(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 492 741 A1**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **91203402.2**

(51) Int. Cl.5: **B01F 15/00**

(22) Date of filing: **23.12.91**

(30) Priority: **28.12.90 NL 9002900**

(43) Date of publication of application:
01.07.92 Bulletin 92/27

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(71) Applicant: **TERLET N.V.**
Oostzeestraat 6 P.O. Box 62
NL-7200 AB Zutphen(NL)

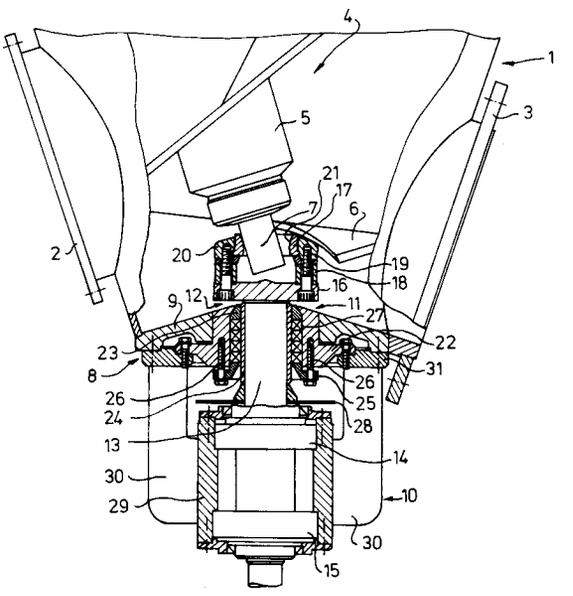
(72) Inventor: **Schröer, Johannes Dominicus**
Onder de Linden 7
NL-7411 SK Deventer(NL)

(74) Representative: **de Bruijn, Leendert C. et al**
Nederlandsch Octrooibureau
Scheveningseweg 82 P.O. Box 29720
NL-2502 LS 's-Gravenhage(NL)

(54) **Mixing screw suspension for a conical mixing vessel.**

(57) A mixing device is provided with a conical mixing vessel (1) and with a mixing screw (4) whose top end is rotatably suspended from a swivel arm, and whose bottom end at least in the radial direction of the mixing screw is supported in the vessel by means of a supporting element which is not connected thereto in the direction of rotation of the screw and which is suspended concentrically with respect to the mixing vessel, the bottom end (7) of the screw and the supporting element (17) being provided with cooperating surfaces (21) which directly bear onto each other. In order to reduce friction between said surfaces, means are provided for making the supporting element rotate with such rotational speed that the cooperating surfaces of the supporting element and the mixing screw do not or do hardly slip with respect to each other.

Fig-1



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The invention relates to a mixing device provided with a conical mixing vessel and with a mixing screw whose top end is rotatably suspended from a swivel arm, and whose bottom end at least in the radial direction of the mixing screw is supported in the vessel by means of a supporting element which is not connected thereto in the direction of rotation of the screw and which is supported concentrically in the mixing vessel, the bottom end of the screw and the supporting element being provided with cooperating surfaces which directly bear onto each other. Such a mixing device is known from Dutch patent application NL-A-7408885. The support in the form of a ring at the bottom end of the mixing screw means that the latter can easily absorb great transverse loads without sagging to an unacceptable degree and coming to lie against the inside wall of the mixing vessel. These mixing devices are therefore suitable in particular for treating mixing material which is heavy and/or difficult to mix. In general, it can be said that the device is suitable for higher loads and greater capacities.

In operation the mixing screw carries out a rotary movement both about its own central axis and about the central axis of the mixing vessel. Since the ring is stationary, said bottom end will generally carry out a sliding movement relative to said ring. Such a mutual sliding movement of the bottom end and the ring causes wear, which moreover increases further with increasing load. Depending on the type of material being mixed, a certain amount of wear is also caused by it.

The object of the invention is to provide a mixing device of the type described above, in which considerably less wear of the bottom support of the mixing screw occurs. This object is achieved in that means are provided for making the supporting element rotate with such rotational speed that the cooperating surfaces of the supporting element and the mixing screw do not or do hardly slip with respect to each other.

The supporting element according to the invention can rotate along with the bottom end of the mixing screw, with the result that the sliding movement between said end and the supporting element can be limited to a considerable degree. If the mutual friction between said end and the supporting element is great enough, simple rolling can even take place. In that case the wear on the support is zero, as a result of which a significant increase in the service life is assured.

