Oct. 20, 1970 G. CHAPLENKO 3,534,914

GRINDING AND MIXING VIBRATOR

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FIG. 1

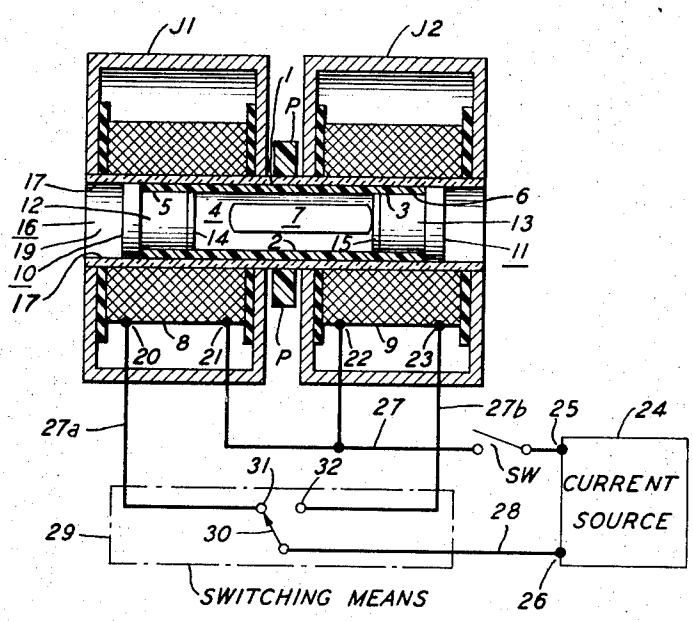
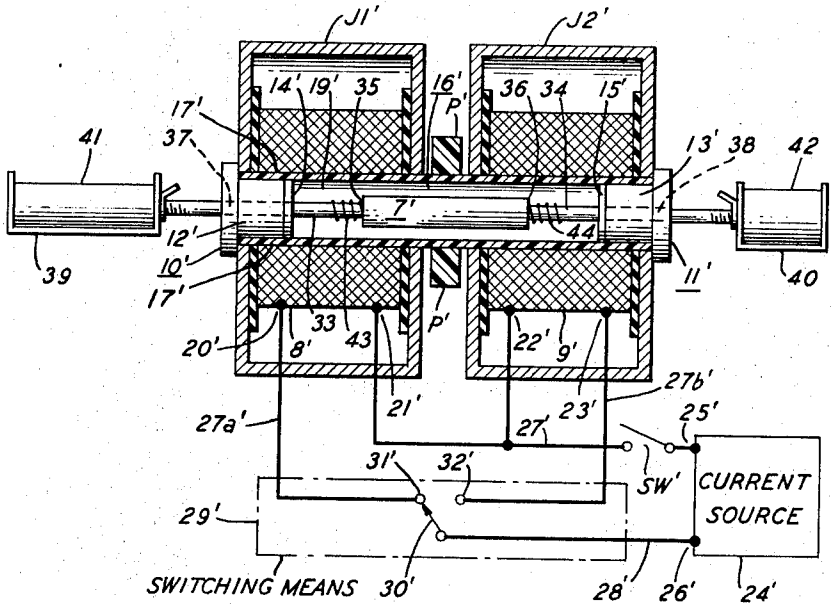


