Sept. 8, 1942. C. J. STIERS 2,295,136

MIXER

Filed Feb. 13, 1940

FIG. 1.

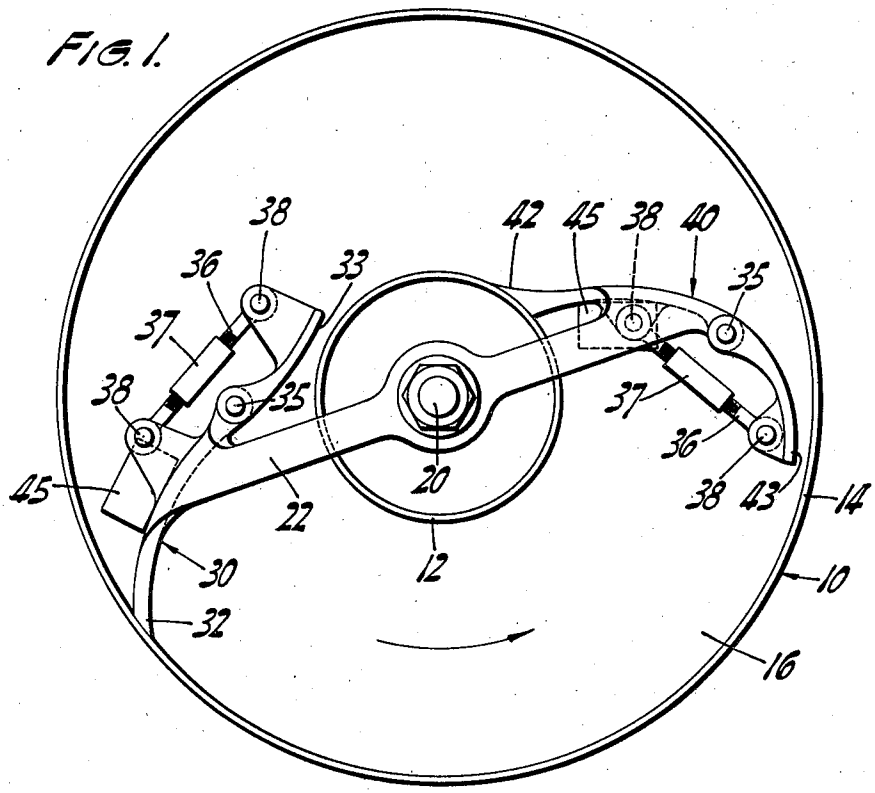
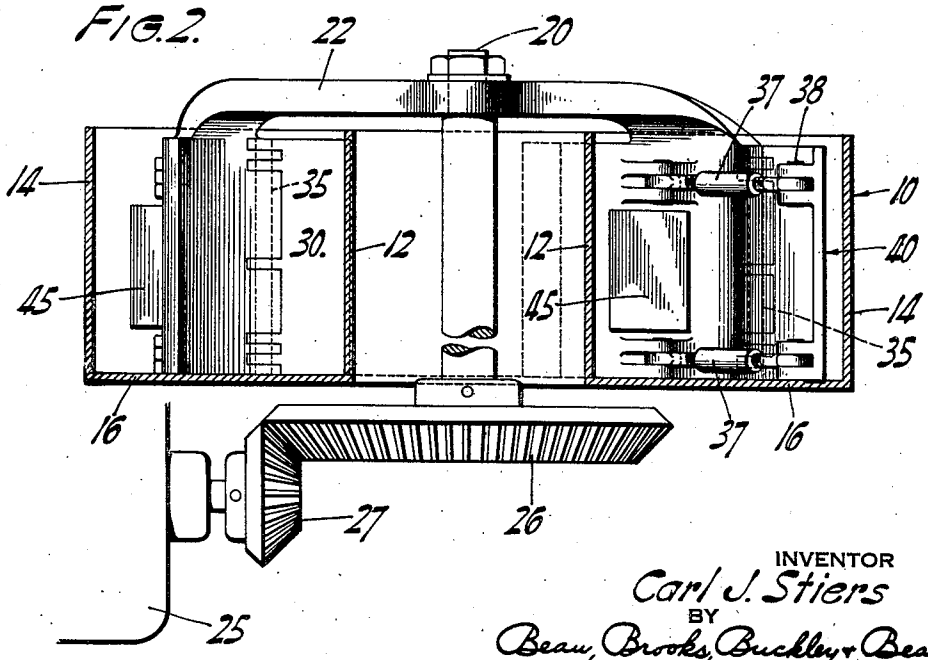


FIG. 2.



