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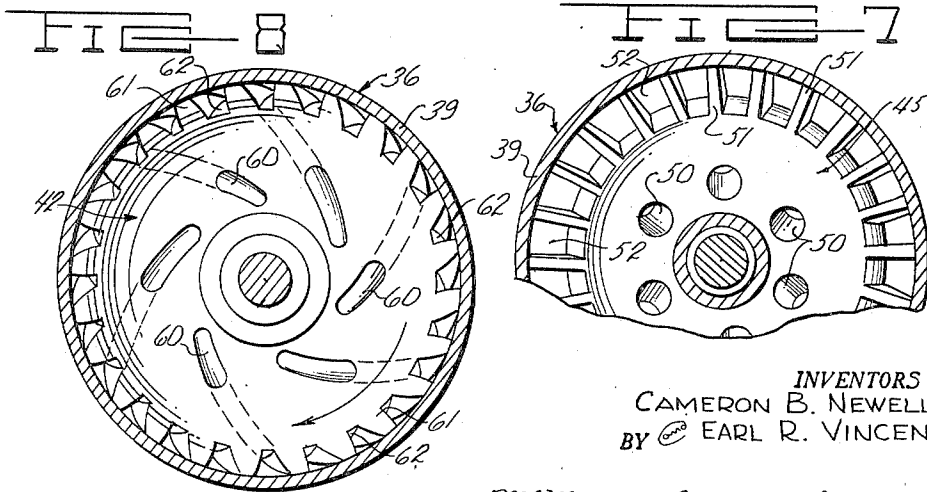
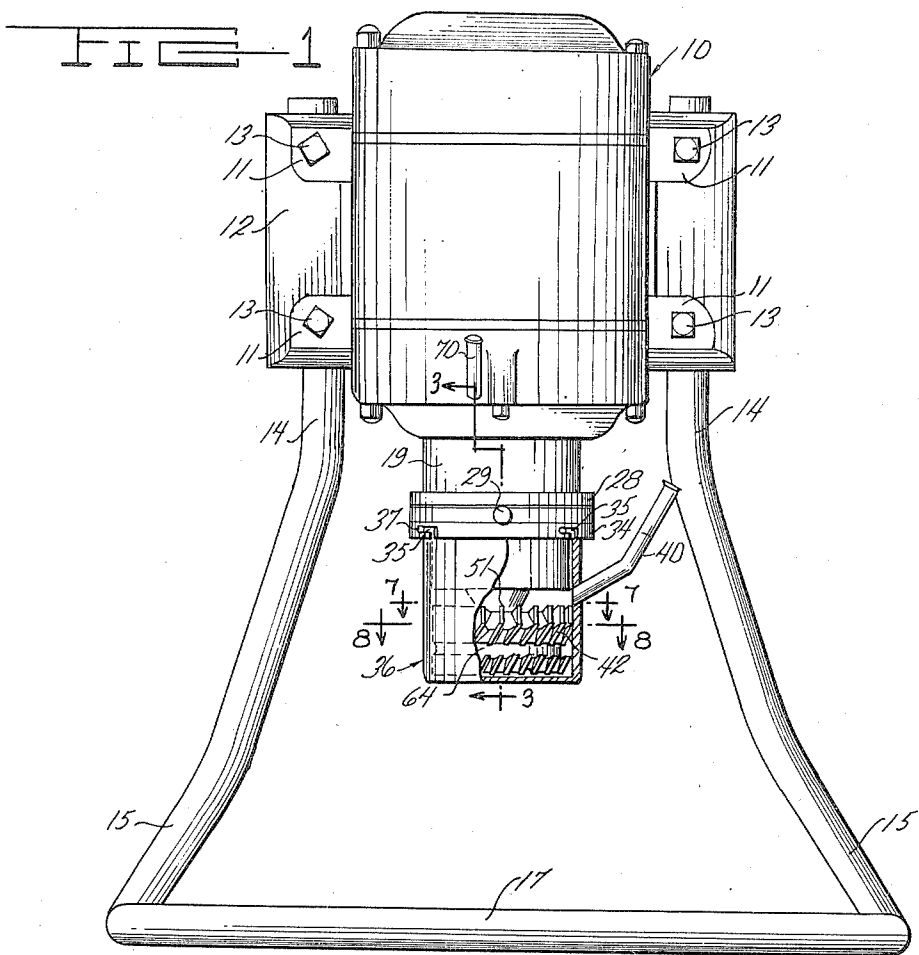
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2,496,017

