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(54) **Cut and mill fiberizer.**

(57) A hard pulp fiberizer housing contains a rotatable disk with axially extending prongs for fragmenting a wood pulp sheet that is fed in through a slot. The radially outwardly centrifuged fragments are engaged between hammer members on the periphery of the disk and a stationary toothed breaker segment where milling action occurs. The fibers are swept around to a screen that is concentric with the disk and through which the fibers are projected into an involute shaped channel for being withdrawn from the housing.

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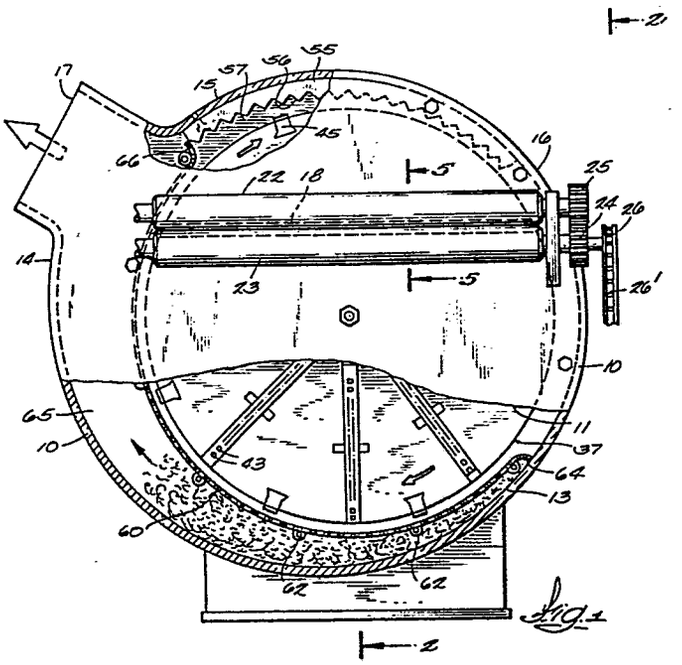
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Fig. 1

CUT AND MILL FIBERIZER

Background of the Invention

This invention relates to a machine for reducing sheets of wood pulp to discrete fibers. Wads of such fibers are pleasingly white and are used, for example, as an absorbent material in disposable diapers, sanitary napkins and the like.

Until recently, webs or sheets of dry soft pulp were used almost exclusively to make fibers. Use of hard pulp is now becoming more common. A disk type fiberizer apparatus, such as the one described in U.S. Patent No. 3,538,551, particulated or fiberized soft wood pulp efficiently and with a satisfactory degree of fineness. The patented fiberizer has a multiplicity of pointed pins extending axially from one face of a disk that is rotated at high speed. The sheets of wood pulp are fed through a slot in the disk housing and into the pointed rotating pins which break off fragments of the pulp sheet and reduce them to fibrous particles as they are being centrifuged radially outwardly from the center of the disk. It has been discovered that this type of fiberizer, although very satisfactory for processing soft pulp, has its pointed pins worn away at a higher than acceptable rate when hard pulp is being processed. However, it had the desirable property of separating the fibers from the soft pulp sheet stock with a minimum of damage to the fibers, that is, it preserved the fiber filaments in relatively long lengths which is desirable when the fiber is destined to be used in an absorbent batting. It has been found that a different approach must be taken to achieve the desirable properties when the feed stock is hard pulp.

Summary of the Invention

An object of the present invention is to provide a fiberizer apparatus that is distinguished by its ability to fiberize hard wood pulp without having to be taken out of service for maintenance at frequent intervals.

Another object of the invention is to provide a fiberizer that divides hard wood pulp into long discrete filaments or fibers while at the same time produces a minimum of short fibers or dust in the batting product.

Still another object is to provide a fiberizer that has elements in a single housing for chipping fiber particles from the end of a pulp sheet, reducing the particles at one stage subsequent to their being segregated from the sheet and then further milling the particles to reduce them to discrete fibers whereupon they are centrifuged through a a screen for further reducing their compactness.

How the foregoing and other more specific objects of the invention are achieved will be evident in the more detailed description of a preferred embodiment of the new fiberizer which will now be set forth in reference to the drawings.

