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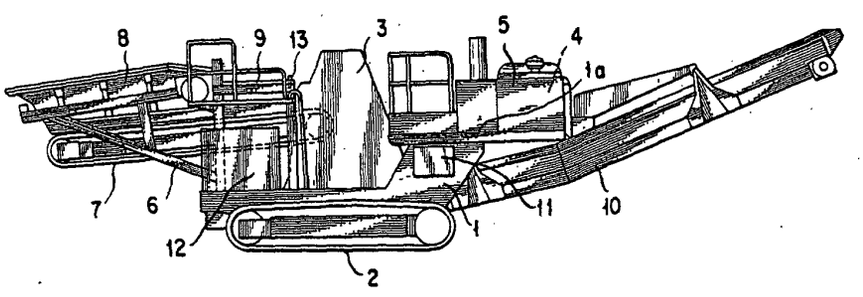
(54) MOBILE SOIL IMPROVING MACHINE

(57) A machine body (1) having a traveling equipment (2) is provided with a mixer (3), a soil hopper (8), a raw soil conveying device (7) and a modified soil conveying device (10). Further, a soil conditioner supply device comprising a liquid supplying means (11), a liquid tank (12) and a liquid ejecting means (13) is provided for the machine body (1), and the liquid ejecting means (13) is attached to a portion close to an input port of the mixer (3), so that the liquid soil conditioner is ejected and supplied on the raw soil on the way of being conveyed by the raw soil conveying device (7). Since the soil conditioner is liquid, the liquid tank (12) and the liquid supplying means (11) can be formed to provide an arbitrary shape and can be mounted to an arbitrary portion with respect to the liquid ejecting means or an arbitrary portion apart from the liquid ejecting means. Accordingly, the liquid tank (12) can be mounted to a lower portion and can be formed to take an arbitrary shape suitable to a space for the tank by utilizing a flowability of the liquid, so that a capacity of the liquid tank can be increased. Therefore, at a time of supplying the liquid soil conditioner into the liquid tank (12), there is no need to use a crane required for supplying a powdery soil conditioner, so that the supplying work can be performed easily and a time interval of supplying the soil conditioner is made long and a frequency of supplying the soil conditioner can be reduced.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a self-propelled soil modifying machine for modifying a soil quality by mixing a raw soil such as an excavated soil, a polluted soil or the like with a soil conditioner or a conditioning agent.

BACKGROUND ART

[0002] Japanese Patent Laid-open Publication No. HEI 9-195265 proposes a self-propelled soil modifying machine.

[0003] This self-propelled soil modifying machine generally comprises a machine body having a traveling equipment, a raw soil hopper into which a soil to be modified i.e., a raw soil, is thrown, a belt conveyer for conveying the raw soil stocked in the raw soil hopper, a soil conditioner supply device for supplying a soil conditioner to the raw soil on the way of being conveyed by the soil conveyer, a mixer for mixing the raw soil with the soil conditioner so as to modify a quality of the raw soil and a modified soil conveyer for conveying the modified soil to discharge it out of the machine body.

[0004] The soil conditioner supply device of the self-propelled soil modifying machine mentioned above comprises a soil conditioner hopper into which the soil conditioner is thrown, a shooter mounted to a discharge port of the hopper, and a rotor having a plurality of feeder plates for feeding the soil conditioner stocked in the hopper to the discharge port, the rotor being provided to a bottom portion in the hopper. When the powdery soil conditioner is thrown into the hopper and the rotor is driven to be rotated, the soil conditioner is supplied through the shooter and dropped down on the raw soil conveyer.

[0005] Further, the soil conditioner supply device is attached to a portion between the raw soil hopper and the mixer, and the device takes a high location position above the raw soil conveyer.

Therefore, because of such high location position, a height of the soil conditioner hopper from a ground becomes very high.

[0006] Due to the above arrangement, in a case where the soil conditioner is thrown into the soil conditioner hopper, it is required to pack the powdery soil conditioner into a bag and then the bag is required to be lifted up to a position higher than that of the hopper by means of a crane. Therefore, the lift-up working for the bag becomes very complicated and troublesome, hence requiring a lot of time.

[0007] In addition, since a mounting position of the soil conditioner hopper is limited, if a capacity of the hopper be increased, it is required to make the machine body large.

Accordingly, the size of the self-propelled soil modifying machine will be made disadvantageously large, and accordingly, there is a limit to increase the capacity of the hopper. Therefore, in a case where the soil modifying operation is continuously performed, the soil conditioner stocked in the soil conditioner hopper will be consumed in a short time, so that the soil conditioner is required to be frequently supplied to the soil conditioner hopper to thereby refill the hopper.

[0008] Based on these disadvantages, the refilling work of the soil conditioner is very troublesome and takes a lot of time.

[0009] Further, although a supplying amount of the soil conditioner is controlled by a rotation speed of the rotor mentioned above, since the soil conditioner is powdery, there may cause a case where the soil conditioner is not accurately supplied at an amount corresponding to the rotation speed of the rotor. Thus, it is difficult to accurately supply the soil conditioner at a predetermined amount.

[0010] Furthermore, in a case where a plurality of soil conditioners having properties different from each other are supplied, a plurality of soil conditioner supply devices are required to be provided to the machine body. Therefore, a space for locating or installing the devices becomes large, and, hence, the size of the self-propelled soil modifying machine is made disadvantageously large.

[0011] In addition, there may cause a case where the solidly aggregated powdery soil conditioner clogs the hopper and the rotor of the soil conditioner supply device, and the soil conditioner cannot hence be supplied.

[0012] Furthermore, there may cause a case where the powdery soil conditioner leaks out through a gap formed between constructional machine members and is floatingly scattered in ambient atmosphere to thereby deteriorate an environmental condition.

DISCLOSURE OF THE INVENTION

[0013] An object of the present invention is to provide a self-propelled soil modifying machine capable of solving the aforementioned problems encountered in the prior arts.

[0014] In order to achieve this and other objects, according to a first aspect of the present invention, there is provided a self-propelled soil modifying machine comprising:

a machine body having a traveling equipment;
a raw soil hopper mounted to the machine body, into which a raw soil to be modified is thrown;
a raw soil conveying device mounted to the machine body for conveying the raw soil thrown in the raw soil hopper;
a mixer mounted to the machine body for mixing the raw soil conveyed by the raw soil conveying device;
a power source mounted to the machine body for supplying a power to the traveling equipment, the

raw soil conveying device and the mixer; and
a soil conditioner supply device for ejecting a liquid soil conditioner from a liquid ejecting means to which the liquid soil conditioner stocked in a liquid tank is supplied by a liquid supply means,

wherein the liquid ejecting means is attached to at least one portion in a passage ranging from the raw soil hopper to a discharge portion of the mixer.

[0015] According to the first aspect of the present invention, the soil modifying machine comprises the soil conditioner supply device in which a liquid soil conditioner stocked in a liquid tank is supplied by a liquid supply means, and the liquid soil conditioner is ejected from a liquid ejecting means. Since the soil conditioner is in a liquid state, the liquid tank and the liquid supply means can be formed to provide an arbitrary shape and can be attached to an arbitrary portion in relation to the liquid ejecting means or a portion apart from the liquid ejecting means.

[0016] Therefore, the liquid tank can be mounted to a lower portion, and since the tank can be formed to provide an arbitrary shape by utilizing a flowability (fluidity) of the liquid so as to be adaptable to a space in which the tank is mounted, the liquid tank can be formed to secure a large capacity. In a case where the liquid soil conditioner is supplied into the liquid tank, there is no need to use a crane or the like for supplying the powdery soil conditioner, so that the work for supplying the conditioner can be easily performed and a time interval of the supplying work becomes long to thereby reduce a frequency of the supplying work.

[0017] In cooperation with these advantages, the work of supplying the liquid soil conditioner can be easily performed in a short time, so that the efficiency of the supplying work can be improved.

[0018] Further, since the amount of the liquid soil conditioner to be supplied by the liquid supplying device per unit time is accurately controlled by the rotation speed or a delivery (discharge) amount of the pump, the liquid soil conditioner can be accurately supplied at a predetermined amount, so that a quality of the modified soil becomes constantly stable. Further, an amount of the soil conditioner to be wastefully used is decreased, so that a production cost can be also reduced.

[0019] Furthermore, the liquid tank can be mounted to an arbitrary portion in an arbitrary shape, so that a space for the liquid tank is efficiently available and a plurality of liquid tanks can be easily equipped. In this case, a plural kinds of soil conditioners can be supplied, so that the liquid soil conditioners suitable for the raw soil can be supplied individually or in a combined state, and the modifying effect is further improved. In addition, the self-propelled soil modifying machine can be formed in a compact scale, providing a small size.

[0020] In addition, since the soil conditioner is used as liquid, there is no fear that the liquid is solidified and clogs like the powdery soil conditioner and no fear that the liquid leaks out and is floated and scattered in an ambient atmosphere. Furthermore, the liquid soil conditioner has a good infiltrating property (permeability) to the raw soil, so that a mixing property can be also enhanced.

[0021] In the first aspect of the present invention, it is preferable that the liquid ejecting means is attached to at least one portion selected from a portion in the raw soil hopper, a portion above the raw soil conveying device close to an input port of the mixer, a portion in the mixer, and a discharge port of the mixer.

[0022] According to the above structure, the liquid soil conditioner can be supplied to at least one soil selected from the raw soil stocked in the raw soil hopper, a raw soil to be conveyed, the soil in the mixer and the soil discharged from the mixer.

[0023] For example, when the liquid soil conditioner is supplied to the raw soil stocked in the raw soil hopper, the liquid soil conditioner is also infiltrated into the soil on the way of being conveyed, and hence, a degree of the infiltration is enhanced to thereby improve a mixing performance of the soil conditioner at the mixer.

[0024] When the liquid soil conditioner is supplied to the raw soil to be conveyed at a portion of the raw soil conveying device close to an input port of the mixer, a portion of the machine to which a suitable measure should be taken to prevent a leakage of the liquid soil conditioner can be reduced. In addition, the liquid soil conditioner quickly infiltrates into the raw soil with their good infiltrating property, so that the conditioner can be sufficiently mixed by the mixer.