GRINDER FOR MATERIAL IN SUSPENSION

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2 Sheets-Sheet 1



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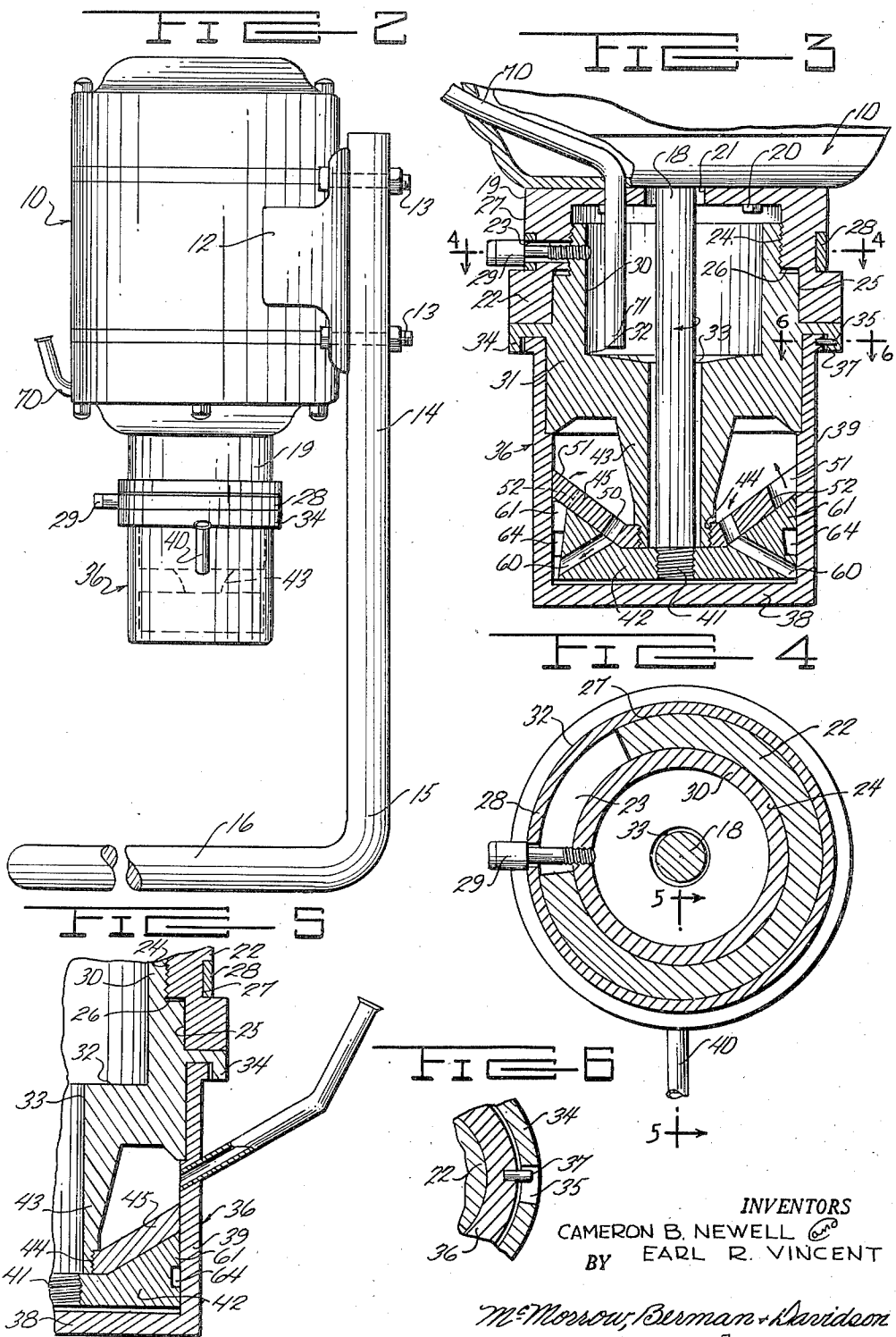
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UNITED STATES PATENT OFFICE

