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CA 2157723 C 2003/05/06

(11)(21) 2 157 723

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 1995/09/07

(41) Mise à la disp. pub./Open to Public Insp.: 1996/03/14

(45) Date de délivrance/Issue Date: 2003/05/06

(30) Priorités/Priorities: 1994/09/13 (PM8047) AU;
1994/10/06 (PM8613) AU

(51) Cl.Int.^{6}/Int.Cl.^{6} B07C 5/344

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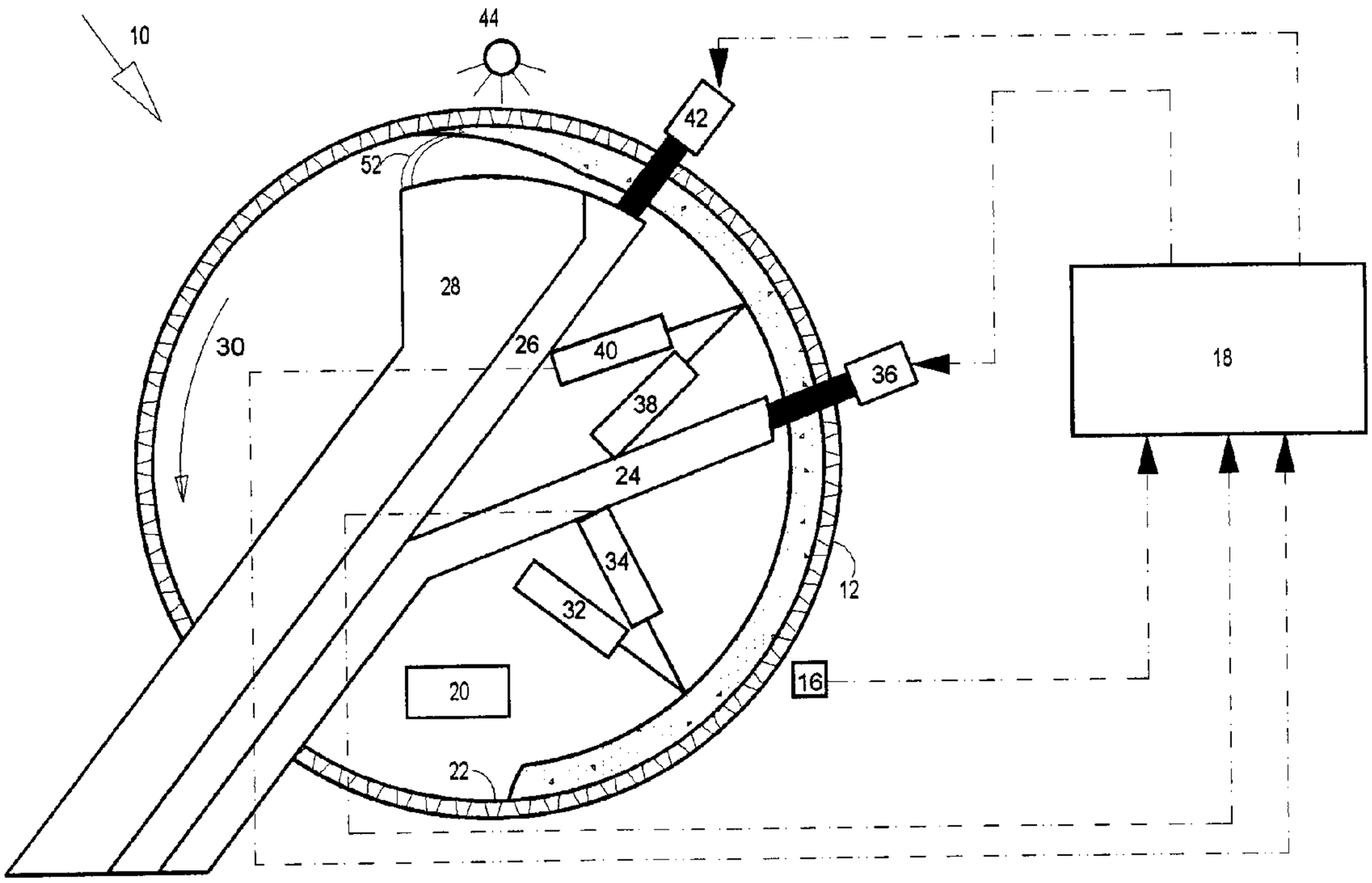
(54) Titre : APPAREIL DE TRI DE MATERIAU PARTICULAIRE ET METHODE CONNEXE
(54) Title: METHOD OF AND APPARATUS FOR SORTING A PARTICULATE MATERIAL



(57) Abrégé/Abstract:
A sorting system wherein particulate material is dispersed by centrifugal force in a layer on an inner surface of a rotating drum, and particles which possess at least one predetermined characteristic are removed from the layer.

