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(54) Wheeled portable water jet machine for dust abatement

(57) Wheeled portable water jet machine for dust abatement comprises a support frame (1), wheeled on wheels or caterpillars (R), whereon there are housed an internal combustion engine (M), a high-pressure pump (P) actuated by said engine (M), a water distribution arm (B) and a nozzle-holding head fixed at the top of said arm (B) in an adjustable way. There are provided water supply means of said pump (P) in the form of an outer water hose or of a self-supported tank and one or more pipes (T) for alternately connecting the delivery of said pump to corresponding nozzles (4) housed in said nozzle-holding head (3). The position of the nozzle-holding head (3) with respect to the arm (B) is controlled through mechanical actuators actuated by hand and/or by electric motors which may be remotely controlled by radio.

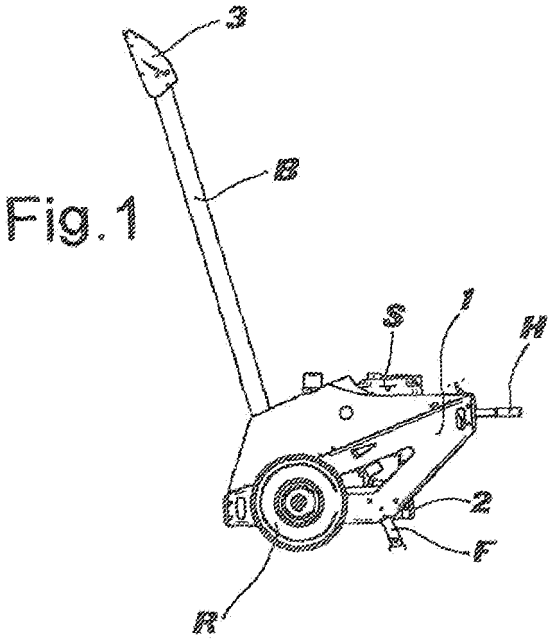


Fig.1

EP 2 377 580 A1

Description

FIELD OF THE INVENTION

[0001] The present invention refers to a wheeled portable water jet machine, to be used for dust abatement. More in particular, the invention refers to a machine of the type indicated above, apt to form an adjustable jet of nebulized water with no need for connection to the power grid.

BACKGROUND OF THE PRIOR ART

[0002] In the most recent years it has begun to spread the use of water nebulization plants to perform dust abatement, both in an industrial and in a city context. In the former case the most frequent applications are in the building industry and in particular in all those jobs which imply soil displacement and which hence, at least in conditions of low humidity, originate large amounts of dusts, but also in other industrial sectors which imply open-air processing with the formation of large amounts of dust. In the latter case they are applications in localised, highly-polluted city areas, in order to keep the level of particulate matter within safety limits from a health point of view, when such limits are exceeded due to particular atmospheric conditions (lack of wind) or of a particular concentration of pollutants (conditions of high traffic of motor vehicles or presence of a high density of active heating plants).

[0003] In both cases, this type of plants normally comprises a centralised, high-pressure electric pump, connected on one side to a water supply and on the other side to a distribution network which carries pressurised water to one or more distribution and nebulization nozzles, located on top of supporting poles of a suitable height.

[0004] Plants of this type are of course characterised by a high cost and by rather long installation times and are hence capable of giving satisfactory performances when they are used for permanent installations, such as for example within industrial areas, or city streets. When these plants are instead used within a short-lived work site or even a moving work site, as typically occurs in the case of road works, it is evident that they suffer from various drawbacks.

[0005] Firstly, the supply of electric energy to the pump can be obtained only through the use of movable cables arranged to the ground, and this evidently determines a high likelihood of accidents, or in any case an obstacle to the free circulation of workers and equipment on the work site.

[0006] Secondly, the temporary installation of poles and nozzles and corresponding distribution network is a long and costly operation. Moreover, the plant thus formed is very little flexible and hence the adaptation thereof to the different and varying work conditions implies a frequent readjustment of the plant, or a smaller effectiveness of use, whenever the fixed position identified for the water distribution nozzles does not coincide with the one most advantageous with respect to the specific work condition.

PROBLEM AND SOLUTION

[0007] The problem underlying the invention is hence that of solving these disadvantages, thus allowing to perform in a very effective way dust abatement also in movable work sites or in any case in all those other applications which require the quick forming of nebulized water jets having range and orientation features varying over time, however, without having the previously arranged on-site availability of fixed water pumping and distribution installations.