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GRINDER FOR MATERIAL IN SUSPENSION

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7 Claims. (Cl. 241-46)

1 Our invention relates to grinders for material in suspension in a fluid, and while susceptible of other uses is particularly intended for the grinding of flaxseed and other oil-bearing seeds. Moreover, it is contemplated that the grinder according to the invention is particularly susceptible of being formed as a small portable grinder. In known grinders for material in suspension, it is common practice to provide a fixed grinding element and a rotary grinding element operating in a closed container, and wherein a circulation of the material to be ground is established, whereby such material passes through the grinding elements in one direction, is discharged from the elements into the surrounding housing and thereafter returned to the intake side for recirculation through the elements. Such grinders are inefficient in that the material to be ground is passed through the grinders in only one direction, and no grinding of the material is accomplished during the return flow to the intake side of the elements.

With the foregoing in view, it is an object of our invention to provide an improved grinder of the class described which includes means for passing the material to be ground through the grinding elements in two directions, whereby a double-action grinding is achieved, the material being ground twice during each cycle of operation.

A further object is to provide an improved grinder of the class described which includes an inner series of ports passing through both grinding elements and an outer series of ports likewise passing through both elements, and wherein both series of ports for at least one element are formed to provide impelling means for circulating the fluid in one direction through both inner series of ports and in the opposite direction through both outer series of ports.

Other objects and advantages reside in the particular structure of the invention, combination and arrangement of the several parts thereof, and will be readily apparent to those skilled in the art upon reference to the attached drawings in connection with the following specification, wherein the invention is shown, described and claimed.

In the drawings:

Figure 1 is an elevational view of the grinder according to the invention, together with the stand therefor, parts being broken away and shown in vertical section;

Figure 2 is a side elevation of Figure 1, looking from the right thereof;

2 Figure 3 is an enlarged fragmentary transverse vertical sectional view taken substantially on the plane of the line 3-3 of Figure 1;

Figure 4 is a horizontal sectional view taken substantially on the plane of the line 4-4 of Figure 3;

Figure 5 is a fragmentary vertical sectional view taken substantially on the plane of the line 5-5 of Figure 4;

Figure 6 is a fragmentary horizontal sectional view on a slightly enlarged scale taken substantially on the plane of the line 6-6 of Figure 3;

Figure 7 is an enlarged horizontal sectional view taken substantially on the plane of the line 7-7 of Figure 1, parts being broken away and showing the stationary cutting element;

Figure 8 is a horizontal sectional view taken on the plane of the line 8-8 of Figure 1 and showing the rotary cutting element.

Referring specifically to the drawings, wherein like reference characters have been used throughout the several views to designate like parts, and referring at first to Figures 1 and 2, 10 designates generally any suitable motor, such as an electric motor. The motor 10 is provided with any suitable means, such as the lugs 11, for attaching the same to a mounting cradle 12. Thus, bolts or the like 13 pass through the lugs 11 and marginal portions of the cradle 12 to secure the motor and its casing to the cradle. In the embodiment shown, the cradle is secured to the upper ends of a pair of legs 14 by the passage of the bolts 13 through such legs. The legs 14 have lower ends 15 which are laterally outwardly directed to provide a wide base. The lower ends of the portions 15 are forwardly directed in horizontal alignment, as at 16, Figure 2, and thereafter connected by the bight 17 to provide a firm stand for the motor 10. As shown, the motor 10 projects forwardly over the base formed by the portions 16 and 17 of the legs, whereby to be firmly supported in vertically-spaced relation to the feet 16 and bight 17.