FIG. 2



INVENTOR
GEORGE CHAPLENKO

BY
Frederick W. Padden
ATTORNEY

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FIG. 3

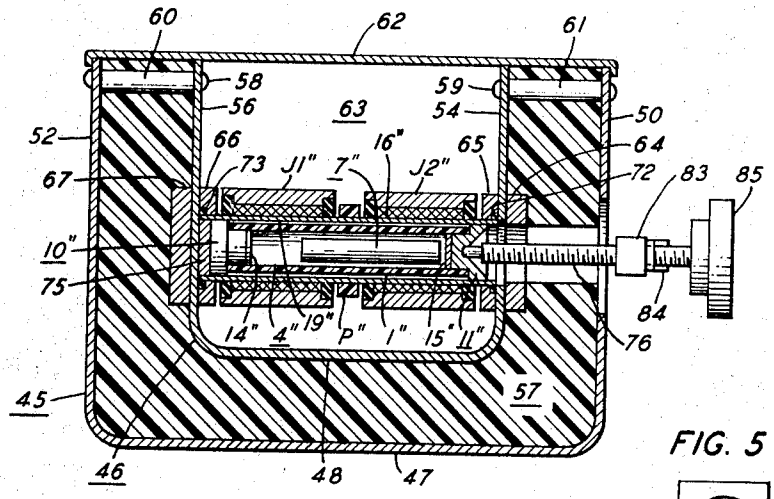


FIG. 5

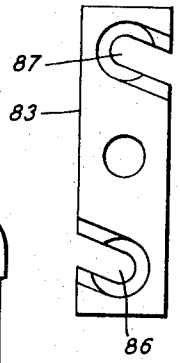
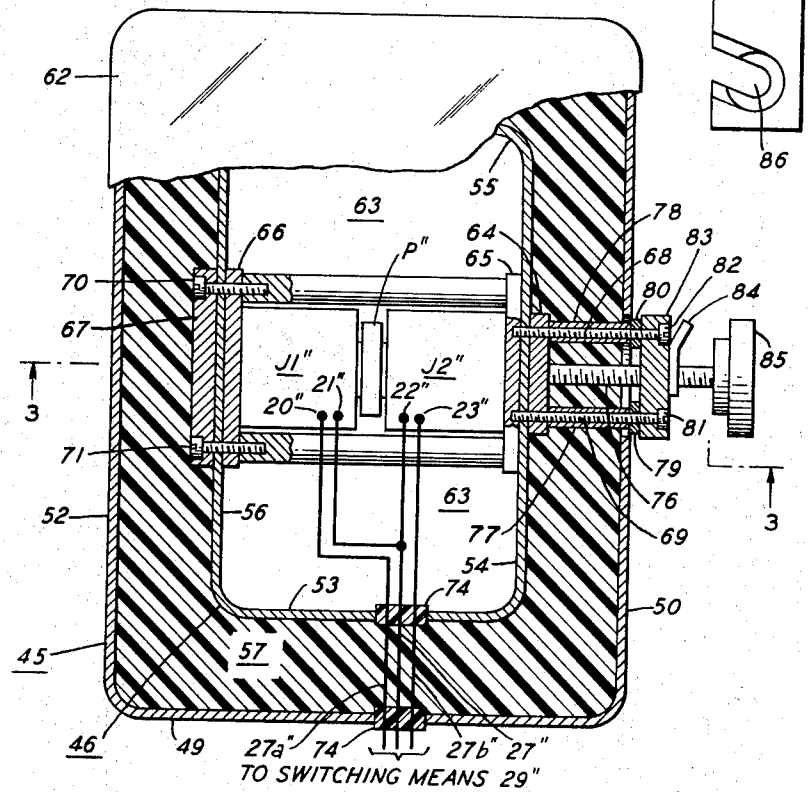


FIG. 4



INVENTOR
GEORGE CHAPLENKO
BY
Frederick W. Padden
ATTORNEY

Oct. 20, 1970 G. CHAPLENKO 3,534,914

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FIG. 6

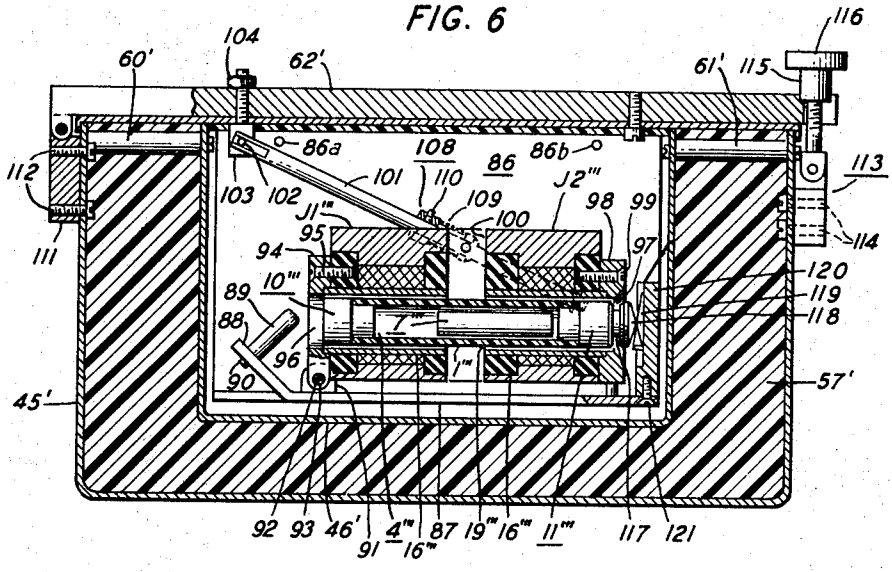


FIG. 8

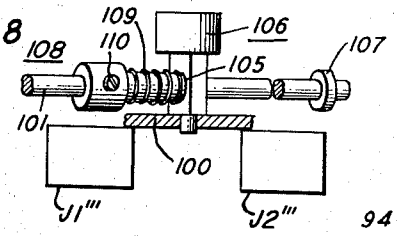


FIG. 9

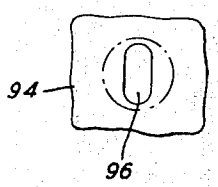


FIG. 7

INVENTOR
GEORGE CHAPLENKO

BY
Frederick W. Padden
ATTORNEY

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GRINDING AND MIXING VIBRATOR

George Chaplenko, Edison Township, Middlesex County, N.J., assignor to Spex Industries, Incorporated, Metuchen, N.J., a corporation of New Jersey

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U.S. Cl. 241—66 12 Claims

ABSTRACT OF THE DISCLOSURE

A reciprocal motion electric motor is disclosed for grinding and mixing a material within and without a sample holder tube under control of an impactor armature which reciprocally is driven between two ends of the tube. A switching means is provided for cyclically applying switching currents to solenoids of the motor to control the reciprocal movement of the armature. The motor is mounted within a temperature insulated chamber wherein it is surrounded by a refrigerant liquid nitrogen for comminuting materials at low temperatures. Linkage apparatus and ejection means are furnished for pivoting and ejecting the sample holder for comminuting operations.

