Feb. 22, 1938. H. R. STRAIGHT 2,109,077

MEANS OF MIXING A PLASTIC MATERIAL

Filed Jan. 16, 1935

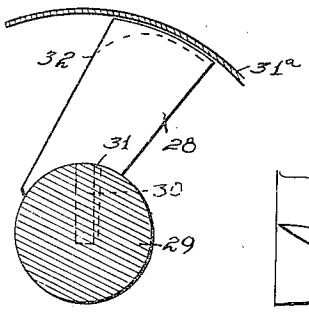


Fig. 5.

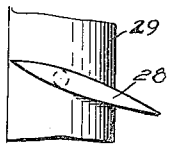


Fig. 6.

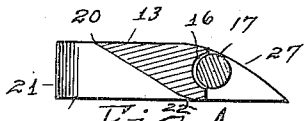


Fig. 4.

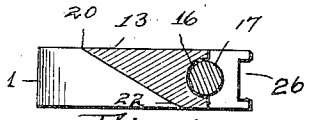


Fig. 3.

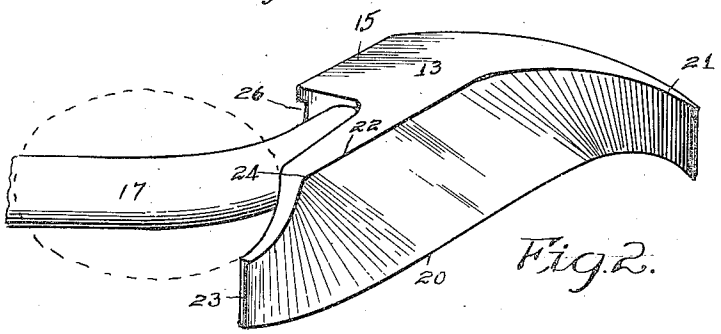


Fig. 2.

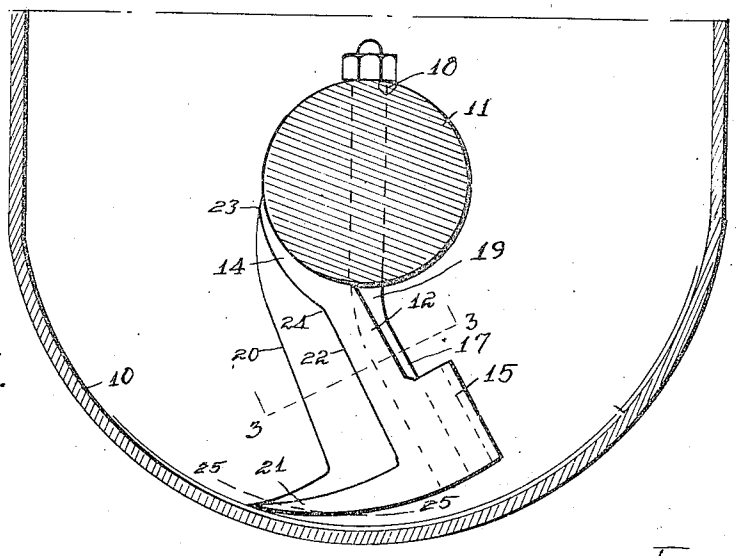


Fig. 1.

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MEANS OF MIXING A PLASTIC MATERIAL

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Application January 16, 1935, Serial No. 2,010

7 Claims. (Cl. 259—109)

The object of my invention is to prevent the mixing of air with the clay, or other plastics, while it is being pugged, thereby improving the plasticity, mouldability, finish, drying properties, strength dried and after fired, or cured, resistance to weather and abrasion and to reduce lamination.

A further object of my invention is to reduce the power required to mix the plastic.

A further object of my invention is to improve the contact of the fluxes in the clays with the silicates and aluminates so that more intimate contact will reduce the temperature required in firing to attain the desired degree of vitrification.

A further object of my invention is to provide an improved mixing knife so constructed that the packing of the material being mixed between the end of the knife and the adjacent side of the container as the knife is operated will be eliminated.