Description of the Drawings

FIGURE 1 is a front elevation view of the fiberizer with a portion of the front wall of its housing broken away to show the interior thereof;

FIGURE 2 is a section taken on the irregular line corresponding with 2-2 in FIGURE 1;

FIGURE 3 is an axial view of a disk that carries cutting and milling members and rotates in the housing of the fiberizer, said disk being shown isolated from the assembled fiberizer of FIGURES 1 and 2;

FIGURE 4 is a side view of the disk in FIGURE 3 with a part broken away and sectioned;

FIGURE 5 is an enlarged view of a section taken on a line corresponding with 5-5 in FIGURE 1; and

FIGURE 6 is a rear view of a portion of a pair of stationary cutter blades which are shown in profile in FIGURES 2 and 5.

Description of a Preferred Embodiment

Referring to FIGURES 1 and 2, the fiberizer includes a housing comprised of a generally circular wall 10 that has a channel shaped cross-section and is closed on its sides by means of a front wall 11 and a rear wall 12. In FIGURE 1, one may see that from a point where the lead line from the reference numeral 13 is applied to a clockwise location where the lead line from the numeral 14 is applied the radius of outer wall 10 of the housing increases so it has an involute shape. Also, from the lead line of numeral 15 clockwise to approximately the lead line from numeral 16, the radius of outer wall 10 of the housing decreases so it has an involute shape. In the left region of FIGURE 1, one may see that the housing has an output port 17 from which the fibers are evacuated or discharged.

As can be seen best in FIGURE 2, the front wall 11 of the housing is provided with a slot 18 for feeding a sheet or web or dry hard pulp into the housing for processing. FIGURE 1 shows that the slot 18 is a chord of the generally circular housing and that the chord is radially displaced from the center of the housing. FIGURE 2 shows some schematically represented guide plates 19 between which there is a gap 20 through which the sheet of hard wood pulp is fed through the slot into the housing along a plane coincident with that of the arrow 21. A pair of driven friction rollers 22 and 23 are used for pushing the pulp sheet through the slot into the housing. Roller 23 has a pinion 24 on its shaft which engages another pinion 25 on the shaft of roller 22. The shaft of roller 24 has a sprocket 26 on it for being driven with a chain 26' which is shown fragmentarily. In an actual embodiment, a pneumatic cylinder, not shown, is provided for pressing upper roller 22 down yieldingly to create the necessary force for driving pulp sheets of various thicknesses through the slot 18.

As shown in FIGURE 2, a shaft 30 extends through an air intake opening 31 in the rear wall 12 of the housing. One of the bearing blocks 32, in which shaft 30 is journaled, is shown as being mounted on a base member 33. There are actually two bearing blocks but one has been omitted from the drawing. A screw 30' in wall 11 acts as a safety stop which precludes shaft 30 from ever shifting so much that rotating and stationary parts would collide. The shaft has a v-pulley 34 on it to facilitate driving it rotationally with belts 35. As can be seen particularly well in FIGURE 2, the shaft has a hub 36 fastened to it and a rotor or disk assembly 37 is fastened to the hub for the disk to rotate in a plane that parallels the front 11 and rear 12 walls of the housing. A circular brake plate 27 is fastened to a shaft 30 and it rotates between brake linings 28 and 29 which are forced toward each other to create friction on the plate for decelerating the high speed disk 37 to a stop when driving power is removed from pulley 34. The disk or rotor 37 is shown in isolation from the hub 36 and in more detail in FIGURES 3 and 4 although it is partly visible in FIGURES 1 and 5 as well.

As can be seen in FIGURE 3, the disk 37 is provided with holes 38, arranged in a circle, for permitting it to be fastened to the hub 36 with machine screws, not shown. The disk has a plurality of equiangularly spaced radially extending bars 39 fastened to the face 40 of the disk that is presented toward front wall 11 of the housing. Each of the bars 39 are secured to the front face 40 of the disk with several cap screws 41. Because the bars are subjected to high centrifugal force, it is desirable to further secure them with keys, such as the one marked 42 which engages complementarily in keyways in the bars and the disk.

