United States Patent

List

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[54] MULTIPLE SPINDLE MIXING DEVICE

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[30] **Foreign Application Priority Data**

March 17, 1969 Switzerland 4103/69

[52] **U.S. Cl.** **259/104,** 241/98, 15/246.5

[51] **Int. Cl.** **B01f 7/00,** B29f 1/10

[58] **Field of Search**.....259/104, 6, 21, 41, 64; 15/246.5; 241/98

[56] **References Cited**

UNITED STATES PATENTS

2,087,492	7/1937	Williams	241/41
3,301,138	1/1967	Cox	259/10 X
3,423,074	1/1969	Loomans	259/104 X
3,498,762	3/1970	Van der Schee et al.	259/104 X
3,071,352	1/1963	McIntyre	259/104
3,090,605	5/1963	Copeland et al.	259/104
3,195,868	7/1965	Loomans et al.	259/104
3,375,985	4/1968	Dodgen et al.	241/98

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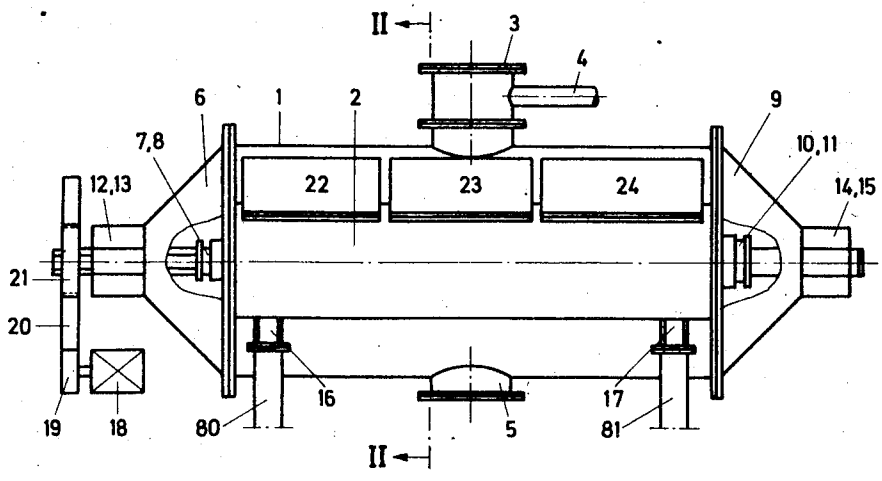
[57] **ABSTRACT**

A multiple-spindle mixing kneader, especially for carrying out thermal processes in liquid, pasty and solid phases, which is of the type comprising a stationary, generally horizontally disposed housing in the form of a drum member having a substantially centrally arranged stirrer shaft member upon which there are mounted radially extending members, typically paddles or disc sectors. According to an important aspect of the invention kneading bar members are arranged between the disc sectors or paddles, also between the latter and the stirrer or agitator arms which move past the end walls of the housing, these kneader bar members wiping the inner surfaces of such housing. Further, a second stirrer shaft member is arranged parallel to the first stirrer shaft member in a further housing disposed parallel to the first housing. This second shaft member possesses stirrer arm members which, on the one hand, clean the inner surfaces of the aforementioned further housing and, on the other hand, also clean the shaft member and the lateral disc surfaces of the first stirrer shaft member.