INVENTOR
Carl J. Stiers
BY
Beau, Brooks, Buckley & Beau.
ATTORNEYS

Patented Sept. 8, 1942 2,295,136

UNITED STATES PATENT OFFICE

2,295,136

MIXER

Carl J. Stiers, Galena, Ohio

Application February 13, 1940, Serial No. 318,733

5 Claims. (Cl. 259—107)

This invention relates to mixing devices, and has application to a wide variety of industrial mixing operations wherein the primary object is to rapidly obtain optimum dispersion of various kinds of materials in conjunction with minimum power consumption and operating expense. The invention is particularly adapted to provide improved performance in connection with especially difficult mixing operations such as wherein dry and liquid ingredients are mixed together to form semi-fluid or plastic masses. For example, the invention is particularly adapted for use in connection with industrial mixing and/or processing of materials entering into abrasive compounds, cements, chemicals, drugs, dye stuffs, food products, greases and oils, synthetic resins, rubber compounds, soaps, waxes, foundry sands, and the like.

In connection with the mixing and processing of compounds comprising mixtures of ingredients having widely different physical characteristics such as texture and viscosity and specific gravity, it is relatively difficult to produce a thoroughly mixed and homogeneous product. Various machines employing stirring and/or kneading means have been previously developed for use in connection with such operations, but they have been deficient in various respects; and the primary object of the present invention is to provide means for more intimately and thoroughly mixing together the ingredients of such products in an improved manner and at less expense. Another object of the invention is to provide a machine that is capable of producing thorough dispersions of semi-fluid and dry materials that are normally relatively difficult to mix together because of their physical characteristics.

For example, in connection with the ceramic industry, it is necessary to obtain as perfect a dispersion as may be possible of the batch ingredients such as silica sand, soda, etc., in order to obtain a uniformly perfect product; and although all of the ingredients of such batches may be dry, it is often difficult to obtain uniformly homogeneous mixtures thereof through use of prior art machines because of differences in sizing and texture and specific gravity of the materials. Also, in the case of some semi-plastic mixtures, such as core sand for foundry use, the differences in characteristics of the materials to be mixed makes the mixing operation particularly difficult. The mixing batch for foundry core sand is usually composed of sand and oil and sometimes an additional binder such as pulverized clay, silicate, or a dextrin compound. In typical industrial foundry practice the mixing of the core sand is usually a production batch method and it is desirable to limit the amount of oil and clay or other binder used to as low proportions as may be possible and to reduce the time of the mixing operation as much as possible. Also, it is sometimes desirable to use as much as possible of "old sand" from previously used foundry operations along with new sand of the mix, but to obtain satisfactory permeability and strength characteristics in the final mixture the amount of old sand that may be employed is usually limited to a relatively low percentage because of the burned binder and other fines which the old sand contains and which detract from the strength and permeability of the mixture to which they are added.

Consequently, the desideratum is to provide a mixer which is capable of thoroughly commingling the ingredients of the batch so that each grain of sand becomes coated with oil and with the clay or other binder substance if used without coincident production of additional fines, and in less time and for less power and operating expense. Obviously, excess amounts of oil in the mixture would be disadvantageous both from the standpoint of economy and from the standpoint of the performance of the finished product, and it is therefore important to obtain as thorough a dispersion of the ingredients throughout the batch as may be possible.

It will also be apparent that in connection with a mixing operation of the type wherein it is desirable to avoid further production of fines in the mixture it will be necessary to avoid the use of mixing devices such as normally tend to simultaneously produce breakage of the material structure. For example, mixing devices of the so-called Muller type would be disadvantageous for use in such operations.

Difficult problems with respect to the mixing of materials also often arise in connection with the production of pasty mixtures such as putty, refractory materials, welding rod coatings, and the like. Due to the surface tension characteristics of the liquid ingredients of such mixtures it is often quite difficult to obtain thorough dispersion of the ingredients throughout the mass in uniform manner and without the production of lumps, without unreasonable expenditure of time and power.