In the illustrative embodiment, bars 39 have a row of axially extending cutter prongs 43 formed on them. The prongs desirably have a square cross section and flat exposed ends. The bars, and, hence, the prongs are made of hardened steel or other especially hard metal. As can be seen, the prongs in each bar constitute a radially extending row of

prongs 43. Since the bar and prongs rise above the face of the disk, they serve as vanes for centrifuging particles of pulp, that are broken away from the end of the sheet by the prongs, radially outwardly beyond the periphery of the disk which is a desirable characteristic for enhancing the fiber communiting process.

Those skilled in the art will appreciate that axially extending prongs comparable to the prongs 43 might be anchored by other means to the disk instead of being integral with bars 39. In any case, it would be desirable to distribute the prongs over the face of the disk in radially offset rows to achieve centrifuging action. Also, as in the preferred embodiment illustrated herein, the prongs in a radial row should have some space between them.

As shown in FIGURE 4, the heads of the cap screws 41 that secure the cutter prong bars to the disk are exposed on the rear of the disk. In an actual embodiment, the heads of the cap screws are provided with a diametral hole, not visible, and a wire, not shown, is fed through all of the holes to limit the amount by which the cap screws could turn out if they should become loosened during use of the apparatus.

A plurality of hammer members 45 are anchored equiangularly about the periphery of the disk 37. The hammer members, as shown in FIGURE 3, have dovetail bases 46 which fit into complementarily shaped slots in the periphery of disk 37 to assure that the hammer members will not be centrifuged out at the high rotational speed of the disk. The hammer members are secured against axial withdrawal from the dovetail slots by screws which pass through holes marked 47 in FIGURE 4. The breaker hammers orbit at high peripheral velocity with disk 37 and about its center.

As can be seen in FIGURE 5 especially well and in FIGURE 2, the cutter prongs 43 on bars 39 project towards the end of the pulp sheet 21 that is being fed through slot 18 into the fiberizer. A pair of bar-like cutter blades 50 and 51 are held by screws to the front wall 11 of the housing. The cutter bars or blades 50 have teeth or

serrations 52 on their faces that are presented toward the prongs 43 on the rotating cutter bars. There is a small gap 53 allowed to remain between the tips of the serrations 52 on the stationary cutter blades and the ends of the prongs 43 on the rotating cutter bars so there is no contact between the stationary serrations and rotating prongs. The stationary cutter blades 50 and 51 extend chordally above and below the chordally extending pulp sheet infeed slot 18. The rotating prongs and stationary serrated blades coact to reduce fragments of pulp that are broken from the end of the pulp sheet.

As shown in FIGURE 1, a breaker segment 55 having a circumferential array of teeth or serrations 56 is fastened in the top of the generally circular housing wall 10. The breaker segment 55 extends substantially from the location marked 15 in the rotational direction of the disk clockwise in FIGURE 1 to the approximate location marked 16. The breaker segment 55 extends over an arc of about 90° in this design. The breaker segment has a width substantially equal to the distance between the front and rear walls 11 and 12 of the housing. The toothed breaker segment 55 has an involute shape corresponding to that of the housing. In one region 57 there is a substantial radial distance between the faces of the hammer members 45 and the teeth or serrations in the breaker segment 55. Because of the involute shape, the hammers 45 get closer and closer to the serrations of the breaker segment in the direction of rotation of the disk but the hammers never contact the breaker teeth as is evident from inspection of FIGURE 1.

A metal band 60 constituting a screen is arranged in the fiberizer housing substantially concentric to rotating disk 37. As can be seen best in FIGURE 2, the screen has a plurality of holes 61 through which the segregated fibers are projected by the centrifugal force of the components on disk 37 and under the influence of the fanning effect they create. The screen band has sufficient width to extend from the front wall 11 to the rear wall 12 of the fiberizer housing.

The screen has several metal tubes 62 welded to it. As shown in FIGURE 2, bolts 63 extend through the metal tubes for anchoring the screen. In an actual embodiment, by way of example and not limitation, screen holes 61 have a diameter of 3/8 of an inch. In the illustrated embodiment, screen 60 subtends an arc of about 180°. In FIGURE 1, one of the curved ends 64 of the screen is in contact with the inside of outer wall 10 of the housing. As indicated earlier, housing 10 starts to take on an involute shape where the lead line for the reference numeral 13 is applied and this involute shape terminates where the lead line for reference numeral 14 is applied. This develops between screen 60 and housing wall 10 a region 65 having an increasingly large radial dimension that is in reality a fluff conducting channel that leads to exit port 17 through which the fluffed fibers are withdrawn. Screen 60 is effective to cause breakup of any agglomerates of fibers that pass through its holes. Thus, the fiber fluff comes out of the fiberizer in a highly homogeneous state insofar as its density is concerned. It should be noted that screen 60 extends from its starting point 64 in the clockwise direction in FIGURE 1 to its other curved end 66 which abuts one end of the toothed breaker segment 55.