[0025] Furthermore, the amount of the liquid soil conditioner to be supplied in accordance with an amount of the raw soil to be conveyed can be accurately controlled through a control of pumping operation, so that the mixing ratio of the conditioner to the raw soil is always made suitable, and the control thereof is made simplified.

[0026] When the liquid soil conditioner is supplied inside the mixer, the interior of the mixer takes an atmosphere of the liquid soil conditioner, the raw soil and the conditioner can be sufficiently mixed, and there is less fear of the liquid soil conditioner leaking outside.

[0027] In the first aspect of the present invention mentioned above, it is preferable that the liquid ejecting means is attached respectively to a passage ranging from the raw soil hopper to the interior of the mixer and the discharge portion of the mixer.

[0028] According to the structure described above, the mixer mixes the raw soil with the liquid soil conditioner ejected from one liquid ejecting means to thereby primarily modify the soil, and then, the liquid soil conditioner is ejected from the other liquid ejecting means to the primarily modified soil discharged from the mixer, so that a reaction for modifying a quality of the raw soil can be promoted. In particular, when a soil polluted with hexavalent chromium is mixed with a ferrous sulfate solvent by means of a mixer to form a primarily modified soil and water is then added to the primarily modified soil, the

reaction of modifying the quality of the soil is quickly promoted, so that the polluted soil can be modified in a short time.

[0029] In the above first aspect of the present invention, it is preferable that a rear mixer for mixing a soil discharged from the mixer is further provided.

[0030] According to this arrangement, the soil discharged from the mixer is further mixed by the rear mixer, so that a mixing performance can be further improved and the modifying reaction is also promoted quickly.

[0031] In the above first aspect of the present invention, it is preferable that the liquid ejecting means is attached to the discharge port of the mixer, and the rear mixer for mixing the ejected liquid soil conditioner with the discharged soil is mounted to a portion lower than the liquid ejecting means.

[0032] According to this arrangement, the soil discharged from the mixer and the liquid soil conditioner are further mixed by means of the rear mixer, so that a mixing performance can be further improved and the reaction of modifying the quality of the soil is promoted more quickly.

[0033] In a second aspect of the present invention, there is provided a self-propelled soil modifying machine comprising:

a machine body having a traveling equipment;
a raw soil hopper mounted to the machine body into which a raw soil to be modified is thrown;
a raw soil conveying device mounted to the machine body for conveying the raw soil thrown into the raw soil hopper;
a mixer mounted to the machine body for mixing the raw soil conveyed by the raw soil conveying device ;
a modified soil conveying device mounted to the machine body for discharging the soil mixed by the mixer;
a power source mounted to the machine body for supplying a power to the traveling equipment, the raw soil conveying device, the mixer and the modified soil conveying device; and
a soil conditioner supply device for ejecting a liquid soil conditioner from a liquid ejecting means to which the liquid soil conditioner stocked in a liquid tank is supplied by a liquid supply means,

wherein the liquid ejecting means is provided to at least one portion in a passage ranging from the raw soil hopper to the modified soil conveying device.

[0034] According to the second aspect of the present invention, in addition to the same advantageous effects as those provided in the first aspect of the present invention, there can be also provided the following effects. That is, the modified soil having improved quality can be conveyed to the outside of the machine body by the modified soil conveying device, and since the modified soil conveying device travels and moves together with the machine body, there can be provided a self-propelled soil modifying machine excellent in mobility.

[0035] In this second aspect of the present invention, it is preferable that the liquid ejecting means is attached at least one portion selected from a portion in the raw soil hopper, a portion above the raw soil conveyer close to an input port of the mixer, a portion in the mixer, and a discharge port of the modified soil conveying device.

[0036] According to this arrangement, the liquid soil conditioner can be supplied to at least one soil selected from the soil stocked in the raw soil hopper, the raw soil to be conveyed, the soil in the mixer and the soil to be discharged from the mixer.

[0037] In the above second aspect of the present invention, it is preferable that the liquid ejecting means is attached respectively to a passage ranging from the raw soil hopper to the interior of the mixer and the discharge port of the modified soil conveying device.

[0038] According to this arrangement, the raw soil is mixed with the liquid soil conditioner ejected from one liquid ejecting means to thereby primarily modify the soil, and then, the liquid soil conditioner is then ejected from the other liquid ejecting means to the primarily modified soil discharged from the modified soil conveying device, so that a reaction for modifying a quality of the raw soil can be promoted. In particular, when a soil polluted with hexavalent chromium is mixed with a ferrous sulfate solvent by means of a mixer so as to form a primarily modified soil and water is then added to the primarily modified soil, the reaction of modifying the quality of the soil is quickly promoted, so that the polluted soil can be modified in a short time.

[0039] In the above second aspect of the present invention, it is preferable that the self-propelled soil modifying machine further comprises a rear mixer for mixing a soil discharged from the modified soil conveying device.

[0040] According to this arrangement, the soil discharged from the modified soil conveying device is further mixed by the rear mixer, so that a mixing performance can be further improved and the reaction is also promoted quickly.

[0041] In the above second aspect of the present invention, it is preferable that the liquid ejecting means is attached to the discharge port of the modified soil conveying device, and the rear mixer for mixing the ejected liquid soil conditioner with the discharged soil is mounted to a portion lower than the liquid ejecting means.

[0042] According to the above arrangement, the soil discharged from the modified soil conveying device and the liquid soil conditioner are further mixed by the rear mixer, and thus, a mixing performance can be further improved and the reaction of modifying the quality of the soil is promoted more quickly.

[0043] In the first and second aspects of the present invention mentioned above, it is preferable that the liquid supply means and the liquid tank are mounted to the machine body.

[0044] According to this arrangement, since the liquid

supply means and the liquid tank travel and move together with the machine body, a mobility of the self-propelled soil modifying machine is excellent.

[0045] In the above first and second aspects of the present invention, it is preferable that either the liquid supply means or the liquid tank is independently provided from the machine body, or both the liquid supply means and the liquid tank are independently provided from the machine body.

[0046] According to such arrangement, the machine body is not required to provide a space for mounting either the liquid supply means or the liquid tank or both the liquid supply means and the liquid tank to be independently provided from the machine body, so that the self-propelled soil modifying machine can be formed so as to provide a compact size.

[0047] In the first and second aspects of the present invention, it is preferable that the liquid supply means comprises a fluid pump driven by the power source for the pump, and a delivery (discharge) side of the fluid pump is connected to the liquid ejecting means through a delivery pipe.

[0048] According to this arrangement, the amount of the liquid soil conditioner to be supplied per unit time is easily and accurately controlled through the adjustment of the power source for the pump to thereby increase or decrease the rotation speed of the fluid pump. Therefore, the supply amount of the liquid soil conditioner can be easily and accurately controlled to be an arbitrary amount.

[0049] In addition, since the delivery side of the fluid pump is connected to the liquid ejecting means through the delivery pipe, even if the fluid pump is located so as to be apart from the liquid ejecting means, the fluid pump is connected to the liquid ejecting means by providing the delivery pipe, so that the liquid ejecting means can be mounted in a narrow space.

[0050] Furthermore, since it is also possible to independently provide the fluid pump and the liquid tank so as to be apart from the machine body, the liquid tank can be formed to have a large capacity, so that the soil-quality modifying work can be continuously performed without resupplying the soil conditioner to the liquid tank for a long time.

[0051] In any one of the arrangements described hereinbefore, the liquid ejecting means may preferably be constituted by any one of members such as a pipe, a long pipe to which a plurality of ejecting holes are provided, a pipe having a funnel-shape at a front end portion thereof and a plurality of ejecting holes are formed to a front end surface of the pipe, and a pipe having a large-diametered front end portion and a plurality of ejecting holes having a small diameter are formed to a front end surface of the pipe.

[0052] According to the above arrangement, the following effects are obtained. That is, the liquid ejecting means constituted by the pipe simplifies a shape of the means, thus resulting in a low cost.

[0053] When the liquid ejecting means is constituted by the long pipe to which a plurality of ejecting holes are provided, the liquid soil conditioner can be uniformly supplied to a broad area of the soil.

[0054] When the liquid ejecting means is constituted by the pipe having a funnel-shape at the front end portion thereof and a plurality of ejecting holes are formed to the front end surface of the pipe, or when it is constituted by the pipe having a large-diametered front end portion and a plurality of ejecting holes each having a small diameter are formed to the front end surface of the pipe, the liquid soil conditioner can be uniformly ejected in a mist form over a broad area of the soil. Therefore, this type of the liquid ejecting means is suitable for a case where the liquid soil conditioner is ejected to the soil in the mixer or the soil discharged from the modified soil conveying device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0055] The present invention will become more apparent upon a consideration of the following detailed explanations of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings. It is to be understood that the embodiments shown in the accompanying drawings are not for particularly specifying the present invention but for merely making the explanations and understanding of the present invention more easily.

[0056] In the accompanying drawings:

FIG. 1 is a side view showing one embodiment of a self-propelled soil modifying machine according to the present invention.
FIG. 2 is a plan view of this embodiment.
FIG. 3 is a front view of the embodiment.
FIG. 4 is an explanatory view explaining an operation of the embodiment.
FIG. 5 is an explanatory view explaining a soil conditioner supply device of the embodiment.
FIGs. 6A to 6C are perspective views each showing a liquid ejecting means for the soil conditioner supply device.
FIGs. 7A to 7C are explanatory views each explaining a mounting position of the liquid ejecting means.
FIG. 8 is a side view showing a mounting portion of a rear mixer for the embodiment.
FIG. 9 is a cross sectional view taken along the line IX-IX in FIG. 8.
FIG. 10 is a side view showing another mounting portion of the rear mixer.
FIG. 11 is a cross sectional view taken along the line XI-XI in FIG. 10.
FIGs. 12A and 12B are explanatory views each showing an embodiment in which a plurality of liquid ejecting means are used.
FIGs. 13A and 13B are explanatory views each showing an embodiment in which a plurality of dif-

ferent liquid soil conditioners are mixed and then the mixed liquid is ejected from one liquid ejecting means.