Due to the fact that little or no sliding movement now occurs, the heat development in the support is also considerably reduced. All this makes the mixing device better suitable for delicate products such as those found in the dairy and foods industry or in the pharmaceuticals industry. In this respect it is also an advantage that such a support can function extremely well in the absence of a lubricant. Contamination risks are consequently ruled out.

The rotation of mixing screw and supporting element can be synchronised in two ways. According to a first possibility, the supporting element can be freely rotatable, in such a way that it can be driven in its direction of rotation by means of friction between supporting element and screw through the rotary movements of the mixing screw. This embodiment is particularly suitable for a mixing device in which the mutual friction between the bottom end of the mixing screw and the supporting element is always sufficiently great.

In the case of certain types of mixing material the above-mentioned friction can be lower. In order to ensure adequate synchronisation also in these circumstances, the mixing device can be designed in such a way that the supporting element is connected to its own drive and can be driven at such an angular speed that the interacting surfaces of the bottom end of the mixing screw and the supporting element are movable at more or less the same speed.

According to a first embodiment, the supporting element can be a ring which is rotatable about its central axis, and against the inner surface of which a journal provided at the bottom end of the screw rests. Ring and journal can interact here preferably in a rolling manner.

Alternatively, the supporting member is a journal which is rotatable around its central axis against which is resting the inner surface of a ring provided at the lower end of the screw.

According to a second embodiment, the supporting element resp. the screw can have an at least partially rounded head, and the screw resp. the support element can be provided with an axially symmetrical recess in which said head is situated in such a way that the inner surface of the recess rests against said head. This embodiment has the advantage that the mixing screw can be supported not only in the radial direction, but also in the axial direction. It is particularly attractive for large mixers, in which no radial support can be used any more because of insufficient rigidity of the swivel arm, the vessel cover and the bridge bar.

The recess is preferably hemispherical and the head more than hemispherical, in such a way that the mixing screw can be supported by the head without play.

If the spherical radii of supporting element and recess are equal to each other, and the mixing screw and the supporting element are drivable at essentially the same angular speed, almost any mutual sliding movement can be avoided. This also

means that hardly any heat development takes place.

The supporting element can have a sealing shaft guided through the bottom of the vessel and supported on the outside of the vessel bottom. Parts exposed to wear, such as the packing and the bearings, are now accessible from the outside, which greatly facilitates adjustment or replacement.

The risk of contamination of the bearings can be further reduced if a sling plate, disposed radially relative to the shaft, is provided between seal and bearings. Any mixing material which might escape through a leaky packing goes onto the sling plate, and is consequently slung away as a result of centrifugal forces before it can reach the bearings.

The invention will be explained in greater detail below with reference to two examples of embodiments shown in the figures.

Figure 1 shows a first embodiment of the mixing screw support according to the invention.

Figure 2 shows a second embodiment of the mixing screw support according to the invention.

In the first embodiment shown in Figure 1 the bottom part of a conical mixing vessel indicated as a whole by 1 is shown. This part of the mixing vessel 1 bears connecting flanges 2, 3 to which a valve (not shown) can be connected. The wall of the mixing vessel 1 is partially cut away, in such a way that the mixing screw, indicated as a whole by 4, can be seen. This mixing screw comprises a central shaft 5, around which the actual screw part 6 runs. At its bottom end the mixing screw 4 is is provided with a journal 7, by means of which it can be supported.

The bottom of the mixing vessel is shut off by a cover, indicated as a whole by 8. Said cover 8 comprises a cover flange 9 which is welded to the vessel wall and from which a bearing block, indicated as a whole by 10, is suspended. Shown centrally in the cover flange 9 is a sealing packing, indicated as a whole by 11. A supporting element 12 for the mixing screw 4 runs through said packing. This supporting element 12 has first of all a shaft 13, which is supported in two bearings 14, 15 which are fixed in the bearing block 10. At its top end the shaft 13 bears a flange 16 on which the actual supporting ring 17 is fixed. Said supporting ring rests on the flange 16 by means of, for example, four bushes 18 through each of which a bolt 19 runs. The bolts are screwed into a cap 20. Supporting ring 17 and cap 20 each have a breast, in such a way that the supporting ring 17 can be held reliably in place by means of the cap 20. The inner surface 21 of supporting ring 17 is rounded off in the known manner, in such a way that the supporting pin 7 rests against a lightly curved supporting surface.