ABSTRACT OF THE DISCLOSURE

A sorting system wherein particulate material is dispersed by centrifugal force in a layer on an inner surface of a rotating drum, and particles which possess at least one predetermined characteristic are removed from the layer.

BACKGROUND OF THE INVENTION

This invention relates to the sorting of particulate material. In this specification the word "material" includes any material that is in a particulate form and refers particularly to ores in the mining industry.

Many industries produce materials that are uneconomic to process by standard means as they are either contaminated by foreign bodies or have a low grade. These materials are generally not processed at all and are discarded.

SUMMARY OF THE INVENTION

The invention provides, in the first instance, apparatus for sorting a particulate material which includes a drum which is mounted for rotation about its axis, means for feeding the particulate material into the drum which, due to centrifugal force produced by its rotation, causes the particulate material to adhere to an inner surface of the drum, means for detecting the presence of at least one predetermined characteristic in the particulate material, and means for separating particles with the predetermined characteristic from the remaining particles.

The separating means may comprise at least one removal device which is responsive to the detection means. In one embodiment of the invention the drum may be made from a solid or semi-permeable material and the material is removed from an inner surface of the drum by one or a plurality of the removal devices. Each removal device may be a suction device.

In an alternative arrangement the removal means comprises at least one fluid ejection device which is responsive to the detection means. The drum inner surface may then be a perforated or slotted surface, or otherwise be formed with a plurality of apertures, and the fluid ejection device or devices may be directed from outside the drum, through the drum wall, to the particles adhering to the inner surface.

The fluid ejection devices may comprise compressed air jets, water jets or the like.

Depending on the type of particulate material mechanical separation devices may also be employed. These may for example comprise flapper gates or similar devices which are moveable to free selected particles directly from the inner surface of the drum.

The drum may for example be made from wedge wires and be similar to a trommel. The wedge wires may extend across the drum thereby forming a surface which includes a plurality of very fine slots.

Material remaining in the drum, after removal of those particles which possess the predetermined characteristic or characteristics, may be removed from the drum by means of suction, water spray, air jet or by means of a mechanical scraper.

The predetermined characteristic or characteristics depend on the nature of the material which is being sorted. The invention is not limited in this regard. For example the predetermined characteristic may comprise any one of the following diverse features: a photometric effect, reflectance or absorbtion criteria, radio-active emissions, a magnetic or conductive effect, optical fluorescence or the like. It may be that the predetermined characteristic or characteristics are emitted only in response to suitable stimulation. Thus it falls within the scope of the invention to stimulate the particles so that those particles which possess the predetermined characteristic or characteristics emit a signal which is indicative of the presence thereof.

For example, in the sorting of diamonds, the particulate material may be subjected to a X-ray source which stimulates the emission of fluorescence by the diamonds.

The invention provides, in a second instance, a method of sorting a particulate material which includes the steps of subjecting the particulate material to a centrifugal force thereby to form a layer of the material, detecting the presence of at least one predetermined characteristic in particles in the layer of material, and removing particles with the predetermined characteristic from the layer of material.

The particulate material may be subjected to the centrifugal force by feeding material into a rotating drum so that a layer of the material is dispersed on an inner surface of the drum. Preferably the drum rotates at a speed which is sufficiently high to ensure that substantially a mono-layer of the particulate material is formed.

The material may be fed continuously into the drum and the material remaining in the drum, after removal of the particles with the predetermined characteristic or characteristics, may be removed continuously from the drum.

Removal of material from the drum may be effected by means of suction or by means of fluid pressure or by mechanical means.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of example with reference to the accompanying drawings in which:

Figure 1 is a somewhat schematic side view of sorting apparatus according to the invention,

Figure 2 is a block diagram of control circuitry for the sorting apparatus of Figure 1,

Figure 3 is a schematic view in elevation of a drum in the apparatus of Figure 1, and

Figure 4 is a sectioned side view, on an enlarged scale, of a drum suitable for use in the apparatus of Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT

Figures 1 and 2 of the accompanying drawings illustrate sorting apparatus 10 according to one form of the invention. The apparatus includes a drum 12 which is mounted for rotation about a horizontal axis. The drum is driven by means of an electrical motor 14 and, where required, use is made of a gear box or similar drive transmission system, not shown, between the motor and the drum.