9 Claims, 10 Drawing Figures



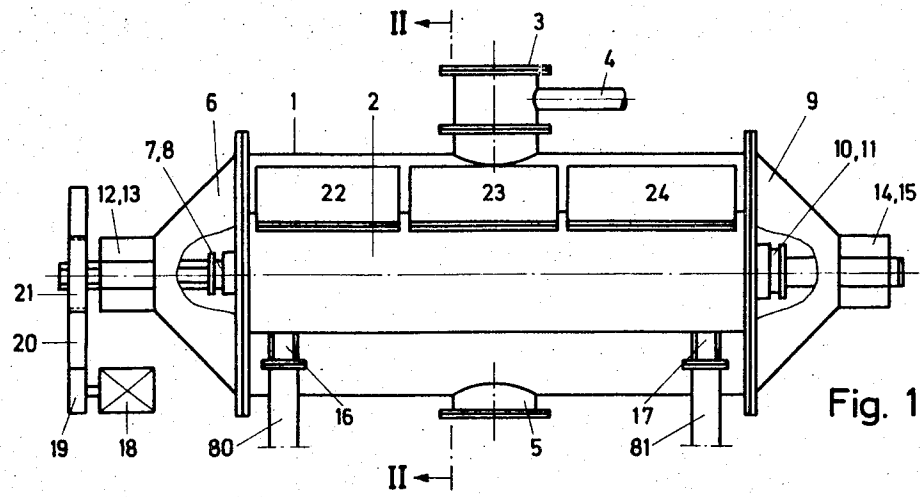


Fig. 1

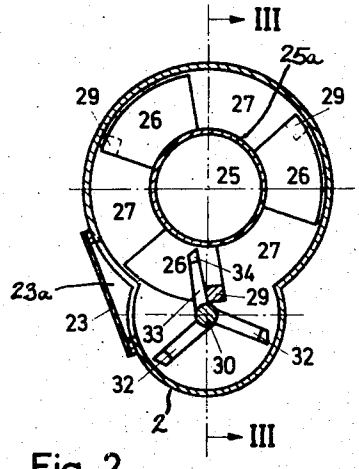


Fig. 2

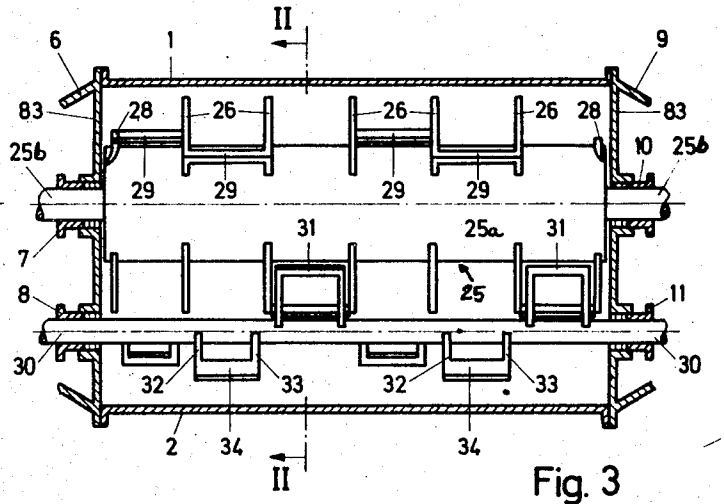


Fig. 3

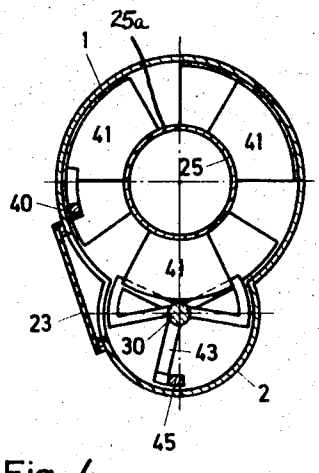