BACKGROUND OF THE INVENTION

This invention relates to reciprocal motion motor equipment and particularly to electrical motor apparatus for comminuting or mixing materials at low temperatures.

Numerous laboratory and industrial applications require materials to be mixed or reduced to minute particles for analysis of their composition. It is well known that, in many such applications, certain materials such as aluminum, lead and rubber are too soft and pliable and other materials such as plastic, wool, wax and gum are too heat-sensitive to be mixed or ground into particles with conventional apparatus. In many instances, such materials have heretofore been satisfactorily impact ground or mixed to minute particles by performing the operation at low temperatures obtained either by immersing the grinding apparatus with the material to be ground directly into a refrigerant substance, such as liquid nitrogen, or by drip feeding such a refrigerant directly into the grinder container having the material to be ground.

Prior art immersion arrangements and procedures have proven inefficient and inconvenient because costly and complex grinding or mixing apparatus must be carefully immersed and withdrawn from the refrigerant for each comminuating operation. In addition, such an immersion technique often results in vigorous splashing of a potentially dangerous refrigerant fluid particularly during the grinding or mixing operation and it therefore is a recognized problem in the field. Moreover, the drip feeding process generally requires a substantial amount of careful manipulations and results in poor heat transfer to the material to be particlized. Because of the caution that must be exercised and the performance limitations of prior art equipments used in such processes, the comminution of materials of the foregoing characteristics has proven to be both expensive, inefficient, and time-consuming.

SUMMARY OF THE INVENTION

In order to provide for safety and to reduce the time and expense of comminuting materials at low temperatures, it is an object of the present invention to provide an improved grinder or mixer arrangement by means of which materials may be particlized at low temperatures with improved heat transfer to the materials and without danger due to splashing while inserting and withdrawing

the material from the grinder or mixer apparatus immersed in a refrigerant.

The foregoing and other objects are achieved in accordance with the exemplary embodiments of this invention by providing simple and inexpensive reciprocating electric motor apparatus for grinding and mixing. This apparatus is immersible within a refrigerant and includes structure for enabling a material to be inserted or withdrawn from its grinding or mixing container without removing the grinding or mixing apparatus from the refrigerant. This structure accordingly maintains the grinding apparatus in the low temperature environment while the materials are admitted and withdrawn therefrom and, as a result, minimal splashing of a potentially dangerous refrigerant occurs. Furthermore, the immersion arrangement of this invention provides for improvement in the heat transfer characteristics of the grinding apparatus which contributes to a reduction in the time used for the comminuting operation and lessens the probability of heat damage to sensitive heat substances.

One of the features of the illustrative embodiment of this invention is the provision of a reciprocating electric motor for grinding, or mixing, materials with minimal splashing during the grinding or mixing operation. The motor comprises a pair of solenoids which are wound around a cylindrical tube having an inner bore for receiving and supporting a removable holder for materials to be comminuted. The holder comprises a cylindrical tube having an inner bore in which a material can be ground or mixed. A magnetic armature is enclosed within the bore of the holder tube and is reciprocally movable therein between two end stop pieces under control of a switched voltage cyclically applied individually to each of the solenoids by a switching means. The latter is suitably an electronic or electromechanical device.

In accordance with another aspect of the exemplary embodiment of this invention, the aforementioned armature is selectively attached at its longitudinal end segments to two shafts which extend through apertures in the end stops. Each of these shafts is illustratively secured to a functional device such as a holder for holding vials to mix substances therein. Such an arrangement further extends the usefulness of the device by enabling it to be used at ambient temperatures.

The operation of the motor is effected by successively applying the switching voltage to the solenoids sequentially to energize each of them and whereby the armature is attracted toward one energized solenoid away from the de-energized solenoid and vice versa. This causes reciprocatiton of the armature between the end stops for enabling the grinding or mixing of materials. In the one embodiment where the material is inserted into the cylindrical holder bore, the material is ground or mixed by the reciprocating impact of the armature between the end stops. In the exemplary arrangement wherein the shafts and vial holders are utilized, springs are coiled about each of the shafts between the armature and end stops to cushion the reciprocation of the armature so that controllable reciprocating action of the armature occurs between the end stops.

For comminuting materials at low temperatures, the impact grinder or mixer motor apparatus is rigidly mounted in a suitably insulated chamber. A refrigerant such as liquid nitrogen is also provided in the chamber and surrounds the reciprocating motor apparatus. As a result, low temperatures are conductable through the cylindrical holder tube to the material or substance to be ground or mixed. The switching means for sequentially supplying electrical switching voltages is illustratively located outside of the insulated chamber and is connectable to the switching solenoids via wires extended through pas-

sageways to the insulated chamber which are sealed to prevent leakage of the refrigerant or are located above the refrigerant level.

