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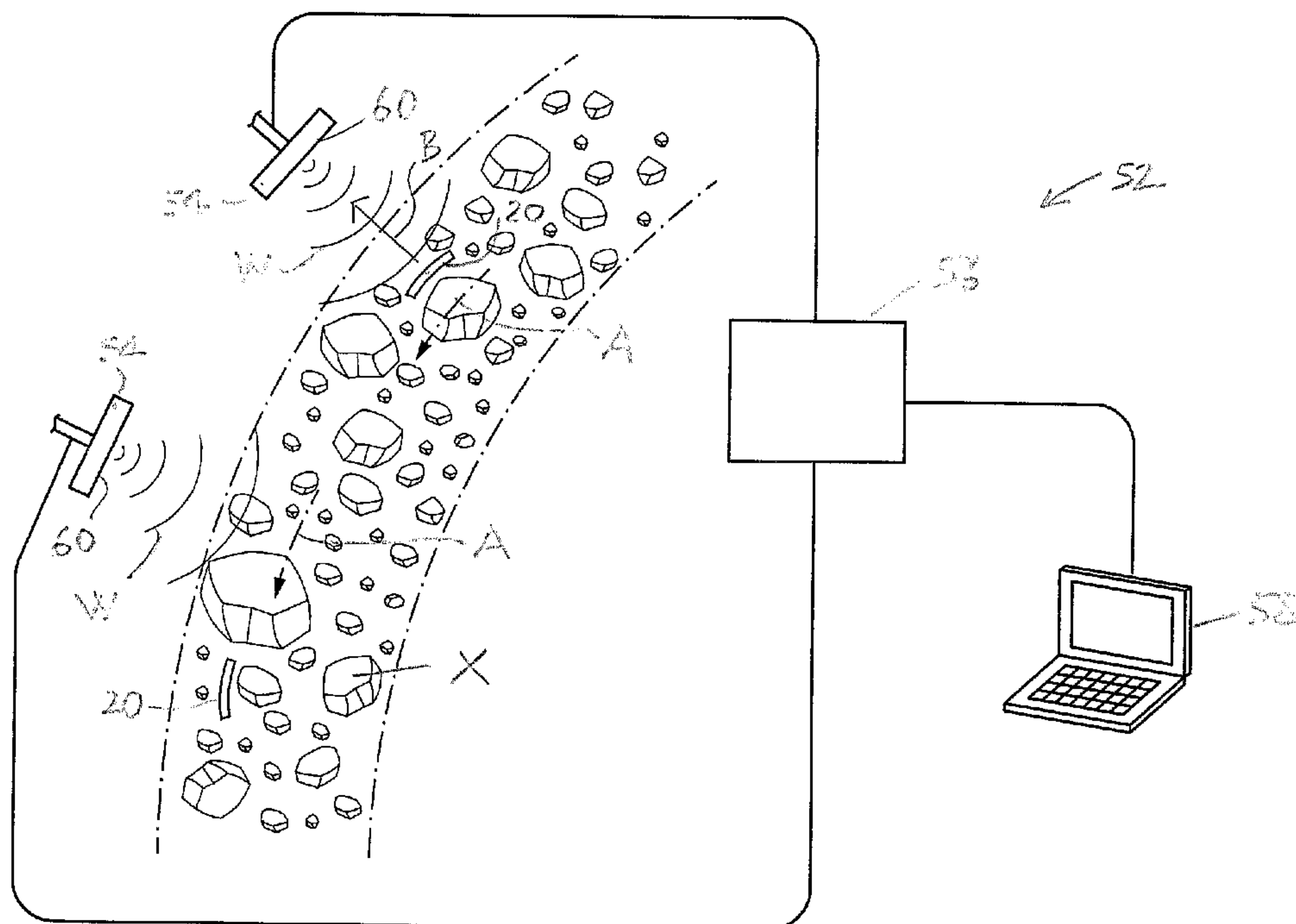
(71) Demandeur/Applicant:
K4 INTEGRATION INC., CA

(72) Inventeurs/Inventors:
ARSENAULT, GILLES, CA;
BRULE, YVAN, CA;
CLEMENT, PATRICK, CA

(74) **Agent:** GOWLING WLG (CANADA) LLP

(54) Titre : ENSEMBLE D'ETIQUETAGE DE MINERAL ET SYSTEME ET METHODE A CE PROPOS

(54) Title: ORE TAG ASSEMBLY AND SYSTEM AND METHOD RE SAME



(57) **Abrégé/Abstract:**

An ore tag assembly including one or more tubes extending between first and second ends thereof and defining a cavity between the first and second ends thereof, and a RFID device located in the cavity. The ore tag assembly includes plugs positioned in the respective first and second ends of said at least one tube, to retain the RFID device in the cavity.

ABSTRACT

An ore tag assembly including one or more tubes extending between first and second ends thereof and defining a cavity between the first and second ends thereof, and a RFID device located in the cavity. The ore tag assembly includes plugs positioned in the respective first and second ends of said at least one tube, to retain the RFID device in the cavity.

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ORE TAG ASSEMBLY AND SYSTEM AND METHOD RE SAME

FIELD OF THE INVENTION

[0001] The present invention is an ore tag assembly and a system including same, and a method of using the system.

