Sept. 28, 1965 K. H. BARUCH 3,208,580

VIBRATING FEEDER FOR MINIATURE PARTS

Filed Sept. 11, 1961

Fig. 1

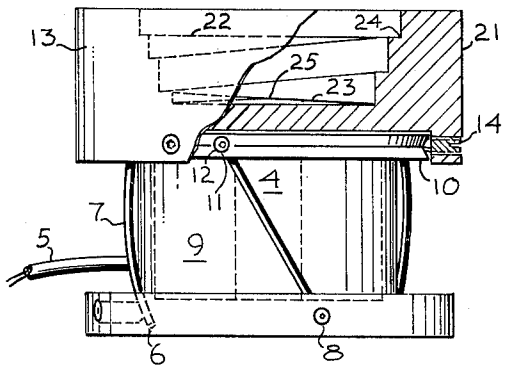


Fig. 3

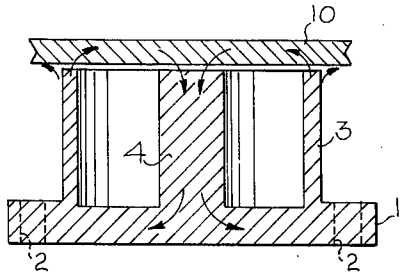


Fig. 2

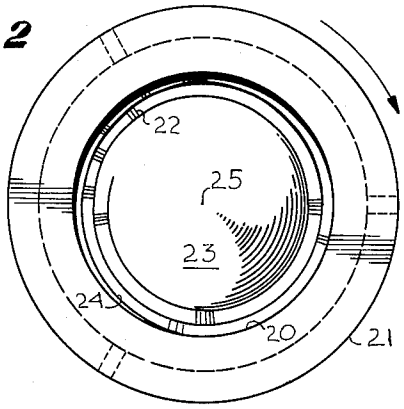
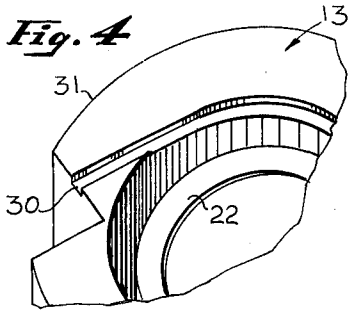


Fig. 4



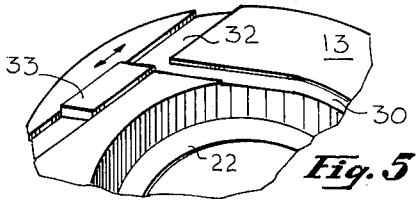


Fig. 5

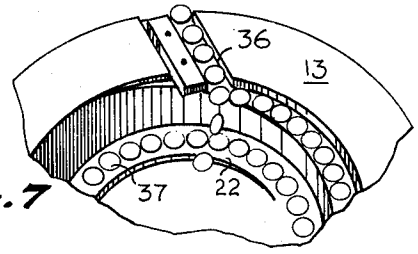


Fig. 7

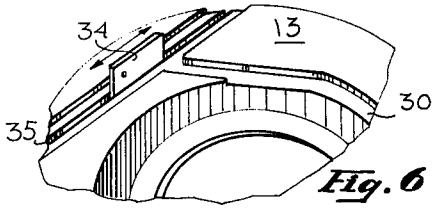


Fig. 6

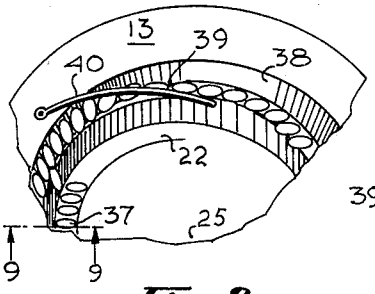


Fig. 8

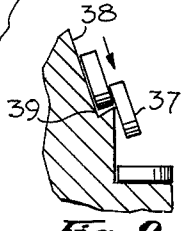


Fig. 9

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VIBRATING FEEDER FOR MINIATURE PARTS

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This invention relates to vibrating feeders in general and more particularly to a vibrating feeder capable of feeding miniature items operable with an unrectified A.-C. power source with very little stray A.-C. flux produced.