Advantageously, in accordance with a specific illustrative embodiment of this invention, the entire reciprocating motor is incorporated into the insulated, refrigerated chamber in such a manner that one end stop is removable from the bore of the cylindrical material holder without causing any leakage of the liquid refrigerant from the chamber. This arrangement enables a material to be comminuted or mixed to be inserted into the grinding or mixing bore without splashing the potentially dangerous liquid nitrogen. The one end stop comprises a female segment which is wedge interfitted with a latching assembly that controls the removal of the end stop to allow material to be inserted into the grinding or mixing holder bore and the subsequent reinsertion of the end stop to latch it within the bore for the comminution operation.

A salient feature of another illustrative embodiment of the present invention is the provision of apparatus for pivotally mounting the reciprocating motor within the insulated refrigeration chamber. The apparatus includes a device for linking the motor assembly to a pivotally secured chamber cover so that the motor is pivotally raised upon the opening of the cover. In addition, the motor mounting apparatus comprises a sample holder ejection pin mechanism which automatically ejects the sample holder from its grinding or mixing position within the motor assembly. The sample holder is equipped with means for facilitating its engagement with a holder tool after the holder ejection and for reducing the need for handling a sample holder particularly a cold one after a grinding or mixing operation. Furthermore, a spring and stop arrangement are furnished as part of the linkage device for maintaining the motor assembly under spring tension during a grinding or mixing operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the present invention will be more clearly understood from a reading of the following description of illustrative embodiments thereof with reference to the drawings in which:

FIG. 1 is a schematic diagram showing mechanical apparatus of the reciprocating motor and the electrical circuitry for controlling the reciprocation of an armature according to an exemplary embodiment of this invention;

FIG. 2 is another illustrative embodiment in which the armature of the reciprocating motor is affixed to shaft members supporting external vial holders;

FIG. 3 is a side cross-section view of the reciprocating motor of FIG. 1 structurally integrated in an insulated container of liquid nitrogen in accordance with a specific illustrative embodiment of the invention;

FIG. 4 is a top view of the structure of FIG. 3;

FIG. 5 shows a latch element of the latching assembly associated with the end stops of the material holder;

FIG. 6 is a side cross-section view of the reciprocating motor of FIG. 1 pivotally mounted within an insulated container of liquid nitrogen in accordance with another specific illustrative embodiment of the invention;

FIG. 7 is another side cross-section view of the apparatus of FIG. 6 showing the reciprocating motor pivoted under control of linkage to the cover of the container and with an extracting pin in engagement with a sample holder;

FIG. 8 shows details of the linkage between the container cover and the motor; and

FIG. 9 shows a slot for admitting the extracting pin into engagement with the sample holder.

It is noted that similar parts of the apparatus in the exemplary embodiments are disclosed in more than one figure of the drawings. Each of the similar parts is designated with the same numeral or letter in each figure and, where repeated, it is additionally designated with a single or double prime (′ or ″). For example, the armature 7 of FIG. 1 also corresponds in FIGS. 2 and 3 to the armatures designated 7′ and 7″, respectively.

DESCRIPTION

Referring to FIG. 1, the reciprocating motor comprises an inner housing tube 1 which is illustratively cylindrical in shape with a wall depicted as cross-section members 2 and 3 to define an inner bore section 4 with respective left and right apertures 5 and 6. Tube 1 may be constructed of an electrically nonconductive material such as ceramic or plastic to form a guidance tube for an armature 7 and a holder for a sample of material to be comminuted or mixed. Armature 7 includes a suitable ferromagnetic material, such as soft iron, with hardened end segments, a predetermined diameter and length and it is located within bore 4 for reciprocal movement therein toward apertures 5 and 6 under control of switching solenoid coils 8 and 9, as later explained. End stop pieces 10 and 11 have respective section elements 12 and 13 which complement and interfit within bore 4 to cover apertures 5 and 6, respectively, and to seal the armature within bore 4 during reciprocal movement therein. Pieces 10 and 11 may comprise soft steel with respective armature impactor surfaces 14 and 15 of tungsten carbide. One of the pieces, for example piece 11, is removable from bore 4 for admitting a material or substance to be comminuted or mixed. The piece 11 is then replaced within bore 4 as shown in FIG. 4 to enable armature 7 to be controllably reciprocated.

Another cylindrical tube 16 having a wall shown by cross-section member 17 define an inner bore 19 for housing the tube 1 and end pieces 10 and 11. Solenoid coils 8 and 9 are shown as wound about exterior end sections of tube 16 and as having the respective terminals 20, 21 and 22, 23. The coils 8 and 9 are each covered by respective magnetic jackets J1 and J2 about tube 16 and are separated by a nonmagnetic spacer P for electrical isolation during immersion in a refrigerant substance.

A source 24 is utilized to supply energizing power AC or DC to its terminals 25 and 26. Terminal 25 is connected through an ON-OFF switch SW over a wire 27 to terminals 21 and 22 of solenoids 8 and 9 while terminal 26 is connected over wires 28, 27*a* and 27*b* selectively to the solenoid terminals 20 and 23 under control of a switching means 29. A simple switch having a wiper 30 and terminals 31 and 32 illustrates the function of the switching means 29 which may also be constructed from known electromechanical and electronic apparatus. Switching means 29 cyclically switches the wiper 30 between terminals 31 and 32 to supply energizing current to solenoids 8 and 9.

