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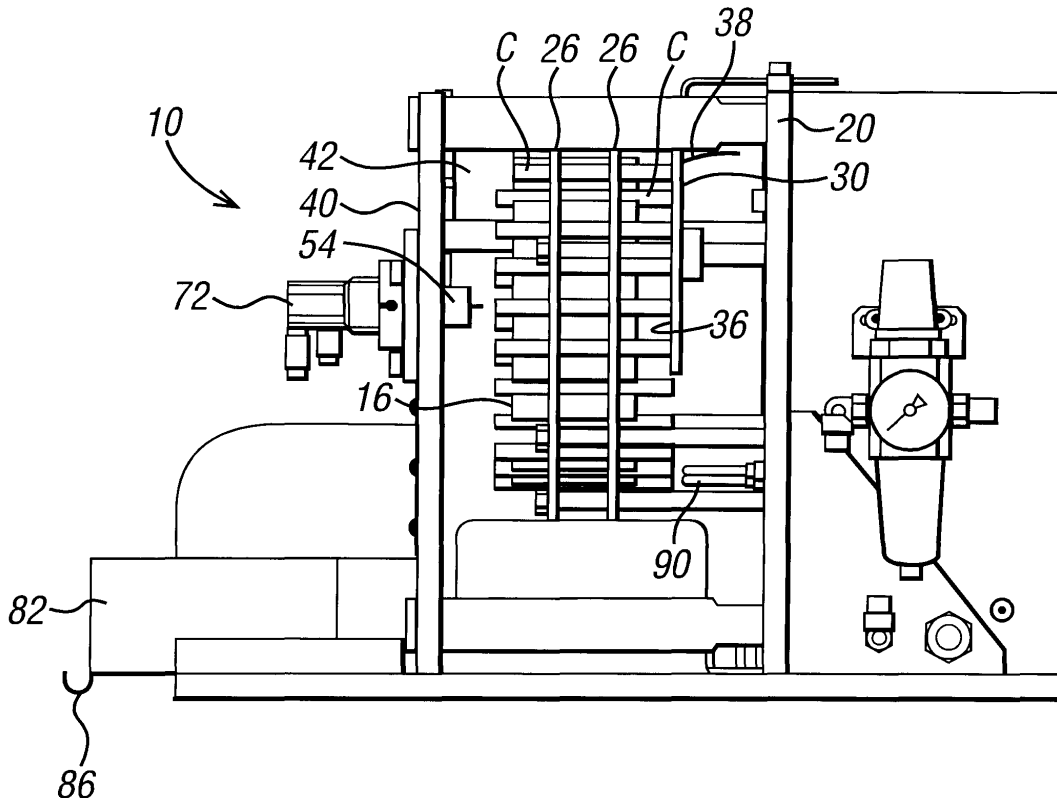
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(54) **Cigarette testing**

(57) An off-line cigarette testing apparatus 10 comprises at least one device 42,54 for detecting the pres-

ence of tobacco at an end of a cigarette C and a rotatable drum 16 for presenting the respective ends of a plurality of cigarettes to the or each detecting device.

FIG. 2



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Description

[0001] The invention relates to cigarette testing and particularly to the off-line testing of cigarettes.

[0002] Cigarette making machines are typically provided with various on-line devices for monitoring the quality of the cigarettes they produce.

[0003] One criterion for determining whether or not a filter cigarette is of suitable quality is the presence of tobacco at the end of the cigarette which is to be lit ("the burn end"). It is possible that during the process of producing a cigarette, loosely packed tobacco from the burn end will fall out leaving an empty space at the end of the cigarette wrapper. This so-called loose ends fall out gives the finished cigarette a most unsatisfactory appearance. In cases where the tobacco does not actually fall out, a problem remains since loosely packed tobacco at the burn end generally results in an unsatisfactory cigarette.

[0004] The incidence of loose ends is well recognised in the cigarette making industry and in addition to on-line testing devices provided on the making machine, quality control inspectors will usually periodically inspect batches of cigarettes taken from the output of a cigarette making machine. This inspection is typically carried out by eye and is therefore a somewhat subjective test being based on the perception of a particular inspector, which in itself may vary from day to day.