The art of vibrating feeders is not a new art in that for many years vibrating feeders have been developed and utilized to provide a continuous flow of articles, such as nuts, bolts and other similar parts, to associated equipment. With the discovery of transistor action and the subsequent manufacture of miniature transistors, diodes, etc., and with the recent increased use of smaller and smaller magnetic cores as computer memory elements, there has arisen a need for a vibrating feeder which is capable of feeding minute articles to counters, testers, production machinery and other such devices. Additionally, in advance atomic and chemical techniques, there often arises a need for a feeder capable of feeding fine powders, chemicals and reagents in small or selectable quantities. The tendency in providing a feeder for miniature parts, powders, reagents, etc., has been to simply scale down the large vibrating feeders heretofore utilized for the larger items. Several shortcomings have, however, become apparent in such an application of prior art feeders. For instance, one such disadvantage which has arisen is that these vibrating feeders, besides being too bulky for the task, are incapable of feeding a single article, as in a test batch, since they usually rely to some degree on the pressure of subsequent parts to cause a part to move out of the feeder. Additionally, these prior art feeders almost all utilize rectifiers to produce a 60 c.p.s. vibratory movement which necessitates a relatively large vertical amplitude to produce the desired horizontal movement of the article. This large vertical amplitude thus necessitates the use of shock absorber devices to prevent the vibration of the feeder from affecting adjacent equipment which may be shock sensitive such as many electronic test devices employing vacuum tube circuitry. Moreover, since most of these prior art type vibrating feeders were designed for use in a production type environment where stray flux could be tolerated, they were designed without any consideration as to the prevention of stray flux. Consequently, the relatively high amount of stray flux produced by these prior art vibrating feeders oftentimes prevents their utilization in an environment where stray flux must be at extremely low levels, as in magnetic core testing areas and other magnetically sensitive areas without extensive shielding.

An ideal vibrating feeder for miniature parts would, therefore, be capable of smoothly and efficiently feeding a small quantity of minute articles, small in size and should be relatively uncomplicated and inexpensive. Thus, ideally, its vertical amplitude should be reduced such that shock absorbers are not required and operating power and heat generation are relatively low. Additionally, it should be capable of operating on unrectified A.-C. current so as to eliminate the need of a rectifying device which speeds up the parts by increasing the vibration rate of the bowl from 60 to 120 c.p.s. Additionally, the stray flux produced by this vibrating feeder should be practically nil to allow its use in those environments where large amounts of stray flux cannot be tolerated.

It is, therefore, an object of the present invention to provide a novel vibrating feeder for miniature parts which

is relatively uncomplicated and relatively inexpensive to manufacture.

Another object of the present invention is to provide a vibrating feeder for miniature parts which has an extremely small vertical amplitude such that shock absorbers are not required.

Another object of the present invention is to provide a vibrating feeder for miniature parts which is operable on A.-C. power without the need of an attendant rectifying device.

Another object of the present invention is to provide a vibrating feeder for miniature parts which, while in operation, produces substantially no stray magnetic flux and which requires relatively little power in operation and the temperature of which remains substantially at ambient.

Another object of the present invention is to provide a novel pole-cup-core piece for use in a vibrating feeder which is highly efficient, which produces relatively little stray flux and which acts as a highly efficient magnetic shield.

Another object of the present invention is to provide a vibrating feeder which employs a novel feeder bowl which, unlike prior art devices, allows the fed articles to exit the bowl in other than a tangential direction;

Another object of the present invention is to provide a novel vibrating feeder bowl which permits numerous escapements and part orienting means to be machined in the bowl itself to practically eliminate the need for escape chutes which are the most frequent source of parts stoppage.