A cycle of the reciprocating action of armature 7 within bore 4 and between the impactor surfaces 14 and 15 is now explained by illustratively assuming that armature 7 is located within bore 4 as depicted in FIG. 1 and that wiper 30 is switched into contact with terminal 31. When these conditions are established, current is supplied by source 24 to solenoid 8 for producing a magnetic field about end piece 10 which attracts armature 7 away from end piece 11 and toward piece 10. The current path is through the closed switch SW, wire 27, solenoid terminals 21 and 20, wire 27*a*, switching terminal 31 and wiper 30, and lead 28 to terminal 26.

Shortly thereafter armature 7 is driven into impact with both surface 14 and a material therein to impact grind or mix it. Next, the wiper 30 is switched from terminal 31 to terminal 32 for interrupting the current flow through solenoid 8 and initiating a current flow through solenoid 9. The interrupted current flow through solenoid 8 switches the magnetic field about end piece 10 and then the field diminishes. The current flow through solenoid 9 is from source 24, terminal 25, switch SW, lead 27, solenoid terminals 22 and 23, lead 27*b*, switch terminal

32 and wiper 30, and lead 28 to terminal 26. This current flow produces a magnetic field about end piece 11 which attracts armature 7 away from piece 10 and into impact with both surface 15 and a material therein for grinding or mixing. Subsequently, the wiper 30 is switched from terminal 32 to terminal 31 and for completing the reciprocation cycle and returning the motor apparatus to the condition in which it rested at the start of the cycle.

FIG. 2 shows a reciprocating motor similar in construction and material properties to that of FIG. 1 and with the similar elements designated in FIG. 2 with a prime such as solenoid 8' of FIG. 2 which corresponds to solenoid 8 of FIG. 1. The inner housing tube 1 of the motor of FIG. 1 is not included in the exemplary motor of FIG. 2. A cylindrical tube 16' has a wall depicted as cross-section member 17' defining an inner bore section 19'. Tube 16' may be constructed of an electrically nonconductive material to form a guidance tube for armature 7' and a holder for a sample to be comminuted or mixed Armature 7' includes a ferromagnetic material with hardened ends 35 and 36 and a prescribed diameter and length. It is located within bore 19' for reciprocal movement therein between the end stop pieces 10' and 11' under control of the switching solenoid coils 8' and 9' in a manner substantially identical to that explained previously with regard to the motor of FIG. 1. End stop pieces 10' and 11' have respective section elements 12' and 13' which complement and interfit at opposite ends of bore 19' and therewithin to seal the armature 7' within bore 19' during reciprocal movement therein. Armature 7' further has two shafts 33 and 34 with first end segments secured to respective armature end portions 35 and 36 and extending through respective longitudinal apertures 37 and 38 in end pieces 10' and 11'. Shafts 33 and 34 have respective holder elements 39 and 40 affixed to second end segments thereof for holding vials 41 and 42 for mixing substances therein. The springs 43 and 44 are fitted about the exterior of shafts 33 and 34 to limit and cushion the movement of armature 7' between surfaces 14' and 15'.

The operation of the motor of FIG. 2 is effected by successively supplying power from current source 24' through switching means 29' to energize sequentially solenoids 8' and 9'. The supplied power reciprocally attracts armature 7' toward the end piece 10' or 11' associated with the energized solenoid 8' or 9' and away from the de-energized solenoid 9' or 8' and then vice versa. This energizing action causes reciprocation of armature 7' within bore 19' which is translated into corresponding reciprocation of the holders 39 and 40 with the vials 41 and 42 for mixing substances therein.

Turning now to the exemplary embodiment of the invention depicted in FIGS. 3, 4 and 5, the reciprocating electric motor apparatus of FIG. 1 is illustratively shown as embodied in an insulated refrigeration container for grinding or mixing materials at low temperatures. The container comprises inner and outer housing elements 45 and 46 constructed illustratively of metal materials of generally rectangular shape defined by respective bottom members 47 and 48 contiguously joined to respective side elements 49, 50, 51 (not shown) and 52, and 53, 54, 55, 56. Inner housing element 46 is structurally smaller than the outer housing element 45. An insulating material 57 such as foam, is positioned between all facing surfaces of housing elements 45 and 46 to provide for thermal insulation. Screw fasteners 58 and 59 and respective spacer members 60 and 61 fasten the housing elements 45 and 46 together as shown in FIG. 3. An insulated cover device 62 is attachable over the upper portions of the housing elements 45 and 46 to close an interior chamber 63 defined by the inner side wall and bottom surfaces of housing element 46. Accordingly, a refrigerant substance such as liquid nitrogen is insertable within the chamber 63 to lower the temperature therein and about the grinder reciprocating motor. Appropriate venting in the cover 62 is provided for gas pressure releasing during a grinding operation.

Structural elements of the grinder reciprocating electric motor of FIG. 1 are illustrated as secured within chamber 63 to the side wall elements 54 and 56 of housing element 46 by means of supporting blocks 64, 65, 66 and 67 and threaded screw fasteners 68, 69, 70 and 71 which complement and interfit with respective threaded segments of the latter blocks. Seal devices 72 and 73 illustratively of Teflon or other suitable sealing materials are interposed between the walls 54 and 56 and the respective supporting blocks 65 and 66 for preventing leakage of a refrigerant out of the inner chamber 63. The three connecting wires 27'', and 27*a*'' and 27*b*'' between a switching means 29'' and solenoids (8, 9 of FIG. 1) are shown extended through passageway 74 through housing elements 46, 45 and insulating material 57.

