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MIXING DEVICE

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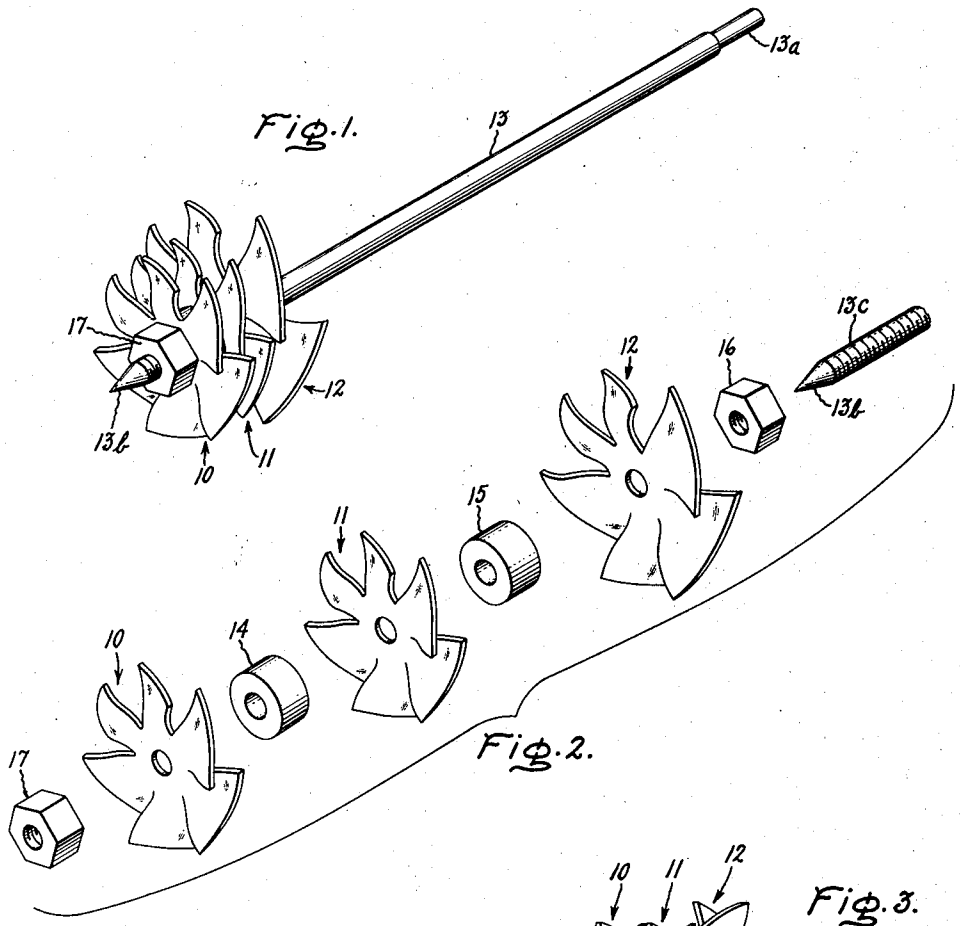


Fig. 1.

Fig. 2.

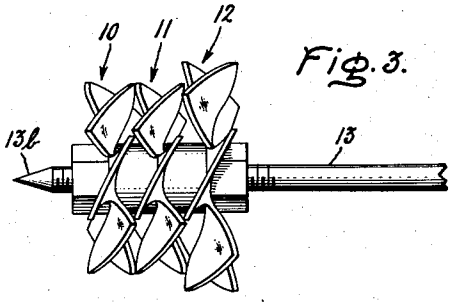


Fig. 3.

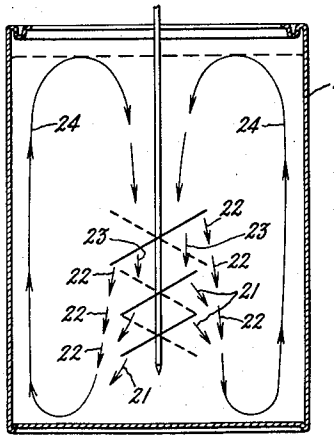


Fig. 4.

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MIXING DEVICE

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1 Claim. (Cl. 259—134)

This invention relates to mixing devices, and more particularly to an improved mixing device for use with relatively high speed rotating equipment such as portable electric drills, drill presses and the like.

The problem of mixing heavy liquids or suspensions such, for example, as paint, has long been troublesome. Various attempts made in the past to solve the problem have not been particularly successful for a variety of reasons, such as insufficiently rugged construction of the mixing device, inefficient mixing action or excessive cost of the device. Today, with the ready availability of portable high speed drills, drill presses and the like, there is an increasing need for a completely satisfactory mixing device adapted for use with these tools.