The present invention provides a novel form of mixing action comprising the combination of plowing and/or kneading and agitating effects by means of a relatively simple mechanism

whereby an improved degree of dispersion and commingling of the ingredients of the mix is obtained. The invention contemplates generally provision of a secondary agitation process in the form of rapid vibrations in the material at the situs of a primary plowing and/or kneading process, whereby the respective particles of the mixture are simultaneously roughly mixed by the primary plowing and/or kneading action and secondarily infused and intimately commingled by the vibration effects. Other objects and advantages of the invention will appear from the specification herein.

In the drawing:

Fig. 1 is a top plan of a mixer of the invention; and

Fig. 2 is a vertical section thereof showing the mixer blades in elevation.

The present invention is adapted for use in connection with a large variety of types of mixing and processing apparatus. It is illustrated in this specification in connection with a mixer including an annular pan 10 having concentric inner and outer vertical walls 12 and 14, respectively, and a bottom plate 16. A vertical mixer shaft 20 is disposed centrally of the pan 10 and carries a cross arm 22 in rigidly mounted relation thereon for rotation with the shaft 20 about its vertical axis. The shaft 20 is mounted for rotation upon any suitable form of bearing means (not shown), and is shown as being operatively connected to a driving motor 25 by means of beveled gears 26 and 27.

The cross arm 22 carries at its ends opposed mixing blades 30 and 40 which are generally in the form of vertical plates extending transversely of the annular space within the pan 10. In plan view the blades are disposed angularly with respect to corresponding radial lines extending from the center of rotation of the mixer shaft 20 so as to provide for each of the mixer blades a leading and a trailing end portion thereof relative to the movements of the blades against material to be mixed when placed within the pan. Thus, when the mixer shaft is rotated in the direction of the arrow of Fig. 1 the end portion 32 of the blade 30 moves against the material placed in the pan for mixing ahead of the end portion 33 thereof; and the end portion 42 of the blade 40 moves ahead of the end portion 43 thereof. Hence, the leading edge of the blades 30 moves adjacent the outer wall 14 of the pan and the trailing edge 33 thereof is adjacent the inner wall 12 of the pan; while the leading edge 42 of the blade 40 moves adjacent the inner wall 12 and the trailing edge 43 moves adjacent the outer wall 14. More specifically, the blade members 30 and 40 are preferably provided of such curvilineal plan form that the front faces of the blades are concavely shaped adjacent the respective leading edge portions thereof and then smoothly curved into convexly shaped trailing edge portions thereof. It will be seen that during operation of the mixer the blade 30 will plow the material to be mixed away from the outer portion of the pan 10 and inwardly against the inner wall 12 thereof where it is allowed to pass between the trailing edge 33 and the inner wall 12. Subsequently the leading edge of the blade 40 moves against the material previously turned by the blade 30 and plows it outwardly against the pan wall 14, where it is allowed to pass between the trailing edge 43 of the blade 40 and the wall 14. Thus, it will be seen that during operation of the mixer the material in the pan will be continuously plowed back and forth from side to side of the annular pan by the blades 30 and 40.

The mixing blades 30 and 40 may be mounted upon the cross arm 22 in a variety of different manners, depending upon mechanical choices and the results to be obtained. For example, they may be rigidly mounted in fixed relation thereon and without means for adjusting either their angular disposition relative to radial lines extending from the center of rotation or the width of the gap between their trailing edges and the adjacent pan walls. Of if desired, the blades may be flexibly mounted upon the cross arm 22 and held in operative position by some suitable resilient means adapted to relax when opposed by excessive loads at various portions of the blades under operating conditions. Or, as illustrated in the drawing, the leading edge and central body portions of the blades may be formed as integral fixed portions of the cross arm 22 and so arranged that the leading edges thereof function as scrapers against the respective adjacent pan walls. The heel portions of the blades may be adjustably attached thereto as by means of pivot pins 35 and adjustable bracing means in the form of adjustable length struts 36 connected at their opposite ends to suitable extending ear portions of the main body and trailing end portions respectively by means of pins 38, and having intermediate screw-threaded adjustment sleeves 37. Thus, the width of the gaps between the trailing edge portions 33 and 43 of the blade, and the respectively adjacent wall portions 12 and 14 may be varied to suit conditions and requirements in different cases.