Fig. 4

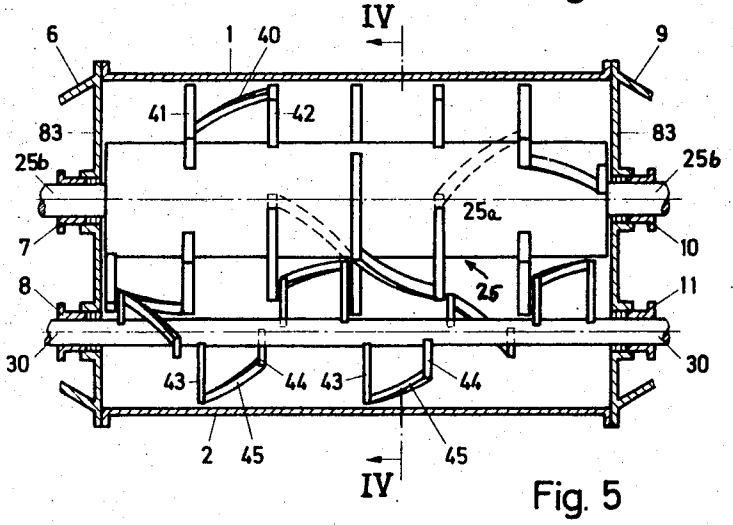


Fig. 5

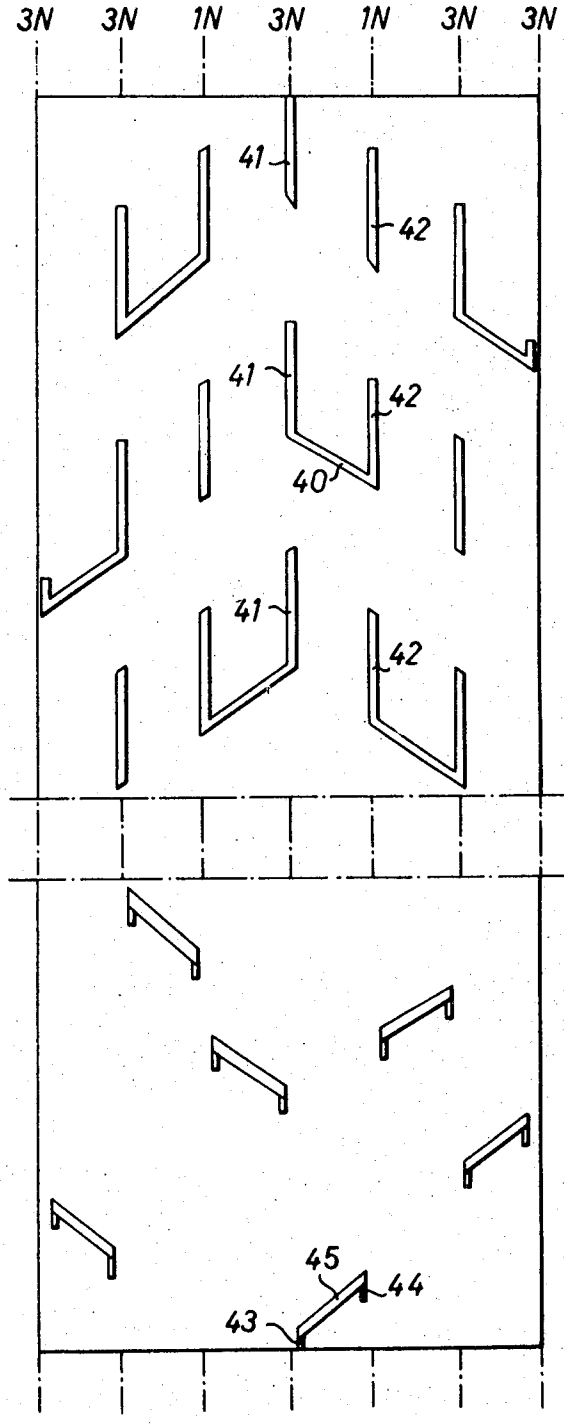


Fig. 6

Fig. 7

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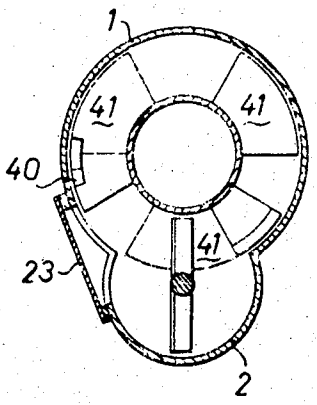