In FIG. 3, a spacer block 75 is utilized between side wall 56 and the end stop piece 10''. The end stop piece 11'' of FIG. 3 comprises a female cavity section which complements and interfits with an end section of screw fastener 76 of a latching assembly for enabling the piece 11'' to be removed from the cylindrical tubes 1'' and 16'' to insert in tube 1'' a sample of material to be ground and without any leakage or disturbance to the refrigerant within chamber 63. As shown in FIG. 4, threaded fastener screws 68 and 69 are extended through respective spacers 77 and 78 and are threadedly interfitted with threaded apertures in supporting blocks 64 and 65. Spacers 77 and 78 are secured to a fixed position by the lock nut elements 79 and 80 whereby respective sections proximate to the heads 81 and 82 of screws 68 and 69 protrude for engagement with a fastening wing latch 83 threadedly affixed to screw 76. A locking nut 84 is threadedly secured to screw 76 for locking the screw 76 in cooperation with the fastening latch 83 when the end stop piece 11'' is tightly fixed in its position of FIG. 3 for grinding or mixing a material. A knob 85 is mounted on screw 76 for facilitating the insertion of screw 76 into the threaded portion of end piece 11'' and locking it in place for the grinding or mixing operation.

FIG. 5 shows the latch 83 as having opened segments 86 and 87 which are movable into engagement with the respective extended segments of screws 68 and 69 selectively upon the rotation of screw 76 during the locking of end piece 11'' for a grinding or mixing operation.

When a material or substance is to be mixed or ground into small particles, the locking nut 84 of FIG. 4 first is rotated on screw 76 to free latch means 83 so that it can rotate to disengage the screws 68 and 69. Screw 76 is then withdrawn to remove the end piece 11'' (FIG. 3) from within bores 4'' and 19'' of cylinders 1'' and 16'' via a cooperating channel of apertures in wall 54, block 64, material 57 and side element 50. A sample of the material to be mixed or comminuted next is inserted into the respective bore 4'' of sample holder 1'' for mixing or grinding. It is desirable to note that the cylinder 1'' and armature 7'' can be removable from within cylinder 16'' after the end stop piece 11'' is withdrawn therefrom. The foregoing illustrates that it is not necessary to disturb the refrigerant chemical in chamber 63 for handling or removing the reciprocating motor grinder or mixer structure to insert or remove a sample of material.

Following the insertion of the material sample, the end piece 11'' attached to screw 76 is reinserted into the bores 4'' and 9'' cylinders 1'' and 16'' as depicted in FIG. 3 and the latch means 83 is rotated on screw 76 whereby the respective opened segments 86 and 87 of latch 83 engage the screws 68 and 69. The locking nut 84 is then rotated to lock the end piece 11'' and latch assembly in position as shown in FIG. 3. The reciprocation of the armature 7'' for mixing or comminution of the material in bore 4'' is initiated by the closure of switch SW as described with respect to the apparatus of FIG. 1.

FIGS. 6, 7, 8 and 9 depict another illustrative embodiment of the invention in which the reciprocating electric motor apparatus of FIG. 1 is illustratively shown as pivotally mounted within an insulated refrigeration container for grinding or mixing materials at low temperatures. The container shown in FIGS. 6 and 7 is substantially the same as depicted in FIGS. 3 and 4. The apparatus pivotally supporting the motor includes an L-shaped member **86** secured to the housing element **46'** by fasteners **86***a* and **86***b* and having a platform extension **87** with a raised section **88** supporting a sample holder ejection pin **89** in cooperation with a threaded screw fastener **90**. Platform extension **87** further includes a pivotal support member **91** having an aperture (not shown) for receiving and supporting a pivot pin **92**. The latter is inserted and pivotally supported in an aperture **93** in a supporting block **94** which is secured to the solenoid jacket **J1'''** by means of a complementing threaded fastener **95**. Supporting block **94** also comprises a slotted section defining an opening **96** as shown in FIG. 9. It admits the sample holder ejection pin **89** for contacting end stop piece **10'''** and slideably urging it and the associated sample holder cylindrical tube **1'''** including armature **7'''** and end stop piece **11'''** out of the bores **19'''** of the split cylindrical tube **16'''** and through an aperture **97** in a supporting block **98** secured by fastener **99** to jacket **J2'''**. The ejection urging action occurs under control of a linkage structure between the reciprocating motor assembly and the container cover **62'** upon the pivotal opening of cover **62'**.

As shown in FIGS. 6 and 7, cylindrical tube **16'''** is split into two sections for enabling a refrigerant, such as liquid nitrogen, to surround the sample holder tube **1'''** directly at its midsection for improved cooling of a sample to be ground or mixed. Each of the split sections of tube **16'''** is maintained in registration by a complementary slot in the respective blocks **94** and **98** and by the assemblies of jackets **J1'''** and **J2'''**. Block **98** further includes a foot extension for horizontally supporting the motor on platform **87**. Jackets **J1'''** and **J2'''** are rigidly secured to a back plate **100** for aligned registration of the bores **19'''** of tube **16'''**.