BACKGROUND OF THE INVENTION

[0002] As is well known in the art, attempts have been made to develop "ore markers" that include devices, such as RFID tags, that can be used to identify where, in a mine, a quantity of ore came from. This information can be used in different ways. For example, reliable information regarding the sources of quantities of ore that have been mined can be used to enable the mine operator to control the ore feed to the mill to optimize processing the ore in the mill.

[0003] However, the known ore markers are generally unsatisfactory, in different ways. The RFID tag is typically located in a shell that is hard, because it is intended to withstand the significant impact pressures to which the shell is subjected as the ore is moved from a stope or other location in the mine toward the mill. In general, the known RFID marker shells have a high attrition rate, because they are frequently crushed by the ore.

[0004] Typically, antennas are positioned at conveyor belts on which the ore is moved, for example, in order to detect the ore markers before the ore reaches the mill. However, the RFID tags frequently are not successfully detected by antennas designed to detect them, because the RFID tags may be, for example, buried in the ore on a conveyor belt.

SUMMARY OF THE INVENTION

[0005] There is a need for an ore tag and a system and a method of utilizing same that overcomes or mitigates one or more of the disadvantages or defects of the prior art. Such disadvantages or defects are not necessarily included in those listed above.

[0006] In its broad aspect, the invention provides an ore tag assembly including one or more tubes extending between first and second ends thereof and defining a cavity between the first and second ends thereof, a RFID device located in the cavity, and plugs positioned in the respective first and second ends of said at least one tube, to retain the RFID device in the cavity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The invention will be better understood with reference to the attached drawings in which:

[0008] Fig. 1 is a longitudinal cross-section of an embodiment of an ore tag assembly of the invention;

[0009] Fig. 2 is an exploded view of certain elements of the ore tag assembly of Fig. 1, drawn at a smaller scale;

[0010] Fig. 3 is a cross-section of the ore tag assembly of Fig. 1;

[0011] Fig. 4 is a side view showing utilization of the ore tag assemblies in ore moving down a chute, drawn at a smaller scale;

[0012] Fig. 5 is top view of the chute of Fig. 4, and the ore and the ore tag assemblies moving down the chute; and

[0013] Fig. 6 is a schematic illustration of an embodiment of a system of the invention.

DETAILED DESCRIPTION

[0014] In the attached drawings, like reference numerals designate corresponding elements throughout. Reference is made to Fig. 1 to describe an embodiment of an ore tag assembly of the invention indicated generally by the numeral 20. Preferably, the ore tag assembly 20 includes one or more tubes 28 extending between first and second ends 30, 32 thereof and defining a cavity 34 therein extending between the first and second ends 30, 32 in which a RFID device 36 is located, as will be described. Preferably, the ore tag assembly 20 also includes plugs

42, 44 that are positioned in the respective first and second ends 30, 32 of the tube 28, to retain the RFID device 36 in the cavity.

[0015] In one embodiment, as illustrated in Fig. 1, the ore tag assembly 20 preferably includes an outer tube 22 extending between first and second ends 24, 26 thereof in which the tube 28 is received. The tube 28 is referred to hereinafter as an inner tube 28 for convenience.

[0016] As will also be described, it is also preferred that sealant 38, 40 is positioned at the respective first and second ends 30, 32 of the inner tube 28, to at least partially seal the cavity 34.

[0017] It will be understood that the outer tube 22 and the inner tube 28 may be made of any suitable material. Preferably, the outer tube 22 and the inner tube 28 are made of a material that is flexible and also generally permits electromagnetic waves at frequencies of interest to pass therethrough, i.e., with minimal interference. Those skilled in the art would be aware of suitable materials. For example, it has been found that high density polyethylene is suitable.

[0018] As can be seen in Figs. 1 and 3, the cavity 34 is partially defined by an inner surface 45 of the inner tube 28. In one embodiment, the inner surface 45 preferably is generally circular in cross-section.

[0019] Preferably, the RFID device 36 is any suitable RFID device. Those skilled in the art would be aware of suitable RFID devices. In one embodiment, it is preferred that the RFID device 36 is a passive RFID device. It is also preferred that the RFID device includes an inlay (not shown) and a body portion 46 in which the RFID inlay is located, as is known in the art. The body portion 46 may be made of any suitable material and may have any suitable configuration, however, it is preferred that the body portion 46 is flexible and elongate, and has opposed first and second surfaces 48, 50. It will be understood that the thickness of the body portion 46 is exaggerated in Figs. 1-3, for clarity of illustration.

[0020] Alternatively, the RFID device 36 may be an active RFID device. Those skilled in the art would appreciate that any suitable alternative form of electronic device may be substituted for the RFID device 36.

[0021] The ore tag assembly 20 may have any suitable dimensions. As an example, the outer tube 22 may be approximately 6.5 inches long, and have an inner diameter of approximately 0.75 inch. The outer diameter may be approximately 7/8 inch. The inner tube 28 may be

approximately 4.25 inches long, and have an outer diameter of approximately 5/8 inch and an inner diameter of approximately 0.5 inch. The body portion 46 may be approximately 4 inches long and about 0.5 inch wide. The body portion 46 may also be about 0.020 inch thick.

[0022] Preferably, the ore tag assembly 20 has a relatively small size. It will be understood that, preferably, the ore tag assemblies 20 are not removed from the ore before the ore is processed in the mill. Accordingly, the ore tag assemblies 20 are, in the mill, considered to be additional waste material, which ultimately is to be separated from the mineral or minerals of interest in the ore, as the ore is processed.