The rotational speed of the drum is monitored by means of a sensor 16. A signal produced by the sensor, which is indicative of the rotational speed of the drum, is applied to a control module 18 which in turn operates to drive the motor 14 so that the rotational speed of the drum is known and kept substantially constant.

The sensor or control module may include suitable switching circuitry to adjust the rotational speed of the drum to a fixed desired speed and to stop the motor in the case of a malfunction.

A feed chute 20 extends into the drum, in a lower region of the drum. The feed chute may be of any suitable construction and may for example

contain an endless conveyor belt which carries particulate material into the drum, depositing the material at one or a number of points onto an inner surface 22 of the wall of the drum.

Three collecting chutes 24, 26 and 28 extend from the interior of the drum. The drum is rotated in the direction of an arrow 30 and the chutes are spaced from one another in this direction of rotation. The chutes 24 and 26 are relatively low capacity chutes while the chute 28 has a higher capacity.

The chutes are oriented so that material entering the upper mouth of a chute moves under gravity action down the chute.

The apparatus 10, in this example of the invention, is intended to be used for the sorting of diamondiferous particulate material. It is known that diamonds can be excited, by means of suitable X-ray sources, to emit fluorescence. To make use of this characteristic an X-ray source or a plurality of X-ray sources 32 are placed in line, in the interior of the drum, extending across the horizontal length 46 of the drum. The arrangement is such that the whole drum surface which passes in front of the array of X-ray sources is irradiated with X-rays. One or a plurality of X-ray detectors 34 are similarly positioned across the interior of the drum, to detect X-ray emissions which may be stimulated by the X-ray sources. The

position of each X-ray detector is known with respect to the horizontal length of the drum. Each X-ray detector therefore monitors a particular track, of a predetermined width, on the inner surface 22 of the drum.

An air or water ejector 36, or a plurality of the ejectors, are positioned opposite the mouth of the chute 24.

A second array of X-ray sources 38, and a corresponding array of X-ray detectors 40, are positioned downstream of the chute 26. The X-ray sources 38 are similar to the sources 32 and the detectors 40 are similar to the detectors 34. Air or water ejectors 42, similar to the ejectors 36, are positioned opposite the mouth of the chute 26.

Additional air or water ejectors 44 are positioned opposite the mouth of the chute 28.

Reference should be made to Figure 3 which schematically illustrates the ejectors 36 and 42 extending in two arrays which are spaced from one another in the rotational direction 30 of the drum and which extend across the horizontal width 46 of the drum.

The drum 12 includes a wall which is formed with a plurality of apertures. The apertures may be provided in any suitable way and the drum wall may

for example be formed with a plurality of perforations. Alternatively, however, as is shown in the partial cross-sectional illustration of the drum in Figure 4, the drum is formed from a plurality of wedge wires 48 which extend across the drum surface to form a plurality of very fine slots 50 between adjacent wedge wires.

Material which is to be sorted is fed via the chute 20 into the interior of the drum. The drum is rotated by means of the motor 14 and, due to centrifugal force, the material is caused to adhere to the inner surface of the drum. Preferably the rotational speed is sufficiently high, or alternatively use is made of mechanical dispersion devices, to ensure that the material on the inner surface of the drum is held in a mono-layer with the particulate material separated so that individual particles are identifiable.

The rotating material is presented to the X-ray sources 32 and the diamonds in the material are stimulated to emit fluorescence. The fluorescing particles are detected by the detectors 34 and control signals are fed by the detectors to the control module 18. As the rotational speed of the drum is known and as the position of each particle, in the longitudinal sense, is known from the particular detector 34 which detects the emission of fluorescence from the particle in question, it is possible for the control module 18 to cause the corresponding ejector 36 to be actuated

as the fluorescent particle passes the mouth of the chute 24. By firing the ejector at the right time an air or water jet is directed through the appropriate portions of the corresponding slots 50 and the particle or particles adhering to the inner surface 22 are displaced from the drum and are directed into the chute 24.

In this example of the invention there are two stimulating and detection sections. Thus after the particulate material has passed the chute 24, the material is again subjected to X-ray stimulation by means of the sources 38 and fluorescing particles are detected by the detectors 40 and are then displaced by the ejectors 42 into the chute 26.

Material remaining on the inner surface 22 is displaced into the chute 28 by means of the ejectors 44. These ejectors could be replaced by means of a mechanical scraper device 52 which simply removes all material from the surface 22 and directs it into the chute 28.