The linkage for pivotally moving the reciprocating motor upon the opening of cover **62'** includes a cylindrical shaft **101**, one end of which has an aperture cooperating with a pivot pin **102** and a supporting block **103** secured to cover **62'** by a threaded fastener **104** for pivotal movement of shaft **101** upon the opening of cover **62'**. As shown in FIG. 8, shaft **101** slideably extends through a bore **105** in a swivel block **106** which is pivotally affixed through an opening in back plate **100**. A stop member **107** is affixed at a second end of shaft **101** which urges against block **106** to pivotally lift the reciprocating motor assembly about pin **92** when cover **62'** is raised toward the position as shown in FIG. 7.

A lock nut **108** and spring **109** are cooperatively affixed about the outer surface of shaft **101** to apply a desired tension against block **106** whereby the reciprocating motor is secured in the position as shown in FIG. 6 during a grinding or mixing operation when cover **62'** is closed. The desired tension is achieved by an adjustment of the location of nut **108** along shaft **101** and the setting of set screw **110** to fixed nut **108** in place.

Cover **62'** is pivotally secured to a pivot pin and block assembly **111** which is affixed to housing element **45'** by fasteners **112**. A lock assembly **113** is also secured to housing element **45'** by fasteners **114**. Assembly **113** includes a pivotally mounted screw **115** which is threadedly associated with a latch element **116** for latching engagement of the cover **62'** during a grinding or mixing operation.

End stop element **11'''** comprises a groove segment **117** and head piece **118** for engagement with an extracting tool (not shown) for withdrawing the sample holder including tube **1'''** and elements **10'''** and **11'''** from

bore **19'''** of the tube **16'''**. This arrangement eliminates the need for handling a cold sample holder after a grinding or mixing operation. In addition, a wedge device **119** is affixed to a support block **120** which is secured to the platform **87** by a fastener **121** for slidably urging against head **118** to move the sample holder into its position as shown in FIG. 6 when cover **62'** is closed. This configuration further eliminates manipulation of the sample holder prior to a grinding or mixing operation and insures that the sample holder is registered and secured in the position as shown in FIG. 6 for such an operation.

It is to be understood that the hereinbefore described arrangements are illustrative of the application of the principles of the invention. In light of this teaching, it is apparent that numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In combination:
guidance means having a wall member defining an inner bore with a first and second terminus,
first and second solenoid means about a periphery of said wall members proximate to said first and second terminus, respectively,
an armature located within said bore and being reciprocally movable therein between said first and second terminus,
means cyclically applying prescribed currents to said first and second solenoid means for sequentially energizing said first and second solenoid means reciprocally to move said armature within said bore between said first and second terminus,
a temperature insulated chamber means in which are mounted said guidance means, said armature, and said first and second solenoid means,
and refrigerant means surrounding said guidance means and armature mounted in said chamber means for conducting low temperatures into said inner bore of said wall member guidance means.

2. The combination in accordance with claim 1:
wherein each of said first and second solenoid means comprises a solenoid coil wound around an individual one of said wall member and termini and having first and second terminal means,
and wherein said current applying means comprises a power source supplying said prescribed currents and having a connection means in common to said first terminal means of each of said solenoid coils,
and switching means connected to said power source and being sequentially operable for applying said prescribed currents supplied from said source selectively to said second terminal means of each of said solenoid coil terminal means for energizing said solenoid coils reciprocally to move said armature within said bore between said first and second wall member terminus.

3. The combination in accordance with claim 1:
wherein said wall member of said guidance means defines an inner bore with first and second apertures at opposite end segments of said bore,
and said refrigerant means comprises a liquid refrigerant,
and further comprising a pair of end stop pieces, each of said pieces being removably inserted within said wall member to cover an individual one of said apertures and thereby to contain said armature within said bore during said reciprocal movement.
and a latching assembly extending through said insulated chamber means and including
means for sealing said liquid refrigerant within said insulated chamber and enabling one of said end stop pieces to be removed from said wall member and chamber without leakage of said liquid refrigerant,

and means cooperating with said chamber for securing said one of said end stop pieces in said wall member bore for said reciprocal movement of said armature within said wall member bore.

4. The combination in accordance with claim 3:

wherein said one of said end stop pieces comprises a cavity section,

and said securing means includes a screw fastener having an end segment thereof which complements and interfits with said cavity section,

fastener post means secured to said chamber means,

a fastening latch means threadedly secured to said screw fastener and being cooperatively engageable with said fastener post means for securing said one of said end stop pieces in said wall member bore with said screw fastener end segment interfitting with said one end stop piece cavity section for said reciprocal movement of said armature within said bore.

5. The combination in accordance with claim 1:

wherein said wall member of said guidance means defines a cylindrical inner bore with first and second apertures at opposite end segments of said bore,

and further comprising a pair of end stop pieces, each of said pieces being affixed to said wall member to cover an individual one of said apertures and thereby to contain said armature within said bore during said reciprocal movement and having surface means for impacting contact with said armature during said reciprocal movement.