Other and further objects and advantages of the present invention will become apparent to one skilled in the art from a consideration of the following detailed description when read in light of the accompanying drawings, in which:

FIG. 1 is a cutaway side view of the hereinafter described vibrating feeder;

FIG. 2 is a top view of one type of bowl which may be utilized with the hereindescribed vibrating feeder;

FIG. 3 is a cutaway side view of the hereindescribed vibrating feeder illustrating flux flow;

FIG. 4 illustrates one simple type of escapement which can be provided;

FIG. 5 illustrates one method of providing an escapement capable of feeding minute parts, one at a time, on command;

FIG. 6 shows an alternate embodiment of FIG. 5 where extremely thin parts are being fed;

FIG. 7 shows an escapement which prevents piling up when the rate of feed is greater than that of acceptance;

FIG. 8 shows an escapement which is suited for use when very thin, non-conductive parts, which may pick up a static charge, are to be fed; and

FIG. 9 is taken on line 9—9 of FIG. 8.

Briefly, the subject vibrating feeder utilizes a novel cup-core piece to impart oscillatory movement to a pole piece which is suspended by a plurality of circumferentially spaced spring members.

Refer to FIG. 1 wherein is shown a vibrating feeder which will hereinafter be more fully described in detail. The vibrating feeder of FIG. 1 is a cup-core member which is machined from one piece of ingot iron or other type of high permeability low retentivity material and is circular in configuration. Base portion **1** is circular in configuration and contains mounting holes **2** disposed circumferentially around it to allow the vibrating feeder to be mounted to a base or support. The cylindrical side wall portion **3** of the cup-more member is opened at its upper extremity. Disposed at the center of base member **1** and extending therefrom is a solid cylindrically shaped

center portion 4 which is substantially the same height as the side wall 3.

Wound upon center core member 4 is a coil 9 which is connected through means of lead 5 to an A.-C. source of power (not shown) which, in the hereindescribed example, is 60 c.p.s. The coil 9 may be, for instance, of magnet wire. Base portion 1 has circumferentially disposed about it a plurality of holes 6 which receive spring members 7 which are secured therein by a screw 8 which is threadedly received within base member 1. Likewise, pole piece 10 has circumferentially disposed about it a plurality of holes 11 which are adapted to receive spring members 7 which are secured by set screws 12 which are threadedly received in pole piece 10. The holes 6 and 11 are angled away from the cup-core member which results in a preloading of the springs 7 and a resultant device substantially free of the "jelly effect." A bowl member 13 secured by three set screws 14 set so their center line is somewhat above the center line of the "V" slot on the circumference of the pole piece 10 when tightened will tend to pull down the bowl 13 securely on pole piece 10. The bowl member 13 is made of non-abrasive plastic, aluminum or other easily machinable metal.

Considering next FIGS. 1 and 2 together. It can be seen that the inside 20 and outside diameter of the bowl 13 are concentric. A helical track 22, the lower portion of which begins on the floor 23 of the bowl 13 during its last (uppermost) full turn, narrows from full width to zero and merges with the wall at the upper extremity 24 of the bowl. When viewed from the side, as illustrated in FIG. 1, to floor portion 23 of the bowl 13 is conical in configuration with its highest point at the center 25 of the bowl 13 and its lowest point at its junction with the helical track 22.

FIG. 4 shows a simple exit slot 30 milled into the top of the bowl 13. As the track 22 rises, its width gradually diminishes to zero. One simply faces off the top of the bowl 13, in a lathe, until the desired track width is reached (allowing only one part of a time to pass). From this point, parts may be guided by a milled tangential slot 30, as shown, or by rails (not shown) mounted on the flat bowl rim 31.

In FIG. 5 is shown one solution to the problem of feeding small parts, one at a time, on command. The tangential exit channel 30, described above, ends in a second channel 32 of equal width and depth. Parts move along the exit channel 30, which is the exact width of the parts, until they come to a stop against the further wall of the second channel 32. Only one part is in the path of the second channel 32, and this part is held against a movable shoe 33. Because the two channels 30 and 32 meet at less than a 90-degree angle, the part will not move by itself. When actuated by a solenoid, hand operated push-button, or other means (not shown), the shoe 33 moves forward and pushes one part ahead of it into whatever receptacle is provided. As soon as the shoe 33 returns to its former position, the next part moves into place.

Where very thin parts are involved, which might tend to slip under a shoe such as that shown in FIG. 5, the configuration shown in FIG. 6 may be useful. It is essentially the same device, except that the shoe 33 has been replaced by a thin, upright blade 34, which rides in a deep groove. The groove 35 and blade 34 should be made very narrow so that parts moving over the groove 35 will not become caught in it.