FIG. 14 is an explanatory view showing an embodiment in which the liquid ejecting means and the rear mixer are mounted to a portion close to a discharge port of the mixer.

FIGs. 15A to 15C are explanatory views each explaining a mounting position of a liquid supply means and a liquid tank.

BEST MODE FOR EMBODYING THE INVENTION

[0057] Next, preferred embodiments of the present invention will be described hereunder with reference to the accompanying drawings.

[0058] As shown in FIGs. 1, 2 and 3, right and left traveling equipment 2, 2 are attached to a machine body 1 so as to form a self-propelled machine (vehicle). A mixer 3 is provided to an intermediate portion between front and rear portions of the machine body 1. At a front portion side of the machine body 1 is provided a power source unit 4 including an engine, a hydraulic pump, a generator, or a combination thereof. The power source unit 4 is covered with a cover 5. The traveling equipment 2 is formed as a crawler-type structure, but may be formed as a wheel-type structure. Further, the machine body 1 is provided with a boarding platform 1a.

[0059] At a rear side of the machine body 1 is provided a mount frame 6 so as to project rearward from the machine body 1, and a raw soil conveying device 7 is mounted on the mount frame 6 so as to extend in the longitudinal direction thereof. Further, a raw soil hopper 8 is mounted to the mount frame 6 so that the hopper 8 is positioned above a rear side of the raw soil conveying device 7. A cover member 9 is attached to a portion between the raw soil hopper 8 and the mixer 3, and this cover member 9 covers a space above a front side portion of the raw soil conveying device 7.

[0060] At a lower portion of the machine body 1 is provided with a modified soil conveying device 10 so as to extend in the longitudinal direction thereof. One end potion (rear side portion) of the modified soil conveying device 10 in the conveying direction is positioned below the mixer 3, while another end portion (front side portion) of the modified soil conveying device 10 extends forward over the machine body 1.

[0061] The power source unit 4 has a function of supplying a power force to the traveling equipment 2, the raw soil conveying device 7, the mixer 3 and the modified soil conveying device 10.

[0062] A liquid supply means 11 is provided to either right or left side portion on the front side portion of the machine body 1, while a liquid tank 12 is provided to either right or left side portion on the rear side portion of the machine body 1. At a portion above the raw soil conveying device 7 close to the inlet port of the mixer 3, a liquid ejecting means 13 is attached to the cover member 9 so as to oppose to the raw soil conveying device 7. This liquid ejecting means 13, the liquid supply means 11 and the liquid tank 12 constitute a soil conditioner supply device.

[0063] As shown in FIG. 4, the mixer 3 is provided with a soil cutter device 15 as a primary mixing unit and a plurality of impact hammers (rotor provided with rotators) 16 as a secondary mixing unit mounted in a case 14.

[0064] The aforementioned raw soil conveying device 7 is constituted as a conveyer which is composed of a driving wheel 17, a driven wheel 18 and an endless belt-like member 19 wrapped therearound. This raw soil conveying device 7 has a discharge side end portion which extends into the case 14 of the mixer 3 through an entrance (input) port 20 formed to a side wall section 14a of the case 14 of the mixer 3. The endless belt-like member 19 is a crawler belt composed of a plurality of iron crawler plates that are connected in an endless shape. However, a belt can be also used as the endless belt-like member 19.

[0065] The raw soil hopper 8 into which the soil to be modified is thrown has a discharge port at which a raking (raking-type) rotor 21 is mounted, the raking rotor having a function of making constant a cut-off height b of the raw soil a. This height b means a height of the raw soil a conveyed by the raw soil conveying device 7 towards the mixer 3.

[0066] A raw soil sensor 17a for detecting a height of the soil is disposed above the raw soil conveying device 7, and this sensor 17a is switched over to "ON" state to detect the conveyance of the raw soil on the conveying device 7 at a time when the height of the raw soil on the conveying device 7 becomes a predetermined height, for example, 70% of the height b.

[0067] One side portion in the conveying direction of the modified soil conveying device 10 is positioned below a discharge port (outlet port) 22 of the case of the mixer 3.

[0068] As shown in FIG. 5, the aforementioned liquid supply means 11 is a fluid pump 31 to be driven by a power source 30 for the pump such as an internal combustion engine, an electric motor or the like. A suction port of the fluid pump 31 is connected to the liquid tank 12 through a suction pipe 32 such as pipe, hose or the like, so that the fluid pump 31 sucks the liquid soil conditioner stocked in the liquid tank 12, and then, the sucked conditioner is delivered to a delivery pipe 33 such as pipe, hose or the like. In this connection, it is also possible to use the engine of the power source unit 4 as the power source 30 for the pump.

[0069] The liquid ejecting means 13 comprises a plurality of pipes 34 and each of the pipes 34 is connected to the delivery pipe 33. In this regard, the pipe 34 may be formed from a single pipe structure.

[0070] As shown in FIG. 4, the raw soil a such as the excavated soil or the like thrown in the raw soil hopper 8 is adjusted by a rotor 21 so as to provide a predeter-

mined cut-off height and then conveyed by the raw soil conveying device 7 towards the mixer 3. When the raw soil is conveyed to the mixer 3, the raw soil sensor 7a is made "ON" and the power source 30 for the pump is started, so that the liquid soil conditioner is sprayed on the raw soil a through the liquid ejecting means 13 (pipe 34). This liquid soil conditioner quickly infiltrates into the raw soil, thus providing a good infiltrating property.

[0071] The raw soil a and the liquid soil conditioner conveyed into the case 14 of the mixer 3 are subjected to a primary mixing treatment by being cut off by the soil cutter device 15, and then, subjected to a secondary mixing treatment (crushing, mixing and stirring) by being crushed by the impact hammers 16, whereby the nature and quality of the raw soil a can be modified to be a modified soil c. The modified soil c of which nature and condition are improved is then fallen and supplied onto the modified soil conveying device 10 through the discharge port 22 formed to the case 14 of the mixer 3, and thereafter, conveyed by the modified soil conveying device 10 forward the machine body.

[0072] As described hereinbefore, the raw soil a is cut off by the soil cutter device 15 so as to provide a flake-shape having a predetermined thickness, and the liquid soil conditioner adheres to a portion of the cut-off soil. The raw soils a each having the flake-shape fall in a state that the portions, to which the liquid soil conditioner adheres, take various positions such as upper position, lower position, lateral position or the like, and then crushed and mixed by the impact hammers 16, so that the raw soil and the liquid soil conditioner are sufficiently mixed.

[0073] As shown in FIG. 6A, the liquid ejecting means 13 can be formed to provide a structure in which a plurality of ejecting holes 36 are formed to a plurality of portions along the longitudinal direction of a long pipe 35, and a connecting portion 37 for connecting a delivery pipe 33 is formed to the long pipe 35.

[0074] Further, as shown in FIG. 6B, the liquid ejecting means 13 can be also formed to provide a structure in which the liquid ejecting means 13 comprises a pipe 38 having a funnel-shape at a front end portion thereof, and a plurality of ejecting holes 36 are formed to a front end surface of the pipe 38.

[0075] Furthermore, as shown in FIG. 6C, the liquid ejecting means 13 can be also formed to provide a structure in which the liquid ejecting means 13 comprises a pipe 39 having a large-diametered front end portion, and a plurality of ejecting holes 36 having a small diameter are formed to a front end surface of the pipe 39 to eject an atomized liquid solid conditioner.

[0076] The liquid supply means 11 and the liquid tank 12 can be formed to provide an arbitrary form and can be mounted to an arbitrary portion of the machine body 1. That is, since the soil conditioner is liquid, the flowability thereof can be utilized, so that the liquid supply means 11 and the liquid tank 12 can be formed to provide an arbitrary form so as to match with the arbitrary portion i.e., a space, and can be mounted to the arbitrary portion.

[0077] The portion to which the liquid ejecting means 13 is attached is not limited to the cover member 9. For example, the liquid ejecting means 13 can be also attached to a portion closer to the mixer 3 than the rotor 21 provided in the raw soil hopper 8. According to above the arrangement, the liquid soil conditioner promptly starts to infiltrate into the raw soil a thrown in the raw soil hopper 8, so that a degree of the infiltration of the liquid soil conditioner is further improved.

[0078] Furthermore, as shown in FIG.7B, the liquid ejecting means 13 may be attached to an upper portion in the case 14 of the mixer 3 so as to, direct downward. In this case, the liquid ejecting means 13 shown in FIGs. 6B and 6C are preferably adopted. According to the above arrangement, an interior of the case 14 of the mixer 3 becomes an atmosphere filled up with the liquid soil conditioner, so that the mixing performance of the raw soil a and the liquid soil conditioner can be improved. In addition, there is no fear of the liquid soil conditioner leaking out from the case 14.

[0079] Still furthermore, as shown in FIG.7C, the liquid ejecting means 13 may be attached to a portion close to the discharge portion of the modified soil conveying device 10 so as to oppose to the soil falling from the modified soil conveying device 10. In this case, the liquid ejecting means 13 shown in FIGs. 6B and 6C are also preferably adopted.

[0080] A concrete structure of the liquid ejecting means shown in FIG. 7C will be explained hereunder.

[0081] For example, as shown in FIGs. 8 and 9, a mount member 40 is fixed to a discharge end portion of a frame body 10a of the modified soil conveying device 10, and a cover member 41 is fixed to the mount member 40. Thereafter, the liquid ejecting means 13 is attached to an upper portion of the cover member 41 so as to oppose to the falling soil.

[0082] Further, a rear mixer 42 is attached to a lower portion of the cover member 41. The mount member 40 has an H-shape in a plan view and is formed in such a manner that a pair of mount plates 43 are connected through a connecting member 44, and then, a pair of plates 45 are fixed to the connecting member 44 and the paired mount plates 43 are fixed to both right and left side portions of the frame body 10a by means of bolts or the like.

[0083] The cover member 41 has an approximately rectangularbox-shape in which a rear side wall 41a is fixed to the connecting member 44 by means of bolts or the like, while right and left side walls 41b being positioned inside the paired plates 45, and the liquid ejecting means 13 is attached to an upper portion of a front side wall 41c of the cover member 41.

