

processing operation the mill is finally rotated to the door-down position as illustrated by the solid line showing thereof in Fig. 1. The door **24** is then opened to permit discharge of the treated material by gravity from the mill onto a conveyor or the like, as is well known in the material handling art. A door control lever **26**, and a pressure control screw **27**, as shown in Fig. 1 may be employed in connection with the door **24** in order to insure vapor-tight locking of the door and ease of handling thereof during the mill discharging and charging operations.

The mill is mounted upon trunnion bearings as indicated at **30, 32** and arranged to be driven by any suitable means, as for example by means of an electric motor **34** through a gear train **36**; the mill per se being supported on the trunnion bearings by means of stub shaft devices **38, 40** which are bolted or otherwise fixed to opposite sides of the mill. Thus, it will be appreciated that under operation of the motor **34**, the gear train will operate to drive the mill to rotate upon the trunnion bearings **30, 32**, whereby the mill feed material **25**, disposed interiorly of the mill casing will be tumbled alternately between the conical end portions **12, 14**. During this process the mill feed material is caused to flow back and forth between the conical section **12** and the conical section **14** through the tubes **22**. This operation of the mill causes the mill feed material to be subjected to a novel churning and heat exchange operation interiorly of the conical sections and the tube portions of the mill.

For example, as the mill rotates from a substantially horizontal position into a vertical attitude, the mill feed material in the lower conical section is caused to slide through the tubes of the mill into the opposite conical section of the mill, wherein it is caused to pour downwardly into its conical apex in such manner as to receive therefrom a novel converging and intermixing motion. Then upon further rotation of the mill the feed material is caused to slide back in reverse direction through the tubes of the mill toward the opposite conical end portion of the mill. The conical end portions thereby function as mixing chambers. Hence it will be understood that the mill feed material is thereby subjected to a diversely directed series of flow paths; thereby receiving a novel beating action featured by maximum churning of the material while it is sliding in heat exchange rubbing relation with a maximum total area of heat exchange surfaces.

For example, as shown in Fig. 1, the stub shaft **38** at one side of the mill may be of hollow form to accommodate therethrough a pair of liquid circulation conduits **42, 44**, whereby steam or hot or cold water or the like may be caused to enter conduit **42** to circulate into and throughout the central tube mounting portion **10** of the mill, from a supply source exteriorly thereof. Thus, the circulating liquid or gas will flow throughout the drum shaped central portion **10** of the mill in intimate heat exchange relation with the outer surfaces of the tubes **22**, thereby imparting to the tubes **22** the desired heat exchange capacities for either heating or cooling the mill feed material as it flows back and forth through the tubes, as explained hereinabove. The condensate or discharge liquid exits through conduit **44**.

As illustrated at the right hand side portion of the mill in Figs. 1, 2, a vacuum conduit may be arranged in conjunction with the hollow interior of the stub shaft **40** if desired; the connection between the vacuum conduit **50** and the stub shaft **40** being made through a suitable stuffing box or the like, as indicated at **52**. The conduit **50** may then lead to any suitable vacuum supply device, and thus it will be appreciated that the interior of the mill casing may be thereby subjected to a partial vacuum so as to facilitate evaporation and removal of moisture

from the mill feed material, where it is designed to effect rapid drying of the mill feed material.

I claim:

1. A heat exchange device for heating or cooling flowable materials, comprising a casing having a portion with tube means extending therethrough and normally closed mixing chamber portions at the opposite ends thereof in communication with said tube means, means mounting said casing for rotation with said tube means and said chamber portions moving in unison about an axis transverse to the direction of said tube means, means constraining material in said casing portion to flow between said chamber portions substantially only through said tube means, whereby upon rotation of said casing portion a load of material therein slides alternately from one chamber portion through said tube means into the other chamber portion, and vice versa, and means for circulating a heat exchange fluid through said casing portion in heat exchange contact with the external surfaces of said tube means.

2. A heat exchange blending device for heating or cooling flowable materials, comprising a casing having tube means extending partially therethrough and normally closed mixing chamber portions at the opposite ends of said tube means in communication therewith, means mounting said casing for rotation with said tube means and said chamber portions moving in unison about an axis transverse to the direction of extension of said tube means, means constraining material in said casing to flow between said chamber portions substantially only through said tube means, whereby upon rotation of said casing a load of material therein slides alternately from one chamber portion of said casing through the interiors of said tube means into the other chamber portion, and vice versa, and means for circulating a heat exchange fluid in heat exchange contact with the external surfaces of said tube means.

3. A heat exchange and blending device for heat exchange treatment of flowable materials, comprising a tumbling mill including a normally closed casing having a pair of tube sheets disposed in parallel relation transversely of said casing and subdividing said casing into a generally cylindrical tube section and generally conical mixing chamber end sections at opposite ends thereof, generally parallel tubes extending endwise between said tube sheets in open communication with said end sections, means mounting said casing for rotation of said tube section and said end sections in unison about an axis transverse to the lengthwise direction of said tubes,

whereby upon rotation of said casing a load of material therein slides alternately from one end section through said tubes into the other end section, and vice versa, and means for circulating a heat exchange fluid through said casing tube section in heat exchange contact with the external surfaces of said tubes.

4. A heat exchange device for heating or cooling flowable materials, comprising a casing having tube means extending partially therethrough and mounted at their opposite ends in spaced headers extending transversely of said casing and defining otherwise normally closed mixing chamber portions at the opposite ends of said casing, means mounting said casing for swinging of said tube means and said chamber portions in unison about an axis transverse to the direction of extension of said tube means, whereby upon swinging of said casing a load of material therein slides alternately from one chamber portion of said casing through the interiors of said tube means into the other chamber portion, and means for circulating a heat exchange fluid in heat exchange contact with the external surfaces of said tube means.

5. A heat exchange and blending device for treatment of flowable materials, comprising a tumbling mill including a normally closed casing having a pair of tube sheets disposed in parallel relation transversely of said casing and subdividing said casing into a tube section and generally conical mixing chamber sections at opposite ends thereof, multiple tubes extending between said tube sheets through said tube section and in open communication with said chamber sections, means mounting said casing for rotation of said tube section and said chamber sections in unison about an axis transverse to said tubes whereby the load of material therein is caused to slide alternately from one chamber section through said tubes into the other chamber section, and means for circulating a heat exchange fluid through said casing tube section in heat exchange contact with the external surfaces of said tubes.

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