FIG. 7 shows a method of preventing parts 37 from piling on top of each other when the rate of feed is greater than the rate of acceptance. In this case, a means must be found to relieve the pressure of the oncoming parts 37 by ejecting some of them (after they have passed a gate or other device for removing parts riding "piggy back"). This arrangement makes it possible to have an open, easily observed track, rather than a closed one, which may clog and prove cumbersome to

clear. For clarity, the angle at which the channel 36 departs from tangential is shown greatly exaggerated. To ease the flow of parts in this configuration, the exit channel might be machined on a slight downward slope.

Refer next to FIG. 8. Often very thin, non-conductive parts, which may pick up a static charge are to be fed. This embodiment is also effective when flat parts are to be fed in an upright position. Feeding fine powders in small amounts, even one grain at a time, can also be accomplished by machining the bowl 13 as shown.

The wall of the uppermost track is turned in a lathe to an angle as shown in FIG. 9 by setting the compound of the lathe to the required angle and then feeding the lathe tool bit in the direction of the arrow (FIG. 9) until the bottom of the track 39 at a point just before the track 22 enters the tangential exit has a width somewhat less than that of one part.

Operation is as follows. Parts 37 come up the track 22 until they pass the part of the track 39 that has been machined. The backslope in this part of the track is greater than the original backslope, which causes the parts to point upward toward the center 25 of the bowl 13. As they pass along, the track 22 narrows and the parts protrude over the edge of the track. At this point, a piece of curved spring wire 40 rests against the edge of the track as shown. The exposed edges of the parts 37 ride up this wire 40 until they flip over with their flat sides against the wall 38 and pass under the wire 40. Just beyond this point comes the narrowest part of the track 39, and any parts 37 that have adhered to each other because of static, or for some other reason, are shaken off by the vibration and fall back into the bowl.

In operation, an A.-C. signal of, for instance 60 c.p.s., is applied along line 5 to energize the cup-core through means of coil 9. The pole piece 10, which is held suspended for instance .006" above the wall portion 3 and center core portion 4 by spring member 7, by magnetic attraction is pulled .003" toward wall portion 3 and center core portion 4 by the A.-C. exciting current. As the A.-C. current begins to fall from its peak point, the spring tends to attain its orignial configuration such that when the A.-C. pulse falls to zero, the pole piece is again disposed .006" from the wall portion 3 and core portion 4. It should be noted that both peaks of this sine wave are utilized and thus the above described action takes place 120 times per second as distinguished from rectified feeders which function at the rate of only 60 c.p.s.

The attraction of the pole piece 10 to the cup-core is quite rapid which results in the bowl 13 dropping away from the articles in a helical path due to the rotating or twisting movement which is imparted to the pole piece 10 and consequently the bowl 13 by the combined action of the spring member 7 and the .003" vertical movement of the pole piece 10. Thus, when the A.-C. pulse begins to fall and the bowl 13 starts its return to its original position, it encounters the falling articles which have fallen a given amount and thus their relative position on the floor 23 has changed by a given amount. For instance, assume that an A.-C. pulse will cause the bowl member to move in the direction of the arrows associated with FIGS. 1 and 2. Assume again that the displacement between the cup-core and pole piece 10 is .006 of an inch and the vertical excursion of the pole piece is .003". When current is applied, the pole piece 10 will move vertically .003" and a circular movement of a given amount which, for this example, will be assumed to be .004", will be imparted to the bowl member 13 in the direction illustrated by the arrows. When the floor 23 and track portion 22 of the bowl member 13 is caused to drop rapidly away from the articles which are resting on it, their circular movement is substantially halted and their only movement then is a vertical movement toward the floor 23 of the bowl 13. As previously stated, however, the floor 23 has both a circular move-

ment in the direction of the arrows as well as a vertical movement. Assume that, for illustrational purposes, the article has fallen .0015" by the time that it is contacted by the floor 23 and track 22 of the bowl member 13 on its return swing. Since the bowl traveled in a circular direction .004", it is still displaced circularly from its original position by ¾ of .004", or .003" when contact with the falling articles is reestablished. Thus, as the bowl member 13 continues its helical return in a direction counter to the arrows, the article is caused to move .003" from its original position.

