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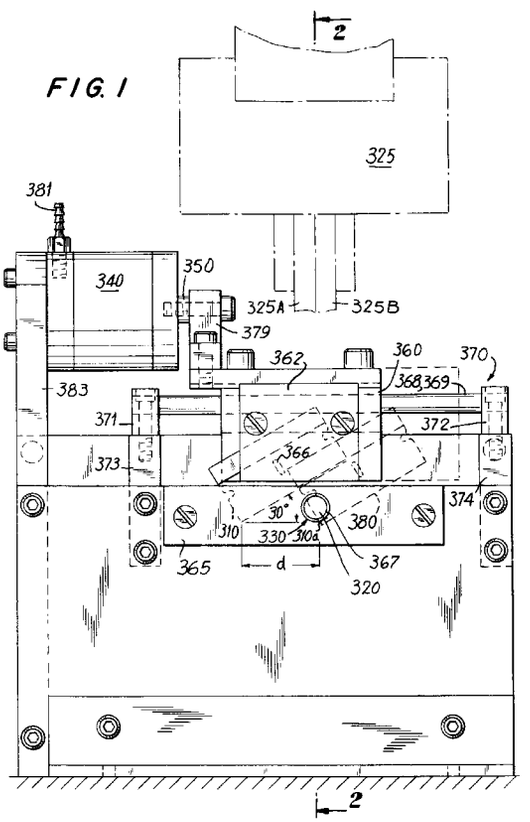
(54) Apparatus and method for cutting a cigarette.

(57) An automated method and apparatus for cutting a smoking article, such as a cigarette into sections and removing a component, such as the filter section from the article is discharged. A mechanical arm of a robot 325 having opposing gripping members 325A, B is used to grip and insert the article 320 into the cutting apparatus whereupon a piston rod 350 causes a blade 310 to sever the article just above the filter. After the robot removes the filter from the apparatus, the filter is then ready to be subjected to characterization tests.

FIG. 1



EP 0 500 300 A2

Background of the Invention

This invention relates to a method and apparatus for cutting a smoking article into sections, and more particularly to removing autonomously the filter section from a tobacco-containing cigarette.

It is common practice to perform various tests on commercial and experimental smoking articles and their component parts following assembly. These tests include measuring the physical characteristics of the article and its component parts. More specifically, a plurality of like smoking articles are subjected to one or more tests corresponding to one or more specific properties to evaluate the uniformity of the measured property or properties from article to article and to obtain statistical data regarding the mean characteristics of like articles. Different groups of like articles are typically subjected to the same series of tests under conditions that permit comparing the mean characteristics of different like articles.

Such tests are performed on the filter portion of a smoking article. To conduct these tests, the filter typically has to be removed from the smoking article body. One technique for removing the filter from a cigarette comprises holding the cigarette with one hand and manually cutting through the cigarette just above the filter with a razor blade or other sharp edge. Although skilled persons can perform this function, it requires the presence of a person having manual dexterity to perform the function. Also, the manual operation is subject to imprecise and inaccurate cuts from cigarette to cigarette.

Another technique employs a device having an aperture for receiving a cigarette, a stop for locating the cigarette in a fixed position, and a razor blade positioned on the end of a rod which is manually moved to cut through the cigarette just above the filter. The cigarette is manually inserted, filter end last, into the cutting aperture,so that it butts against a stop plate. The stop plate is selectively positioned at a fixed distance from the cutting edge of the razor blade so that the cigarette can be cut at a precise position just below the filter. This apparatus, however, has several disadvantages.

For one thing, it requires an operator to be present to insert manually the cigarette into the cutting apparatus and to push manually the rod to pass the blade through the cigarette. Further, the precision of the cut through the cigarette is dependant upon the operator's precision in locating the stop plate and inserting the cigarette to butt against the stop plate. This can result in too much filter paper being left on the filter portion that is separated from the cigarette body or severing through the filter, each of which can introduce errors during the tests subsequently performed on the filter.

A problem with the prior known techniques is that the reproducibility of the quality of the cut depends on the operator's ability to exert reproducibly a force on the push rod, which force may vary over the course of a day. Consequently, the prior techniques do not provide for consistently reproducible results. Another problem is that the known techniques are labor intensive and are not adaptable to an automated cutting technique.

It has, therefore, been desired to provide for an improved method and apparatus for cutting a smoking article into sections.