Fig. 8

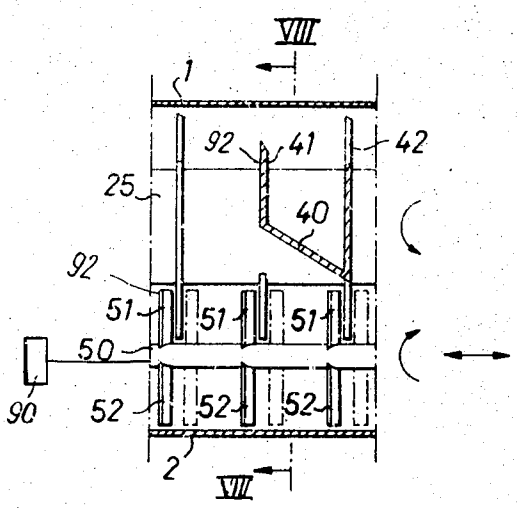

Fig. 9

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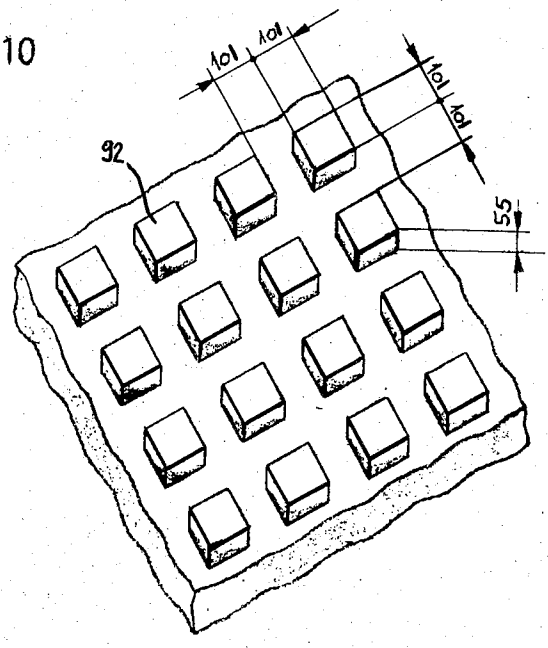
Fig. 10



MULTIPLE SPINDLE MIXING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved multiple-spindle mixing kneader, especially for carrying out thermal processes, and which is of the type embodying a stationary, generally horizontally disposed housing in the form of a drum member equipped with a first stirrer element incorporating a centrally arranged stirrer shaft member upon which are arranged paddles or disc segments. Further, the inventive mixing kneader is of the type wherein mixing- or kneading bar or beam members are arranged between the disc sectors and there is provided at least one second stirrer shaft member which is disposed parallel to the first stirrer shaft member which, on the one hand, serves as a counter-mixing tool and, on the other hand, also cleans the surfaces of the first stirrer element.

There have already been proposed to the art mixing equipment and heat exchangers for the vaporization, drying and crystallization of materials, in which a single stirrer shaft member having radial disc members rotates in a housing, or rotates and oscillates within such housing. The disc members are cleaned by stripper or wiper members mounted in the housing. However, at the region of the stripper members the cleaning operation at the surface of the cylindrical housing is not possible and is unsatisfactory at the end walls thereof.

Furthermore, multiple-spindle mixing- and kneading machines are known in different variations. However, the known constructions are devoid of the radial disc members or sectors with the intermediately disposed kneading bars or beams.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide an improved multiple-spindle mixing kneader which effectively overcomes the drawbacks of the prior art constructions.

Another, more specific object of the present invention relates to an improved multiple-spindle mixing kneader which is designed to effectively self-clean the surface of the components of the equipment used during processing of the material.

Still another significant object of the present invention relates to an improved multiple-spindle mixing kneader which is relatively simple in construction, extremely efficient in operation, not readily subject to breakdown, and equipped with means for affording a cleaning action of the components used during the mixing operation.

The mixing kneader construction of the present invention effectively overcomes the heretofore mentioned drawbacks of the prior art, provides for extremely large heat transfer surfaces with especially good coefficient of heat transmission owing to the self-cleaning effect which is achieved and the pronounced movement of the material, both in liquid as well as also pasty and solid phases. The principles of the invention are therefore especially suitable for carrying out thermal processes, such as for instance, vaporization, drying, crystallization, reactions, and so forth.

Now, in order to implement the aforementioned objects and advantages, as well as others which will be more readily apparent as the description proceeds, the

inventive multiple-spindle mixing kneader which is especially designed for carrying out thermal process in liquid, pasty and solid phases, is of the type comprising a stationary, generally horizontally disposed drum-like housing member having a centrally arranged stirrer shaft member upon which there are mounted radially extending paddles or disc sectors. According to the invention, kneading bar members are arranged between the sectors or and the stirrer arms which move past the end walls of the housing, these kneading bar members wiping the inner surfaces of the housing. Additionally, a second stirrer shaft member in a second housing mounted substantially parallel to the first housing. This second stirrer shaft member is equipped with stirrer arms which, on the one hand, clean the inner surface of the second mounted housing and, on the other hand, also clean the shaft member and the lateral disc surfaces of the first stirrer shaft member.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent, when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. **1** is a schematic front view of a mixing kneader machine;