As is obvious, several desirable results are achieved through utilization of an unrectified 60 c.p.s. A.-C. power source as the current supply for the hereindescribed vibrating feeder. One such result is that the device vibrates at 120 vibrations or cycles a second which, therefore, causes the required amplitude of the vertical movement to be substantially ½ of that which would have been required to move an article the same distance where a rectified 60 c.p.s. source is utilized. As heretofore pointed out by cutting the required amplitude in half, the necessity for shock absorbing devices is alleviated and, therefore, considerable expense is eliminated and a more rigid device results. Additionally, the spring member 7, due to this decreased amplitude, can be made smaller and consequently less power is required to operate the device in that the magnetic force pulling the pole member 10 down to the cup-core is opposed by the springs 7. Again, with this reduced amplitude, less stray magnetic flux is produced since there is a very small air gap as compared to the air gap between the pole and core member of prior art devices. Thus, most of the flux produced by the core member travels through the pole piece 10 and a negligible amount strays into the surrounding area.

Low current also reduces substantially the heat rise of the device, which in similar devices, often interfers with operations sensitive to temperatures, such as with various test equipment. In prior devices, this heat often traveled from the core through the metal bowl to the article. A plastic bowl 13, being a good thermal insulator, eliminates this shortcoming.

Refer next to FIG. 3, which will facilitate a description of the flux flow in the novel cup-core pole arrangement utilized in the subject vibrating feeder to produce the requisite magnetic attraction between the pole piece 10 and cup-core member with an extremely small amount of stray flux being produced. As shown by the flux flow arrows associated with FIG. 3, it can be seen that flux flows down through the center core 4 and through base member 1 to the periphery of base member 1 and up through wall portion 3. As is obvious, the flux concentration in the wall member 3 adjacent pole piece 10 is substantially uniform and below saturation since the center portion 4 is disposed at the center of base member 1 and the thickness of base member 1 is uniform. Thus no great areas of high flux concentration which might result in saturation of the wall member 3 with a consequent flux leakage are allowed to form. Consequently, all of the flux which is present at the extremity of wall member 3 adjacent pole piece 10 passes across the air gap into pole piece 10. Pole piece 10, as illustrated in FIGS. 1 and 3, has a greater diameter than that of the cup-core member such that any flux which is at the extremity of wall member 3 and which tends to fringe out into the air is captured by the extended portion of pole piece 10. Another feature of the cup-core pole piece arrangement is that not only is there a minimum flux at any one point such that most of the flux passes through the wall member 3 and pole piece 10 across the gap between pole piece 10 and center core member 4 and down through center core member 4, but, in addition, the coil is totally surrounded by the wall member 3. Thus, any stray flux which is produced by the coil 9 is captured by the high permeability wall member 3.

In the above described manner, I have provided a vibrating feeder for feeding miniature parts which is relatively inexpensive to manufacture and which feeds such parts smoothly and efficiently. Additionally, I have provided a vibrating feeder which will feed miniature parts when only a single or small number of parts is in the bowl member. Moreover, the device herein described utilizes alternating current such that no relatively expensive and bulky rectifying means is required. Thus, for 60 c.p.s. current, the device operates at 120 vibrations per second which allows a reduced vertical amplitude with a consequent reduction in power required and shock absorbing means.

Another novel feature which I have provided in the heretofore described vibrating feeder is that of the cup-core pole piece assembly which is operable with the spring members to provide vibrating movement in the bowl assembly. This cup-core pole piece assembly in operation produces practically no stray magnetic flux.

While there has been described what is at present considered to be a preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is aimed in the accompanied claims to cover all such changes and drawings as fall within the true spirit and scope of the invention.

What I claim is:

1. A vibrating feeder comprising: a source of alternating current, a cup-core piece open at one end, a coil disposed in said cup-core piece electrically connected to said alternating current source, a plurality of springs attached to said cup-core piece, a pole piece attached to said plurality of springs and in magnetic association with said cup-core piece adjacent said open end, and a bowl removably mounted on said pole piece.