[0084] The rear mixer 42 mentioned before comprises a rotor 48 formed in such a manner that a plurality of mixing blades 47 are arranged around a rotational shaft 46 so as to extend radially from the shaft to form a mixing

unit, then a plural set of the mixing units are attached to the rotational shaft 46 with intervals in an axial direction of the rotational shaft 46. The rotational shaft 46 passes through holes 49 formed to lateral side walls 41b of the cover member 41 and is supported to be rotatable by the paired right and left plates 45 through bearings 50.

[0085] A hydraulic motor or an electric motor 52 is mounted to one of the paired plates 45 through a cylinder body 51, a drive shaft of the motor 52 is connected to the rotational shaft 46 in the cylinder body 51 through a coupling member (not shown), so that the motor 52 is driven so as to rotate the rotor 48. In this regard, as a power source for the motor 52, the hydraulic pump or the generator constituting the power source unit 4 mentioned before may be also utilized.

[0086] In addition, the rear mixer 42 can be also formed so as to provide a concrete structure shown in FIGs. 10 and 11. That is, a cover member 41 having a rectangular section and cylindrical shape is fixed to a discharge end portion of the frame body 10a of the modified soil conveying device 10 so as to direct downward, and the liquid ejecting means 13 is attached to an upper portion of the cover member 41 so as to oppose to the falling soil.

[0087] The rotational shaft 46 of the rear mixer 42 is supported to be rotatable at lower portions of the lateral side walls 41b of the cover member 41, and the hydraulic motor or the electric motor 52 is mounted to a rear side wall 41a of the cover member 41.

[0088] A belt 55 is wrapped around a portion between a pulley 53 fixed to the rotational shaft 46 and a pulley 54 to be rotated by the motor 52, so that the motor 52 is driven to rotate the rotor 48.

[0089] According to the arrangement mentioned above, the liquid soil conditioner is ejected to the soil falling from the modified soil conveying device 10 to mix the soil and the soil conditioner together. Thereafter, the soil and the liquid soil conditioner are sufficiently mixed again by the rear mixer 42.

[0090] In this case, as the mixer 3, it is also possible to use a mixer having a function of only crushing the raw soil a so as to realize a fine powdery state without including a lump soil.

[0091] In a case where the liquid ejecting means 13 is attached to a portion shown FIGs. 7A and 7B, there can be adopted an arrangement in which the liquid ejecting means 13 is not attached to a portion close to the discharge portion of the modified soil conveying device 10 but only the rear mixer 42 is mounted thereto.

[0092] A portion to which the liquid ejecting means 13 is attached is not limited to one portion, but the liquid ejecting means 13 may be also attached respectively to four portions as indicated in FIGs. 4, 7A, 7B and 7C.

[0093] Furthermore, the liquid ejecting means 13 can be also attached respectively to two portions arbitrarily selected from the four portions shown in FIGs. 4, 7A, 7B and 7C.

[0094] Still furthermore, the liquid ejecting means 13 can be also attached respectively to three portions arbitrarily selected from the four portions shown in FIGs. 4, 7A, 7B and 7C.

[0095] As mentioned hereinbefore, in a case where the liquid ejecting means 13 are attached respectively to a plurality of portions, a set of the fluid pump 31, the liquid tank 12 and the power source 30 for the pump may be independently provided to each of the liquid ejecting means 13 as shown in FIG. 12A.

[0096] According to the above arrangement, when the liquid soil conditioners of the kinds different from each other are packed in the liquid tanks 12 respectively, the liquid soil conditioners of the different kinds can be ejected and supplied to various portions.

[0097] Further, as shown in FIG. 12B, there can be also adopted an arrangement in which one fluid pump 31, one liquid tank 12 and one power source 30 for a pump are provided so that one kind of liquid soil conditioner is supplied under pressure to a plurality of the liquid ejecting means 13.

[0098] Furthermore, there may be also provided a structure in which the liquid soil conditioners of the kinds different from each other are mixed so that the mixed conditioner is ejected through one liquid ejecting means 13. In this case, as shown in FIG. 13A, the liquid soil conditioners stocked in the plurality of the liquid tanks 12 are sucked and discharged by one fluid pump 31. In another case such as shown in FIG. 13B, the liquid soil conditioners stocked in the plurality of the liquid tanks 12 are respectively sucked by the fluid pumps 31, and discharge sides of these fluid pumps 31 are formed so as to be combined together, whereby the liquid soil conditioner is forcibly supplied to one liquid ejecting means 13.

[0099] The rear mixer 42 may be disposed independently from the modified soil conveying device 10. In this case, for example, the cover member 41 is mounted to a support frame disposed on the ground or a movable support frame through the mount member 40, or the cover member 41 is directly mounted to the support frame.

[0100] Further, the liquid ejecting means 13 and the rear mixer 42 may be mounted to an intermediate portion in the conveying direction of the modified soil conveying device 10.

[0101] Next, a concrete example of the soil modification will be explained hereunder.

[0102] An explanation will be started by way of example in which the liquid ejecting means 13 is attached to the cover body 9 as shown in FIG. 4 or the liquid ejecting means 13 is attached to a portion closer to the mixer 3 than the rotor 21 mounted in the raw soil hopper 8 as shown in FIG. 7A and a polymer-type solidifying agent is ejected as a liquid from the liquid ejecting means 13.

[0103] A mud as the raw soil is thrown in the raw soil hopper 8. Then, the mud and the polymer-type solidifying agent are mixed by the mixer 3 to thereby modify the nature and condition of the mud to form a modified soil,

which is then conveyed by the modified soil conveying device 10 and discharged outside the machine body.

[0104] According the operation mentioned above, the mud, for example, discharged at the time of the tunnel excavation using a shield-type tunnel excavator, can be modified to a hard soil having a good quality.

[0105] Further, it is preferable that a ferrous sulfate solvent is ejected from the liquid ejecting means 13 (shown in FIG. 6A) attached to the cover body 9 shown in FIG. 4 while water is ejected from the liquid ejecting means 13 (shown in FIG. 6B or 6C) attached to the modified soil conveying device 10 shown in FIG. 7C, and a soil polluted with hexa-valent chromium is thrown in the raw soil hopper 8.

[0106] According to this arrangement, the soil polluted with hexavalent chromium and the ferrous sulfate solvent are mixed by the mixer 3, and the water is then ejected to the mixture, so that the soil polluted with hexavalent chromium can be modified to obtain a state of the hexavalent chromium being undissolved. In addition, due to the addition of the water, the reaction of modifying the quality of the soil can be easily promoted.

[0107] Furthermore, it is also preferable that a ferrous sulfate solvent is ejected from the liquid ejecting means 13 (shown in FIG. 6B) attached to the mixer 3 shown in FIG. 7B while water being ejected from the liquid ejecting means 13 (shown in FIG. 6B or 6C) attached for the modified soil conveying device 10 shown in FIG. 7C, and the soil polluted with hexavalent chromium as a raw soil is thrown in the raw soil hopper 8.

[0108] According to such arrangement, the soil polluted with hexavalent chromium and the ferrous sulfate solvent are mixed by the mixer 3, and the water is then ejected to the mixture, so that the soil polluted with hexavalent chromium can be modified to obtain a state of the hexavalent chromium being undissolved. In addition, due to the addition of the water, the reaction of modifying the quality of the soil can be easily promoted.

[0109] It is also possible to modify the self-propelled soil modifying machine to a soil modifying machine having no modified soil conveying device 10 described hereinbefore. In this case, the power source unit 4 supplies the power to the traveling equipment 2, the raw soil conveying device 7 and the mixer 3.

[0110] In such case, since the modified soil is discharged through the discharge port 22 of the mixer 3, it is also possible to adopt an arrangement in which a belt conveyer for discharging the modified soil is independently mounted below the discharge port 22 to thereby discharge the modified soil outside the machine body or the discharge port 22 of the mixer 3 is formed to a portion outside the machine body (i.e., a portion forwardly apart from the traveling equipment 2) to thereby discharge the modified soil outside the machine body.

[0111] In case of using the self-propelled soil modifying machine mentioned above, it is also possible to mount the liquid ejecting means 13 and the rear mixer 42 to a portion close to the discharge port 22 of the mixer 3.

[0112] For example, as shown in FIG. 14, the discharge port 22 of the mixer 3 is formed so as to provide a shape having a narrow width, and the liquid ejecting means 13 and the rear mixer 42 are mounted to a portion close to the discharge port 22 of the case 14 through the mount member 40 and the cover member 41 as the same manner as described hereinbefore.

[0113] According to this arrangement, a crushed soil having a fine powdery state including no lump soil discharged from the discharge port 22 of the mixer 3 can be effectively mixed with the liquid soil conditioner, thereafter, the mixture can be further sufficiently mixed by the rear mixer 42.

[0114] Next, the control system for controlling a supply amount of the liquid soil conditioner will be explained hereunder.

[0115] In the above case, a supplying speed of the raw soil is controlled by adjusting the motor for driving the driving wheel 17 of the raw soil conveying device 7 and the motor for rotating the rotor 21 mounted in the raw soil hopper 8.

[0116] Further, the amount of the liquid soil conditioner to be ejected from the liquid ejecting means 13 is controlled by adjusting a rotation speed of the fluid pump 31 driven by the power source 30 for the pump.

[0117] Furthermore, a detecting means for detecting a raw soil supply amount is provided for a portion close to the input port 20 of the mixer 3. For example, a plurality of switches or laser systems as the detecting means detect a height of the raw soil to be supplied, and the amount of the raw soil to be supplied per unit time is detected in accordance with the height of the raw soil to be supplied and a supplying speed (conveying speed) of the raw soil at the raw soil conveying device.

[0118] In the arrangement mentioned hereinbefore, a mixing ratio of the raw soil and the liquid soil conditioner is previously set to an appropriate value. Based on this mixing ratio and the detected amount of the raw soil, the supply speed of the raw soil or the amount of the liquid soil conditioner is controlled to thereby secure a constant mixing ratio at any time.