[0005] It is known to provide an off-line testing apparatus for testing for loose ends fall out. This apparatus takes the form of a drum-like wire cage mounted for rotation. In use, a batch of cigarettes is weighed, placed in the drum and then the drum is rotated. The tumbling action of the drum causes any loose tobacco to fall from the ends of the cigarettes. This tobacco is collected in a tray positioned below the drum and at the end of the tumbling process, the tobacco collected in the tray is weighed. The figures obtained by weighing the cigarettes and the collected tobacco can be inserted in a formula to provide an indication of the fall-out of tobacco from cigarettes being produced by a machine. However, this testing machine suffers from the disadvantage that a particularly poor cigarette may lose a large amount of tobacco during the tumbling process resulting in an inaccurate indication of the overall quality of the cigarettes being produced.

[0006] The invention provides an off-line cigarette testing apparatus comprising at least one device for detecting the presence of tobacco at an end of a cigarette and a device for presenting the respective said ends of a plurality of cigarettes to the or each said detecting device.

[0007] The invention also includes an off-line method for testing for the presence of tobacco at an end of a cigarette, said method comprising the steps of removing a plurality of cigarettes from a stream of cigarettes produced in a cigarette making machine, presenting at least one said end of each cigarette to at least one device for

detecting the presence of tobacco in an end of a cigarette.

[0008] In this specification, by off-line is meant, an apparatus which is not an integral part of a cigarette making machine and which is used to carry out a quality check on batches of cigarettes removed from the stream of cigarettes produced by such a machine. Preferably, the apparatus would be a bench testing apparatus. However, the apparatus could for convenience be mounted on a making machine and it is envisaged that in this instance, provision may be made for automatically removing a batch of cigarettes for testing from the output of the machine and feeding it into the testing apparatus. It is also to be understood that although the apparatus is off-line, it would be possible to feed suitably conditioned signals from the apparatus to the control system of a maker, should this prove desirable.

[0009] In order that the invention may be well understood, an embodiment thereof, which is given by way of example only, will now be described with reference to the drawings, in which:

Figure 1 is a plan view of an off-line cigarette testing apparatus;

Figure 2 is a side view of the apparatus shown in Figure 1;

Figure 3 is a section on line III-III in Figure 1;

Figure 4 is a section view of a detecting device incorporated in the apparatus;

Figure 5 is an end view of another detecting device incorporated in the apparatus; and

Figure 6 is a front view of a control unit of the apparatus.

[0010] Referring to Figures 1 to 6, an off-line cigarette testing apparatus 10 includes a casing 12 which houses a hopper 14 and a cigarette conveyor. The cigarette conveyor is in the form of a rotatable drum 16. The drum 16 has a series of regularly spaced axially extending slots, or flutes, 18 (Figure 3) defined in its peripheral surface. The flutes 18 are each capable of holding a cigarette C and the drum is arranged to pass through an aperture at the front, lowermost, end of the hopper so that as it rotates, a cigarette can be collected in each flute.

[0011] The hopper is mounted to a cross-member 20, which is part of the casing 12. An adjustable guide plate 22 is fixed to the cross-member 20 by means of pair of nuts which threadingly engage respective studs that protrude from the cross-member and pass through respective slots 24 defined in the guide plate. The guide plate is L-shaped and is made adjustable to allow the apparatus to test different length cigarettes.

[0012] A pair of arcuate retaining rails 26 is provided for retaining the cigarettes in the flutes. The retaining rails are mounted in parallel spaced apart relationship close to the circumferential surface of the drum and, as shown in Figure 3, extend around approximately 200° of the drum circumference.

[0013] A curved backplate 30 is mounted between the drum and cross-member 20. The backplate 30 has a tapered lead-in 32 positioned adjacent the hopper. The arrangement of the guide plate 22 and backplate 30 is such that a guide wall 34 (Figure 1) of the guide plate extends downwardly into the hopper (as viewed in Figure 1) and is positioned slightly to the right of the backplate so that as the cigarettes C are conveyed from the hopper, the ends of the cigarettes directed towards the guide wall 34 are guided into contact with the lead-in 32. As the cigarettes are moved along the lead-in by the drum, they are caused to slide axially to the left such that the end engaging the lead-in will on further rotation of the drum, engage a datum surface 36 of the backplate. By this means, the cigarettes can be positioned precisely at a known position in their respective flutes.

[0014] A fibre optic detecting device 38 is mounted to the backplate 30 and is arranged to check for the presence of a cigarette in the flutes 18.