It has also been desired to provide for autonomously cutting a tobacco-containing smoking article into segments in an automated facility for testing the segments

It has also been desired to sever reproducibly filters from filter-tipped tobacco-containing smoking articles.

It has also been desired to provide a method and apparatus for severing smoking articles having a range of circumferences and lengths without complicated mechanical adjustments to the cutting apparatus

It has also been desired to improve the precision and accuracy of the cutting process by computer controlled activating devices.

Summary of the Invention

In accordance with the present invention, an apparatus and method for cutting a smoking article into segments is provided. Broadly, the invention concerns a workstation comprising a cutting element, a means for moving the cutting element along a predetermined path, a means for gripping a smoking article at a first location and maneuvering the article to a second location so that the article is disposed in the cutting path, and means for activating the means for moving the cutting element to sever the smoking article in response to the smoking article being in the second location.

In one embodiment, the gripper means grips the article at a designated area while the article is stationary at the first location. For example, the article may be gripped at the very end length of the filter section while the article is at rest in a holding device or against a stop at the terminus of a chute for feeding articles one at a time. Further, the gripping means preferably continues to grip the section severed from the article for delivery to subsequent workstations. Preferably, placing the article in the second location comprises inserting the article into an aperture for receiving the smoking article so that the longitudinal axis of the article is at a selected angle, preferably perpendicular, to the direction of travel of the cutting element. This provides for transecting the article perpendicular to its longitudinal axis. The aperture preferably has a cross-sectional shape that is appropriate to accommodate smoking articles having corresponding cross-sec-

tional dimensions, e.g., circular and oval.

In an alternate embodiment, the present invention is directed to a method for cutting a smoking article into sections automatically. One preferred embodiment of such a method comprises the steps of providing a sharp cutting element with a predetermined cutting path, gripping a smoking article at a first location, maneuvering the gripped article to a second location so that the article is disposed in the cutting path, and moving the cutting element along its cutting path to sever the article in response to the article being in the second location.

The present invention is preferably incorporated as part of an automatic test station for conducting a series of tests on smoking articles and their constituent parts, for example, measuring certain characteristics of the finished smoking article such as a conventional cigarette followed by severing the filter portion from the article and performing tests on the filter portion.

In a preferred embodiment, the gripper and maneuvering means comprises a robot having an arm at the end of which are a pair of opposing members for gripping a smoking article about its circumference. The arm is provided with a sufficient range of motion to manipulate the gripped article from the first location into the cutting apparatus so that the portion of the article to be severed is located in the cutting path. Subsequent to the article being in the desired location, the cutting element is actuated to sever the article, for example, immediately below the filter. The robot arm, which continues to hold the filter portion during the cutting operation, then extracts the severed filter from the apparatus and maneuvers the filter to an appropriate test station.

In accordance with a preferred embodiment, a microprocessor device is used to control the operation of the robot to grip a smoking article and maneuver it into the cutting apparatus to the selected location, and to activate a device for passing the cutting element through the article. After the cut is made the computer may then direct the robot to remove the filter from the apparatus and manipulate it to an appropriate test station.

Advantageously, in the present invention, the precision and accuracy of the cutting operation is determined by the precision and accuracy of the mechanical parts of the computer controlled apparatus as contrasted to an operator's manual ability. Furthermore, the need for an operator to be present to insert the article and to move the cutting edge for each cutting operation has been eliminated. The quality of the cut also has been made more reproducible, thereby enhancing statistical analysis and accuracy of tests performed on a plurality of like components severed from a plurality of like smoking articles.

Brief Description of the Drawings

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the invention, in which like reference numerals refer to like elements, and in which:

Fig. 1 is a top view of the cutter apparatus in accordance with an embodiment of the present invention; and

Fig. 2 is a side view taken along line 2-2 of Fig. 1.

Detailed Description of the Invention

Referring to Figs. 1 and 2, an embodiment of the present invention includes a cutting element 310, aperture 330, robot 325, air cylinder 340, and ball slide unit 370. Cutting element 310 is used to pass through to sever a smoking article 320 after it is positioned at a selected location in aperture 330 by robot 325. Cutting element 310 is mounted on carriage 360 of ball slide unit 370 between opposing carriage bracket 361 and clamp plate 362. Carriage 360 is mounted on two slide bars 368 and 369, which are mounted in two end blocks 371 and 372 that are respectively supported by spanner bars 373 and 374. Spanner bars 373 and 374 are in turn supported by front side plate 364 and rear side plate 375. Ball slide unit 370 provides a straight, one-dimensional cutting path along which element 310 will travel and may be, for example, model no. DS3-2-C, manufactured by Stelron. The length of unit 370 thus defines the maximum stroke length for element 310 whereas air cylinder 340 determines the usable stroke length, for example, 2.5 cm.

