Dec. 29, 1942. E. KROPP 2,306,962

MIXING APPARATUS

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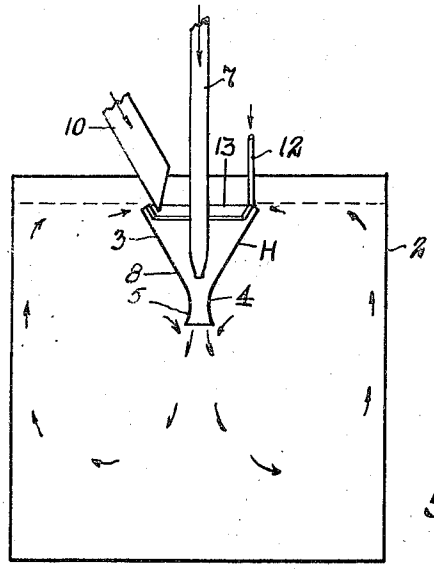


Fig. 1

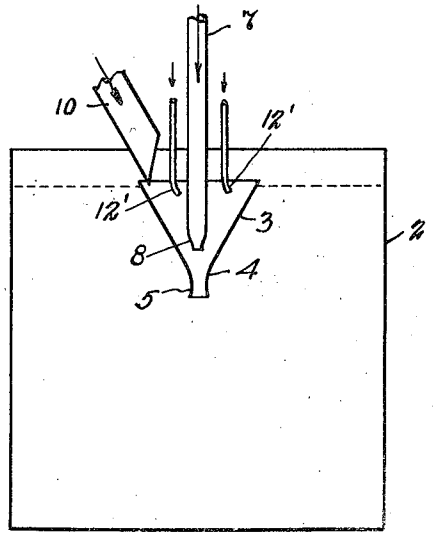


Fig. 2

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MIXING APPARATUS

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5 Claims. (Cl. 259—11)

In the mixing of materials it is particularly desired to attain a homogeneity of the admixed materials quickly and with a minimum application of power; and where the materials mixed are of dissimilar character a particular desideratum is to attain homogeneity without undue introduction of extraneous air to cause foaming and froth where liquid is involved. In accordance with the present invention, dissimilar components may be mixed thoroughly and quickly, and where one component is for instance a liquid and another is a powder or finely divided solid, undue lumping and segregation, as well as foaming, may be avoided, while attaining the desired dispersion or homogeneity of mixture.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing—

Fig. 1 is a vertical elevation, partly in section, showing an embodiment of the invention; and Fig. 2 is a fragmentary similar view of a modification.

The invention may be best understood by reference to a particular form involving the mixing of pulverized coal in water to form a homogeneous slurry adapted to be forwarded through pipe line transportation systems. A mixing tank or container 2 for such purpose is provided with a mixing hopper H which has a conically tapering inlet section 3 leading to a narrow throat 4 whence a shorter diverging section 5 opens into the tank. In relationship, a form of Venturi effect is initially provided. Axially directed into the throat portion and slightly spaced back therefrom is a feed jet 7 having a choked or constricted nozzle outlet 8. By this, and by the converging shape of the hopper leading to the throat, an acceleration velocity of materials proceeding down in the hopper to the throat is attained. Another feed inlet is provided laterally near the wall of the hopper, as an inlet 10. Positioned in a zone intermediate between this latter and the wall of the hopper is a further feed inlet 12 which, as shown more particularly in Fig. 1, may take the form of a circular distributing nozzle 13 extending entirely around within the wall of the hopper, but spaced therefrom to allow in-flow of liquid as over-flowing from the tank into the hopper under the propulsive action of the axial jet. Feeding powdered coal through the inlet 10 and water through the axial inlet 7, the propulsive jetting of the water at high velocity through the nozzle 8 introduces a differential of velocity into the mass above the throat of the hopper, and forwards it through the throat, while the powdered coal progressively comes down from the feed inlet 10 and a wall of liquid in two layers is supplied from the annular feed inlet 13 and the in-flow of liquid entering from the tank over the upper edge of the hopper. A slurry stabilizing agent, for instance such as disclosed in patent to R. E. Burk No. 2,128,913 may be included in one or both liquid feeds, if desired. The highest velocity is at the center of the throat 4 and in progressive zones to the bounding wall virtual thin layers in differential velocity are in effect rubbed into each other and thence in turbulent or thorough intermixture at the diverging section 5, it being noticed however that such turbulence is in a region below the converged sealing-off mass of coal so that air is not drawn in to cause deleterious foaming. With the divergence of the outlet section there is a sufficient lessened pressure to bring about rapid lateral in-flow and commingling from the surrounding liquid in the tank, and thereby particularly rapid homogeneous mixing of the entire mass.