[0015] The casing 12 includes a second cross-member 40 on which is mounted a first tobacco detecting device 42. The detecting device 42 is shown in detail in Figure 5 and includes a shroud 44 which has a diametral slot 47 provided in it. The slot 47 is arranged such that as the drum rotates, the ends of the cigarettes disposed remote from the datum surface 36 can pass through the shroud and receive an infrared beam from a source of infrared radiation 46. The shroud 44 houses four infrared detectors 48 which are spaced 90° apart. The detectors 48 are arranged to receive infrared rays which have entered the end of a cigarette under test and passed radially outwards through the cigarette wrapper. This form of detector is known to those skilled in the art and a similar detector is currently in use on the Molins Passim cigarette making machine

[0016] Downstream from the detecting device 42, there is a second tobacco detecting device 54 which is also mounted on the second cross-member 40. The second detecting device is shown in detail in Figure 4.

[0017] The second detecting device 54 comprises a hollow cylindrical body 56 mounted for relative sliding movement in a housing 58. A plunger 60 is housed in the cylindrical body and has a coaxial pin 62 which protrudes from a through-hole provided in an end plate 64 which closes the end of the cylindrical body disposed remote from the housing 58.

[0018] The plunger 60 is biased towards the end plate 64 by means of a compression spring 66 and has a circumferentially extending groove 68 defined in an end region thereof adjacent the pin 62.

[0019] The body 56 has a radially extending aperture which houses a fibre optic detector 70 arranged to detect movement of the plunger 60.

[0020] A pneumatic actuating cylinder 72 is fitted to the end of the housing 56 disposed furthest from the end plate 64 and is arranged to provide selective axial reciprocating movement of the cylindrical body in the housing 56. The actuating cylinder 72 has a speed control 73 to

control the speed of the reciprocating movement.

[0021] An air regulator 74 combined with a pressure gauge 76 and filter 78 is mounted to the casing 12 and is used to regulate a supply of compressed air to the cylinder arrangement 72.

[0022] A receptacle 80 for cigarettes is provided at the rear of the casing 12 beneath the hopper 14. The arrangement is such that cigarettes C conveyed by the drum 16 beyond the downstream ends of the retaining rails 26, are able to drop into the receptacle 80.

[0023] A further receptacle in the form of a drawer 82 is provided to the left (as viewed in Figure 1) of the drum 16 and has a handle 84 to facilitate its withdrawal from the casing. The drawer 82 is divided into three compartments 82(1), 82(2), 82(3).

[0024] A cigarette ejection device 90 (Figure 2) is fitted to the cross-member 20. The ejection device 90 comprises three air nozzles mounted in the same horizontal plane in a spaced apart relationship and arranged to send respective jets of air along the flutes 18 aligned therewith. The arrangement is such that the air nozzles can be selectively operated to eject a cigarette into a respective one of the compartments 82(1), 82(2), 82(3).

[0025] The apparatus 10 also includes a control unit 100 which is connected to the various detecting devices housed in the casing 12 by means of a suitable control cable 102. In addition to receiving output signals from the detecting devices, the control unit transmits actuating signals to the devices contained on the casing to control the operation of the apparatus.

[0026] The control unit 100 includes a PLC and a data-logger (neither of which is shown). Additionally, the control unit has a rotary switch 104 by means of which a threshold value associated with the detecting device 42 is set.

[0027] As explained in more detail below, the detecting devices 42, 54 perform tobacco detecting tests on the burn ends of the cigarettes C and in accordance with the results of those tests, cigarettes may be ejected by the air nozzles of the ejection device 90 into the respective compartments 82(1), 82(2), 82(3). The control unit includes four display devices 108, 110, 112 and 114. The display device 108 provides an indication of the number of cigarettes ejected into the compartment 82(1) in reliance on the result of the test performed by the detecting device 42. Similarly, the display device 110 provides an indication of the number of cigarettes ejected into the compartment 82(2) in reliance on the result of the test performed by the detecting device 54. The display device 112 indicates the number of cigarettes ejected into the compartment 82(3), which cigarettes will have failed the test made by each of the detecting devices. The display device 114 shows the total number of cigarettes tested.

[0028] In use, an operative, typically a quality control inspector, will periodically remove a batch of cigarettes from the output of a cigarette machine. Those cigarettes are placed in the hopper 12 with their filter ends against

the guide wall 34. The operative then initiates a test run by pressing a start button 116. On pressing of the start button, the control unit transmits the necessary signals to operate the apparatus and the test run is then run automatically under the control of the control unit without further input from the operative.

[0029] The drum is progressively indexed in a clockwise direction by means of a stepper motor (not shown). As the drum rotates, cigarettes from the hopper are picked up in the flutes 18.