FIG. **2** is a cross-sectional view of the machine depicted in FIG. **1**, taken along the line II—II of FIG. **3**;

FIG. **3** is a longitudinal sectional view of the machine shown in FIG. **1**, taken substantially along the line III—III of FIG. **2**;

FIG. **4** is a cross-sectional view through a mixing kneader machine designed according to the teachings of the present invention with a substantially helical or worm-shaped arranged or wound kneading bar or beam means, and taken along the lined IV—IV of FIG. **5**;

FIG. **5** is a longitudinal sectional view through the equipment depicted in FIG. **4**;

FIG. **6** is a development of the main shaft member of the equipment shown in FIGS. **4** and **5**, along the outermost diameter of the disc members and kneading bar members;

FIG. **7** is a development of the auxiliary shaft member used in the equipment of FIGS. **4** and **5**, along the outermost diameter of the stirrer element;

FIG. **8** is a cross-sectional view through a modified version of inventive machine with a rotating and oscillating auxiliary shaft member, the sectional view being taken substantially along the line VIII—VII of FIG. **9**;

FIG. **9** is a longitudinal sectional view through the machine depicted in FIG. **8**;

FIG. **10** is a fragmentary perspective view showing the teeth-like projections for the paddles or countertools of the arrangement of FIGS. **8** and **9**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, in FIG. **1** there is shown a front view of a first embodiment of inventive mixing and kneading machine having a main cylindrical housing **1** in the form of a drum member and a second or auxiliary housing **2** for the second stirrer element or arrangement to be described shortly. The main housing **1** is equipped at its upper region with the filling inlet or

flange 3 with which communicates a vapor withdrawal conduit or pipe member 4. The lower outlet or stud 5 serves for emptying the equipment. At both end faces of the apparatus there are mounted the cover members 6 and 9 equipped with packing sleeves 7 and 10 for the main stirrer shaft member 25, embodying the stub shafts 25*b* and the intermediate drum-like shaft portion 25*a* and the further packing sleeves 8 and 11 for the auxiliary stirrer shaft member 30, as best seen by referring to FIG. 3.

Continuing, at the cover members 6 and 9 there are also mounted the bearings 12, 14 and 13, 15, respectively, for both material agitation or stirrer shaft members 25 and 30, respectively. The entire machine is supported by means of the braces or members 16 and 17 upon the supports or columns 80 and 81, respectively. Furthermore, the drive for both stirrer shaft members 25 and 30, in the present embodiment, is undertaken by means of a suitable drive motor 18 and the pinion 19 meshing with the larger gear 20 which drives the main shaft member, and from that location via the further gear 21 which drives the second stirrer shaft member. The drive arrangement may be constructed such that both shafts 25 and 30 rotate continuously, or that the second shaft 30 rotates intermittently, or where one shaft member rotates and reciprocates, and further the direction of rotation of the shafts may be the same or counter one another, all as will be further explained in detail hereinafter. Finally, in order to easily clean the installation there are provided sufficiently large size access openings, one of which indicated at reference character 23*a* of FIG. 2 is shown, and closed by the cover members 22, 23 and 24.

The sectional views of the equipment shown in FIGS. 2 and 3 depict an embodiment of the invention in which kneading bar or beam members 29 are arranged between the paddle members 26, here shown for instance as disc sectors, and in a portion axially parallel to a surface line or generatrix of the cylindrical housing 1.

It will be seen that the main shaft member 25 is equipped with the redially extending disc sectors 26 which may be attached to the drum-like shaft portion 25*a* in any convenient manner, as by welding for instance. Further, in each respective radial plane there are arranged three such disc sectors 26, so that three gaps or spaces 27 also appear. These gaps or spaces 27 permit an axial material exchange within the machine. However, at the end walls 83 of the equipment only stirrer arms 28 are arranged which are welded to the main stirrer shaft member 25 and which scrape such end walls. Further, as explained above between the disc sectors 26 there are arranged the kneading bar or beam members 29, which also may be connected to any suitable way with the disc sectors, as by screws or welding, and which serve both for mixing and kneading, also for scraping the cylindrical inner wall of the housing 1.