In operation, a sheet of hard wood pulp is driven through slot 18 under the influence of rollers 22 and 23. The end of the pulp sheet encounters the rotating staggered and axially extending cutter prongs which break fragments of the pulp from the end of the sheet. The fragments are further divided by the coaction of the rapidly moving prongs and the stationary serrated cutter blades 50 and 51. The material is centrifuged radially outwardly for being further broken down by the interaction of the rotating hammers 45 and stationary breaker segment 55 which is in the nature of a milling action. The now finely divided fibers are carried around and projected through screen 60 into involute channel 65 where the fluffy material becomes more influenced by the suction provided at discharge port 17. The fluffy material

is then conducted, by means, not shown, to a dispenser, not shown, which deposits measured quantities of the material on a continuous backing sheet that is used to form diapers by methods well known in the art.

Although a preferred embodiment of the invention has been described in detail, such description is intended to be illustrative rather than limiting, for the invention may be variously modified and is to be limited only by interpretation of the claims which follow.

CLAIMS

1. A wood pulp fiberizer including:

a housing comprising a generally circular wall and front and rear walls, respectively, enclosing opposite sides of the circular wall, the front wall having a slot for feeding a sheet of wood pulp into the housing axially of the circular wall,

rotatable shaft means extending axially into said housing and a disk mounted to said shaft means for rotation in said housing with one side of the disk facing the front wall and the other side facing the rear wall,

a multiplicity of cutter prongs projecting axially from said one face of the rotatable disk toward the front wall of the housing,

stationary cutter blades arranged above and below said slot inside of said housing, said blades extending axially to proximity with but in noncontacting relation to said cutter prongs, said cutter prongs cooperating with said blades to particulate a pulp sheet fed through said slot,

a plurality of hammer members extending radially from the periphery of the disk for orbiting with the disk,

a breaker segment arranged along at least a part of the orbital path of the hammer members, said segment having teeth projecting toward the path of the hammers for cooperating therewith to further break the particles into fibers, and

screen means arranged along the orbital path of said hammer members and through which fibers are propelled by said hammer members for being withdrawn from the outside of the screen.

2. The fiberizer according to claim 1 including radially extending bars mounted in equiangular spaced relationship on said one face of the disk, said cutter prongs being formed integrally with said bars.

3. The fiberizer according to claim 2 wherein the cutter prongs on a bar are radially spaced from each other.

4. The fiberizer according to any one of claims 1, 2 or 3 wherein said cutter prongs are arranged in radially extending rows and the rows are arranged equiangularly on said one face of the disk.

5. The fiberizer according to any one of the preceding claims wherein said cutter prongs are square in cross section and are flat on their ends that face axially away from the disk.

6. The fiberizer according to any one of the preceding claims wherein said generally circular housing wall has an involute portion, said screen is circular and is concentric with the orbital path of the hammer members such that the radial space between the screen and said housing wall continually increases in the direction of disk rotation and said space terminates where it is largest near a discharge port for the fibers that is provided in said wall.

7. The fiberizer according to any one of the preceding claims wherein the teeth on said breaker segment follow a nominally involute line adjacent said orbital path of the hammer members such that the distance between said hammer members and teeth decreases in the rotational direction of the disk.