The material which is fed via the chute 20 into the interior of the drum, may be fed in wet or dry form. For very fine wet material the bottom of the drum could be in a trough of water. The material is flung onto the inner surface 22 by the centrifugal force generated due to the drum rotating and most of the moisture is moved. The material remains in a stable position on the surface 22 and is transported, preferably in a mono-layer.

The control module 18 calculates whether the detected particles are of accept or reject quality. The accepted particles, which are the minority part of the feed, are removed by means of the accept ejectors 36 and 42.

The principles of the invention may be used with particulate material which ranges in size from a fine size to relatively coarse material.

It is not necessary to make use of gas or fluid ejectors. These devices could be replaced by means of suction systems which suck selected particles from the inner surface 22. In this variation of the invention the drum wall may be solid or be made from a semi-permeable material.

The invention has been described with reference to the removal of desired components from the particulate material. The invention can be used in a different sense in that contaminants can initially be removed from the particulate material and the remaining material, which is then the desired component, can be collected in the chute 28. For example if the particulate material includes a food product such as rice or beans then damaged grains or beans can be removed, or dangerous inclusions such as glass or grit can be separated from the food product. This sorting technique is based on visual differences which are detectable without prior stimulation.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Apparatus for sorting a particulate material which includes a drum which is mounted for rotation about its axis, means for feeding the particulate material into the drum which, due to centrifugal force produced by its rotation, causes the particulate material to adhere to an inner surface of the drum, means for detecting the presence of at least one predetermined characteristic in the particulate material, and means for separating particles with the predetermined characteristic from the remaining particles.

2. Apparatus according to claim 1 wherein the separating means comprises at least one suction device which is responsive to the detection means.

3. Apparatus according to claim 1 wherein the separating means comprises at least one fluid ejection device which is responsive to the detection means.

4. Apparatus according to claim 3 wherein the drum has a plurality of apertures.

5. Apparatus according to claim 1 wherein the detection means includes means for stimulating the particles so that the particles which possess the predetermined characteristic emit a signal which indicates the presence of the predetermined characteristic.

6. Apparatus according to claim 1 which includes at least one chute into which the particles with the predetermined characteristic are directed.

7. A method of sorting a particulate material which includes the steps of subjecting the particulate material to a centrifugal force thereby to form a layer of the material, detecting the presence of at least one predetermined characteristic in particles in the layer of material, and removing particles with the predetermined characteristic from the layer of material.

8. A method according to claim 7 wherein the particulate material is subjected to the centrifugal force by feeding the material into a rotating drum so that a layer of the material is dispersed on an inner surface of the drum.

9. A method according to claim 8 wherein the material is fed continuously into the drum and the material remaining in the drum, after

removal of the particles with the predetermined characteristic, is removed continuously from the drum.

10. A method according to claim 7 wherein material is removed from the drum by means of suction.

11. A method according to claim 7 wherein material is removed from the drum by means of fluid pressure.

12. A sorting system comprising means for dispersing particulate material by centrifugal force in a layer on an inner surface of a rotating drum, and means for removing from the layer, particles which possess at least one predetermined characteristic.