Accordingly, a primary object of the present invention is to provide an improved mixing device adapted for use with modern high speed drill equipment, which will quickly and efficiently mix heavy liquids and suspensions. An example of the latter class of materials is paint, which may have separated to leave a heavy pigment material settled in the bottom of the container with a liquid carrier on top of the pigment. A particularly effective mixing action is required quickly to effect a re-suspension of the two constituents.

Another object is to provide a mixing device that is rugged in construction, and yet is inexpensive to construct.

A mixing device constructed in accordance with the teachings of the invention may comprise three circular series of blades coaxially mounted on a shaft, which is adapted to be retained in the rotating chuck of high speed drill equipment. Each of the series of blades includes six blades, and the series are spaced from each other by amounts depending on the size and pitch of the blades. The blades of the series nearest the chuck held end of the shaft are larger than those of the other two series, which are of like size and configuration, so that the blades of the one series extend outwardly beyond the blades of the other two series. The blades of the three series form a screw.

The sizes of the blades, the spacings between the series of blades and the pitch of the blades are so chosen that the flow of liquid through the blades and hence throughout a liquid filled container in which the mixing device is used is greatly improved over that resulting from the use of such devices heretofore known. The action of the mixing device of the invention is positive and quick, and it will completely and thoroughly mix in a matter of seconds even a heavy suspension such as paint.

For a better understanding of the invention, together with further objects and advantages thereof, reference is made to the following description of one embodiment thereof, taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a perspective view of a mixing device constructed in accordance with the invention;

Fig. 2 is an exploded perspective view of the mixing device shown in Fig. 1;

Fig. 3 is a side view of a portion of the mixing device; and

Fig. 4 is a diagrammatic view showing the flow of liquid in a container in which the mixing device of the invention is being used.

As seen in Fig. 1, a mixing device constructed in accordance with the invention comprises three circular series **10**, **11**, **12** of blades coaxially mounted on a shaft **13**, with the upper end **13***a* of the shaft being of reduced diameter and adapted to fit into the rotating chuck of high speed drill equipment (not shown). The lower end of the shaft **13** is pointed, as at **13***b*, for a reason to be later pointed out, and may be threaded, as at **13***c*, to provide means for securing the series of blades in place. Of course, the entire shaft may be of the proper diameter to fit the rotating chuck of a drill, so that the end portion of the shaft need not be of reduced diameter.

As best seen in Fig. 2, the series of blades are separated by spacers, spacer **14** being located between blade series **10** and **11**, and spacer **15** being located between blade series **11** and **12**. A nut **16** may be threaded on the portion **13***c* of the shaft to provide a shoulder against which the blade series **12** bears. If desired, a shoulder may be formed on the shaft **13** at the proper position, and thus the nut **16** may be eliminated. The entire assemblage of blade series and spacers is retained in position near the end of the shaft **13** by a nut **17** threaded on the portion **13***c* of the shaft below the lowest blade series **10**. Although the spacers **14** and **15** are illustrated as washers, nuts may be threaded on the portion **13***c* of the shaft to act as spacers. Of course, if nuts are used instead of washers, each nut must be tightened down to retain in position the blade series next above the nut.

One of the outstanding features of the present invention lies in the configuration and sizes of the blades comprising each of the blade series, which contribute toward a mixing action that is greatly improved over that of such devices heretofore known. Each of the series of blades **10**, **11**, **12** comprises six blades with the blades of the outer or lower two series **10** and **11** being of equal size and the blades of the upper series **12** being larger than those of the other series. If it is assumed that the blades of each series are contiguous, the six blades define a circle with each blade constituting a 60° sector thereof. The two lower series **10**, **11** have the blades of each series so formed relative to those of the other series that they form a screw, as best seen in Fig. 3. The blades of the upper series **12**, although deeper than the blades of the two lower series, continue the screw configuration. Corresponding blades of the three series **10**, **11**, **12** are axially aligned.

The depths of the blades of each series and the spacings between the series of blades determine the pitch of the screw formed by the blades. "Depth" is taken to mean the extent of the blades outwardly from the shaft **13**. For example, if the depth of each blade of the lower two series **10**, **11** is equal to the spacing between the series **10**, **11**, each of the blades is twisted at an angle of approximately 45° to the general plane of the series. It is pointed out that each blade is so twisted that it extends both above and below the plane of the series; that is, each blade is twisted about a line lying in the plane of the series and extending from the axis of shaft **13** outwardly through the center of the blade. As a further example, it is noted that if the spacing between the series is twice the depth of the blades thereof, the angle of twist of each blade relative to the plane of the series is approximately 60°, so that a smooth screw effect is obtained from the three series. Because the depth of the blades of the upper series **12** is greater than that of the blades of the lower series **10**, **11**, the spacing between

the upper series 12 and the series 11 next below may be made somewhat greater than the spacing between the lower series 10 and 11, in order to have the wider blades of the upper series 12 continue the screw formed by the narrower blades of the lower series 10 and 11. The depth of a blade is defined as the distance from the spacer, which determines the inner limit of the blade, to the outer arcuate edge of the blade measured along a radius of the circle formed by the blade series.