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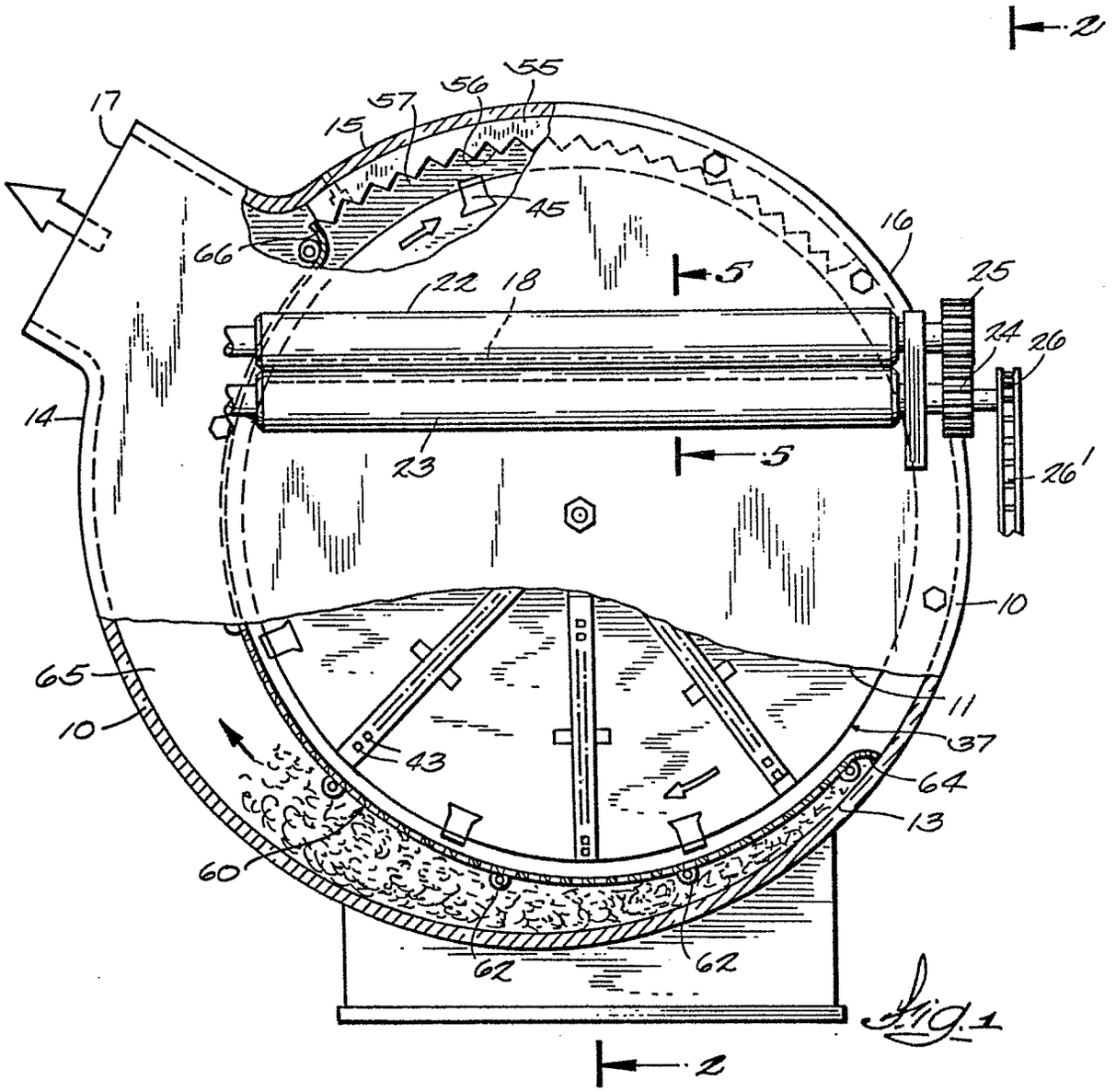