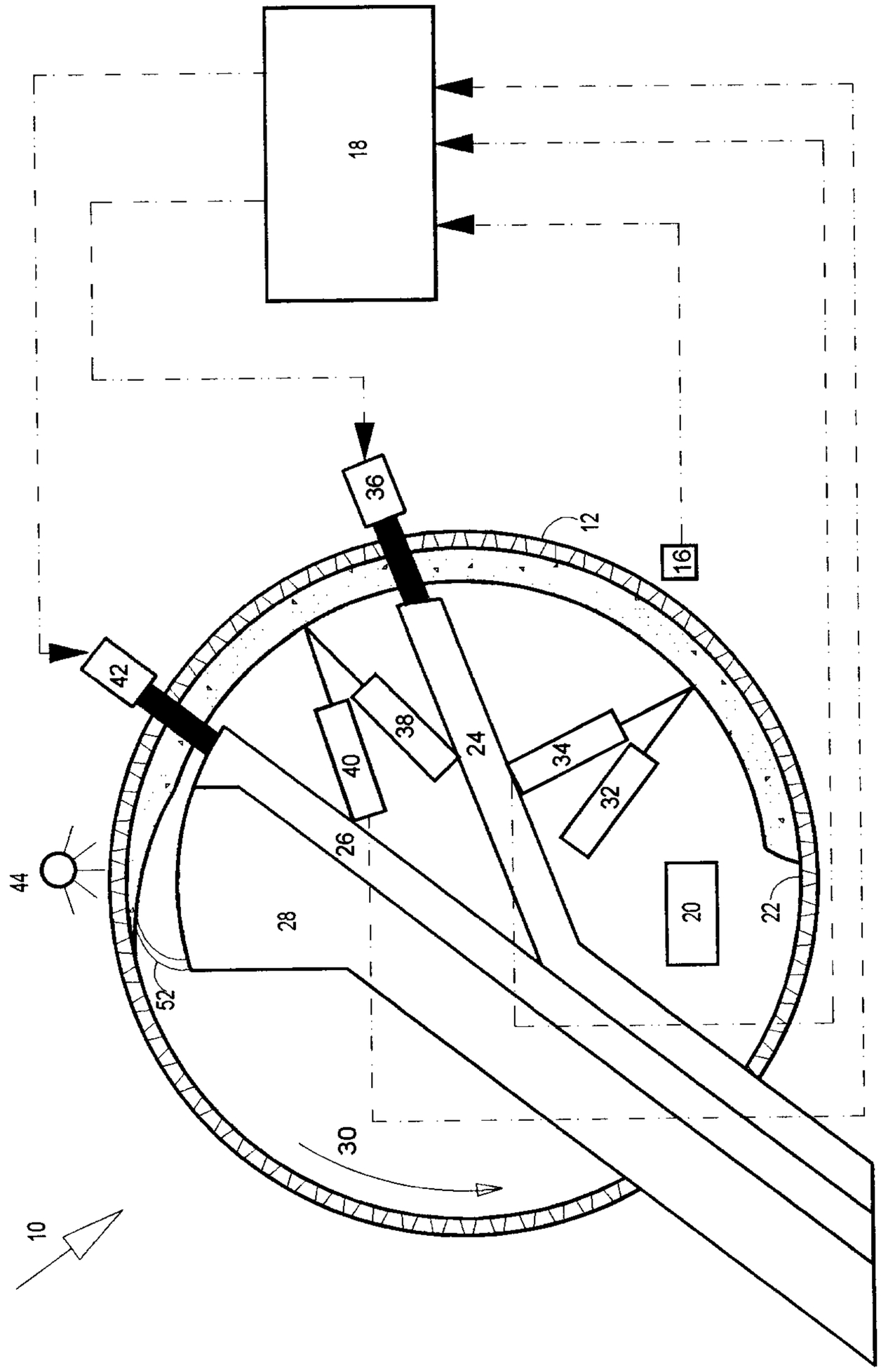


Fig. 1

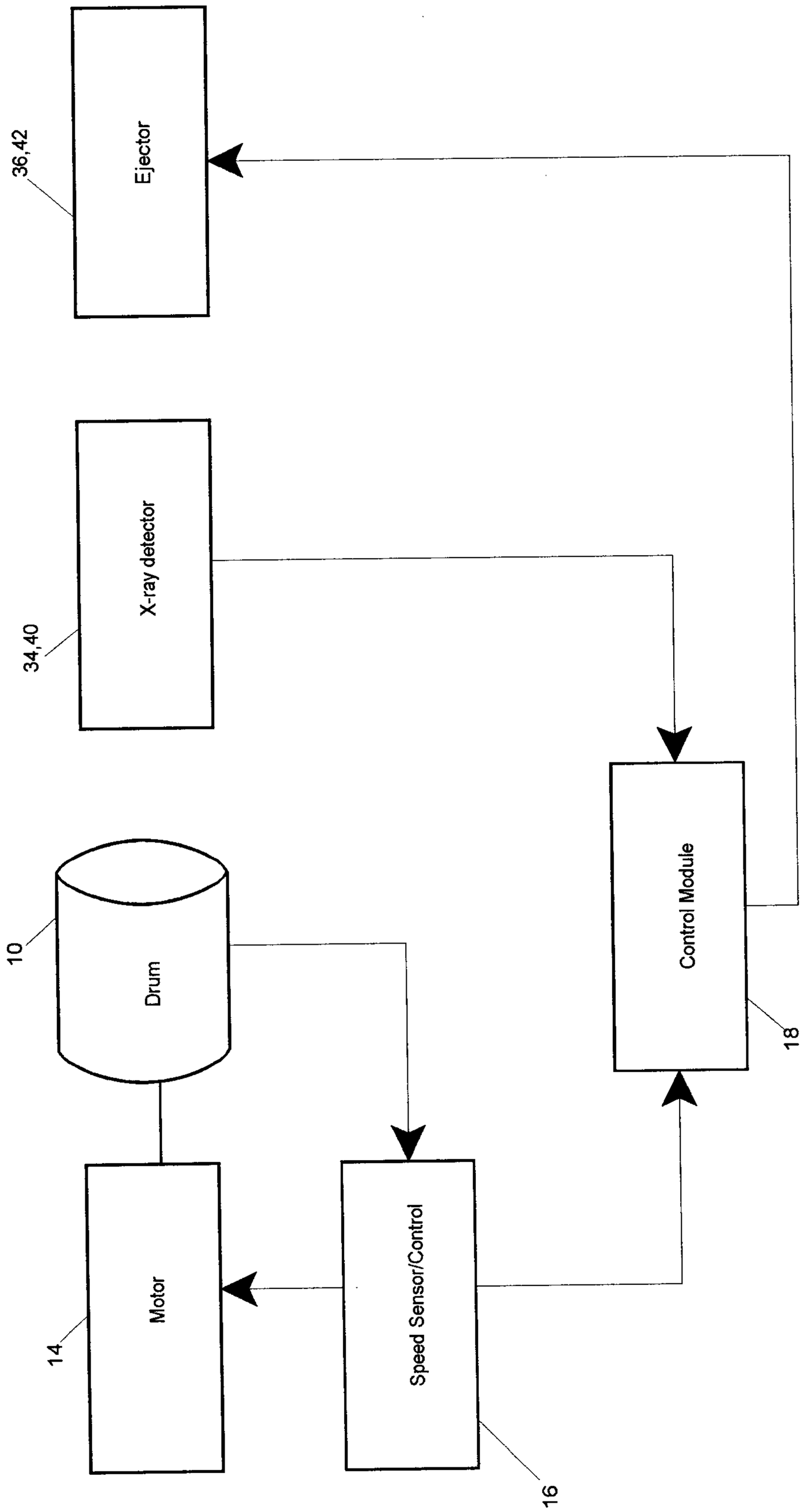

Ejector
36,42
X-ray detector
34,40
Drum
10
Motor
14
Speed Sensor/Control
16
Control Module
18