By reason of the arrangement shown and described hereinabove the material being operated upon is plowed back and forth through the mixer and is simultaneously pressed between the trailing edge portions of the blades and the side walls of the pan due to the streamlined converging form of the blade trailing ends. Hence, when mixing ingredients of widely differing physical properties such as dry pulverized materials and oils for example, an additional heneficial kneading action is provided by the trailing edge portions of the blades and the materials are literally pressed together in conjunction with the mixing operation provided by the plowing action. By varying the adjustment of the struts 36 the character of the pressing action may be varied to suit different conditions to provide best results. It is also contemplated that in lieu of the adjustable length positive strut type of members 36 resilient braces may in certain cases be employed with good results. In such event a bracing device employing springs or other elastically deformable elements under either tension or compression forces may be employed, but it is believed that this will be clearly understood by persons skilled in the mechanical arts and in the interest of simplifying this specification no further explanation or illustration thereof is included herein.

The vibration producing means in connection with the mixing elements of the device may be provided, as illustrated herein, in the form of electrical vibration units 45 mounted upon the blades 30 and 40 at the rear faces thereof. During operation the vibration devices impart to the blades 30 and 40 rapid oscillations or tremors of such character that as the blades plow through the material being mixed they simultaneously jostle the particles next adjacent thereto and

introduce adjunctive admixing impulses which cause nearby particles of material to move into intimate commingling relationship. Hence, there is provided a novel combination mixing action comprising a primary plowing of ingredients into roughly mixed state and a secondary agitation-produced commingling of the previously roughly mixed particles. Simultaneously a pressing action is imposed upon the mixed mass as it squeezes past the respective mixing blades; whereby the commingling process made possible by the local agitation is accelerated by direct pressure forces. Consequently a perfect infusion of fine or liquid particles into the relatively coarse and/or dry materials is effected, with the result that the coarser and/or dry particles become coated with the finer and/or more liquid particles in a vastly improved manner in return for minimum expenditures of power and time.

I have also noted that when operating on some kinds of materials, the vibration effects of the invention provide aeration and beneficial fluffing of the material being processed.

It will be apparent that in lieu of the electrical vibrator devices illustrated herein, any other suitable form of vibration producing device may be employed for the purposes of the invention. For example, the vibration may be produced by means of any suitable mechanical means; and it will also be understood that either single or multiple vibration devices may be mounted upon the mixer elements in various ways and at various locations relative thereto. For example, a single vibrator unit may be mounted upon the cross arm 22 or the central shaft 20, or at any other suitable location whereby the features of the invention will be obtained by reason of the vibration imparted to the mixing blades in conjunction with the primary stirring or plowing operation.

It will also be understood that the present invention contemplates application of the combination plowing, vibrating and/or pressing action principle in connection with a large variety of other types of stirring, agitating, mixing, or processing devices as are in present day use and such as employ different forms of stirring, mixing and/or kneading, plows, scrapers, mullers, paddles, blades, screws, gears, and the like, and which function upon relative movement between the operating parts. For example, in the case of the mixer device illustrated herein, it will be understood that the mixing operation will be obtained either upon fixation of the pan 10 and rotary movement of the shaft 20, or through rotary movement of the pan 10 and either fixation or reverse movement of the shaft 20. In other words, the requirement is to provide relative movement between the operating parts.

The invention is particularly suited to provide many improved forms of mixed products and at minimum operating expense. For example, in connection with the processing of foundry sand, the sand and oil and other binder ingredients of the mix are roughly mixed by the plowing action of the blades 30 and 40 and simultaneously jostled as the blades vibrate. Consequently, the oil and/or other fine filler particles rapidly disperse throughout the vibration-affected zones, and the sand grains become thoroughly coated with oil and the finely pulverized clay or other bonding substance is simultaneously moved into position around each grain. Hence, each grain is quickly surrounded by oil and/or pulverized binder without employment of excess amounts of oil and/or binder in the mix. Hence, economies with respect to the relatively expensive ingredients are effected, along with economies with respect to power and time consumed during the mixing operation. It will also be understood that in connection with the mixing operation just described there will be no appreciable formation of additional fines or stratification of segregated ingredients. Also, because of the combination plowing and agitating and pressing action there will be no formation of lumps or nodules in the product.