[0008] Such object is reached - according to the present invention - through a wheeled portable water jet machine having the features defined in the main claim enclosed at the bottom of the present description. The dependent claims define other preferred features of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Further features and advantages of the invention will in any case be more evident from the following detailed description of a preferred embodiment of the invention, provided purely as a non-limiting example and illustrated in the enclosed drawings, wherein:

fig. 1 is an elevation side view of a wheeled portable water jet machine according to the present invention;
fig. 2 is a front view of the machine of fig. 1;
fig. 3 is a plan view of the machine of fig. 1 devoid of the protection carter;
fig. 4 is a side view of the water distribution arm of the machine of fig. 1;
fig. 5 is a front view of the distribution arm of fig. 4;
fig. 6 is another side view, in longitudinal section, of the distribution arm of fig. 4;
fig. 7 is an enlarged-scale view of the detail enclosed in the circle VII of fig. 6, which illustrates the structure of the nozzle-holding head;
fig. 8 is an enlarged-scale view of the detail enclosed in the circle VIII of fig. 6, which illustrates the structure of the rotation control of the nozzle-holding head housed under the distribution arm; and
fig. 9 is an enlarged-scale, explicative view of the sole rotation control of the nozzle-holding head.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] The portable water-jet machine according to the present invention has been conceived starting from a preliminary insight, which is an integral part of the invention, i.e. the one of abandoning the traditional layout which

contemplated the use of electric pumps associated with fixed or semi-fixed water distribution plants, to pass to a fully independent and self-sufficient, compact machine, i.e. a machine comprising all the elements of the traditional systems brought together in a single unit, which for its operation only requires connection to a water source. The invention was then completed, starting from this original insight, providing the machine with additional functions to make the transport and placing thereof easy and to allow - when the machine is stationary - a wide opportunity for the adjustment of the quality and direction of the water jet delivered by the same, as can be clearly appreciated from the following description.

[0011] The overall structure of the wheeled portable water jet machine of the invention is clearly visible in figs. 1 to 3 and comprises a sturdy frame 1 whereto an internal combustion engine M provided with a relative fuel tank S is fixed, a high-pressure pump P, a pair of wheels R, a pair of support feet F and a distribution arm B. Arm B is rigidly fastened to frame 1 and lies in a longitudinal centre line plane of the machine, extending from the same in a sub-vertical direction, i.e. forming an angle smaller than 90°C to the horizontal and preferably ranging in the interval between 60° and 85°. The wheeled portable water jet machine of the present invention, due to the presence of rubber wheels R, of suitably arranged grips H and of a correct balancing of the masses, can be easily moved by hand into the desired positions of use by a single operator, despite an overall weight with a fully filled tank of about 200 kg. The wide track of wheels R and the presence of support feet F with anti-slip surface further allow the immediate use of the machine, as soon as it is positioned, with no need for any preventive stabilising or fastening operation.

[0012] Preferably, for construction simplicity and containment of construction costs, high-pressure pump P is directly keyed on the engine shaft of internal combustion engine M; however, this pump is in no way a limiting feature of the invention, and the connection between these two elements of the machine may hence comprise possibly disengageable connection devices known *per se*. A clutch-type connection device is of course essential should engine M be used, as well as for the actuation of pump P, also for other services, for example to actuate wheels R, which in the basic version of the machine are instead simply idle wheels.

[0013] The wheeled portable water jet machine of the present invention can of course be delivered in a self-propelled version; in this case motion of wheels R is preferably achieved by means of dedicated electric motors which are independent for each of the two wheels, so as to make it also easily possible to carry out curved trajectories or remote-controlling the machine. In the presence of motor-driven wheels, feet F are replaced by small swivelling idle wheels. Moreover, when motor-driven, wheels R can be replaced by caterpillars, when the nature of the soil on which the machine operates shows remarkable irregularities or slopes which make it necessary to provide the machine with greater stability.

[0014] The suction mouth of pump P is connected to a short piping which ends with an outer fitting 2, preferably of the fast-engagement type, arranged in the lower part of the machine in a protected and easily accessible position, for the connection to a usual water supply hose. It is also possible to provide a water tank on board the machine, when the same must operate at a certain distance from a water plug or when it is supplied by a hose having a lower flow rate than the jet one; in this case the inner tank also acts as a compensation lung.

[0015] The delivery mouth of pump P is instead connected to one or more flexible adduction hoses T (represented indicatively by discontinued lines in sole figs. 8 and 9), of the type resistant to high pressures which, starting from pump P, extend within arm B until arriving in correspondence of a nozzle-holding head 3, fastened to the free end of arm B, where pipes T are connected to corresponding special nozzles 4 for high nebulization. Should more than one nozzle 4 be mounted in nozzle-holding head 3 and hence should there necessarily be more than one adduction pipe T connected to pump P, a distribution valve is furthermore provided - arranged between the delivery mouth of pump P and the high-pressure adduction pipes T - capable of displacing the delivery of pump P from one to the other of said adduction pipes T. The position of the distribution valve may be changed by controlling an electric actuator or directly by the operator by acting on a suitable selection lever 5 arranged on the outside of the machine.