It will be observed that in the arrangement of FIGS. 2 and 3 only a single kneading bar or beam member 29 is located in the region between two disc sector planes. Naturally, it would be possible to install a greater number of such kneading bar members, for instance, three such elements. Now, the second stirrer shaft member 30 possesses counter-tool elements in the form of frame members 31 consisting of two side or leg portions 32 and 33 and the kneading bar or beam member 34. These components may be also connected by welding as previously discussed. The side portions 32 and 33 are constructed as scraper elements which maintain the side surfaces of the disc sectors 26 clean whereas the kneading bar members 34 wipe the inner surface of the housing 2 and the main shaft member 25. However, they also serve for mixing and kneading of the product or material undergoing processing.

The speed of rotation of the second stirrer shaft member 30 and the transmission ratio of the second stirrer shaft member 30 with respect to the first stirrer shaft member is chosen such that the kneading bar members always pass one another. The mixing and kneading effect is thus achieved in that the kneading bar members upon meeting one another will transport material from the working compartment of the one stirrer shaft member into the working compartment of the other stirrer shaft member. In so doing, the stirrer shaft member can either work in counter-rotational sense or in the same rotational sense. The latter operation, however, naturally requires a somewhat different drive arrangement from that shown in FIG. 1, as such is quite well known in the art.

Moreover, as previously explained the drive of the second shaft member can also occur intermittently, for instance, in such a way that the second stirrer member together with the kneading bar or beam member 34 only performs one revolution when the kneading bar or beam members 29 of the first stirrer device comes into the working compartment of the second stirrer device and then is fixedly held as a scraper until the kneading beam member 29 again arrives in the working compartment of the second stirrer arrangement.

The large surfaces provided by the paddles or stirrer segments and the very good self-cleaning effect render the described construction especially suitable for thermal processes such as vaporization, melting, drying, cooling, crystallization, and reactions. The only thing necessary to perform these various operations is heating and cooling of the surfaces in any suitable known manner.

With the construction of the machine so as to possess linear or straight kneading beam or bar members according to FIGS. 2 and 3, the material exchange in the lengthwise direction is often insufficient. A considerable improvement of this construction is therefore attained if the kneading bar members, as such has been shown in the embodiment depicted in FIGS. 4 through 9 inclusive, are arranged along a worm or helical line and as shown in FIGS. 4 and 5 in particular arc curved. As a result, there is achieved a forced transport of material in the lengthwise direction. For instance, in the arrangement shown in FIGS. 4 and 5, such for instance depicts a working element having kneading bar or beam members 40 between the paddles or disc sectors 41 and 42. The counter mixing element upon the second stirrer shaft member 30 and consisting of the scrapers 43 and 44 with the kneading bars 45, is likewise appropriately mounted at an inclination. Thus, as the development views of FIGS. 6 and 7 clearly show, also the edges of the disc sectors, such as, for instance, the paddles or disc sectors 41 and 42, are arranged in offset fashion to one another.

The arrangement depicted in FIGS. **6** and **7** refers to a machine which works according to a batchwise process, in which the product in the lower portion of the housing **1** is always fed towards the middle or central region and at the top is again transported back toward the end walls. By changing the direction of rotation the material transport occurs in the opposite direction. If the kneading bar or beam members are only rotated in one direction then the machine can easily be continuously operated in that the product is infed at one end and at the other end there is mounted the discharge stud or flange means. As a special variation of the invention for continuous operation, it is possible to also arrange several kneading beam members opposite the general transport direction in order to increase the mixing action.

FIGS. **8** and **9** depict a variation of the invention concepts in which the second stirrer shaft member not only rotates, but also reciprocates back and forth axially. Reference numeral **90** schematically depicts a drive mechanism suitable for this purpose. In so doing, it is sufficient for an adequate mixing- and cleaning effect to equip the stirrer shaft member **50** only with the scrapers **51** and **52**. Owing to the axially reciprocating or oscillating movement of the second stirrer shaft member **50** the entire working compartment between the disc members **41** and **42** equipped with the kneading bar or beam members **50**, on the one hand, and also the working compartment around the second stirrer shaft member **50**, on the other hand, will be wipingly contacted.