[0023] As can be seen in Figs. 1 and 2, it is preferred that the cavity 34 is generally not filled by the RFID device 36. As will be described, it is preferred that the RFID device 36 is not secured to the inner wall 45, nor is the RFID device 36 secured to the sealant 38, 40. It is believed that the position of the RFID device 36, sealed inside the cavity 34 but not securely attached to the inner wall 45 or the sealant 38, 40, is one important reason why the ore tag assembly 20 appears to be able to survive moving from a point of origin in the mine to the mill without serious damage to the RFID device 36. Also, because of the size and elongate shape of the cavity 34 and the size and corresponding elongate shape of the RFID device 36, the RFID device 36 is likely to remain positioned in the cavity generally aligned with an longitudinal axis "Y" (Fig. 1) of the ore tag assembly 20.

[0024] The cavity 34 is sufficiently large that the inner and outer tubes 28, 22 could be subjected to significant bending before the inner surface 45 of the inner tube 28 would push against the RFID device 36. Accordingly, the relatively large internal cavity 34 is also believed to be important to the ability of the ore tag assembly 20 to survive significant impact loading by the ore without impairing the functioning of the RFID device 36. In addition, even if the inner and outer tubes 28, 22 are bent so that the inner surface 45 pushes against the RFID device 36, because the RFID device 36 is positioned loosely in the cavity 34, the RFID device 36 would move with the inner surface 45 in response to such engagement.

[0025] In one embodiment, the ore tag assembly 20 is assembled, first, by inserting the inner tube 28 into the outer tube 22. Preferably, the inner tube 28 fits into the outer tube 22 in a friction fit, so that the inner tube 28 is initially held in place in the outer tube 22 by friction. The sealant 38 is then positioned on the inner tube 28 at its first end 30. The sealant may be any suitable sealant. Preferably, the sealant 38, 40 is a silicone sealant, which solidifies relatively

quickly. Next, the inner tube 28 and the outer tube 22, while held together by friction, are positioned at an acute angle to the horizontal, with the first end 30 downward, and the RFID device 36 is located in the cavity 34. As noted above, the RFID device 36 preferably has an elongate body portion 46, and it is preferred that the RFID device 36 is positioned in the cavity 34 so that it is lying generally flat on, or partly engaged with, the inner surface 45 of the inner tube 28, with the body portion 46 extending the entire length thereof, substantially aligned with the longitudinal axis "Y". As is also noted above, the RFID device 36 preferably is not secured to the inner surface 45, but instead is loosely positioned in the cavity 34, and this is believed to be important in the survival of the RFID device 36 as the ore tag assembly 20 is moved, along with the moving ore, toward the mill.

[0026] Next, the sealant 40 is positioned on the inner tube 28 at its second end 32. Once the sealant 40 has solidified, the plugs 42, 44 are inserted into the first and second ends 24, 26 of the outer tube 22. Those skilled in the art would appreciate that the plugs 42, 44 may press inwardly upon the sealant 38, 40 after the plugs 42, 44 have been inserted.

[0027] The assembly of the ore tag assembly 20 is schematically illustrated in Fig. 2. It will be understood that the sealant 38, 40 is omitted from Fig. 2 for clarity of illustration.

[0028] It will also be understood that the ore tag assembly 20 may be assembled in other ways. For instance, the ore tag assembly 20 may include only one tube 28, or it may include more than the two tubes 22, 28 that are illustrated in Figs. 1-3. As an example, the process may commence with positioning the RFID device 36 inside the cavity 34 therein. The plugs 42, 44 may then be inserted into the ends 30, 32 respectively.

[0029] It will be understood that the ore tag assemblies 20, once assembled, may be distributed in any manner that is appropriate in the circumstances. In general, the ore tag assemblies 20 are respectively individually identified by radio frequency identity, and then distributed at convenient locations (for example, transfer points, and/or storage locations) that will enable the originating location of the ore to be associated with a number of specific ore tag assemblies 20. In this way, when the ore tag assemblies 20 are subsequently read, the respective originating locations of the ore in which the ore tag assemblies 20 are positioned can be known, and the user can make appropriate adjustments in the feed to the mill, or to the processes in the mill. Those skilled in the art would be aware of suitable adjustments, the details of which would vary from one mine and mill to another. For example, if the ore about to enter the mill is from a

location in the mine that is known to have an unusually high percentage of a valuable mineral, then the processes in the mill may be adjusted slightly, to optimize the processing of such ore.

[0030] Those skilled in the art would appreciate that the ore tag assemblies 20 may also be used in industries other than mining, to enable the user (not shown) to optimize processes based on the originating locations of different materials that are fed to a processing facility, or to adjust the feed to the processing facility. Alternatively, the ore tag assemblies 20 may be used simply to track the progress of material through a facility, for example, to identify any unusual delays in the movement of the material through the facility.

[0031] The invention preferably also includes a system 52 (Fig. 6) in which the ore assembly 20 provides the data that may be utilized as described above. In one embodiment, the system 52 preferably includes one or more antennas 54 operatively connected with one or more RFID readers 56. As schematically illustrated in Fig. 6, the RFID reader 56 preferably is operatively connected with one or more computers 58, to enable users (not shown) to analyze and use the data provided by the RFID devices 36 to take appropriate action.