[0030] On exiting the hopper, the flutes are checked for the presence of a cigarette by the fibre optic detecting device 38 which provides a suitable signal to the control unit 100. The control unit uses the signal provided by the detecting device 38 to trigger the detecting devices 42, 54 so that each carries out a tobacco detecting test when a cigarette bearing flute is indexed to a position in line with the detecting device. A test is not carried out on an empty flute. The signal from the device 38 is also used to index the display 114 to provide an indication of the number of cigarettes tested.

[0031] When the first tobacco detecting device 42 is faced with a cigarette bearing flute, the infrared source 46 emits an infrared beam which is directed axially into the cigarette at the burn end. According to the amount of tobacco present in the cigarette end, a certain amount of infrared radiation will pass through the cigarette wrapper and this radiation is detected by the infrared detectors 48 which provide a voltage signal proportional to the amount of infrared radiation detected. This voltage signal is fed to the control unit and is compared with a threshold voltage set by means of the rotary switch 104 and this comparison determines whether the cigarette C is of an acceptable quality or not. Thus, for example, if the threshold value is set at 7 volts and the voltage signal from the detecting device is 7 volts or less, this cigarette is deemed acceptable; if the voltage signal from the detecting device is greater than 7 volts the cigarette is deemed a reject. The acceptability of the cigarette is logged by the control unit.

[0032] When the second tobacco detecting device 54 is faced with a cigarette bearing flute, the actuating cylinder 72 supplies air to the back of the hollow body 56 causing the body to slide axially away from the valve arrangement towards the drum 16. The body slides a predetermined distance and in the event that there is tobacco at the end of the cigarette and this tobacco is sufficiently firm, the plunger 60 is pushed back against the spring 66 causing the groove 68 to be moved past the fibre optic detector 70. The detector 70 responds by producing a signal which is registered by the control unit as an indication of the presence of tobacco at the end of the cigarette, which is therefore deemed acceptable. If there is no tobacco at the end of the cigarette, there is no deflection of the plunger and the fibre optic detector does not produce a tobacco detected signal. The control unit determines whether the cigarette is acceptable according to whether or not the detecting device produces

a tobacco detected signal.

[0033] The control unit registers the acceptability of each cigarette and causes the ejection device 90 to eject the cigarettes not deemed acceptable into one of the drawer compartments 82(1), 82(2), 82(3): cigarettes which are deemed unacceptable in reliance on the signal produced by the detecting device 42 are ejected into the compartment 82(1); cigarettes deemed unacceptable in reliance in the test performed by the detecting device 54 are ejected into the compartment 82(2); and cigarettes which fail both tests are ejected into the compartment 82(3).

[0034] Each time a cigarette is ejected into one of the compartments 82(1), 82(2), 82(3), the control unit causes the associated display device 108, 110, 112 to be indexed so as to provide a visual indication of the number of cigarettes ejected into each compartment.

[0035] Cigarettes not deemed unacceptable by either of the detecting devices 42, 54 are carried past the ejection device 90 by the drum and fall from the drum into the receptacle 80 as the flutes in which they are carried move past the downstream end of the retaining rails 26.

[0036] It will be appreciated that the control unit and the connections between the control unit and the detecting devices, ejection device and stepper motor may be of any suitable type. Suitable connections, including signal conditioning devices, will be familiar to those skilled in the art and have therefore not been described in any detail herein. It will also be understood that the control unit need not include data storage and sorting facilities, and that the apparatus could be linked to a PC if desired. The various possibilities for handling the signals output from the tobacco detecting devices will be apparent to those skilled in the art and will not therefore be detailed herein

[0037] The stepper motor continues to rotate the drum a predetermined number of times after the last cigarette detected signal is received from the detector 38 to ensure that all of the cigarettes placed in the hopper are tested.

[0038] It will be appreciated that the apparatus provides a simple and easy to perform quality inspection of the burn ends of a batch of cigarettes and that the inspection results should be consistent and not dependent on an operative's perception.

[0039] It will also be appreciated that once the apparatus 10 is loaded with a batch of cigarettes and a test-run has been initiated, there is no counting or weighing of the cigarettes or fall out tobacco required. Instead, the inspection process is entirely automated.