Because the scraper elements **51**, **52** have to pass the kneading bar members **40**, the rotating movement or even the intermittently rotating movements of the working shaft members, are coupled with one another. The axially reciprocating or oscillating movement, on the other hand, is independent and can occur at any random frequency. However, it is advantageous to provide at both terminal positions at the disc segments, of which one such position is shown in phantom lines, suitable stop means in order to insure for a complete scraping of the disc members.

To increase the heat transfer surfaces it is also possible to construct the scraper elements of the stirrer shaft member in the form of paddles or disc segment sectors. The outer diameter of the stirrer elements upon the stirrer shaft member is maintained smaller than that of the housing member **1**, as clearly shown in the drawings. Naturally, it would be possible to maintain the same external diameter for both stirrer shaft members. Furthermore, it does not change the basic inventive concepts if more than two stirrer shaft members, for instance three, are provided. In so doing, at the region of the thickness of the sectors disc sectors of the first stirrer shaft member there remains only a small strip at the housing **2** of the second stirrer shaft member which is not wipingly contacted by the tools. Generally, this strip is engaged by the pressure of the adjacently disposed product. However, it is also possible to mechanically scrape the strip if the axial movement of the stirrer shaft member **50** with the scrapers **51** and **52** is made so large that the scrapers, in each instance, enter through the gaps between the disc segments into the adjacently disposed working compartment. However, this throughpassage movement requires a coupling between the rotating and the reciprocating movement of the stirrer shaft member **50**.

The working principle of the invention also is extremely suitable for comminuting the product simultaneously with a mixing- and kneading operation and eventually also a thermal process, such as reaction- or dissolving operations. In such case, it is advantageous to equip the paddles or disc sectors and the counter working tools with teeth-like projections, schematically indicated at **92** in FIG. **9** and also in FIG. **10**, as such for instance are used nowadays for the processing of cellulose in double-trough kneaders. These teethlike projections **92** are spaced from one another by an amount corresponding for instance to their width as indicated by reference character **101**, the possess a suitable tooth height as indicated by reference character **55**.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. ACCORDINGLY,

What is claimed is:

1. A multiple-spindle mixing kneader, especially for carrying out thermal processes in liquid, pasty and solid phases, comprising a stationary generally horizontally disposed housing having end walls and substantially in the form of a drum, a substantially centrally arranged stirrer shaft member, means for mounting said stirrer shaft member at said housing to extend in the axial direction of said housing, radially extending members and stirrer arm means mounted upon said stirrer shaft member, kneading bar members mounted between said radially extending members and between said radially extending members and said stirrer arm means which pass the end walls of said housing and serve to wipe the inner surface of said housing, a second housing mounted substantially parallel to the first-mentioned housing and in material flow communication with the interior thereof, a second stirrer shaft member arranged substantially parallel to said first stirrer shaft member, said second stirrer shaft member possessing counter-tool means which clean at least a portion of the inner surface of said second housing and also said first stirrer shaft member and the lateral surfaces of said radially extending members of said first stirrer shaft member.

2. A multiple-spindle mixing kneader as defined in claim **1**, wherein said radially extending members are paddles.

3. A multiple-spindle mixing kneader as defined in claim **2**, wherein said paddles are in the form of disc sectors.

4. A multiple-spindle mixing kneader as defined in claim **1**, wherein said kneading bar members possess a curved shape and lie along a helical line in order to achieve increased agitation and processing of the material.

5. A multiple-spindle mixing kneader as defined in claim **4**, further including means for continuously rotating said second stirrer shaft member.

6. A multiple-spindle mixing kneader as defined in claim **4**, further including means for causing said second stirrer shaft member to carry out a rotational movement with intermittent stationary periods.

7. A multiple-spindle mixing kneader as defined in claim 6, including means wherein at least one of said stirrer shaft members in addition to its rotational movement, but not coupled with such rotational movement, reciprocates.

8. A multiple-spindle mixing kneader as defined in claim 6, including means for ensuring that at least one of said stirrer shaft members in addition to its rotational movement carries out a positively coupled reciprocating movement.

9. A multiple-spindle mixing kneader as defined in claim 1, further including teeth-like projections provided for said radially extending members of said stirrer shaft member and said counter-tool means of said second shaft member for comminuting the material being processed.

* * * * *