[0032] Those skilled in the art would appreciate that the data may be stored and processed in any suitable manner. For instance, in one embodiment, the data may be stored locally on the reader 56. The data may be transferred to the computer via a network connection (Fig. 6), or the data transfer may be effected by downloading the data to a portable storage device (e.g., a USB stick), and then transferring the data to the computer.

[0033] As is known, the passive RFID devices 36 respond to a signal from the reader 56, in the form of a radio wave directed from the antenna 54. The reader 56 sends electrical energy to the antenna 54, at which the energy is converted to an electromagnetic wave that is directed into the zone through which the RFID devices 36 (i.e., included in the respective ore tag assemblies 20) are intended to move. The RFID devices 36 respond to the initial radio frequency wave from the antenna with a responding signal back (i.e., backscatter) to the antenna 54. Preferably, the antenna 54 includes a surface 60 that is in the form of a substantially flat element, and as illustrated, the surface 60 is generally square.

[0034] Those skilled in the art would appreciate that any suitable form of antenna may be used. It will be understood that the antennas illustrated include substantially flat surfaces 60 for exemplary purposes only.

[0035] As is known, the radio wave directed from the antenna 54 is initially generally directed orthogonally to the surface 60. Similarly, the responding signal directed back from the RFID device 36 tends to be directed generally orthogonally to the first surface 48 of the body portion 46 of the RFID device 36, or the second surface 50, as the case may be. It will be understood that, in order for the strongest signal to be received by the antenna 54 from the RFID device 36, the first surface 48 or the second surface 50 of the body portion 46 is substantially parallel to the surface of the antenna 54.

[0036] Accordingly, it is preferred that the antennas 54 are positioned for optimal signal transmission and reception. Those skilled in the art would appreciate that the positioning of the antennas 54 relative to the moving stream of the ore "X" in which the ore tag assemblies 20 are located is generally approximate, and based on estimated positions of the ore tag assemblies 20 in the ore "X" as they move past the antennas 54. Also, the configurations of the antennas would need to be considered in determining their respective positioning.

[0037] The antennas 54 may be positioned at any suitable locations. Those skilled in the art would appreciate that the system 52 may be configured to include any suitable number of antennas. For example, the antennas 54 may be located at a conveyor, positioned so that the radio waves emitted thereby are receivable by the RFID devices 36 in the ore tag assemblies 20 that are buried in the ore on the conveyor (Fig. 6). As illustrated in Fig. 6, the ore "X" may be moved by a conveyor (not shown), and two antennas 54 are positioned to direct electromagnetic waves "W" to the ore tag assemblies 20 that are buried in the ore "X", or positioned on the ore "X". The direction of the movement of the ore "X" is indicated by arrows "A". The two ore tag assemblies illustrated in Fig. 6 as being located in or on the moving ore "X" are identified by the reference numeral 20.

[0038] In use, it has been found that the ore tag assembly 20 generally tends to survive the impact loading and other loading on it during movement of the ore, and accordingly the data obtained in the system 52 using the ore tag assembly 20 can be very useful. It is believed that the high survival rate of the ore tag assembly 20 is due to, among other things, the flexibility of the inner tube 28 and the outer tube 22. It is also believed that the ability of the outer tube 22 and the inner tube 28 to move and bend independently of each other along most of their lengths also helps the ore tag assembly 20 survive its movement while embedded in the ore "X".

[0039] As noted above, it is also believed that the manner in which the RFID device 36 is loosely held inside the cavity 34 is another reason why the ore tag assemblies 20 appear to successfully survive the journey from a location in the mine to the mill, mixed in with the moving ore "X". Because the RFID device 36 is loosely held in the cavity 34, the bending, squeezing, and twisting to which the outer and inner tubes 22, 28 are subjected as the ore is transported generally does not result in corresponding bending or twisting of the RFID device 36, at least not to the same extent.

[0040] It will be understood that Fig. 6 may alternatively be seen as schematically illustrating a substantially vertical movement of the ore "X", i.e., a free fall movement, propelled by gravity, at a transfer point.

[0041] In Fig. 6, one of the ore tag assemblies 20 is illustrated as directing backscatter therefrom (schematically represented by arrow "B") toward the antenna 54 closest to it.

[0042] Those skilled in the art would appreciate that, depending on the extent to which the ore tag assemblies 20 are buried in the ore "X", the ore may interfere with communications between the antenna 54 and the ore tag assemblies 20. This may happen, for example, when the antennas 54 are positioned to identify the ore tag assemblies 20 located in the ore located on a conveyor belt. Accordingly, in one embodiment, the antennas 54 preferably are positioned to read the ore tag assemblies 20 when the ore (and the ore tag assemblies with the ore) are in free fall, due to gravity. Those skilled in the art would also appreciate that such movement of the ore may occur at one or more transfer points as the ore is moved from its source location (e.g., a stope) in the mine to the mill.

[0043] Examples of how the antennas 54 may be positioned to read the ore tag assemblies 20 when the ore in which the ore tag assemblies 20 are located is vertically moved by gravity are illustrated in Figs. 4 and 5. In Figs. 4 and 5, the antennas are identified by reference characters 54A-54D for convenience. They are positioned above a chute 62 down which the ore "X" moves, with the ore tag assemblies 20 being located in the ore. The direction of movement of the ore is indicated by arrow "A". At a lip 64 of the chute 62, the ore is not supported by the chute 62, and the ore "X" moves generally vertically downward under the influence of gravity.