2. A vibrating feeder capable of feeding minute articles comprising: a source of alternating current, a cup-core piece having an opening at one end, a coil disposed in said cup-core piece electrically connected to said source of alternating current, a plurality of springs disposed about said cup-core piece, a pole piece mounted on said plurality of springs in magnetic association with said cup-core piece adjacent said open end, a .006" air gap separating said cup-core piece and said pole piece in the absence of an exciting pulse from said alternating current source, and a bowl having a helical track therein removably mounted on said pole piece.

3. A vibrating feeder for feeding minute articles comprising: a cup-core piece made of a material of high permeability and low retentivity, a source of alternating current, a coil mounted in said cup-core piece electrically connected to said source of alternating current, a plurality of springs disposed about said cup-core piece, a pole piece attached to said plurality of springs and in magnetic association with said cup-core piece, said pole piece overlapping said cup-core piece, and a bowl having a helical track therein mounted on said pole piece.

4. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a cup-core piece made of a material of high permeability and low retentivity, a coil disposed in said cup-core piece and electrically connected to said alternating current source, a plurality of springs disposed about said cup-core piece, a pole piece of high permeability and low retentivity in magnetic association with said cup-core piece, said pole piece overlapping said cup-core piece and held by said springs in the absence of an alternating current exciting current spaced apart from said cup-core piece, and a bowl having a helical track therein mounted on said pole piece.

5. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil dis-

posed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece held by said plurality of spring members and overlapping said cup and core members, and a bowl having a track therein mounted on said pole piece.

6. A vibrating feeder for feeding minute articles operable on an alternating circuit power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil disposed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said pole piece everywhere overlapping said cup and core members held by said spring members away from said cup and core members in the absence of an energizing pulse from said alternating current source, and a bowl having a track therein mounted on said pole piece.

7. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil disposed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece held by said plurality of spring members and overlapping said cup and core members, and a bowl mounted on said pole piece having a track therein which, as it rises, the width thereof gradually diminishes to zero whereby said bowl can be faced off until the desired track width is reached.

8. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil disposed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece held by said plurality of spring members and overlapping said cup and core members, a bowl mounted on said pole piece having a track therein which, as it rises, the width thereof gradually diminishes to zero whereby said bowl can be faced off until the desired track width is reached, and tangential escapement means machined in said bowl.

9. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil disposed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece held by said plurality of spring members and overlapping said cup and core members, a bowl mounted on said pole piece having a track therein which, as it rises, the width thereof gradually diminishes to zero whereby said bowl can be faced off until the desired track width is reached, tangential escapement means machined in said bowl, and second escapement means machined in said bowl at substantially a 90° angle with said tagential escapement means.

10. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity, a coil disposed in said cup member about said core member and electrically connected to said alternating current source, a plurality of springs disposed circumferentially about said cup member, a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece held by said plurality of spring members and overlapping said cup and core members, a bowl mounted on said pole piece having a track therein which, as it rises, the width thereof gradually diminishes to zero whereby said bowl can be faced off until the desired track width is reached, escapement means comprising a portion of said track having a greater back slope than the other portion of said track, and a spring wire member whereby said articles are flipped over by said wire and pass under said wire onto the narrowest portion of said track.

11. The apparatus of claim 1 in which the springs of said plurality of springs are in a preloaded, prestressed state.

12. The apparatus of claim 3 in which the springs of said plurality of springs are in a preloaded, prestressed state.

13. A vibrating feeder for feeding minute articles operable on an alternating current power source comprising: a circular cup having an integral core member disposed therein, said cup and core members being made of a material of high permeability and low retentivity; a coil disposed in said cup member about said core member and electrically connected to said alternating current source; a plurality of springs disposed circumferentially about said cup member; a circular pole piece made of a material of high permeability and low retentivity in magnetic association with said cup and core members, said circular pole piece being attached to and overlapping said cup and core members by said spring members in a prestressed condition; and a bowl, removably mounted on said pole piece for holding minute articles, said bowl having a helical track formed on the inner periphery thereof, said track having a gradually diminishing width as it rises, whereby said bowl can be faced off until a desired track width is reached corresponding to minute articles being fed, said bowl further having a peripheral rim of substantial width and adapted to have escape means formed therein.

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