When the mixing device is in operation the mixing screw 4 rotates about both its own central axis and about the central axis of the mixing vessel. In the process the journal 7 can roll over the curved surface 21 of the supporting ring 17, in view of the rotation facility of the latter. If the friction between journal 7 and supporting ring 17 is great enough, it is sufficient if the latter is suspended so that it can rotate freely. In an alternative embodiment it is, however, possible for the part of shaft 13 projecting from the lower end of the bearing 15 to be driven, in such a way that the rolling of the journal 7 on the supporting ring 17 can be achieved positively.

The advantage of this support according to the invention is also that all rotating parts and the packing are accessible from the outside. The bearings 14 and 15 can be changed from the outside if it is found to be necessary for, for example, servicing and maintenance. The packing 11 can also be adjusted from the outside. This packing 11 comprises a supporting sleeve 22, which has a tapering inner surface at its end facing the inside of the vessel. A first correspondingly shaped packing ring 23, resting on the inside against a bush 24 disposed on the shaft 13, fits on said tapering inner surface. The packing 11 also has a pressure ring 25, which can be pressed in to a greater or lesser extent by means of bolts 26. Situated between the packing ring 23 and the pressure ring 25 is packing cord 27, which can be pressed by means of the pressure ring 25. If the packing cord 27 shows signs of wear after a certain period of operation, the packing cord can be placed under such pressure again by tightening of the bolts 26 that a good seal is ensured.

Any mixing material which may leak through between the packing cord 27 and the bush 24 goes onto a sling plate 28 welded radially onto the shaft 13. As soon as this mixing material reaches the sling plate 28, it is slung away sideways, in such a way that it cannot reach the bearings 14 and 15.

These bearings 14 and 15, finally, are accommodated in a bearing housing 29, which is fixed by means of spokes 30 and the bearing ring 31 to the bottom flange 9. The bolts 26 for adjusting the packing are readily accessible between the spokes.

The bottom part of a conical mixing vessel 1 shown in Figure 2 corresponds largely to the part described with reference to Figure 1. Only the support of the mixing screw 4 is designed differently. At the bottom end of the mixing screw 4 no solid pin is now provided, but a hemispherical recess in which a spherical head can be accommodated. This recess is indicated as a whole by 32. This hemispherical recess 32 is formed by four segments 33, which are clamped in place by means of clamping sleeve 34 on a threaded end 35 of the mixing screw 4. At the top end of the shaft

13 projecting into the mixing vessel 1 a hemispherical head 36 is now provided, fitting tightly into the hemispherical recess 32 at the bottom end of the mixing screw 4. As in the case of the previous embodiment, said shaft 13 can be freely rotatable, in such a way that as a result of the friction between the recess 32 and the hemispherical head 36 it rotates along with the mixing screw 4. Almost no sliding movement whatsoever - and thus almost no heat development - occurs here between interacting surfaces of the recess 32 and the hemispherical head 36.

If the friction between these surfaces is insufficient to drive the shaft 13, the latter can also be driven separately. If the angular speed of mixing screw 4 and pin 13 is equal, a slight friction movement occurs.

Claims

1. Mixing device provided with a conical mixing vessel and with a mixing screw whose top end is rotatably suspended from a swivel arm, and whose bottom end at least in the radial direction of the mixing screw is supported in the vessel by means of a supporting element which is not connected thereto in the direction of rotation of the screw and which is suspended concentrically with respect to the mixing vessel, the bottom end of the screw and the supporting element being provided with cooperating surfaces which directly bear onto each other, characterised by means for making the supporting element rotate with such rotational speed that the cooperating surfaces of the supporting element and the mixing screw do not or do hardly slip with respect to each other.

2. Mixing device according to Claim 1, in which the supporting element is freely rotatable, in such a way that it can be driven in its direction of rotation by means of friction between supporting element and screw through the rotary movements of the mixing screw.

3. Mixing device according to Claim 1, in which the supporting element is connected to its own drive and can be driven at such an angular speed that the interacting surfaces of the bottom end of the mixing screw and the supporting element are movable at more or less the same speed.

4. Mixing device according to Claim 2 or 3, in which the supporting element is a ring which is rotatable about its central axis, and against the inner surface of which a journal provided at the bottom end of the screw rests.

5. Mixing device according to claim 2 or 3, in which the supporting member is a journal which is rotatable around its central axis against which is resting the inner surface of a ring provided at the lower end of the screw.

6. Mixing device according to Claim 4 or 5, in which ring and journal interact in a rolling manner.

7. Mixing device according to Claim 2 or 3, in which the supporting element resp. the screw has an at least partially rounded head, and the screw resp. the supporting element can be provided with an axially symmetrical recess in which said head is situated in such a way that the inner surface of the recess rests against said head.