[0044] Each of the antennas 54A-54D is energized to direct electromagnetic waves "W" therefrom. It is believed that, when the antennas 54 are positioned to locate the ore tag

assemblies 20 that are in the ore "X" that is falling, data is obtainable from all, or substantially all, of the ore tag assemblies 20 in the falling ore "X".

[0045] It will be appreciated by those skilled in the art that the invention can take many forms, and that such forms are within the scope of the invention as claimed. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

We claim:

1. An ore tag assembly comprising:

at least one tube extending between first and second ends thereof and defining a cavity between the first and second ends thereof;

a RFID device located in the cavity; and

plugs positioned in the respective first and second ends of said at least one tube, to retain the RFID device in the cavity.

2. The ore tag assembly according to claim 1 in which:

said at least one tube comprises an outer tube extending between first and second ends thereof, and an inner tube received in the outer tube, the inner tube extending between first and second ends thereof.

3. The ore tag assembly according to claim 2 additionally comprising sealant positioned at the respective first and second ends of the inner tube, to at least partially seal the cavity.

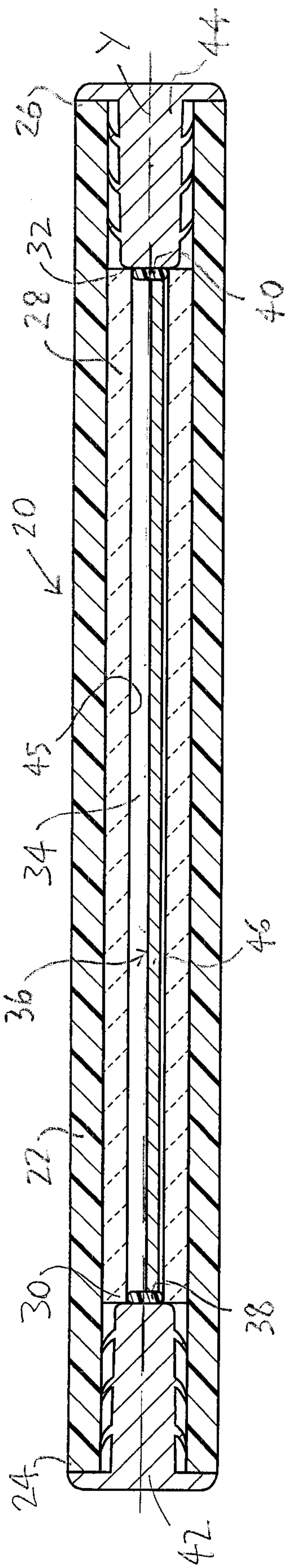


FIG. 1

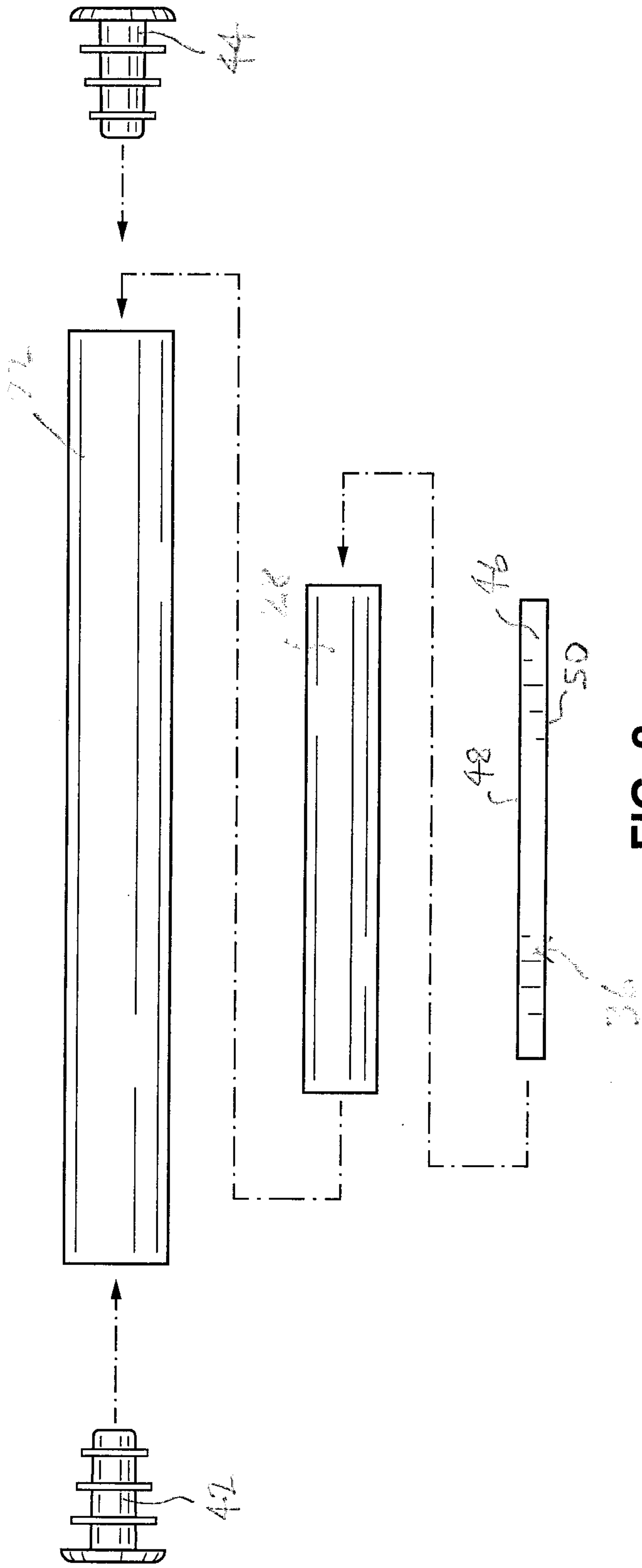


FIG. 2

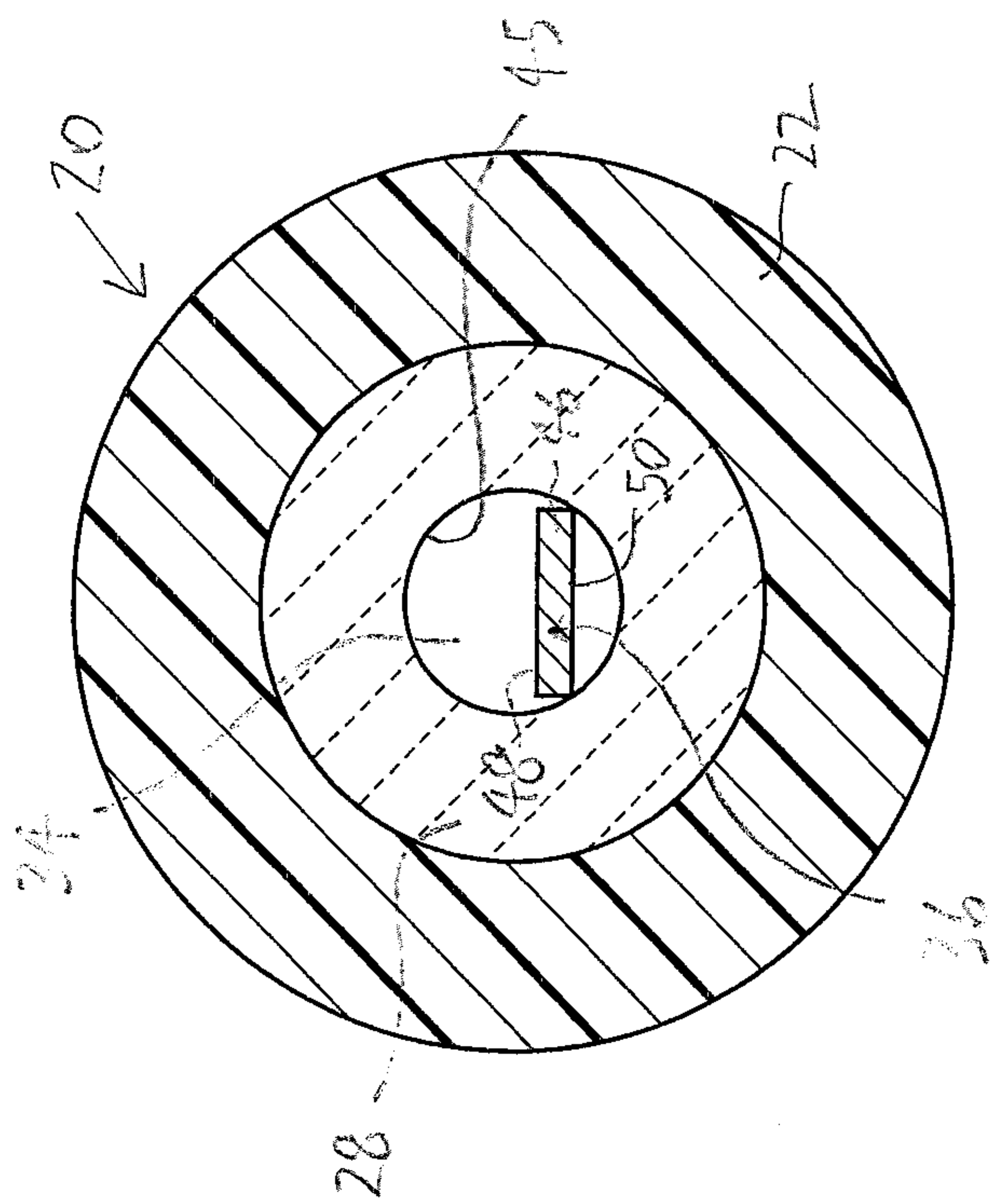


FIG. 3

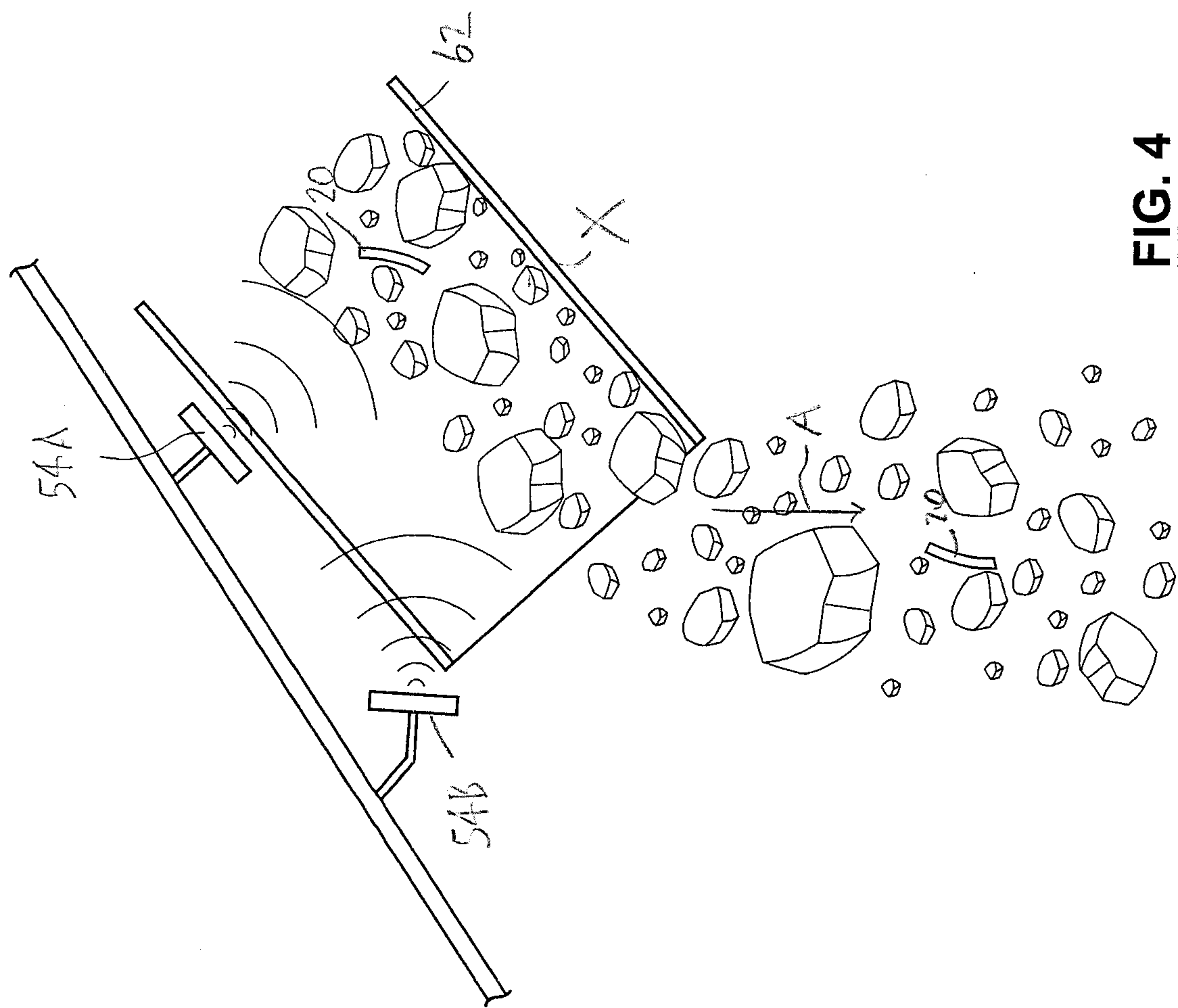


FIG. 4

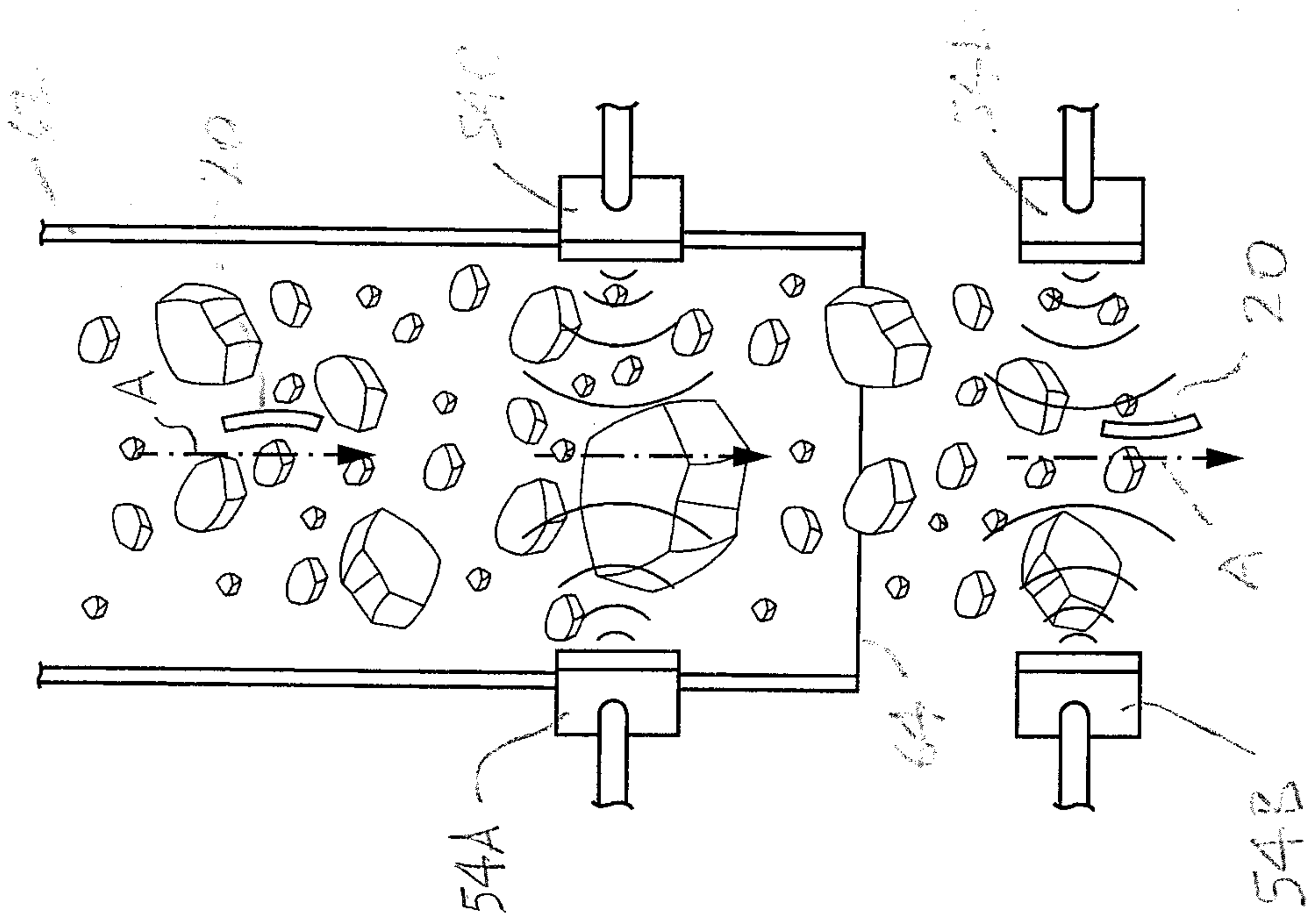


FIG. 5

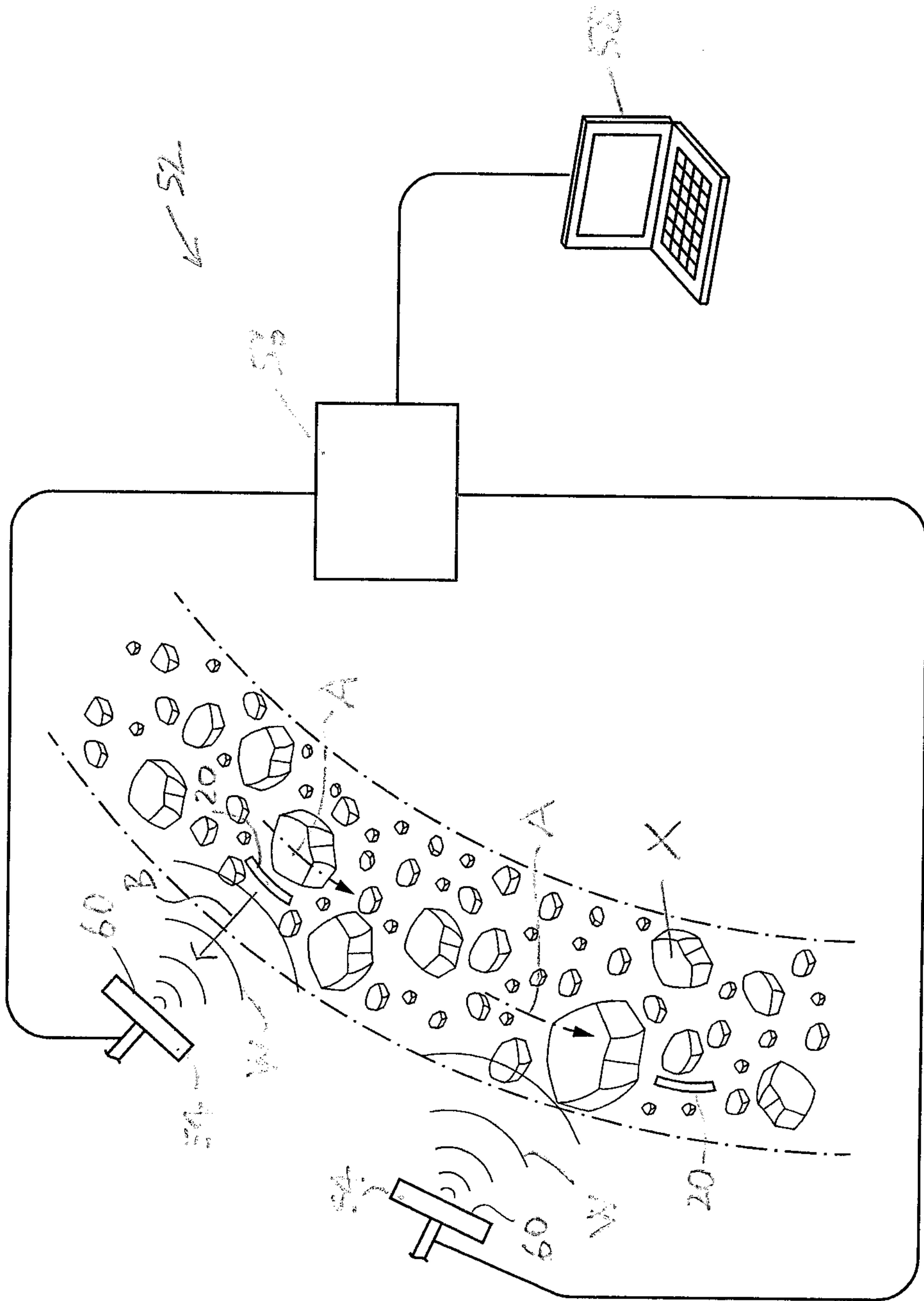


FIG. 6