Movement of element 310 is controlled by air cylinder 340 which actuates piston rod 350 to move carriage 360 and carriage bracket 361 in a lateral direction along slide bars 368 and 369. Piston rod 350 is attached to carriage bracket 361 by cylinder block 379. Piston rod 350 is connected to air cylinder 340 and is moved back and forth by air cylinder 340. Air cylinder 340 is preferably a single action device in that a force is applied to extend piston 350 and a spring (not shown) returns piston 350 to its rest position following a lowering of the force. For example, a pressure 300 k Pa (40 psi) of compressed air , applied to compressed air inlet 381 of air cylinder 340, may be used to extend piston 350 to drive carriage 360 so that cutting element 310 gasses through smoking article 320. Referring to FIG. 1, on full extension the blade edge of cutting element 310 should pass through article 320, but element 310 should not pass completely through the periphery of article 320 as indicated at 310A. This facilitates the return stroke of element 310 and minimizes the likelihood of damaging article 320 during the severing operation. Air cylinder 340 is preferably part no. FOS-04-1.000-3 (Flat 1 air cylinder-

single acting-spring return-3/4 inch bore-1 inch stroke) manufactured and available from Bimba. Air inlet 381 of the cylinder is preferably model no. 11752-1 (hose fitting-#10-32 to 3 mm (1/8 inch).I.D. hose) manufactured by Clippard.

Air cylinder 340 is supported by end plate 383 which is also used to separate front side plate 364 from rear side plate 375 and to give overall stability to the cutting unit. Further stability to the cutting unit is provided by operating it in a verticle position and by support angles 377 and 378 attached to front side plate 364 and rear side plate 375.

In one embodiment of the present invention, a solenoid (not shown in the Figures) is used to control delivery of compressed air to inlet 381 to initiate the cutting process. The solenoid is preferably actuated by the computer in response to the article being placed in the selected second location. In another embodiment (also not shown in the Figures), the solenoid can be controlled manually by a switch mounted in the vicinity of the cutting apparatus. A further embodiment would allow both computer-controlled and manual solenoid actuation.

Alternate devices for moving cutting element 310 in response to article 320 being placed in the second position include stepper motors, linear actuators, rack and pinion mechanisms and similar devices.

Cutting element 310 is preferably a sharp blade, more preferably a conventional single-edged razor blade having a blade length of 3.88 cm. Blade 310 is mounted to carriage 360 between opposing carriage bracket 361 and clamp plate 362. The razor-blade side of clamp plate 362 includes recess 363 which is configured to hold razor blade 310 in the recess at a fixed angle relative to the piston direction. The angle must be sufficient so that the blade severs the smoking article (as contrasted to crushing the article) and passes through the cross section of article 320. Angles of 25 to 35 degrees for a conventional 3.88 cm long razor blade may be used, more preferably a 30 degree angle. Additionally, roll pin 366 maybe used to keep razor blade 310 in place during the cutting motion.

In operation, article 320 is gripped by opposing members 325A and 325B of robot 325 from a first location, such as an article holding device (not shown) and maneuvered to pass article 320 axially into aperture 330 extending through front side plate 364 and blade guard 365 to a selected distance or depth. The diameter of aperture 330 is preferably larger than the circumference of the article to be cut to provide tolerance for inserting articles 320 having a range of circumferences and withdrawal of severed portions. In a preferred embodiment, the diameter of aperture 330 is 8.33 mm (0.328 inches) for cigarettes having a circumference in the range of 22-25 mm. Aperture 330 can be modified to accommodate smoking articles of other diameters or cross-sectional shapes by replacing front side plate 364 and blade guard 365 with a front side plate and blade guard having an aperture of appropriate dimensions. Preferably, aperture 330 also includes countersink 367 in blade guard 365 to assist in the initial guiding of article 330 into cutting position 33.