Similarly, other powders and liquids may be brought into slurry form, and components also not precisely of such categories, but any substances which are capable of being fed and commingled in this manner. With some materials the liquid feed at the wall of the hopper can be omitted.

In some cases, instead of an annular feedhead 13 for liquid, the supply may be provided by a plurality of spaced pipes or nozzles; or where sufficient, one such feed pipe or nozzle may be applied.

As a further refinement, the feed inlet, such as at 12', Fig. 2, may desirably have its discharge directed angularly to form a whirling layer effect while being downwardly directed into the converging mixing throat. For some materials, the upper edge of the hopper 3 instead of being slightly submerged below the level of the liquid in the tank or container 2 such as to receive a constant over-flow therefrom, may be elevated slightly above the level of liquid in the tank, and thereby materials which inherently foam or involve components which are prone to accumulate at the top, can thus be selectively skimmed off

into the vortex of the mixing hopper, without bringing in large amounts of liquid body proper.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A mixing apparatus, comprising a container, a hopper therein with its upper edge at a level to receive liquid over-flow circulating from the container and having a conically tapering inlet section leading to a narrow throat and a diverging section leading from the throat into the container, an axial feed jet with a constricted nozzle near the hopper throat, a feed inlet for pulverulent solid matter near the top of the hopper, and an annular feed inlet for liquid interposed between the periphery of the hopper and said feed inlet for pulverulent matter introducing a layer of liquid in flowing direction along the wall of the hopper.

2. A mixing apparatus, comprising a container, a hopper therein above the liquid level in the container, said hopper having a conically tapering inlet section leading to a narrow throat and a diverging section leading from the throat into the container, an axial feed jet with a constricted nozzle near the hopper throat, a feed inlet for pulverulent solid matter near the top of the hopper, and an annular feed inlet for liquid on the slope of the hopper interposed between the periphery of the hopper and said feed inlet for pulvrulent matter introducing a layer of liquid in flowing direction along the wall of the hopper.

3. A mixing apparatus, comprising a container, a hopper therein having a conically tapering inlet section leading to a narrow throat and a diverging section leading from the throat into the container, an axial feed jet with a constricted nozzle near the hopper throat, a feed inlet for pulverulent solid matter near the top of the hopper, and an annular feed inlet for liquid on the slope of the hopper interposed between the periphery of the hopper and said feed inlet for pulverulent matter introducing a layer of liquid in flowing direction along the wall of the hopper.

4. A mixing apparatus, comprising a container, a hopper therein having a conically tapering inlet section leading to a narrow throat and a diverging section leading from the throat into the container, an axial feed jet with a constricted nozzle near the hopper throat, a feed inlet for pulverulent solid matter near the top of the hopper, and an annular feed inlet for liquid on the slope of the hopper interposed between the periphery of the hopper and said feed inlet for pulverulent matter introducing liquid along the wall of the hopper.

5. A mixing apparatus, comprising a container, a hopper therein having a conically tapering inlet section leading to a narrow throat and a diverging section leading from the throat into the container, an axial feed jet with a constricted nozzle near the hopper throat, a feed inlet for pulverulent solid matter near the top of the hopper, and another feed inlet for liquid on the slope of the hopper interposed between said feed inlet for pulverulent matter introducing liquid along the wall of the hopper.

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