It has been found preferable, in order to obtain the most efficient mixing action, to have the depth of the blades of the lower series 10, 11 approximately equal to the spacing between those series of blades, and to have the depths of the blades of the upper series 12 approximately one and one-half to two times as great as that of the blades of the lower two series. The spacing between the upper series 12 and the next adjacent series 11 may be equal to the spacing between the series 10, 11 or may be somewhat greater in order to continue the screw effect without a change of pitch, as previously pointed out. In a mixing device designed for use in conventional one-gallon paint containers, the depth of the blades of the lower two series may be approximately one-quarter inch, and the depth of the blades of the upper series approximately one-half inch, with approximately one-quarter inch spacing between series 10 and 11 and approximately three-eighths inch spacing between series 11 and 12. These particular dimensions are given as illustrative only, and are not to be construed as constituting a limitation of the invention.

Fig. 4 illustrates the movement of a liquid in a container 20 in which the mixing device of the invention is in use. It is seen that the effect of the two lower series 10, 11, taken alone, is to force the liquid downwardly and outwardly, with the principal action being in an outward direction as shown by the arrows 21. Because the blades of the upper series 12 are deeper than those of the lower series 10, 11, they force the liquid outwardly and downwardly past the lower blades as shown by arrows 22, as well as downwardly into the lower blades as shown by arrows 23. Thus, the upper blade series 12 forces the liquid downwardly into the lower blades, which further force it outwardly and downwardly into the stream of liquid from the upper blade series 12. The combined effect is to circulate the liquid from the bottom of the container 20 outwardly and upwardly along the sides of the container, across the top of the liquid and downwardly in the center of the container, as indicated by the lines of flow 24. The action near the bottom of the container is particularly strong and effective in circulating any heavy material that may have settled to the bottom of the container.

In use, the mixing device may first be inserted only part way into the container, somewhat as shown in Fig. 4. The partial insertion increases the action of the device to remove separated liquid from the top of the contents of the container, as in the case of paint where the liquid carrier has begun to rise to the top of the container. After the lighter portion of the mixture has been partially pulled into the mixture, the mixing device may be rested on the bottom of the container and mixing continued to mix in the remainder of the materials, including any that may have settled to the bottom of the container. It may also be advantageous to move the mixing device about the container in a circular pattern while mixing continues.

As previously mentioned, the lower end of the shaft 13 may be pointed as at 13*b*. Thus, when the mixing device is inserted all the way into a container, the pointed end portion 13*b* aids in maintaining the device at the desired position and prevents slipping. It has been found that the most effective mixing action is obtained if the lower blade series 10 is spaced from the end of the shaft 13 a distance equal to several times the depth of the blades of the lower series 10. For example, in the illustration previously set forth wherein the blades of the lower series are approximately one-quarter inch deep, the lower blade series 10 may be located approximately three-quarters of an inch from the lower end of the shaft 13. Any desired portion of that space may be taken up by the pointed portion 13*b* of the shaft.

In addition, because of the pointed portion 13*b* of the end of the shaft, the shaft may serve as a punch. Thus, a hole may be punched in the cover of a container, the shaft of the mixing device extended therethrough, and the cover replaced on the container. Mixing may then proceed with the container cover in place, and the danger of liquid spilling over from a completely filled container is eliminated.

The mixing device of the invention is well adapted for construction by mass production methods. Each of the series of blades may be completely formed from sheet metal in a single operation. The circular disk for each series may be cut from the sheet, partially sectored to define the blades, and the blades twisted at the proper angle, all of one punching operation. Of course, the entire structure, including the shaft and blades, may be molded from a plastic material, if desired. The invention is in no way limited to the use of any particular material or method of construction.

It is now apparent that the mixing device of the invention fulfills the objectives set forth and possesses several outstanding advantages over those devices heretofore known. Although only a single embodiment of the invention has been illustrated, it is apparent that various modifications may be made by those skilled in the art. Therefore, it is intended to be limited only by the scope of the appended claim.

What I claim as new and desire to secure by Letters Patent of the United States is:

A mixing device comprising a shaft adapted to be retained in rotating means, said shaft having a threaded portion adjacent one end thereof, three circular series of blades coaxially mounted on said shaft over said threaded portion, spacers on said shaft between adjacent series of said circular series of blades, members threaded on said threaded portion of said shaft to retain said blades and spacers on said shaft as a unitary assembly, each of said circular series comprising six blades constituting contiguous sectors of equal angular width with corresponding blades of all said series being axially aligned, the blades of that series remote from said one end of said shaft being from one and one-half to two times the depth of the blades of the other two series, the blades of said other two series being of equal depth, said spacers having an axial dimension substantially equal to the depth of the blades of said other two series, the blades of said three series cooperating with said spacers to form a screw of uniform pitch.

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