Referring now to Figures 1 to 6, inclusive, the motor 10 includes a shaft 18 driven thereby and depending therefrom. Also, a support 19 of cup-shaped form is secured to the frame of the motor 10 by any suitable means, such as the cap screws 20, Figure 3. Also, the floor of the support 19 is formed with a hole 21 therein through which the shaft 18 for the motor freely passes. The support 19 is formed with a depending cylindrical side wall 22 which is formed with a laterally-directed slot 23 therethrough for a purpose to be apparent. Interiorly, the support 19 includes a

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threaded bore 24 and a lower counterbore 25 merging with the bore 24 to provide a shoulder 26. The periphery of the side wall 22 of the support is formed with a peripheral groove 27 in which a ring or sleeve 28 is slidable. The sleeve 28 mounts a set screw 29 which includes a shank portion extending through the sleeve and also through the slot 23 in the side wall 22. The free inner end of the set screw 29 is threadedly engaged with the externally-threaded upper end 30 of a closure member now to be described.

The closure 31 includes a cylindrically and exteriorly-threaded upper end 30 aforesaid, and is generally cup-shaped to provide a floor 32 formed with a bore 33 therein in which the shaft 18 is freely extended. The outer periphery of the upper portion of the support 31 is stepped to be complementary to the inner periphery of the support 19 to provide shoulders seating against the shoulder 26 and also the lower end edges of the wall 22 of closure 19. That portion of the closure 31 abutting the lower end edges of the wall 22 is formed with a depending cylindrical flange 34 which in turn has a plurality of bayonet slots 35 formed therethrough, Figure 1.

The depending flange 34 forms a downwardly-directed groove in which is seated the upper end of a housing 36. The housing 36 includes a side wall 39 of circular cross-section, the upper end of which is provided with pins 37 extending radially outwardly therefrom and adapted to be seated in the bayonet slots 35 in a well known manner to support the housing 36 on the closure 31 for the same. The housing 36 likewise includes a floor 38. A charging tube 40 is attached to the wall 39 of the housing 36 in any suitable manner and opens therein below the floor 32 of the closure 31. The charging tube 40 provides a convenient means for supplying a charge of material to be ground and liquid suspending the same to the interior of the housing 36. The lower end of the shaft 18 is exteriorly threaded, as at 41, for threaded engagement with a rotary cutter 42. Likewise, the floor 32 for the closure 31 is formed with a cylindrical hub 43 extending downwardly into the housing 36 toward the floor 38 thereof. The lower end of the hub 43 is reduced and exteriorly threaded, as at 44, for threaded connection with a stationary cutter 45. It is to be understood that the threaded connections 24, 41 and 44 are so arranged as to be retained in engagement while the shaft 18 is being driven. Thus, in the embodiment shown, it is assumed that the shaft 18 rotates in the direction of the arrow, Figure 3, whereby the threads 41 are conventional right-hand threads, while the threads 24 and 44 are left-hand threads. Thus, as the shaft 18 rotates, the connection is maintained among the several parts.