[0040] It will also be appreciated that the two-stage testing procedure carried out on the apparatus 10 provides the advantage of a double-check and that, for example, the second detecting device 54 may identify unacceptable cigarettes which are not identified by the first detecting device 42. This may occur because the tobacco in the end of the cigarette is very loose and although there is sufficient present to block enough infrared radi-

ation to satisfy the detecting device 42; this will not be of sufficient firmness to move the plunger 60 against the spring 66. Such a cigarette would satisfy an on-line infrared detecting device on a cigarette making machine, but would be quite likely to suffer loose ends fall out during the subsequent handling processes resulting in its rejection at the packing stage, where typically, the presence of one faulty cigarette leads to the rejection of a pack size bundle. It will be understood that a testing procedure which makes it possible to more accurately and reliably identify quality problems at the making stage is particularly advantageous if it leads to the possibility of a reduction in the number of cigarettes rejected at the packing stage. It will also be understood that the second tobacco testing device is not suitable for on-line application on cigarette making machines and that its use in the apparatus 10 provides a check on the quality of the cigarettes output by a maker which cannot be relied upon if a similar device is used on a packaging machine. Since in the latter case, it cannot be known whether the faults detected are induced downstream of the maker by rough handling.

[0041] It is well known in the cigarette making industry to manufacture double-length cigarettes which are subsequently cut in half to provide two complete cigarettes. It is envisaged that the apparatus could be modified to allow the two burn ends of a double-length cigarette to be inspected on the same pass, and preferably simultaneously, through the apparatus. This would preferably involve providing opposed pairs of detecting devices with a cigarette conveyor mounted between them.

[0042] It will be appreciated that the apparatus could be modified to include devices for carrying out other tests on the cigarettes, such as a diameter check, if desired.

Claims

1. An off-line cigarette testing apparatus comprising at least one device for detecting the presence of tobacco at an end of a cigarette and a device for presenting the respective said ends of a plurality of cigarettes to the or each said detecting device.
2. An apparatus as claimed in claim 1, wherein the or at least one said detecting device comprises an infrared tobacco detecting device.
3. An apparatus as claimed in claim 1 or 2, wherein the or at least one said detecting device comprises a member arranged to be advanced into said end and deflectable by tobacco at said end and a device for detecting said deflection.
4. An apparatus as claimed in any one of claims 1 to 3, comprising a plurality of said testing devices arranged that a plurality of tobacco detecting tests are conducted on each said end.
5. An apparatus as claimed in any one of the preceding claims, wherein said cigarette presenting device comprises a conveyor for conveying a plurality of cigarettes past the or each said detecting device.
6. An apparatus as claimed in claim 5, wherein said conveyor comprises a rotatable drum provided with a plurality of spaced apart cigarette receiving positions.
7. An apparatus as claimed in any one of the preceding claims, further comprising a cigarette ejection device for ejecting cigarettes in which an absence of tobacco at said ends has been detected.
8. An apparatus as claimed in claim 7, comprising a plurality of said detecting devices, wherein said ejection device is arranged to eject said faulty cigarettes to one of a plurality of cigarette receiving zones according to which detecting device detected said absence of tobacco.
9. An apparatus as claimed in claim 8, wherein said receiving zones are defined by a plurality of receptacles arranged to receive said faulty cigarettes from said ejection device.
10. An apparatus as claimed in any one of the preceding claims, further comprising a device for recording an output signal of the or each said detecting device.
11. An apparatus as claimed in claim 2 of any one of claims 3 to 10 when dependent on claim 2, further comprising means for providing a graphical representation of an output signal from said infrared detecting device.
12. An apparatus as claimed in any one of the preceding claims, further comprising means for designating a cigarette as faulty based on an output signal of the or each said detecting device and a display for providing an indication of a number of cigarettes designated faulty.
13. An off-line method for testing for the presence of tobacco at an end of a cigarette, said method comprising the steps of removing a plurality of cigarettes from a stream of cigarettes produced in a cigarette making machine and presenting at least one said end of each cigarette to at least one device for detecting the presence of tobacco in an end of a cigarette.
14. A method as claimed in claim 13, wherein said cigarettes are presented to the or each detecting de-

vice one-by-one.

15. A method as claimed in claim 14, comprising placing said plurality of cigarettes in a receptacle and removing said cigarettes from said receptacle by means of a conveyor arranged to present the cigarettes to the or each detecting device.