[0119] In the described embodiment, although both the liquid supply means 11 and the liquid tank 12 are mounted to the machine body 1, it is also possible to independently or separately dispose at least one of the liquid supply means 11 and the liquid tank 12 from the machine body 1.

[0120] For example, as shown in FIG. 15A, the liquid supply means 11 is independently disposed from the machine body 1, and the suction port of the liquid supply means 11 is connected to the liquid tank 12 mounted to the machine body 1 through the suction pipe 32 while the delivery pipe 33 is connected to the liquid ejecting means 13.

[0121] Further, as shown in FIG. 15B, the liquid tank 12 is independently disposed from the machine body 1, and the suction port of the liquid supply means 11

mounted to the machine body is connected to the liquid tank 12 through the suction pipe 32.

[0122] Furthermore, as shown in FIG. 15C, both the liquid supply means 11 and the liquid tank 12 are independently disposed from the machine body 1, and the delivery pipe 33 is connected to the liquid ejecting means 13.

[0123] Although the present invention has been described with reference to the exemplified embodiments, it will be apparent to those skilled in the art that various modifications, changes, omissions, additions and other variations can be made in the disclosed embodiments of the present invention without departing from the scope or spirit of the present invention. Accordingly, it should be understood that the present invention is not limited to the described embodiments and shall include the scope specified by the elements defined in the appended claims and range of equivalency of the claims.

Claims

1. A self-propelled soil modifying machine comprising:

a machine body (1) having a traveling equipment (2);
a raw soil hopper (8) mounted to the machine body (1), into which a raw soil to be modified is thrown;
a raw soil conveying device (7) mounted to the machine body (1) for conveying the raw soil charged into the raw soil hopper (8);
a mixer (3) mounted to the machine body (1) for mixing the raw soil conveyed through the raw soil conveying device (7);
a power source unit (4) mounted to the machine body (1) for supplying a power to said traveling equipment (2), the raw soil conveying device (7) and the mixer (3); and
a soil conditioner supply device for ejecting a liquid soil conditioner from a liquid ejecting means (13) to which the liquid soil conditioner stocked in a liquid tank (12) is supplied by a liquid supply means (11),

wherein said liquid ejecting means (13) is attached to at least one portion in a passage ranging from the raw soil hopper (8) to a discharge portion of the mixer (3).

2. A self-propelled soil modifying machine according to claim 1, wherein said liquid ejecting means (13) is attached to at least one portion selected from a portion in the raw soil hopper (8), a portion above the raw soil conveying device (7) close to an input port of the mixer (3), a portion in the mixer (3), and a discharge portion of the mixer (3).

3. A self-propelled soil modifying machine according to claim 1, wherein said liquid ejecting means (13) is attached respectively to a passage ranging from the raw soil hopper (8) to the interior of the mixer (3) and the discharge portion of the mixer (3).

4. A self-propelled soil modifying machine according to claim 1, further comprising a rear mixer (42) for mixing a soil discharged from the mixer (3).

5. A self-propelled soil modifying machine according to claim 1, wherein said liquid ejecting means (13) is attached to the discharge portion of the mixer (3), and the rear mixer (42) for mixing the ejected liquid soil conditioner with the discharged soil is mounted to a portion lower than said liquid ejecting means (13).

6. A self-propelled soil modifying machine comprising:

a machine body (1) having a traveling equipment (2);
a raw soil hopper (8) mounted to the machine body (1), into which a raw soil to be modified is thrown;
a raw soil conveying device (7) mounted to the machine body (1) for conveying the raw soil charged into the raw soil hopper (8);
a mixer (3) mounted to the machine body (1) for mixing the raw soil conveyed by the raw soil conveying device (7);
a modified soil conveying device (10) mounted to the machine body (1) for discharging the soil mixed by said mixer (3);
a power source unit (4) mounted to the machine body (1) for supplying a power to said traveling equipment (2), the raw soil conveying device (7), the mixer (3) and the modified soil conveying device (10); and
a soil conditioner supply device for ejecting a liquid soil conditioner from a liquid ejecting means (13) to which the liquid soil conditioner stocked in a liquid tank (12) is supplied by a liquid supply means (11),

wherein said liquid ejecting means (13) is provided to at least one portion in a passage ranging from the raw soil hopper (8) to the modified soil conveying device (10).

7. A self-propelled soil modifying machine according to claim 6, wherein said liquid ejecting means (13) is attached to at least one portion selected from a portion in the raw soil hopper (8), a portion above the raw soil conveyer (7) close to an input port of the mixer (3), a portion in the mixer (3), and a discharge portion of the modified soil conveying device (10).

8. A self-propelled soil modifying machine according to claim 6, wherein said liquid ejecting means (13) is attached respectively to a passage ranging from the raw soil hopper (8) to the interior of the mixer (3) and the discharge portion of the modified soil conveying device (10).

9. A self-propelled soil modifying machine according to claim 6, further comprising a rear mixer (42) for mixing a soil discharged from the modified soil conveying device (10).

10. A self-propelled soil modifying machine according to claim 6, wherein said liquid ejecting means (13) is attached to the discharge portion of the modified soil conveying device (10), and the rear mixer (42) for mixing the ejected liquid soil conditioner with the discharged soil is mounted to a portion lower than said liquid ejecting means (13).

11. A self-propelled soil modifying machine according to claim 1 or 6, wherein said liquid supply means (11) and the liquid tank (12) are mounted to the machine body (1).

12. A self-propelled soil modifying machine according to claim 1 or 6, wherein either said liquid supply means (11) or the liquid tank (12) is independently provided from the machine body (1).

13. A self-propelled soil modifying machine according to claim 1 or 6, wherein both the liquid supply means (11) and liquid tank (12) are independently provided from the machine body (1).

14. A self-propelled soil modifying machine according to claim 1 or 6, wherein said liquid supply means (11) comprises a fluid pump (31) driven by a power source (30) for a pump, and a discharge side of said fluid pump (31) is connected to said liquid ejecting means (13) through a delivery pipe (33).

15. A self-propelled soil modifying machine according to any one of claims 1 to 14, wherein said liquid ejecting means (13) is a pipe (34).

16. A self-propelled soil modifying machine according to any one of claims 1 to 14, wherein said liquid ejecting means (13) is formed with a plurality of ejecting holes (36) to a long pipe (35).

17. A self-propelled soil modifying machine according to any one of claims 1 to 14, wherein said liquid ejecting means (13) is a pipe (38) having a funnel-shape at a front end portion thereof and a plurality of ejecting holes (36) are formed to a front end surface of the pipe (38).

18. A self-propelled soil modifying machine according to any one of claims 1 to 14, wherein said liquid ejecting means (13) is a pipe (39) having a large-diametered front end portion, and a plurality of ejecting holes (36) having a small diameter are formed to a front end surface of the pipe (39).