The stationary cutting element 45 has an under surface complementary to the upper surface of the rotary cutting element 42, and both cutting elements have a shape corresponding substantially to the interior of the housing 36, whereby they have a close fit within the side wall 39 of the housing. Also, the rotary cutter 42 is located in closely-spaced relation to the floor 38 for the housing 36. Moreover, the set screw 29 aforesaid is adapted to be loosened to loosen the clamping engagement of the ring or sleeve 28 in the groove 27, whereby to permit relative pivoting of the closure 31 about the shaft 18. On account of the threaded engagement of the upper end 30 of the closure 31 with the threads 24 of the support 19, such pivotal movement serves to move the closure

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31 and the stationary cutting element 45 carried thereby toward and away from the rotary cutting element 42, whereby to vary the spacing between the complementary surfaces of the same. Thus, where a finely ground batch of material is desired, the parts are closely spaced into substantial abutting relation, as shown in Figures 3 and 5. However, when the grind is to be coarser, the set screw 29 is moved in a clockwise direction, Figure 4, about the shaft 18, whereby the closure 31 and stationary cutting element 45 will be raised slightly away from the rotary cutting element 42 to increase the spacing of the cutting elements and provide for a coarser grind in a well known manner. Thus, the clamping ring or sleeve 28 has a relatively loose fit in the groove 27 to permit upward and downward movement with the set screw 29 and closure 31. It is to be understood that such relative movement of the cutting elements is small. Moreover, the elevation of the closure 31 takes with it the housing 36, whereby the floor 38 thereof is more closely spaced to the under surface of the rotary cutter element 42, but as no grinding occurs between such surfaces, this narrowing of the spacing is immaterial. Also, this arrangement enables a tight joint to be maintained between the closure 31 and the housing 36 at all times, whereby to prevent the escape of fluid from the housing when a coarser grind is being made.

The stationary cutting element 45, Figure 7, is provided with an annular inner series of ports 50 for the passage therethrough of material to be ground. The outer edge of the stationary grinding element 45 is provided with a plurality of radially-directed blades 51, the free edge of which have a close fit against the side wall 39 of the housing 36. The blades 51 cooperate with the side wall 39 to provide a plurality of ports 52 which are arranged in an annular series concentrically of the housing and of the inner series of ports 50.

The rotary cutter element 42 is likewise provided with an annular inner series of ports 60, the upper ends of which are intermittently registrable with the lower ends of the ports 50 upon rotation of the element 42. However, the ports 60 are downwardly and outwardly directed in helical directions at a given pitch, whereby upon rotation of the element 42 in the direction of the arrow, Figure 8, material to be ground is sucked downwardly into the ports 60 from the ports 50 and thereafter discharged at the lower ends of the ports 60 by centrifugal force. Likewise, it should be noted that the upper edges of the ports 60 and the lower edges of the ports 50 are defined by sharp edges having a shearing action in use, whereby material passing down through the ports 50 and into the ports 60 is constantly ground by the shearing action of the edges defining such ports. The outer edge of the rotary cutting element 42 is formed with a plurality of substantially radially-directed blades 61 which cooperate with the side wall 39 of the housing 36 to provide a plurality of ports 62 between adjacent blades. Moreover, as clearly seen in Figure 1 and in Figure 8, the blades 61 comprise impeller blades having a pitch the reverse of that of the first-mentioned series of ports 60. Also, it should be noted that the lower ends of the ports 60 discharge through the outer edge of the rotary element 42 between adjacent pairs of blades 61. Thus, in the embodiment illustrated the arrangement of parts is such that material in the housing 61 above the stationary cutter element 45 is not only drawn

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by gravity downwardly through the ports 59 which are disposed on a lower level than the ports 52, but such material is positively drawn down by the impeller action of the ports 60. Thus, material passing through the ports 59 and 60 is ground by the meeting edges thereof and thereafter discharged radially outwardly and downwardly to the periphery of the rotary cutting element 42. At that point, it is engaged by the upwardly-directed impeller teeth 61 and driven upwardly through the ports 62 of the outer series and ports 52 of the stationary cutting element. At the same time, it should be noted that the lower edges of the teeth or blades 51 and the upper edges of the teeth 61 are sharpened to provide a shearing effect as the ports 52 and 62 are intermittently registered. Thus, the material is likewise ground as it passes upwardly through the ports 62 and 52 into the space above the stationary cutting element 45. Thus, a double-action cutting effect is achieved as the fluid bearing the material to be ground is circulated through the device. Thus, finer grinds may be achieved in less time whereby to effect a substantial saving in time and power.