Fig 2

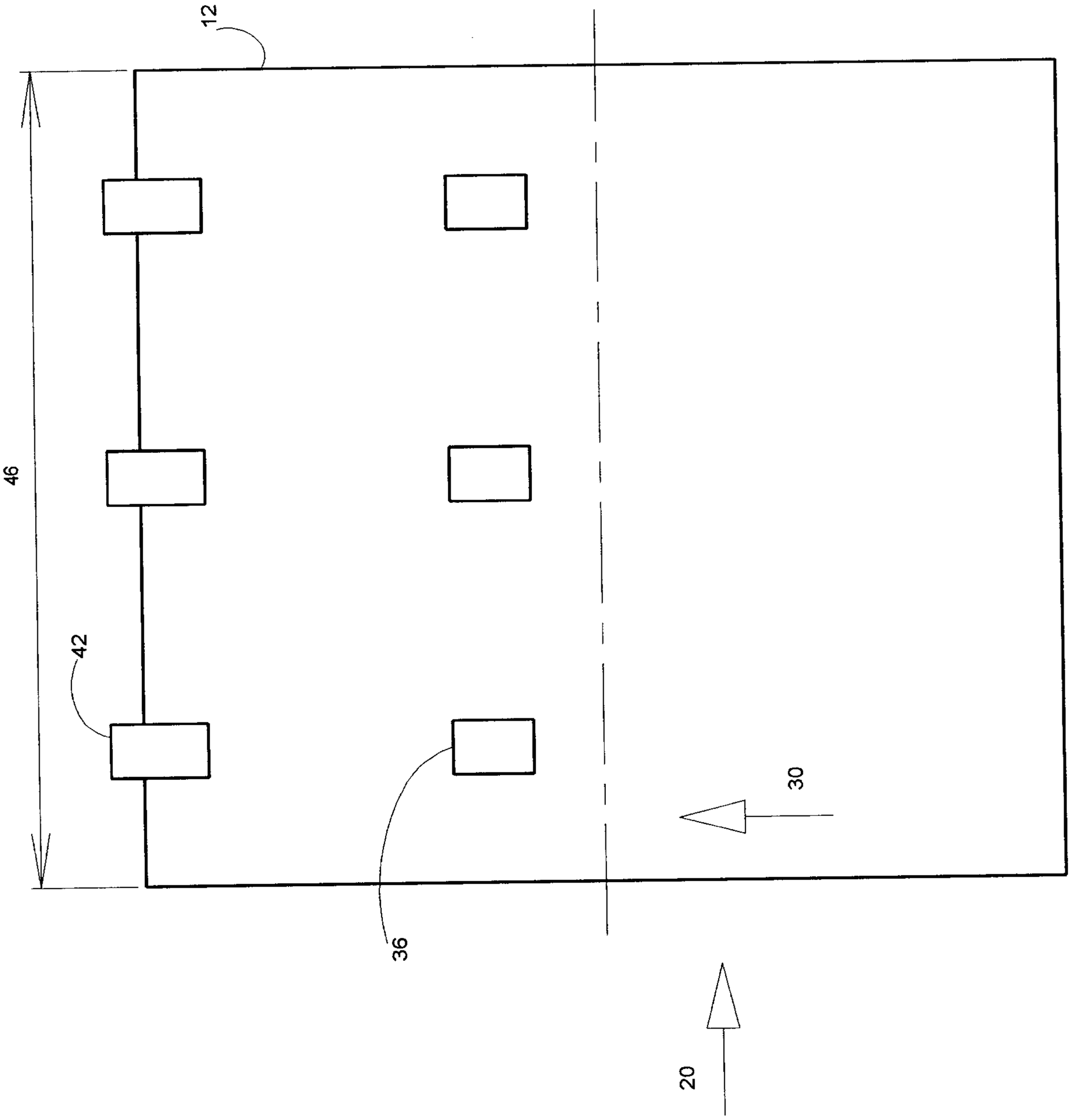


Fig 3

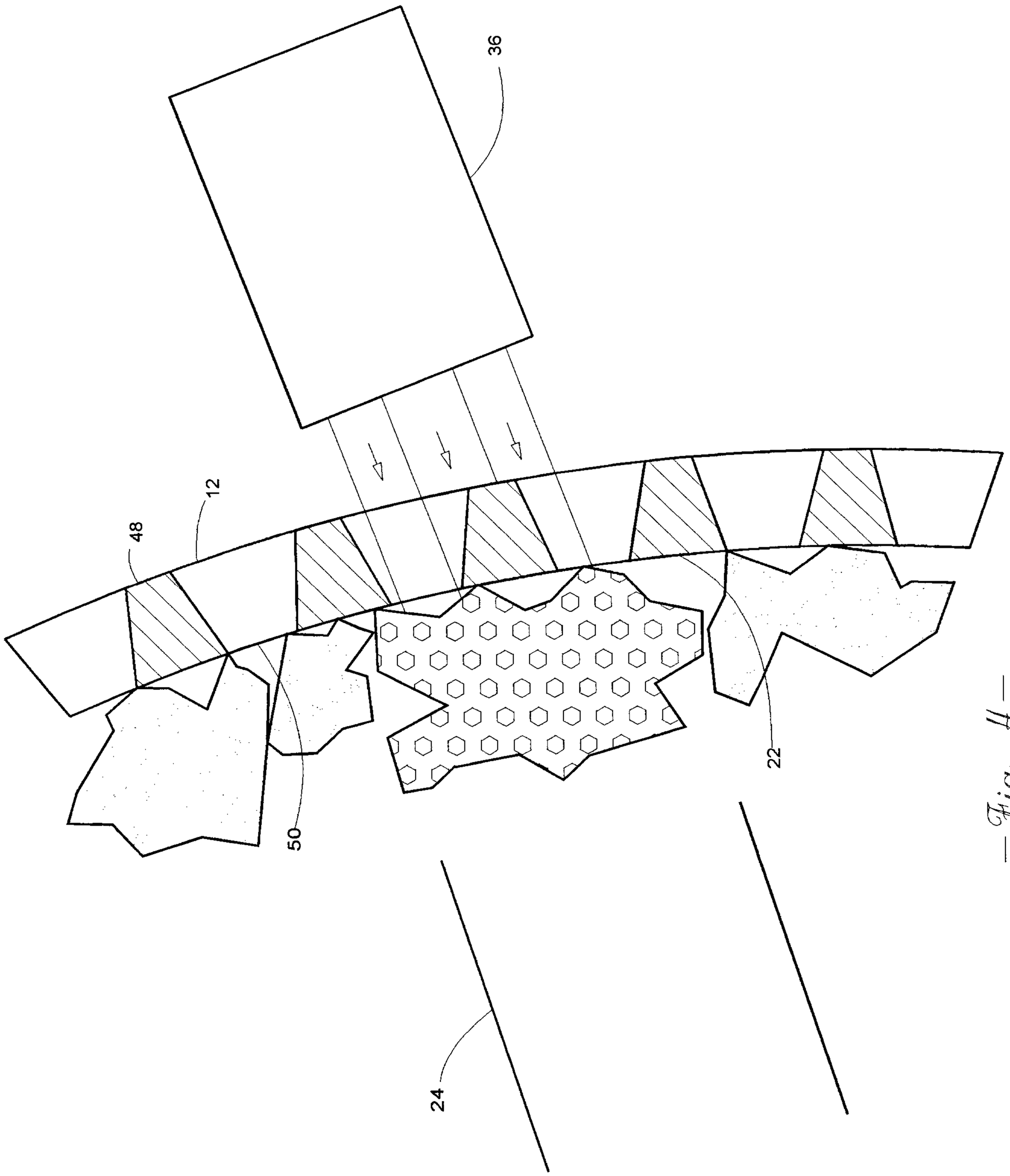