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FIG. 1

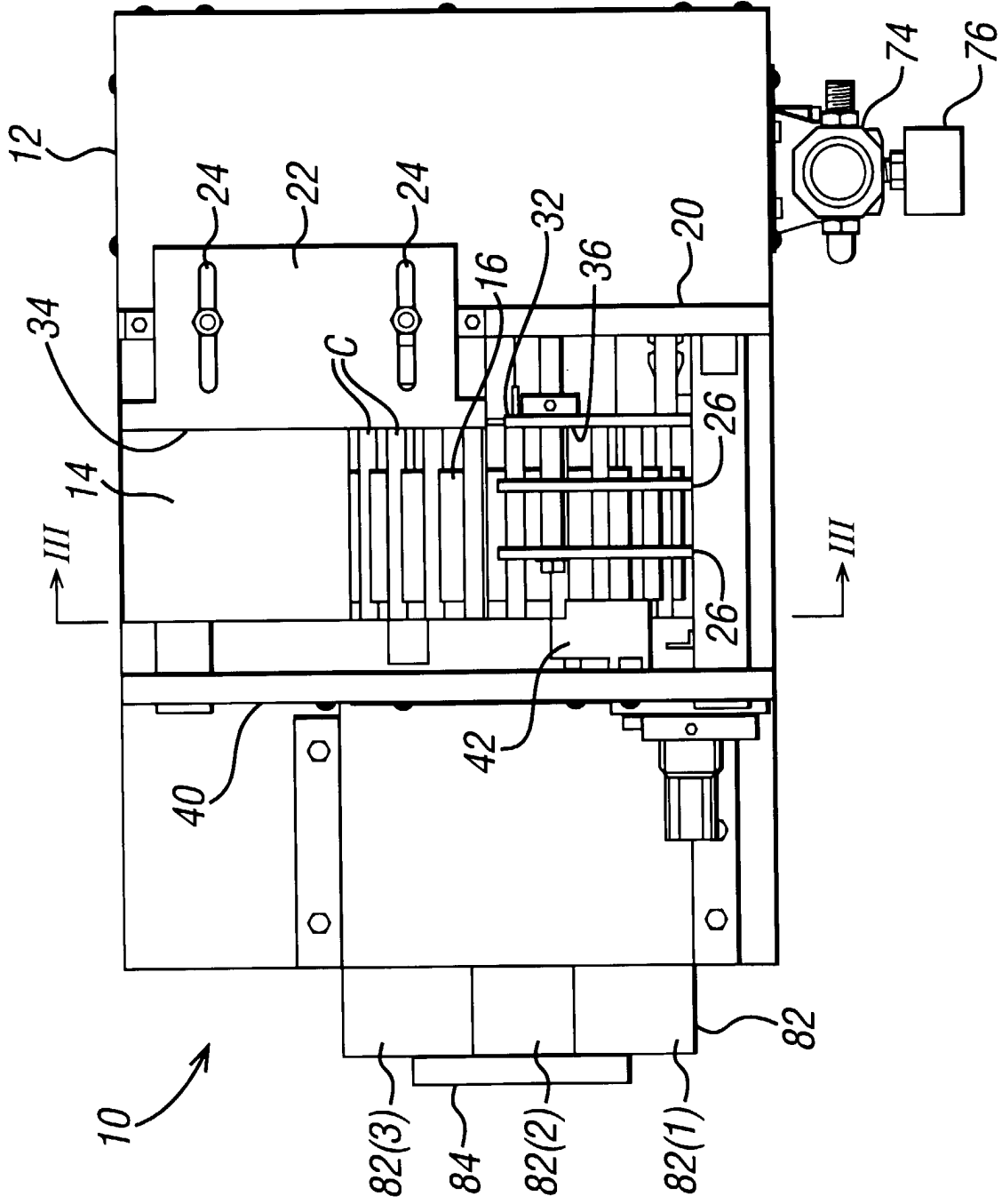