As stated, the amount of pressure applied upon the material during the pressing action between the trailing ends of the blades and the pan walls will be varied according to the requirements in each case, and it will be understood that the beneficial results of pressing under vibration will be obtained by application of the invention in connection with any other type of mixing device wherein kneading or pressing of the material between relatively moving members is obtained. For example, some modified forms of pug mills employ moving blades that intermesh to provide kneading and squeezing actions therebetween, and it will be understood that in connection with any such device the application of vibration devices thereto will provide the improved results of the present invention.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a mixing machine, an annular material containing pan having inner and outer walls and adapted to receive successive charges of materials to be mixed, a pair of opposed plows and means for mounting said plows for revolution within said pan, both of said plows being generally inclined relative to corresponding radials extending from the center of said revolution so as to have leading and trailing end portions respectively, one of said plows being so arranged that its leading edge moves adjacent said outer wall to scrape material therefrom and so that its trailing end moves in spaced relation with respect to said inner wall to release said material therebetween in conjunction with a pressing action thereon, the other of said plows being so arranged that its leading end moves adjacent said inner wall to scrape material therefrom and so that its trailing end moves in spaced relation with respect to said outer wall to discharge said material therebetween in conjunction with a pressing action thereon, and vibration producing means operatively associated with said plows for imparting vibration impulses thereto in conjunction with the scraping and pressing actions.

2. In a mixing machine, an annular material containing pan having inner and outer walls and adapted to receive successive charges of materials to be mixed, a pair of opposed plows and means for mounting said plows for revolution within said pan, both of said plows being generally inclined relative to corresponding radials extending from the center of said revolution so as to have leading and trailing end portions respectively, one of said plows being so arranged that its leading edge moves adjacent said outer wall to scrape material therefrom and so that its

trailing end moves in spaced relation with respect to said inner wall to release said material therebetween in conjunction with a pressing action thereon, the other of said plows being so arranged that its leading end moves adjacent said inner wall to scrape material therefrom and so that its trailing end moves in spaced relation with respect to said outer wall to discharge said material therebetween in conjunction with a pressing action thereon, each of said plows having mounted thereon a vibration producing device for imparting vibrations thereto in conjunction with the plowing and pressing actions.

3. In a mixing machine, a material container adapted to receive successive batches of material to be mixed, a plow and means for mounting said plow for movement against material placed in said container and having a trailing end portion arranged in inclined relation with respect to a wall portion of said container and adapted to move in spaced relation therefrom to gather and press said material between said plow and said container wall portion, a vibrator operatively associated with said plow for imparting vibration impulses thereto during the plowing and pressing operation, and means for adjusting the width of the space between said trailing end portion and said adjacent container wall portion.

4. In a mixing machine, a container adapted to receive successive batches of materials to be mixed, a pair of mixing impellers disposed in said container, mechanical means for moving said impellers continuously through said materials, one of said impellers being arranged to continuously shift the materials in said container and the other of said impellers being arranged to shift the materials in an opposite direction in said container, said shifting movements cooperating to accomplish a primary mixing of the materials, and means for imparting relatively rapid vibrations of small amplitude to one or more of said impellers to accomplish a secondary mixing of the materials.

5. In a mixing machine, a receptacle having an annular mixing chamber, a drive shaft disposed coaxially with respect to said mixing chamber, arms radiating from said shaft and secured thereto for movement therewith, each of said arms having a mixing impeller at its outer end and disposed in said mixing chamber, one of said impellers having a leading portion fixed with respect to its carrying arm and adapted to scrape along the inner interior wall of said annular mixing chamber, said impeller having a trailing portion extending toward the outer wall of said chamber, said trailing portion being adjustably carried by said leading portion for varying the proximity of the trailing portion to said outer wall, another of said impellers having a leading portion fixed with respect to its carrying arm and adapted to scrape along the outer interior wall of said annular mixing chamber, said other impeller having a trailing portion extending toward the inner wall of said chamber, said trailing portion being adjustably carried by said leading portion for varying the proximity of the trailing portion to said inner wall.

CARL J. STIERS.