FIG. 1

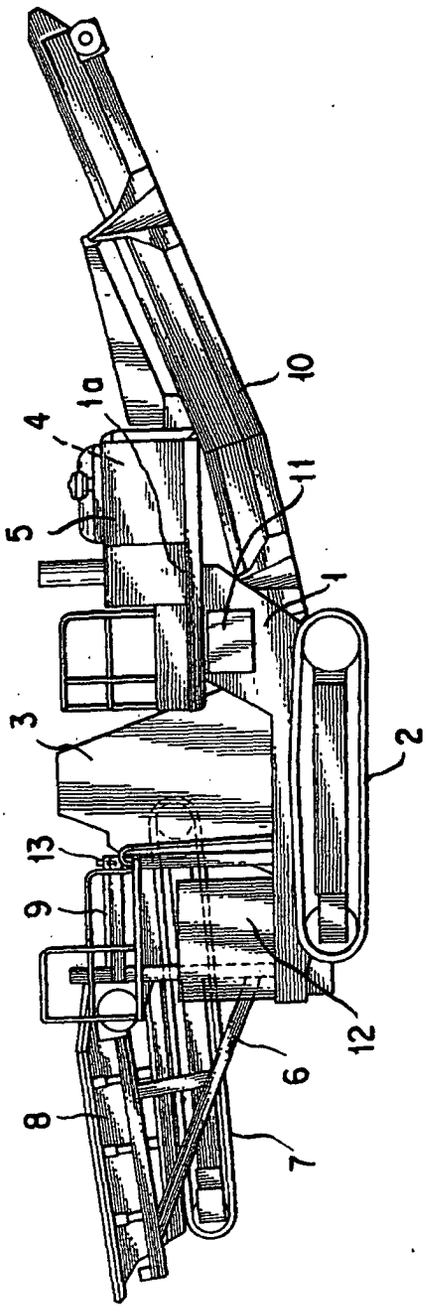


FIG. 2

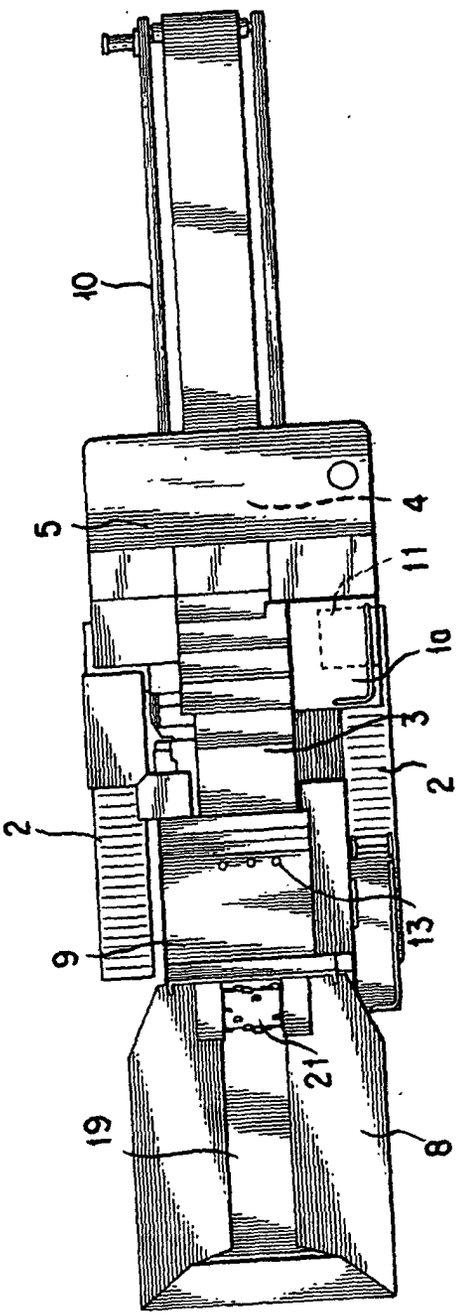


FIG. 3

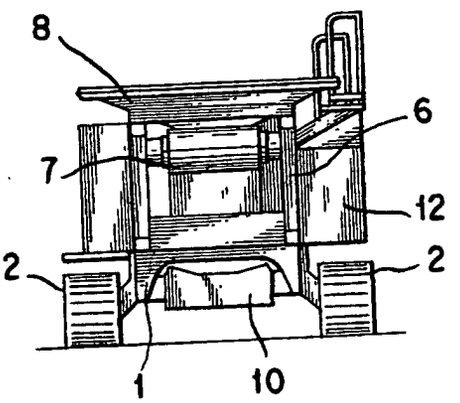


FIG. 4

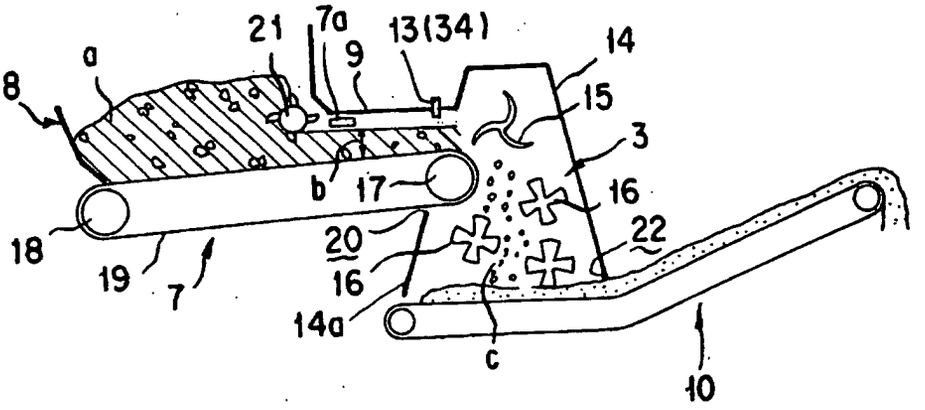

21
7a
13(34)
14
a
9
15
8
3
b
17
16
18
20
22
19
16
7
14a
c
10

FIG. 5

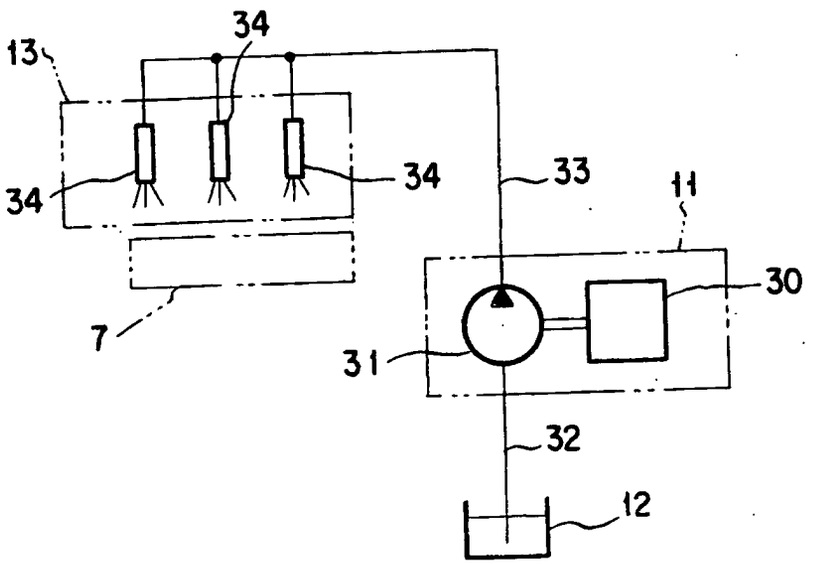

34
13
34
34
33
11
30
7
31
32
12

FIG. 6A

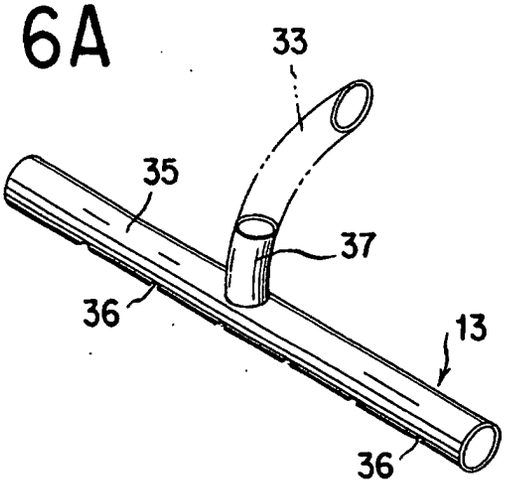


FIG. 6B

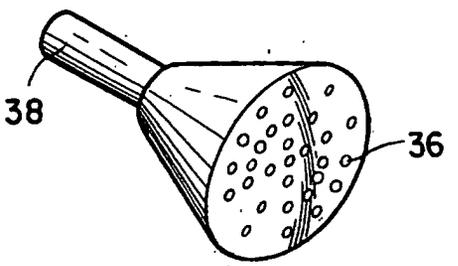


FIG. 6C

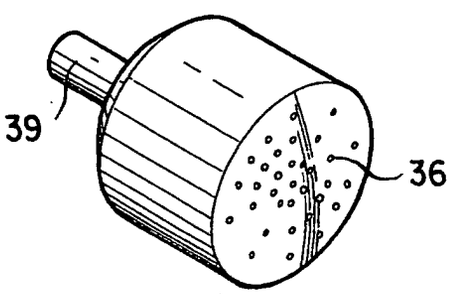


FIG. 7A

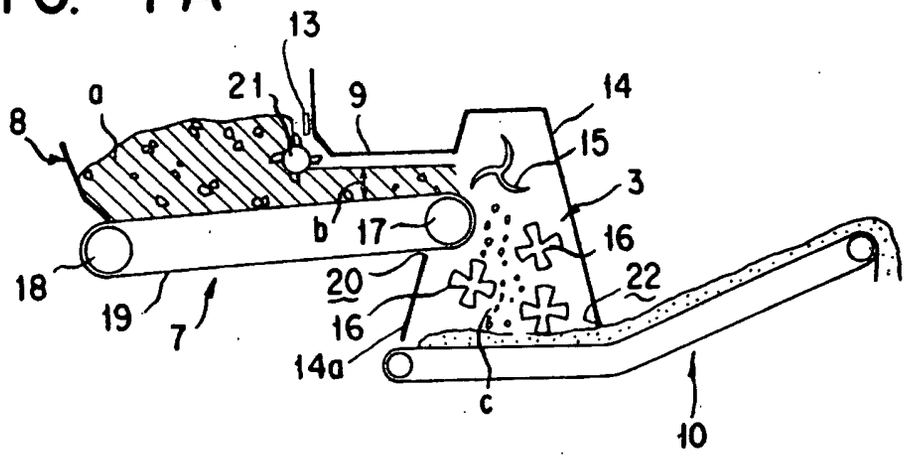


FIG. 7B

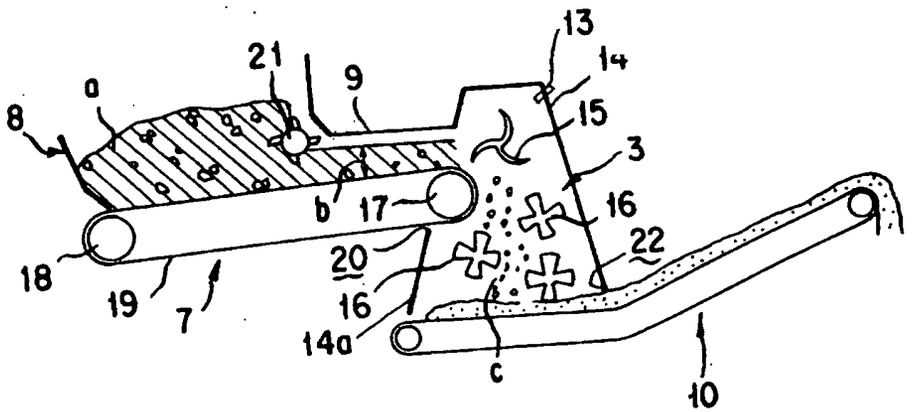


FIG. 7C

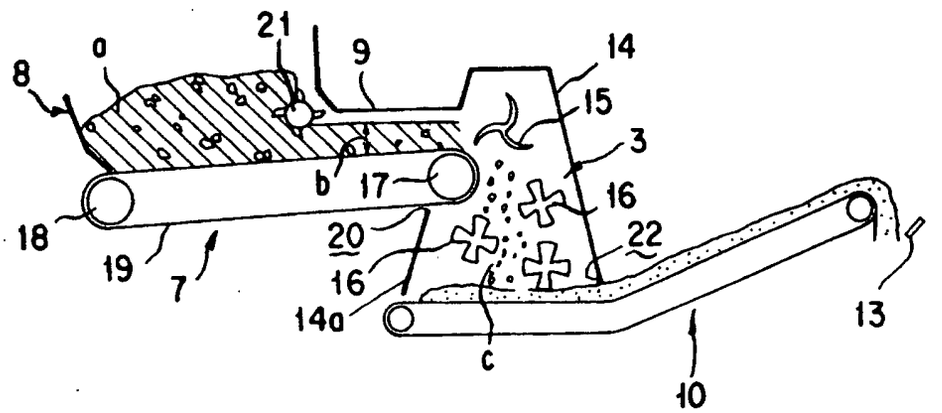


FIG. 8

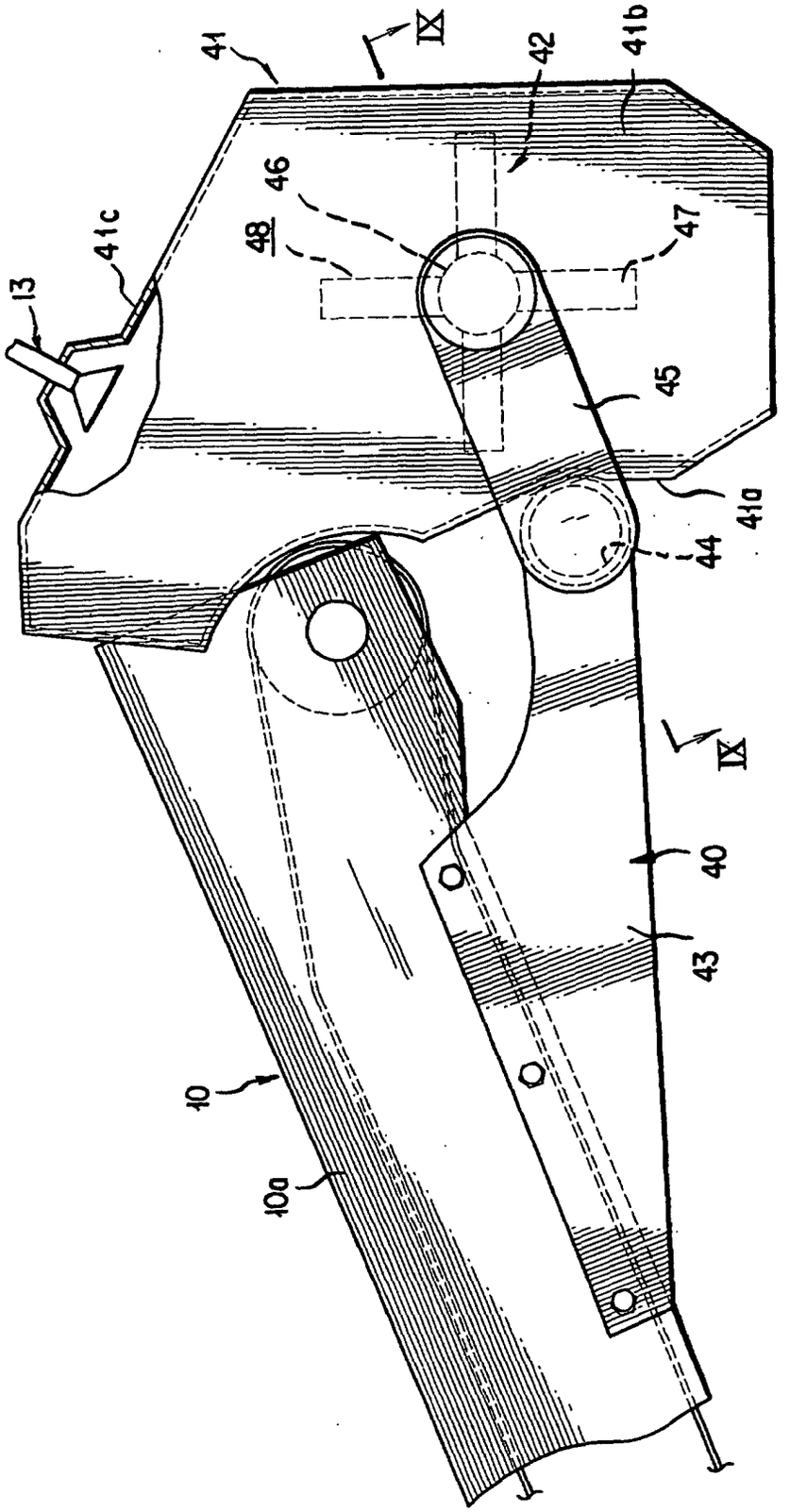


FIG. 9

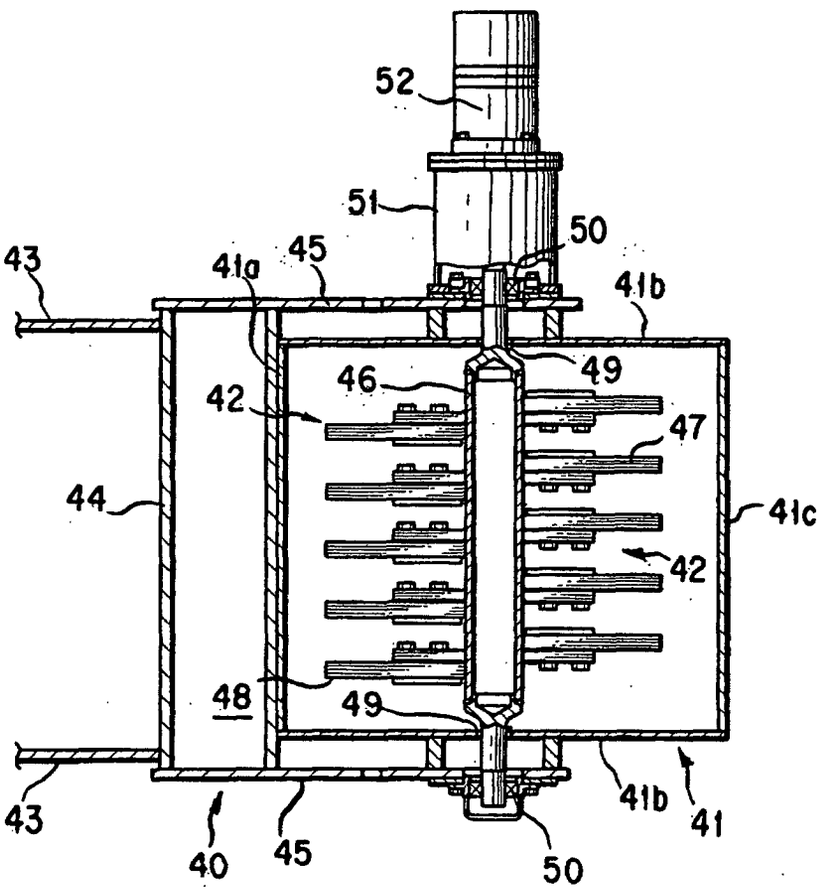