FIG. 2

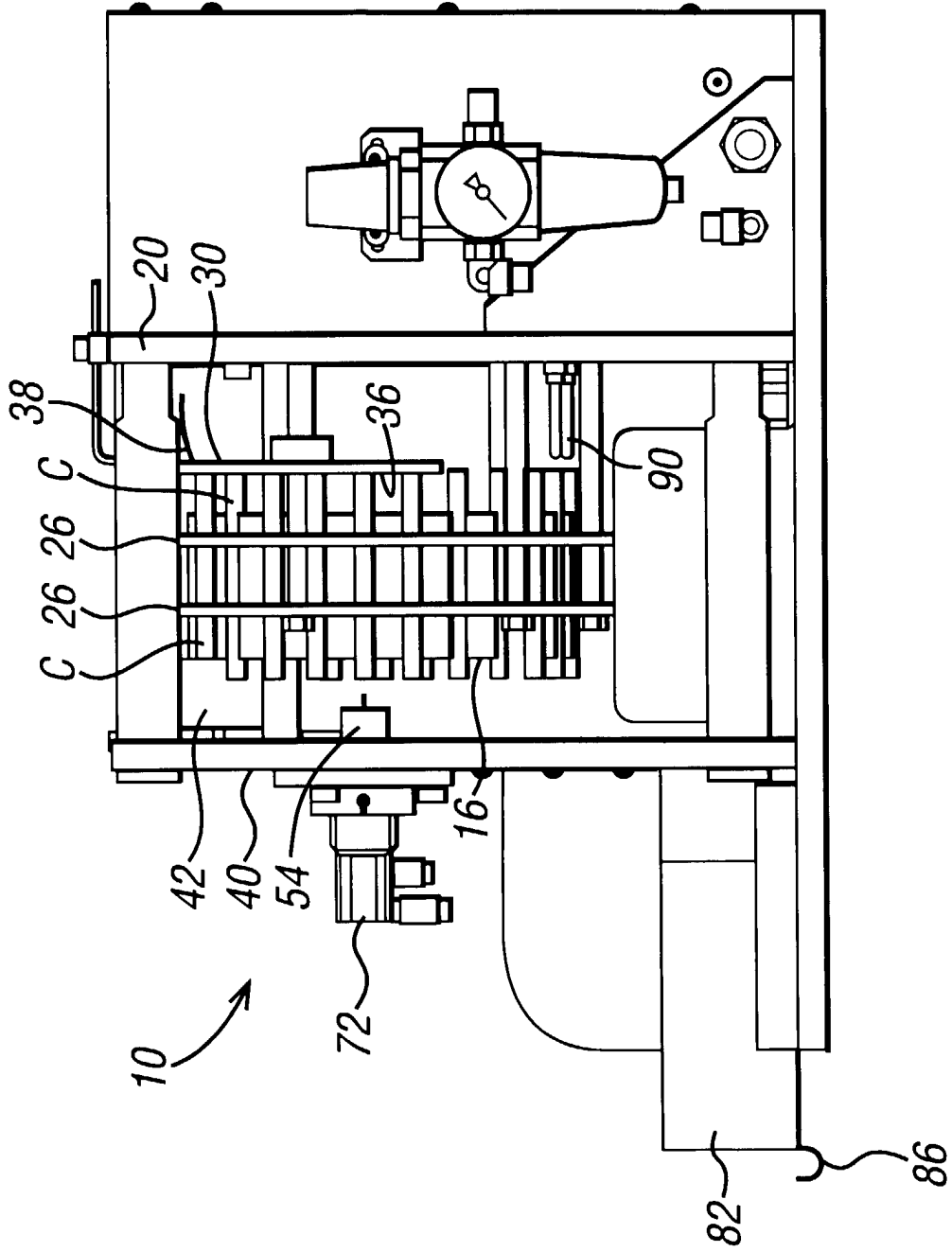


FIG. 3

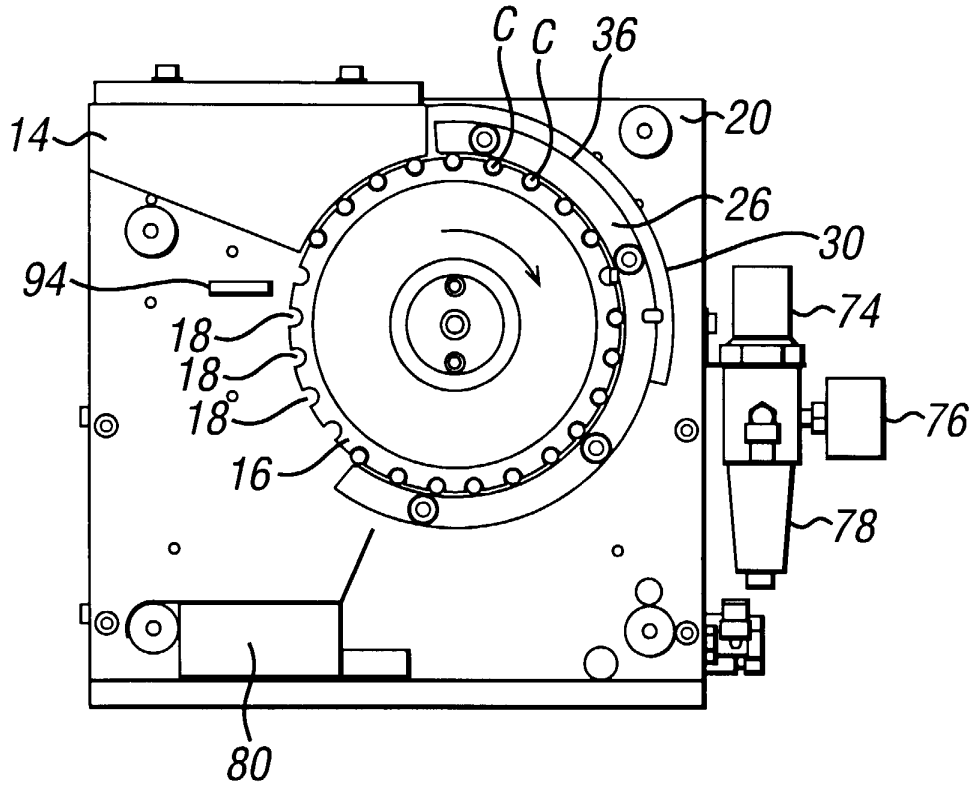


FIG. 4