Referring to Fig. 1, during the cutting operation, robot 325 holds article 320 by its filter end between two opposing fingers 325A and 325B so that article 320 extends into aperture 330 to a predetermined second location corresponding to placing the portion of the article to be severed in the defined cutting path of blade 310. Once in the second location, air cylinder 340 is actuated to move razor blade 310 to sever article 320 at the designated portion. Robot 325 is preferably a model Movemaster II, manufactured by Mitsubishi, Tokyo, Japan, distributed by Perkin-Elmer, Norwalk, Connecticut, under Model No. 9000, and is programmable. Thus robot 325 can be provided with information specifying the length of the article and its segment to be severed, e.g., the filter portion of a cigarette, and is programmed to move members 325A and 325B to grip article 320 at a selected location, for example, at the mouth end or at midpoint of the filter segment, and to insert article 320 to a depth so that razor blade 310 will sever article 320 at a location that is a selected distance from the end of the segment to be severed.

In one embodiment, the selected distance is approximately 2 mm from the end of the filter closest to the tobacco containing portion of a conventional cigarette. Thus, the razor blade will cut through the tobacco and not the filter material. For example, for a smoking article having a nominal filter length of 27 mm, the robot may be programmed to cut the smoking article at a distance of 29 mm from the mouth end of the filter. Also, robot 325 fingers 325A and 325B are adapted to grip a smoking article without crushing the smoking article. For example, the opposing fingers may be rectangular structures disposed in parallel having right angle notches cut on their inner opposing surfaces (not shown). In gripping a smoking article, the members may be moved towards each other so that notches form a parallelogram surrounding the article without crushing the article.

Alternately robot 325 may be controlled by a microprocessor device having software and instructions for controlling the movement of robot 325, opposing members 325A and 325B, and air cylinder 340.

Claims

1. Apparatus for cutting a smoking article (320) at a selected point comprising:
   a cutting element (310);
   means (370) for moving the cutting ele-

ment along a predetermined cutting path;

means (325) for gripping the smoking article at a first location and maneuvering the article to a second location so that the selected point of the article is disposed in the cutting path in the second location; and

means for actuating movement (340) of the cutting element along the cutting path to sever the smoking article in response to the smoking article being in the second location.

2. Apparatus according to claim 1, in which the gripping and maneuvering means further comprises a robot (325) having a movable arm having a first member (325A) second member (325B) in opposition thereto for gripping therebetween the article (320), and a microprocessor for controlling the movement of the robot arm and the first and second members.

3. Apparatus according to claim 1 or 2, in which the moving means (370) comprises a translatable carriage (360), a track (368, 369) for guiding the carriage, and means (362) for securing the cutting element to the carriage.

4. Apparatus according to claim 3, in which the means for securing the cutting element (310) to the carriage (360) comprises a clamp (362).

5. Apparatus according to claim 3 or 4, in which the moving means (340) comprises a piston rod (350) having a first position and a second position defining a range of motion secured to the carriage (360) to reciprocate the carriage in a corresponding range of motion, and a bracket for securing the razor blade to the carriage.

6. Apparatus according to any preceding claim, in which the actuating means comprises an air cylinder (340) for moving the carriage (360) along the track (368, 369).

7. Apparatus according to any preceding claim, in which the cutting element (310) comprises a razor blade.

8. Apparatus according to any preceding claim, in which the actuation means (340) further comprises a computer-controlled switch.

9. Apparatus according to claim 8, in which the computer-controlled switch includes an air cylinder (340) having an inactive condition and an active condition and means for placing the air cylinder in the active condition to move the cutting element (310) to sever the article (320).

10. Apparatus according to any preceding claim, in which the cutting element (310) is secured at an angle of from 25 to 30 degrees relative to the direction of the cutting path.

11. A method for cutting a smoking article into sections comprising:

providing a cutting element having a predetermined cutting path;

gripping the smoking article at a first location;

maneuvering the article to a second location so that the article is disposed in the cutting path in the second location; and

moving the cutting element along its cutting path to sever the smoking article in response to the smoking article being in the second location.

12. A method according to claim 11, further comprising providing a robot arm having a pair of opposing members and in which gripping the article further comprises gripping the article between the first and second members and in which maneuvering the article further comprises maneuvering the opposing members and the arm to place the article in the second location.

13. A method according to claim 12, in which the robot is a computer controlled device and the method further comprises programming the robot to grip the article at the first location and to maneuver the gripped article to the second location.

14. A method according to claim 13, in which programming the robot comprises programming the robot with a first set of instructins to grip and maneuver a first plurality of smoking articles and with a second set of instructions to grip and maneuver a second plurality of smoking articles, the first and second plurality of smoking articles being different smoking articles and the first and second set of instructions being different.