FIG. 10

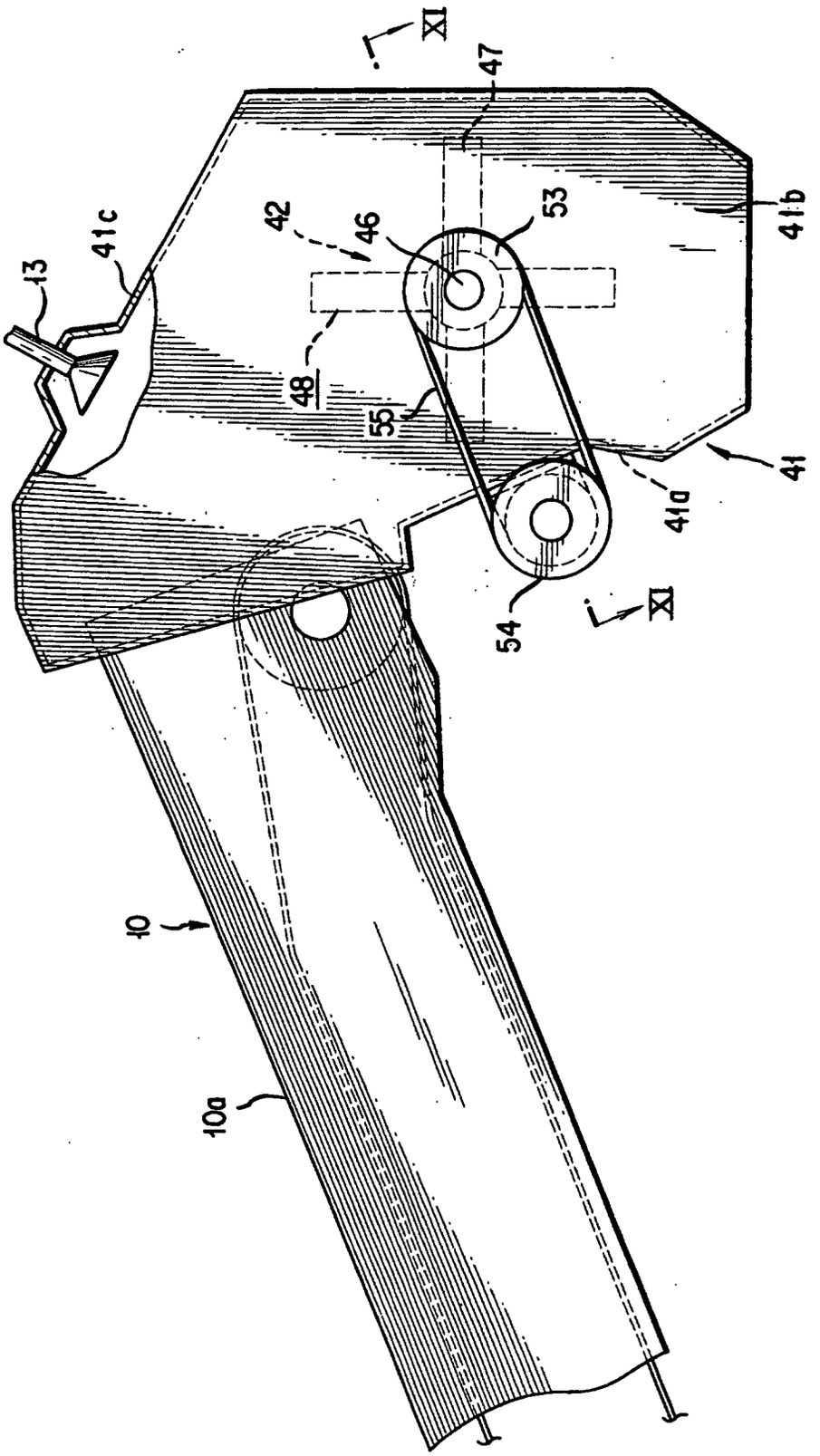


FIG. 11

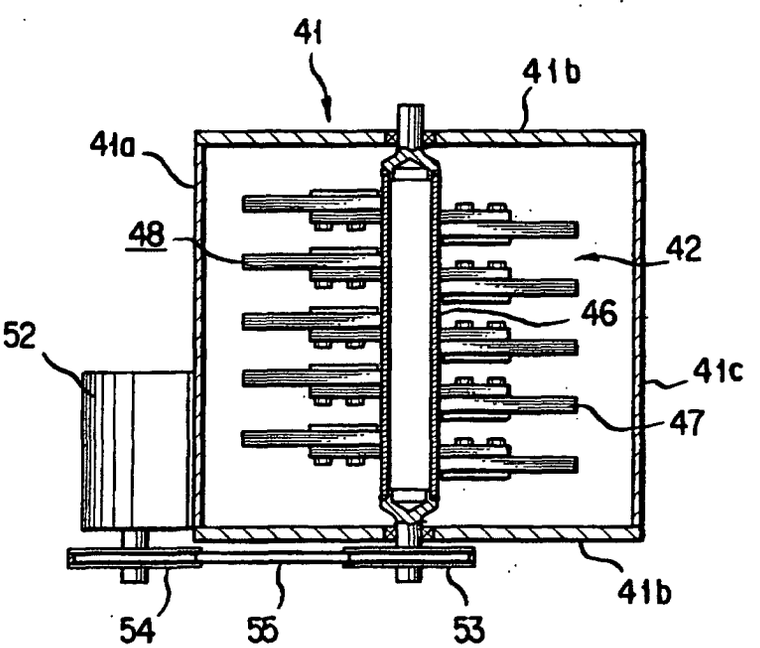


FIG. 12A

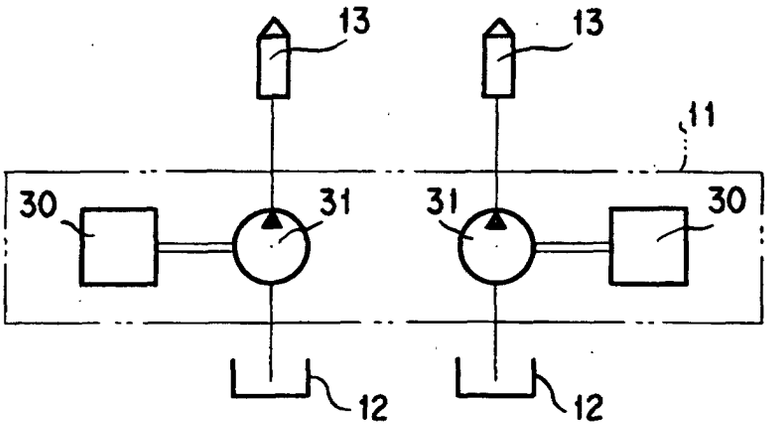


FIG. 12B

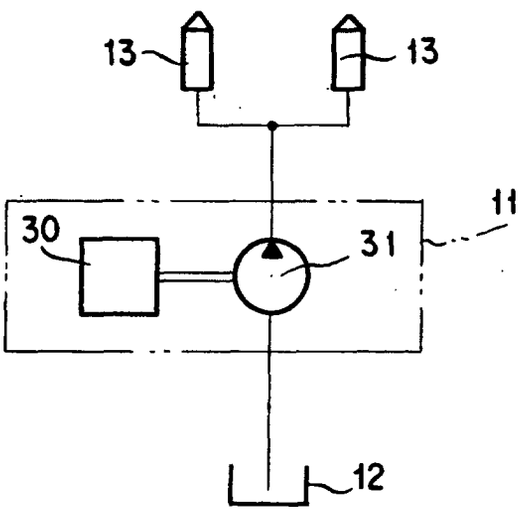


FIG. 13A

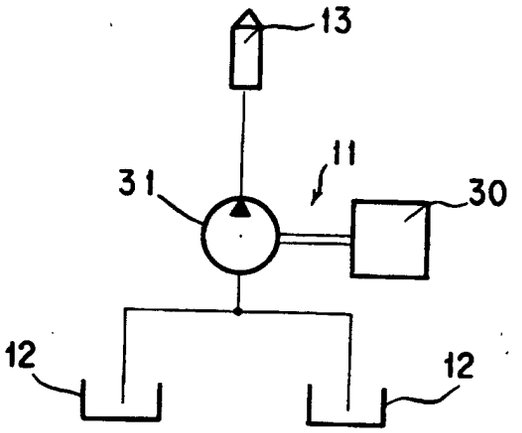


FIG. 13B

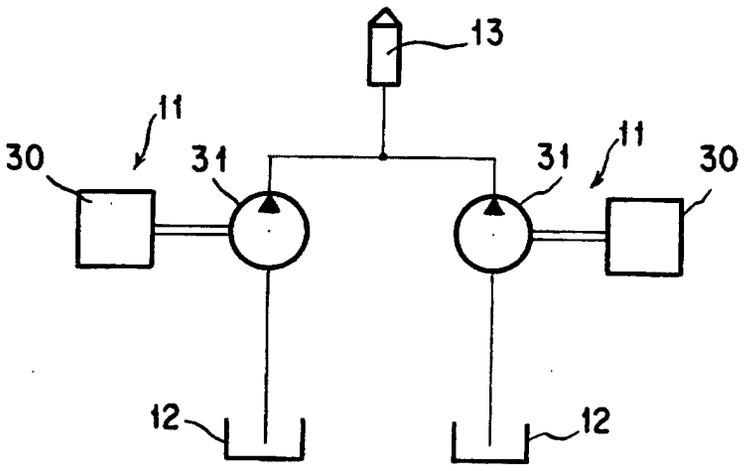


FIG. 14

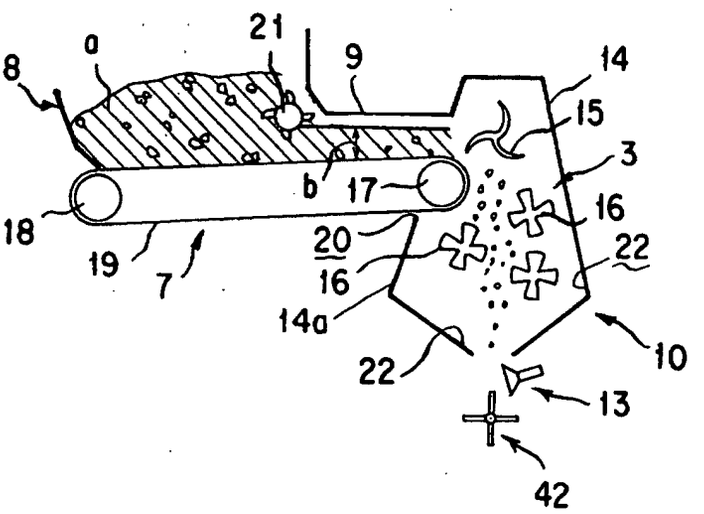


FIG. 15A

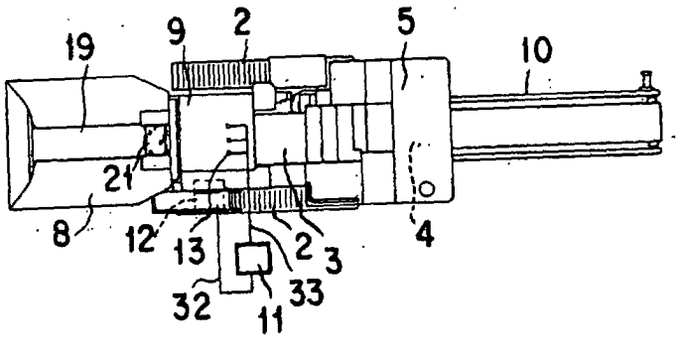


FIG. 15B

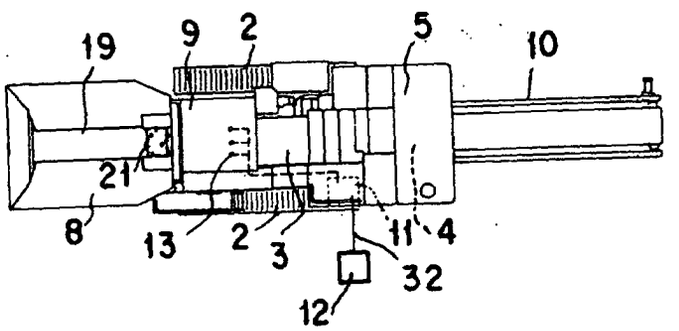
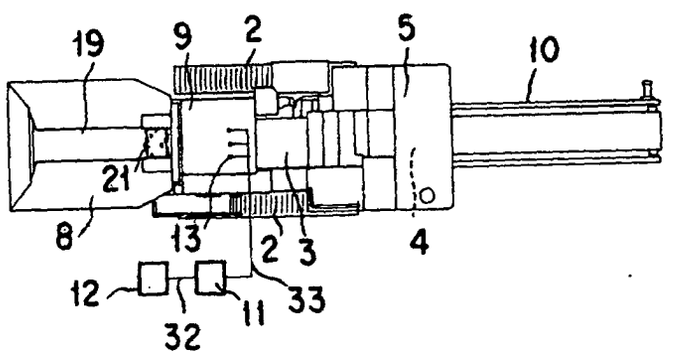


FIG. 15C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/03671

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] E012D3/12, E02F7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] E012D3/12, E02F7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Kokai Jitsuyo Shinan Koho 1971-2000
Jitsuyo Shinan Toroku Koho 1996-2000 Toroku Jitsuyo Shinan Koho 1994-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO, 97/25485, A1 (Komatsu Ltd.), 29 July, 1997 (29.07.97), Full text; all drawings & JP, 9-195265, A	1,2,6,7, 11-18 3-5,8-10
Y	JP, 10-280471, A (JDC corp.), 20 October, 1998 (20.10.98), page 3, left column, lines 18 to 23; Fig. 1 (Family: none)	1,2,6,7, 11-18
Y	JP, 7-80498, A (Toyo Eng. Works Ltd.), 28 March, 1995 (28.03.95), page 2, right column, lines 39 to 46; Fig. 1 (Family: none)	1,2,6,7, 11-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
05 September, 2000 (05.09.00)	12 September, 2000 (12.09.00)
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