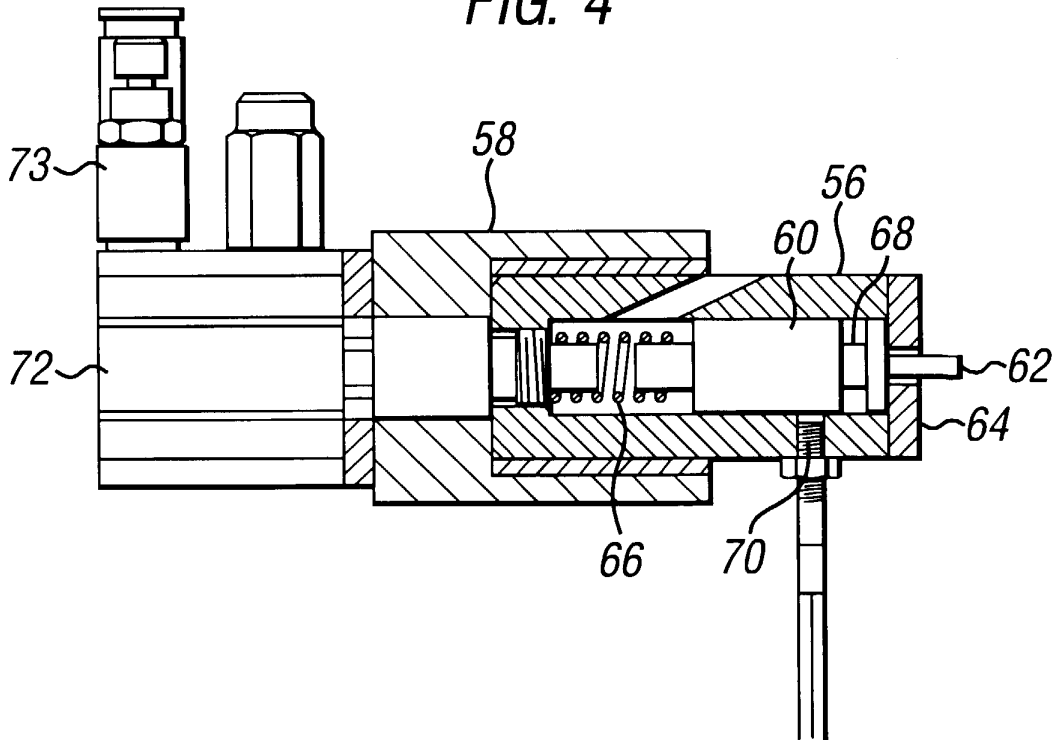


FIG. 5

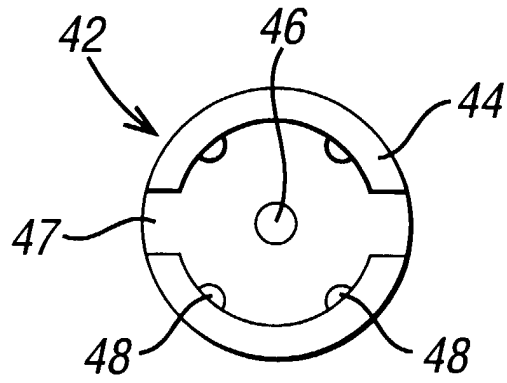


FIG. 6