15. A method according to any of claims 11 to 14, further comprising moving the cutting element in a one-dimensional path thereby to sever the smoking article.

16. A method according to any of claims 11 to 15, further comprising providing a computer-controlled device for determining when the smoking article is in the second location and moving the cutting element in response to the determination.

17. A method according to any of claims 11 to 16, in which moving the cutting element comprises advancing the cutting element with a preselected

force for cutting through a smoking article.

18. A method according to any of claims 11 to 17, in which the smoking article comprises a first segment, a second segment and an interface therebetween, and maneuvering the article to the second position comprises selecting a location on the article to be cut that is a selected distance from the interface so that cutting the article comprises passing the cutting element through one of the first or second elements.

19. A method according to claim 18, in which the selected distance is 2 mm.

FIG. 1

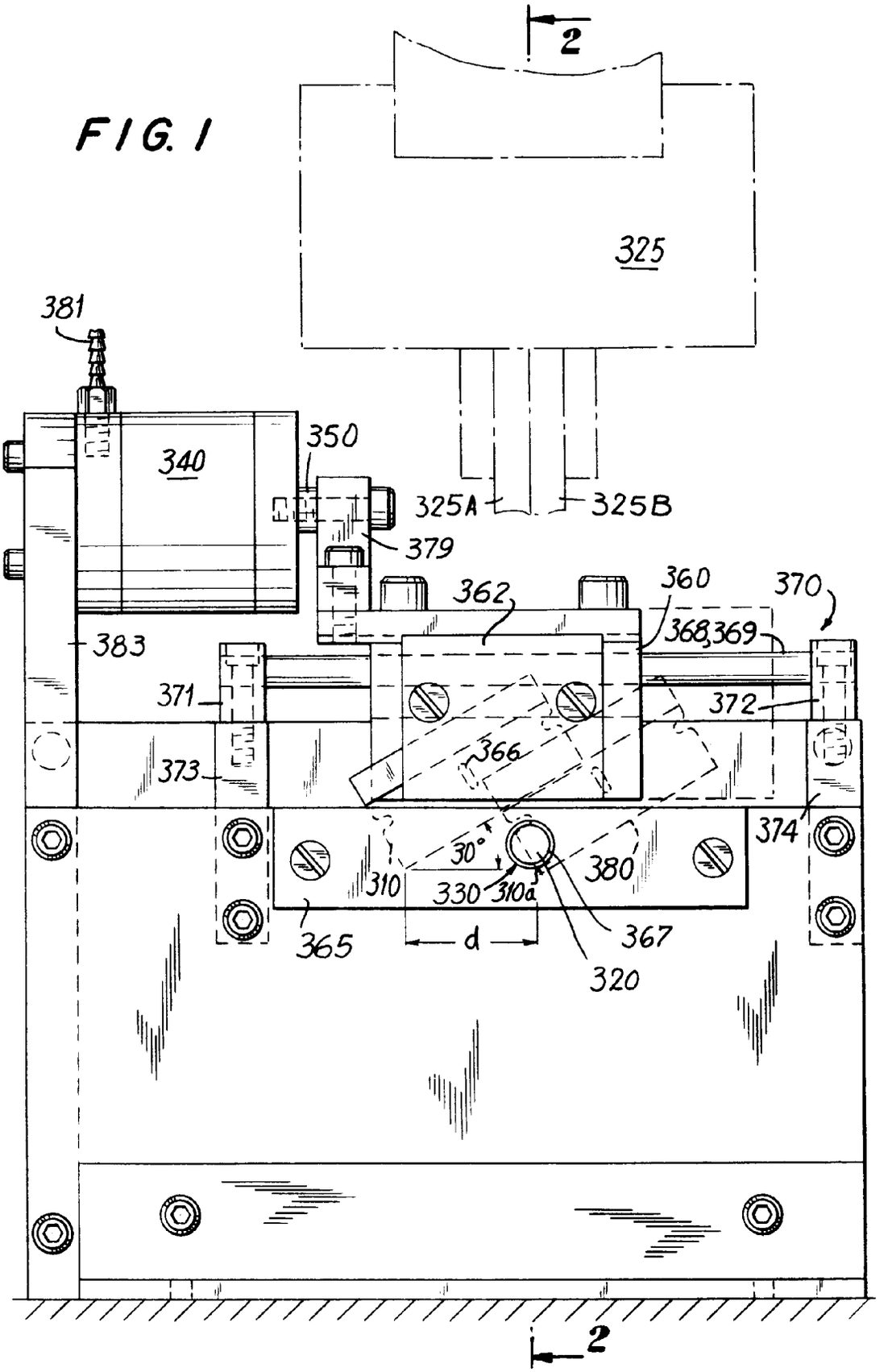

2
325
381
340
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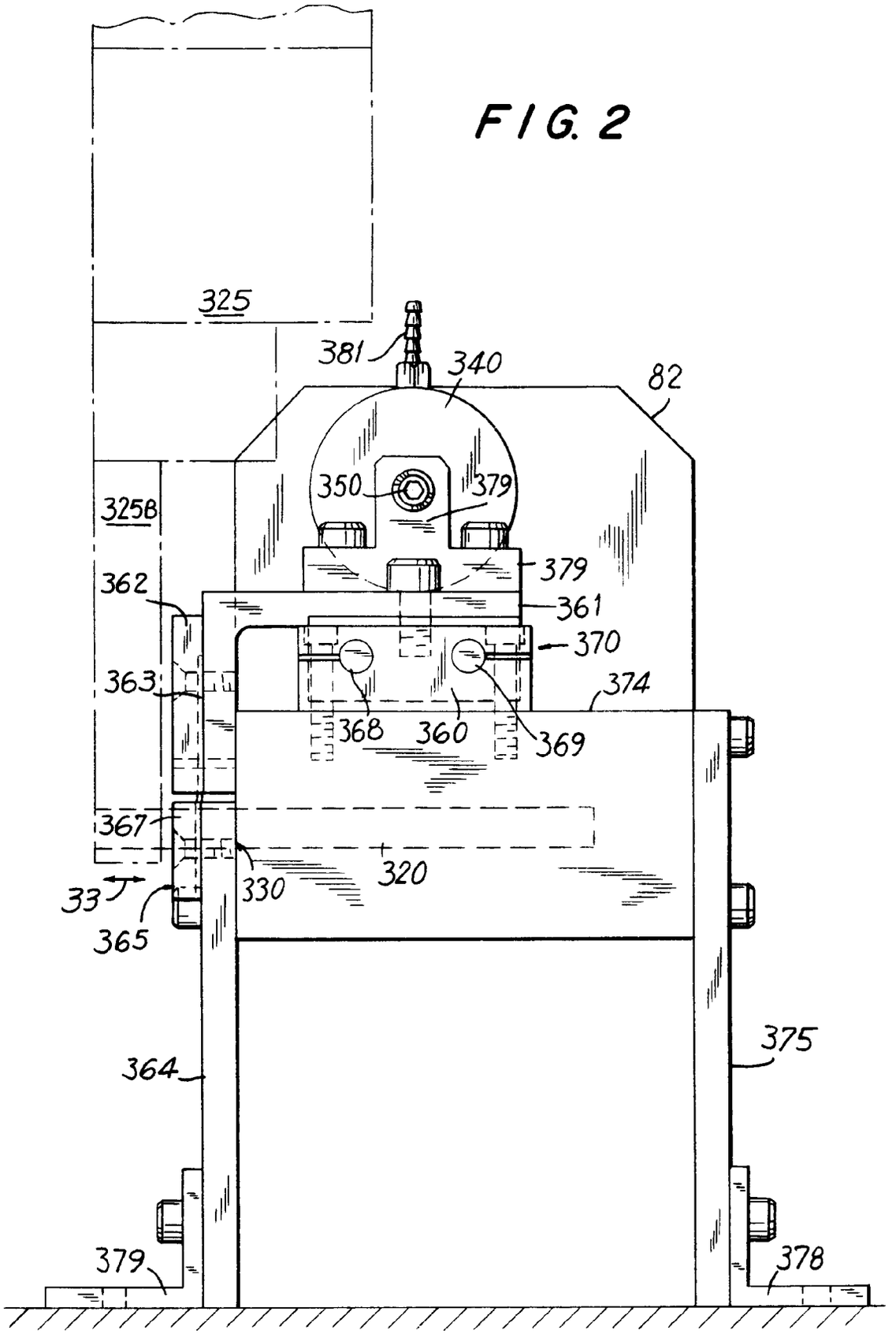
FIG. 2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