A further object of my invention is to provide a mixing knife having an improved cutting edge to clear a path through which its outer end may pass which will be self-sharpening and reduce the power required to operate it.

A further object of my invention is to provide in a mixing knife a flat backwardly sloping surface at substantially right angles to its plane of rotation and along its front edge, next to the shaft in which the knives are mounted, for the purpose of forcing outward away from the shaft part of the clay being worked, while at the same time the clay is being advanced toward the discharge point of the container, in which the clay is contained as worked, and which with its cutting edge at the extreme outer radius acts to pack the plastic into a more compact mass than would be obtained by simply cutting through it.

A further object of my invention is to provide a mixing knife having a ductile shank cast into its body of a hard non-yielding metal adapted to resist abrasion which ductile shank may be free to bend backward relative to the direction of rotation without passing the limit of elongation of the metal comprising the shank to reduce breakage.

My invention consists in shaping, or streamlining, the knives or mixing blades in such a manner that substantially no air suction is created in the wake of the knives as the plastic substance is cut through and as the knives revolve, or conversely to add more air to the plastic by increasing the air mixed in by providing a groove down the back of the knife so air may more freely mix in. Also in shaping the knives in such a manner that a slicing and draw cut is obtained and either or all in combination, of the modifications from the conventional design attain part of my objects contemplated as pointed out in my claims and as illustrated in the accompanying drawing.

My invention in connection with the improvement further consists in providing means of reducing the friction on the end of the knife by making a major portion of the knife self-clearing from the plastic packed around the inside of the container in which the plastic is being worked, thereby greatly reducing the power required to operate the mixer blades or knives. By making all points of the end surface of shortening radius from the center of rotation toward the rear of the knife the forward cutting edge, during its successive revolutions, wears sharp and constantly maintains a very sharp cutting edge.

My invention further consists of providing a warped surface approaching a warped cam in shape which will cause the clay or other plastic to be moved away from the shaft at the same time it is being advanced toward the point of discharge and in such a manner that the plastic pulled inward by the outer cutting tip or edge and the surface inside of this cutting edge will cause the clay to be squeezed or packed before passing beyond the influence of each knife as moved toward the discharge end of the mixer by the pitched surface of the mixing knife.

My invention further consists of casting a ductile shank or holder into a wear resisting metal blade or knife in such a manner that it is free to bend backward whatever distance is necessary to relieve such pressure as is exerted upon striking a non-movable object without breaking off the shank or bending it beyond limits of its yieldability.

In the accompanying drawing Fig. 1 is a transverse sectional view of the lower end of a mixing chamber and a mixing shaft rotatively mounted therein showing the manner in which my improved knife mounted in such container and to the mixing shaft.

Fig. 2 is a perspective view of my improved mixing knife.

Fig. 3 is a detailed sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is also a detailed sectional view showing a slightly modified form wherein the outer end of the knife is curved to produce a streamlined effect.

Fig. 5 illustrates a modified form of my improved mixing knife together with the portion of the mixer shaft and the container in section.

Fig. 6 is a detailed view showing the modified

form of my improved mixing knife in an end elevation together with a portion of the mixer shaft.

In the drawing I have used the reference numeral 10 to indicate the lower portion of the mixer chamber such as is commonly used in connection with pugmills of ordinary construction. The lower side of said mixing chamber is preferably of cylindrical construction so that substantially all of the material in the bottom of the container may be agitated and mixed by the revolving knives therein. Rotatively mounted in the mixing chamber 10 is a mixer shaft 11 mounted concentrically in the bottom of the said container and driven by suitable mechanism in the usual manner not illustrated.