6. The combination in accordance with claim 5:

wherein at least one of said end stops has a longitudinal inner wall member defining an opening in alignment with said bore,

and further comprising shaft means joined to said armature and extendable through said wall member opening for reciprocal movement therethrough under control of said reciprocal movement of said armature.

7. Apparatus for comminuting a material at low temperatures comprising:

electrical motor means including first and second tube means each having a wall member defining an inner bore,

first and second solenoid means wound about a periphery of an individual one of said wall members,

means pivotally supporting said wall members of said tube means with said respective inner bores in aligned registration,

a material sample holder having a member defining an inner bore for holding material to be comminuted and located within said aligned inner bores of said tube means,

and an armature located within said sample holder bore and being reciprocally movable therein between a first and a second terminus of said bore,

a temperature insulated chamber having means pivotally supporting said electrical motor means for the comminution of a material at low temperatures with a refrigerant means surrounding said sample holder bore defining member,

and further comprising means cyclically applying prescribed currents to said first and second solenoid means for effecting reciprocal movement of said armature within said sample holder bore between first and second termini thereof.

8. Apparatus for comminuting a material at low temperatures in accordance with claim 7:

wherein said temperature insulated chamber comprises a pivotally mounted cover device,

and further comprising linkage means pivotally secured to said cover device and to said supporting means and being responsive to the pivotal movement of said cover means in opening said chamber for pivotally moving said first and second tube means and said sample holder on said supporting means.

9. Apparatus for comminuting material at low temperatures in accordance with claim 8 further comprising spring means cooperating with said linkage means for urging said supporting means with a tension to secure said first and second tube means and sample holder in a position for material comminution at low temperatures after said cover means is pivotally moved to close said chamber.

10. Apparatus for comminuting a material at low temperatures in accordance with claim 8:

wherein said supporting means includes a supporting block having a slotted section defining an opening in aligned registration with said material sample holder and the bore thereof,

and a sample holder ejection means admittable through said slotted section opening of said supporting block under control of said linkage means for contacting said sample holder and slideably urging said holder out of said inner bores of said first and second tube means.

11. Apparatus for comminuting a material at low temperatures in accordance with claim 10 wherein said sample holder comprises an aperture,

and further comprising an end stop piece being removably inserted in said bore aperture to cover said aperture and thereby to contain said armature within said holder bore,

said end stop piece having a groove segment and head piece for engagement with an extracting tool to withdraw and insert said sample holder from and within said inner bores of said first and second tube means.

12. Equipment for particlizing a material at low temperature comprising:

electrical motor means including first and second split tube means each having a wall member defining a cylindrical inner bore having first and second apertures at opposite end segments thereof,

first and second solenoid means wound about a periphery of an individual one of said wall members and enclosed with an individual jacket means,

a first supporting block fastened to an individual one of said jacket means and having a slotted section defining an ejection pin admitting aperture,

a second supporting block fastened to an individual second one of said jacket means and having a wall member defining a sample holder aperture,

means supporting said jacket means with said wall members of said tube means and said apertures in aligned registration,

a material sample holder having a member defining an inner bore for holding material to be particlized and having first and second openings at opposite termini thereof,

a pair of end impactor pieces each of said pieces being removably inserted within said wall member to cover an individual one of said holder bore openings and to retain a material to be particlized therein,

an armature located within said sample holder bore and being reciprocally movable therein between said impactor pieces,

a temperature insulated chamber having means pivotally supporting said electrical motor means for the comminution of a material at low temperature with a liquid refrigerant surrounding said sample holder bore defining member and including

a pivot pin and block means affixed to said first supporting block for pivotal movement of said electrical motor means,

a sample holder pin ejection means cooperatively secured for admission through ejection pin admitting aperture to contact a first one of said impactor pieces to slidably move said sample holder and a second one of said impactor pieces out of said bores of said tube means and said sample holder bore upon the pivotal movement of said electrical motor means,

a pivotally mounted cover means for said chamber,

linkage means pivotally secured to said cover means

and to said means supporting said jacket means and including swivel block means pivotally mounted on said jacket means and shaft means pivotally secured to said cover means and cooperating with said swivel block means for effecting the pivotal movement of said electrical motor means and contact between said pin ejection means and said first one of said impactor pieces upon the pivotal opening said said cover means,

spring means embracing said shaft means of said linkage means for urging against said swivel block means to secure said electrical motor means in a position for material particlizing at low temperatures after said cover means is pivotally moved to close said chamber,

and a wedge means cooperating with said second one of said impactor pieces for urging said second one of said impactor pieces and said sample holder bore defining member through said second supporting block member and said bores of said tube means upon the pivotal movement of said cover means to close said chamber,

and said electrical motor means further includes a current source for supplying electrical current and

switching means for cyclically connecting said supplied current individually to each of said solenoid means in sequence for effecting the reciprocal movement of said armature within said sample holder bore and impacting of said armature against said impactor pieces.

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ROBERT C. RIORDON, Primary Examiner

D. G. KELLY, Assistant Examiner

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