It should be noted that the outer edge of the rotary cutting element 42 is formed with a peripheral groove 64 dividing the blades 61 into upper and lower sets of blades. The ports 60 discharge between adjacent blades of the lowermost set and without the groove 64, the material in suspension would be forced upwardly by the blades 61 unequally and with excessive pressure. However, the groove 64 permits the material which is initially upwardly directed unequally by the lower set of blades to be distributed equally about the outer edge of the rotary cutting element and thereafter forced upwardly through the outer ports equally.

A tube 70 extends through the casing for the motor 10 and has a lower end 71 extending through the floor of the support 19 so as to open into the space of annular form surrounding the upper portion of the shaft 18. In use, ground material occasionally works up through the bore 33 into such space, whereby the tube 70 provides a convenient means for discharging a fluid into such space to clean the same.

In practice, the fluid used to grind flaxseed and other oil-bearing seeds is preferably one which comprises a solvent for the oil contained in the seeds. However, it is obvious that any suitable suspending fluid may be used, and that the use of the machine is not necessarily limited to the grinding of oil-bearing seeds. Moreover, while we have shown and described what is now thought to be a preferred embodiment of the invention, it is to be understood that the same is susceptible of other forms and expressions. Consequently, we do not limit ourselves to the precise structures shown and described hereinabove except as hereinafter claimed.

We claim:

1. A grinder for grinding solid material in suspension in a fluid, comprising a stationary housing having a side wall of circular cross-section and a floor, a top closure for said housing detachably secured thereto, a rotary shaft extending through said closure into said housing axially thereof, a rotary grinding element fixed to said shaft in closely-spaced relation to said floor and side wall, a stationary grinding element carried by said closure above said rotary element and in closely-spaced relation thereto and to said side wall, said closure being formed to provide an annular space in said housing above said grind-

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ing elements, said grinding elements each being formed with an inner annular series of downwardly-directed ports and an outer annular series of upwardly-directed ports, said ports of said elements registering intermittently upon rotation of said rotary element, the adjacent ends of said ports of both elements being defined by sharp edges whereby to have a shearing action upon rotation of said rotary element, and said ports of said rotary element being formed and arranged to provide impellers for circulating said material in suspension downwardly through both inner series of ports and upwardly into said annular chamber through both outer series of ports.

2. A grinder for grinding solid material in suspension in a fluid, comprising a stationary housing having a side wall of circular cross-section and a floor, a top closure for said housing detachably secured thereto, a rotary shaft extending through said closure into said housing axially thereof, a rotary grinding element fixed to said shaft in closely-spaced relation to said floor and side wall, a stationary grinding element carried by said closure above said rotary element and in closely-spaced relation thereto and to said side wall, said closure being formed to provide an annular space in said housing above said grinding elements, said grinding elements each being formed with an inner annular series of downwardly-directed ports and an outer annular series of upwardly-directed ports, said ports of said elements registering intermittently upon rotation of said rotary element, the adjacent ends of said ports of both elements being defined by sharp edges whereby to have a shearing action upon rotation of said rotary element, said inner series of ports of said rotary element being downwardly and outwardly directed helical passages of like pitch, and said outer series of ports of said rotary element being defined by said housing wall and by a plurality of helical impeller blades of a reverse pitch formed on said rotary element whereby to circulate said material in suspension downwardly through both inner series of ports and upwardly into said annular chamber through both outer series of ports.