8. Mixing device according to Claim 7, in which the recess is hemispherical and the head more than hemispherical, in such a way that the mixing screw can be supported also in its axial direction by the head.

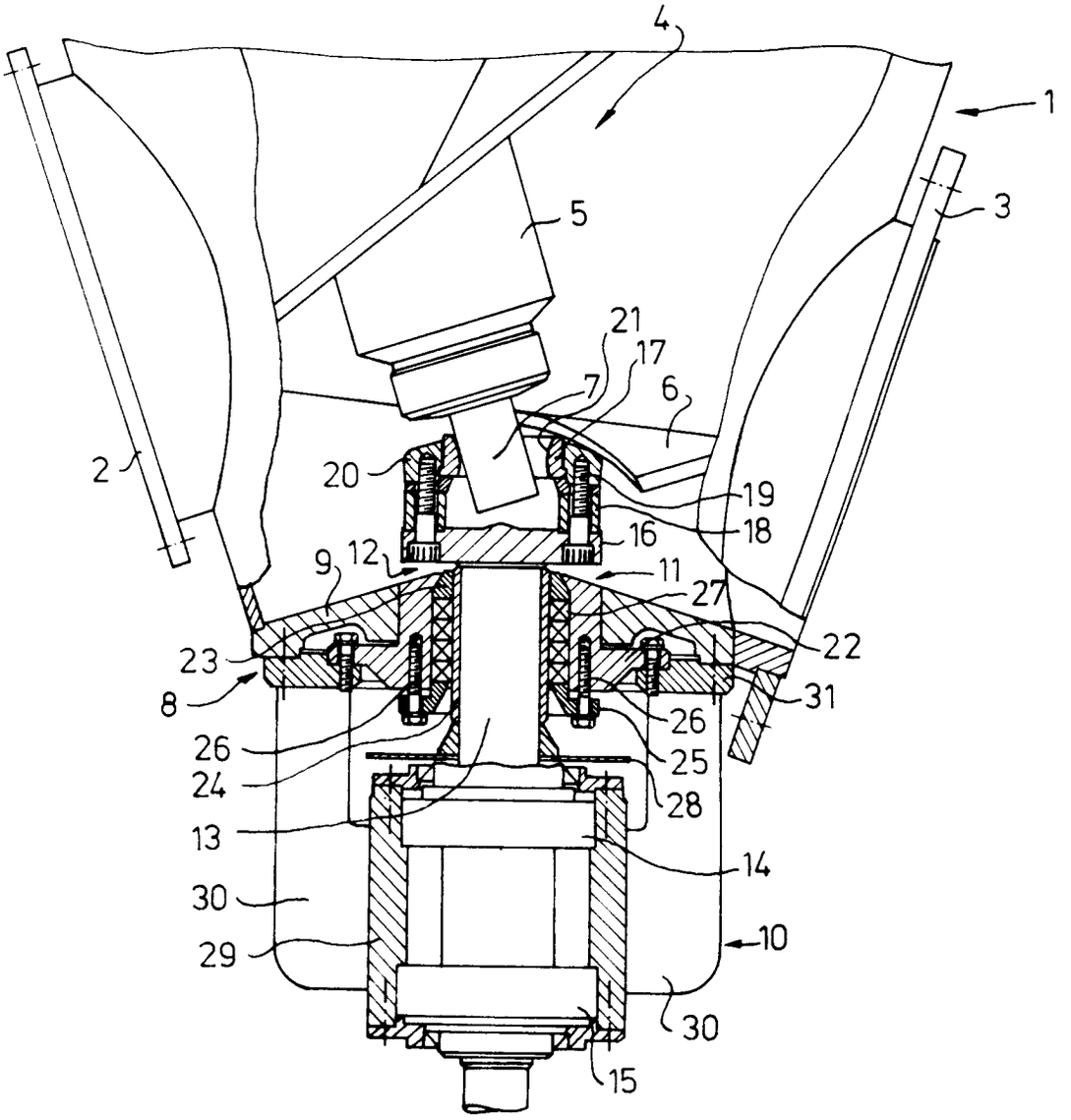
9. Mixing device according to Claim 8, in which the spherical radii of supporting element and recess are equal to each other, and the mixing screw and the supporting element are drivable at essentially the same angular speed.

10. Mixing device according to any of the preceding claims, in which the supporting element has a sealing shaft guided through the bottom of the vessel and supported on the outside of the vessel bottom.