My improved knife comprises the body portion 12 having substantially parallel side faces 13 the inner end of the body 12 having a concaved portion 14 adapted to fit the contour of the shaft 11. The back edge of the body 12 is inclined rearwardly of the line of rotation of said body when mounted on a supporting shaft. The outer end of the back side of said body has rearwardly extending portion 15. The portion of the back side of the body 12 between the rearwardly extending portion 15 and the member 14 is provided with a groove 16 to receive a shank 17, the outer end of the shank 17 projecting through the member 15 and fixed therein, the inner end of the shank 17 being mounted in an opening 18 in shaft 11. The said shank 17 is formed of ductile material and curved at the point 19 outside of the shaft 11 in such a manner that excessive strains applied to the outer end of the body 15 as the knife is rotated in a clockwise direction as illustrated in Fig. 1 will tend to bend the shank 17 at a point between the shaft 11 and curved extending member 15 and thereby eliminate excessive concentrated bending strains being applied to the shank 17 at a point immediately adjacent to the circumference of the shaft 11. This will greatly reduce any tendency of the shank to crystallize at said point and in turn will eliminate breakage. Thus the crystallizing effect is eliminated due to the fact that the strains are more uniformly distributed throughout the entire portion of the shank beween shaft 11 and member 15.

The forward edge 20 of the body 12 is also inclined outwardly and rearwardly from the line of rotation of the said knife, the inner edge of the forward edge terminates at the forward end of the member 14 in the manner clearly illustrated in Fig. 1. The outer end of the forward face of the body 12 is provided with an outwardly and forwardly projecting portion 21 so as to provide a cutter adapted to move the material inwardly from the side of the container 10 as the said knife is rotated, the outer end of the body 12 being formed eccentrically with the center of the shaft 11 so as to provide clearance between the outer end of the member 12 and the inside wall of the container 10 to prevent packing and binding of material between the outer end of said member 12 and the said container as the member 12 is rotated.

The front face of the member 12 is beveled from the forwardly extending edge 20 to the line 22 of the opposite side of the body 12, the forward edge 23 of the member 14 being substantially parallel with the axis of the shaft 11, and that portion of the front face of the member 12 between the point 24 and the edge 23 being warped in a manner clearly illustrated in Fig. 2. This provides means whereby the material being mixed would have a tendency to be moved outwardly towards the wall of the container 10 and also laterally of the member 12 as the said member 12 is rotated, said material tending to move toward the material being moved inwardly by the inclined forwardly extending portion 21 and being packed with material being moved laterally by inclined central portion of the member 12, thereby causing a more intimate relation to be established between the various ingredients of the material being worked or mixed.

It will readily be seen in Figs. 1 and 2 that the forwardly projecting member 21 provides a cutter element of substantially the same thickness of the body 12 which is adapted to cut or shave material being packed against the wall of the container 10 to move the same inwardly and provide clearance with the outer end of the member 12 wherein any wedging or binding between the outer end of the member 12 and material packed against the inner surface of the container 10 would be eliminated with a saving of power to operate the knife. It has been found by actual experience that the outer surface of the forward end of the projecting member 21 would wear concentric of the center of the shaft 11 as illustrated by the dotted line 25—25. The cutting edge of the member 21 always is sharp and at the same time providing a great amount of clearance between the outer end of the member 12 and the material packed against the inner surface of the container 10 regardless of the amount of wear imparted to the outer end of the knife during its useful life.

The back edge of the rearwardly extending portion 15 is provided with a longitudinally extending groove 26 to permit the air to move inwardly through said groove to the partial vacuum created back of the moving member 15 which thereby increases the amount of air mixed in the material. It sometimes is not desirable to increase the amount of air mixed with the material but rather to decrease the amount of air mixed with the material, in which case the one side of the rearwardly extending portion 15 is beveled at 27 as illustrated in Fig. 4 to produce a streamlined effect and thus prevent the tendency toward pulling air into the partial vacuum created back of the moving member 15. In Figs. 5 and 6 I have illustrated a modified form of mixing knife, the body of which is inclined rearwardly of the line of rotation and indicated by the numeral 28. The inner end of the body 28 is formed concavely to fit the contour of the shaft 29. The end of the body 28 is also provided with an inwardly extending shank 30 for securing the knife in said shank by securing the end in by means of a wedge 31 or other suitable means. The face of the knife 28 is beveled as illustrated in Fig. 6 to produce a streamlined effect said knife being mounted on an angle to advance the material longitudinally of the shaft 29. By inclining the forward edge of the knife 28 rearwardly of its line of rotation I have provided means whereby a draw cut effect will be produced and at the same time means tending to move the material toward the side of the container 31.