3. A grinder for grinding solid material in suspension in a fluid, comprising a stationary housing having a side wall of circular cross-section and a floor, a top closure for said housing detachably secured thereto, a rotary shaft extending through said closure into said housing axially thereof, a rotary grinding element fixed to said shaft in closely-spaced relation to said floor and side wall, a stationary grinding element carried by said closure above said rotary element and in closely-spaced relation thereto and to said side wall, means for adjusting said grinding elements toward and away from each other to vary the spacing thereof, said closure being formed to provide an annular space in said housing above said grinding elements, said grinding elements each being formed with an inner annular series of downwardly-directed ports and an outer annular series of upwardly-directed ports, said ports of said elements registering intermittently upon rotation of said rotary element, the adjacent ends of said ports of both elements being defined by sharp edges whereby to have a shearing action upon rotation of said rotary element, and said ports of said rotary element being formed and arranged to provide impellers for circulating said material in suspension downwardly through both inner series of ports and

upwardly into said annular chamber through both outer series of ports.

4. A grinder for grinding solid material in suspension in a fluid, comprising a stationary housing having a side wall of circular cross-section and a floor, a top closure for said housing detachably secured thereto, a rotary shaft extending through said closure into said housing axially thereof, a rotary grinding element fixed to said shaft in closely-spaced relation to said floor and side walls, a stationary grinding element carried by said closure above said rotary element and in closely-spaced relation thereto and to said side wall, means mounting said closure for adjustment of the same and said stationary grinding element toward and away from said rotary grinding element whereby to vary the spacing of said grinding elements, said closure being formed to provide an annular space in said housing above said grinding elements, said grinding elements each being formed with an inner annular series of downwardly-directed ports and an outer annular series of upwardly-directed ports, said ports of said elements registering intermittently upon rotation of said rotary element, the adjacent ends of said ports of both elements being defined by sharp edges thereby to have a shearing action upon rotation of said rotary element, and said ports of said rotary element being formed and arranged to provide impellers for circulating said material in suspension downwardly through both inner series of ports and upwardly into said annular chamber through both outer series of ports.

5. A grinder for grinding solid material in suspension in a fluid, comprising a stationary housing having a side wall of circular cross-section and a floor, a top closure for said housing detachably secured thereto, a rotary shaft extending through said closure into said housing axially thereof, a rotary grinding element fixed to said shaft in closely-spaced relation to said floor and side wall, a stationary grinding element carried by said closure above said rotary element and in closely-spaced relation thereto and to said side wall, said closure being formed to provide an annular space in said housing above said grinding elements, said grinding elements each being formed with an inner annular series of downwardly-directed ports and an outer annular series of upwardly-directed ports, said ports of said elements registering intermittently upon rotation of said rotary element, the adjacent ends of said ports of both elements being defined by sharp edges whereby to have a shearing action upon rotation of said rotary element, said inner series of ports of said rotary element being downwardly and outwardly-directed helical pas-

sages of like pitch, said rotary grinding element having an outer edge formed with a peripheral series of impeller blades of a reversed pitch co-operating with said housing wall to define said outer series of ports of said rotary element, said outer edge of said rotary element being formed with a circumferential groove dividing said blades into upper and lower sets of blades, and said blades and passages of said rotary element comprising means for circulating said material in suspension downwardly through both inner series of ports and upwardly into said annular chamber through both outer series of ports.

6. In a grinder for grinding material in suspension, including complementary stationary and rotary grinding elements, the improvement comprising a fixed housing surrounding said elements and having a close fit therewith, said elements being formed with annular inner series of registrable ports and with annular outer series of ports being concentrically disposed relative to each other and to said housing, said elements having adjacent complementary surfaces including shearing edges defining adjacent ends of said ports, and said ports of said rotary element being formed to provide impellers for circulating material to be ground in one direction through both inner series of ports and in the opposite direction through both outer series of ports.

7. In a grinder for grinding material in suspension, including complementary stationary and rotary grinding elements, the improvement comprising a fixed housing surrounding said elements and having a close fit therewith, said elements having opposed grinding means, at least one of said elements being formed with means for passing said material to be ground through both elements and grinding means in one direction, and at least one of said elements being formed with means for returning said material to be ground through both elements and grinding means in the opposite direction whereby to provide a closed circuit for said material and double-action grinding thereof.

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