11. Mixing device according to Claim 10, in which a sling plate, disposed radially relative to the shaft, is provided between seal and bearings.

12. Mixing device according to Claim 10 or 11, in which the bearings are supported by means of a number of spokes fixed to the bottom of the vessel.

Fig-1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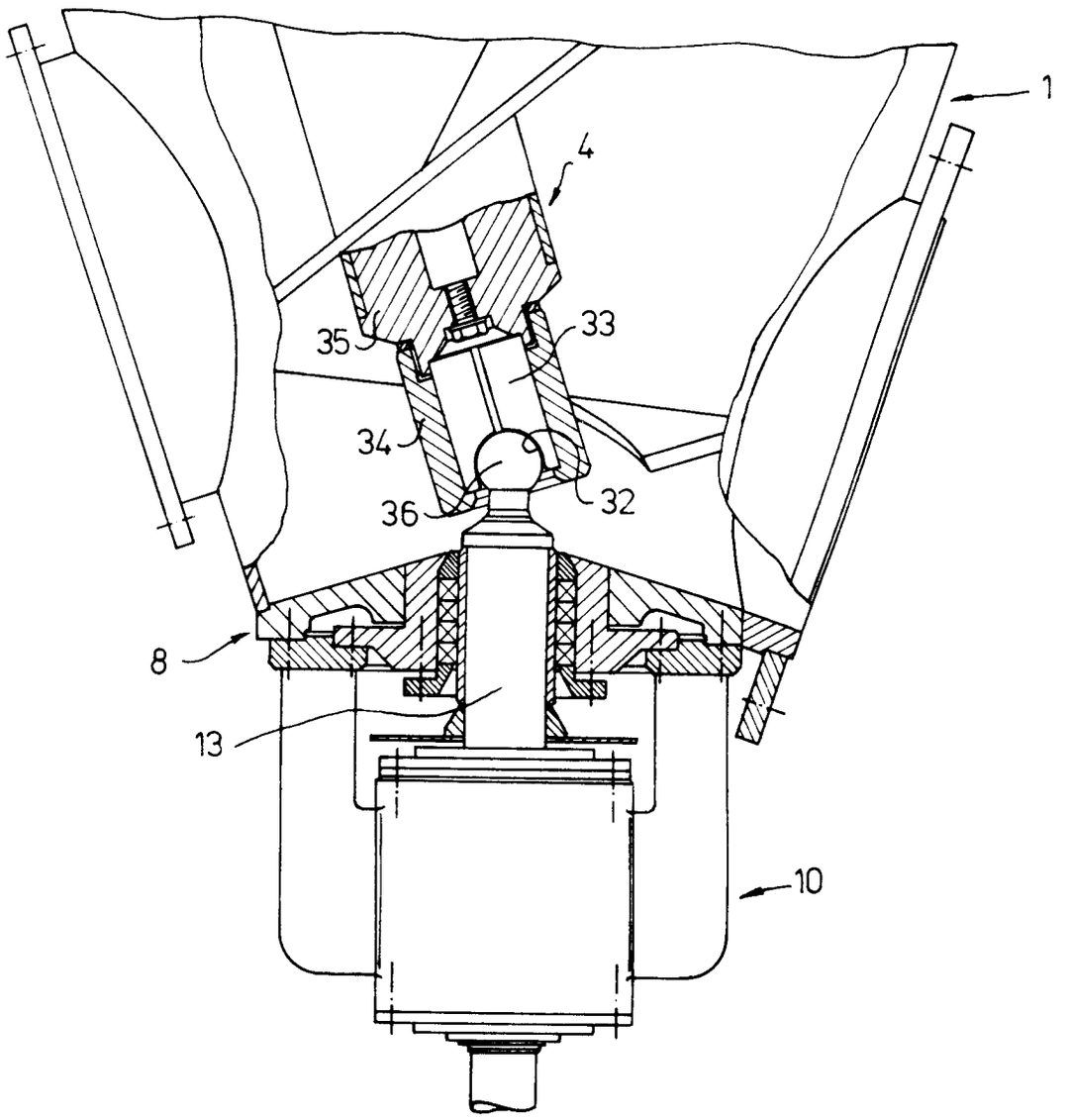

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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 3402

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A,D	NL-A-7 408 885 (VRIECO) * figure 2 *	1	B01F15/00
A	DE-A-3 109 106 (BOLZ)	1,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B01F
F16C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07 APRIL 1992	PEETERS S.

CATEGORY OF CITED DOCUMENTS

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