Fig. 1

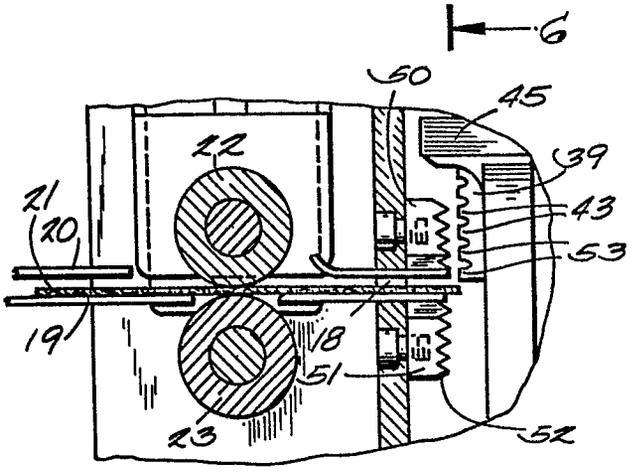

Fig. 5

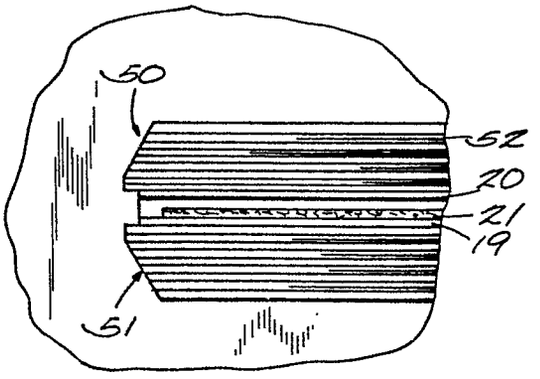

Fig. 6

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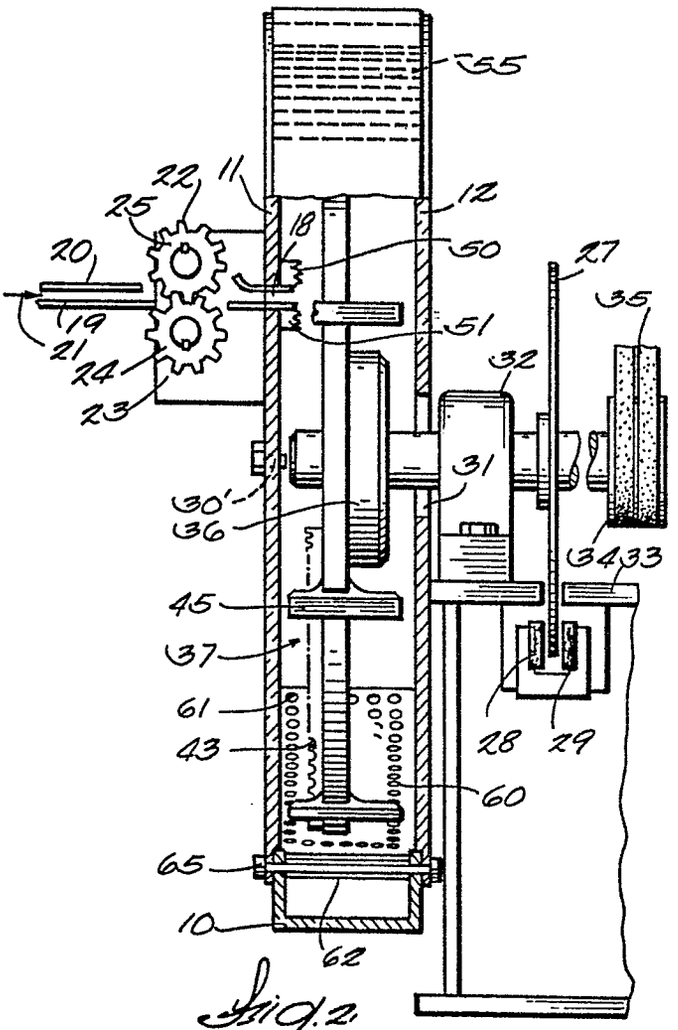

Fig. 2

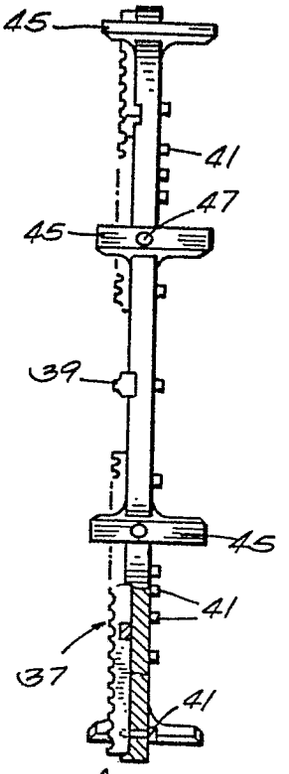

Fig. 4

Fig. 3