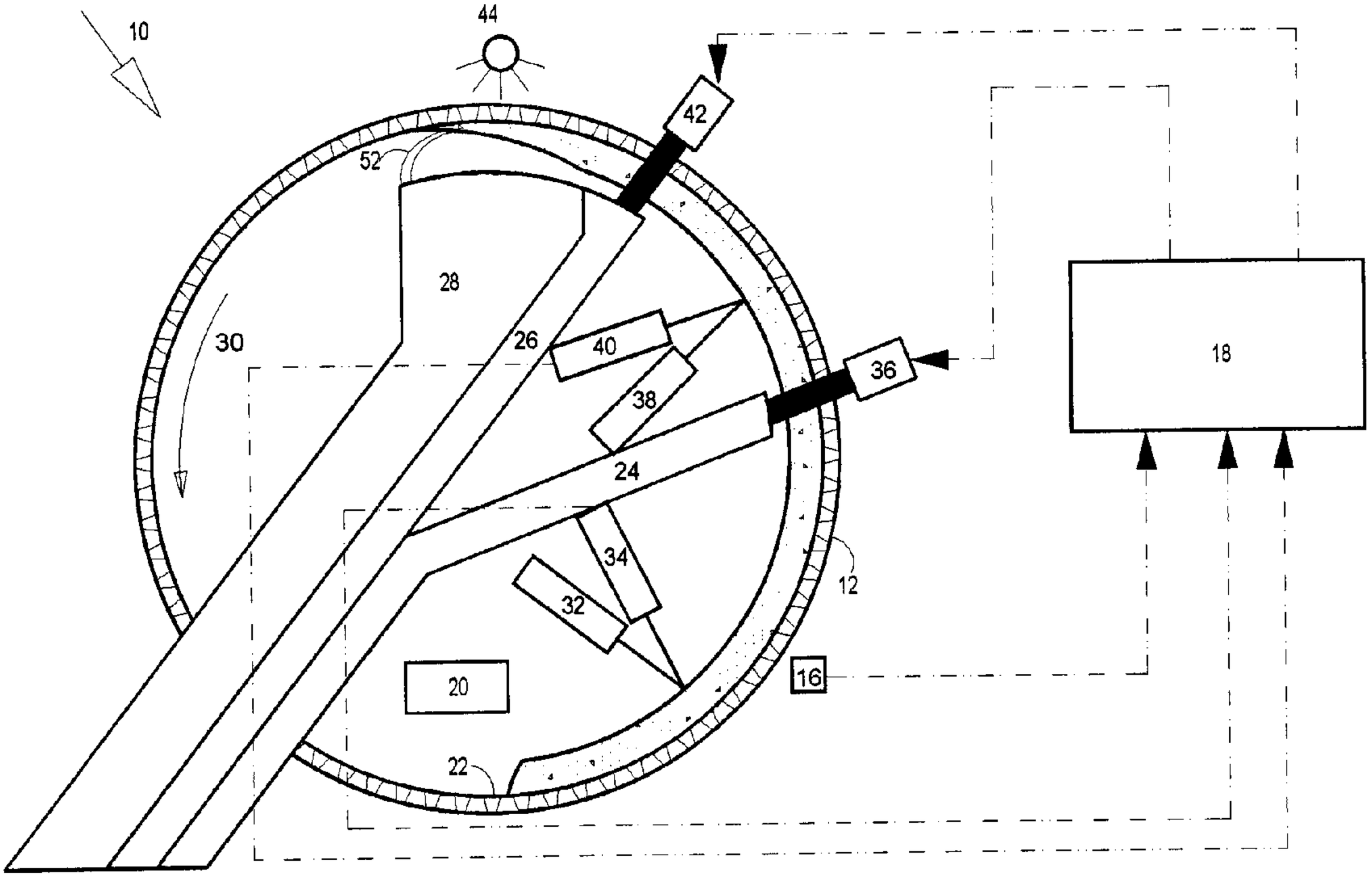


Fig 4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