I list some of the advantages of my improvement as follows: An advantage of sloping back of the forward advancing edge of my mixing knife and the self clearing end is in reduction of the power required.

A further advantage is the thorough mixing

and working of a plastic substance without cutting or mixing into the plastic increasing amounts of air as the substance becomes more thoroughly mixed.

One of the advantages of my improved knife over the ordinary knives resides in forming the outer end of the knife eccentrically with its center of rotation so as to provide clearance between the end of the knife and the wall of the container and to prevent the front end of the outer end of the knife wearing in a curved manner in the opposite direction as illustrated by the dotted line **32**, in which case the packing of the material being mixed takes place between the outer end of the knife and the adjacent end of the container which acts as a decided drag to increase the power required to rotate the shaft **30** and yet does not add in any substantial amount to the mixing of the material.

A further advantage is in the design of a ductile shank or holder adapted to be mounted in a shaft cast into a mixing blade or knife in such a manner that if the knife meets an unyielding object while revolving it can bend back and relieve the pressure without breaking the ductile shank.

A further advantage is the saving in fuel for firing such as clay products due to the more intimate mixing and contacting of the fluxes and the other substances composing the body of the mixture.

I claim as my invention:

1. In a device of the class described, a mixing knife having its back face provided with a rearwardly extending portion near its outer end, a shank formed of ductile material having one end mounted in the inner end of said rearwardly extending portion and supported adjacent to the back side of the inner end of said knife, the inner end of said shank extending inwardly of the inner end of said knife.

2. In a device of the class described, a mixer shaft, an outwardly extending supported mixing knife having its outer end provided with forwardly and rearwardly extending portions the forwardly extending portion terminating in a sharpened edge to move material inwardly, a shank formed of a ductile material supported adjacent to the back face of said knife having its outer end mounted in said rearwardly extending portion and its inner end mounted in said shaft.

3. The combination of a mixing shaft, a mixing knife comprising a body portion, the outer and inner ends being substantially rectangular in cross section, that portion of its front face intermediate its ends being beveled from one face to the other, the inner end of said knife being curved to fit the contour of said shaft, and means for securing said knife to said shaft.

4. In a device of the class described, a mixing knife comprising a body portion having its front edge inclined rearwardly of its radius of rotation and terminating in an outwardly and forwardly extending wedge shaped portion at its outer end having a cutting edge parallel with its axis of rotation the inner face of said wedge shaped portion being inclined inwardly and rearwardly to move material inwardly as the knife is rotated.

5. A mixing knife comprising a body portion, its outer and inner ends being substantially rectangular in cross section, that portion of its front face intermediate its ends being beveled from one face to the other, the outer end of said front edge terminating in a forwardly projecting and tapered portion to form a cutter edge substantially parallel with its axis of rotation and having its inner face inclined inwardly and rearwardly, to move material inwardly from its outer end as the knife is rotated.

6. In a device of the class described an outwardly extending mixing knife having its front edge beveled and its outer end terminating in a forward projecting and tapered portion having the tapering faces terminating in a cutting edge substantially parallel with the axis of rotation of said knife, the inner face of said forwardly extending portion being inclined inwardly and rearwardly, terminating in said beveled edge to first impart a positive movement of material inwardly from its outer end toward its center and thence longitudinally of the axis of rotation of said knife.

7. A mixing knife having its back face provided with a rearwardly extending portion near its outer end, said rearwardly extending portion having one of its faces tapered to produce a streamline effect, the outer end of said knife terminating in a forwardly extending tapered portion to form a cutting edge, said cutting edge being substantially parallel with the axis of rotation of said knife.

HALVER R. STRAIGHT.