[0016] Nozzle-holding head 3 is mounted on the free end of distribution arm B so as to be able to rotate about the longitudinal axis of the arm, as well as to incline upwards and downwards in a vertical plane about a pin 6 perpendicular to such axis, so as to be able to direct the water jet exactly in the preset position. Preferably the angle of head 3 around the longitudinal axis of arm B may be caused to vary in a sector of $\pm$ 60°, or preferably of $\pm$ 45° with respect of the centre line of the machine, while the angle which the axis of nozzle 4 builds with respect to a horizontal plane, may be caused to vary from 15° downwards up to 60°, or preferably up to 30°, upwards, so as to be able to operate on a wide range of distances and directions with respect to the machine installation point. The specific control devices will now be illustrated in detail which are employed, in the embodiment of the wheeled portable water jet machine illustrated here, to allow the above-said rotation movements of head 3 with respect to distribution arm B, it being understood that the present invention is not limited to such systems, but of course comprises any one mechanical or electromechanical device, known per se, suitable to obtain such movements.

[0017] As visible in the detail views of figs. 7, 8 and 9, nozzle-holding head 3 is pivoted on a pin 6 fastened to a pair of brackets protruding from a plate 7 and integral with the same. Plate 7 is fastened on the upper end of arm B, in a plane perpendicular to the longitudinal axis

of the same, and is mounted on arm B so as to be able to rotate with respect to it about the above-said longitudinal axis. The rotation of plate 7 is controlled by a central rod 8 which extends for the entire length of arm B and until the base of the same, where the rod is fastened in an integral way to the end of a connecting rod 9 pivoted to the frame 1 of the machine, while the free end of said connecting rod is controlled in its displacements by a linear electric actuator 10. This coupling is illustrated in detail in fig. 9, where rod 8 is shown, for greater clarity, in the same plane as the sheet of the drawing, while in actual fact it extends in a direction perpendicular to said plane. The actuation of actuator 10 causes the rotation of the pivoted end of the connecting rod and, with it, the rotation of rod 8 about its own axis, which rotation determines the rotation of plate 7 and with it of pin 6 and of nozzle-holding head 3.

[0018] The change of inclination of head 3 is instead obtained through a rocker arm 11 pivoted at 12 to another pair of brackets, which are also integral with plate 7. A first end 13 of the rocker arm is fastened to a flexible control wire 15, while the opposite end 14 of the rocker arm is pivoted to the nozzle-holding head 3 in correspondence of a slit-shaped hole formed in the rocker arm. Also flexible wire 15 runs within arm B and is actuated, in a way well-known per se, by an electric actuator 16 arranged in the machine body beside the base of arm B.

[0019] The electric controls of actuators 10 and 16, as well as the one of the actuator for the actuation of the distribution valve of pipes T and possibly the control motors of wheels R, may be actuated through suitable buttons arranged on the machine body or, and preferably, through a radio control RC arranged at the base of arm B and remotely actuatable by the operator. This solution is particularly effective when the wheeled portable water jet machine of the invention is used in cooperation with an earth displacement machine; as a matter of fact, the operator of this latter machine is able, through the use of the remote control, to adapt at best both the position and the type/shape of the jet, and possibly also the position of the machine, depending on the progress of its work, without having to abandon its work position, as well as to interrupt the operation of the machine or to resume it (this last opportunity only in the machine versions equipped with electric ignition of engine M) depending on requirements. Also in this case the opportunity of a manual actuation of the above-said movements of nozzle-holding head 3 is nevertheless provided, through two control levers 17 arranged beside grips H, to adjust the jet direction in the vertical plane and in the horizontal plane, respectively. All the above-described electric controls are powered, in a way well-known per se, by an electric battery maintained under charge by the movement of engine M.

[0020] The opportunity to install more than one nozzle on nozzle-holding head 3 allows to have available differentiated functions of such nozzles, with reference in particular to the type/shape of the water jet which comes out of it, to be able to cover all the different possible use requirements, often varying even during a same processing. For example, even with only two nozzles it is possible to mount a first, very narrow, tapered nozzle, or even a cylindrical nozzle which hence privileges the range, to be able to operate at a long distance, and a second nozzle which privileges instead jet width by widening and possibly flattening the exit cone thereof to operate on close distances. In both cases the high water pressure and the particular shape of nozzles 4 allows strong nebulization of the jet so that the effectiveness of the jet in the dust abatement action is very high, despite very reduced water consumption over known-type plants.

[0021] The machine size is not particularly critical and can be adapted to the specific field of use depending on the flow rate and pressure required for the water jet and hence of the power of engine M. However, it is particularly useful even though not strictly necessary, for safety purposes, that the length of arm B be sufficient to bring the height of the nozzle-holding head 3 above the operators' passing area, for example between 1.8 and 2.5 m, so as to avoid any risk that the jet may interfere with the operators walking in the immediate proximity of the machine.

[0022] From the preceding description it should be clear that the wheeled portable water jet machine according to the present invention has fully achieved the set objects, by gathering into a single, easily movable piece of equipment which may be positioned by hand on the site of use, all the elements necessary for obtaining jets of high-pressure nebulized water, having different shape or range, which may be directed at will towards the desired target. Said machine hence allows to brilliantly solve the problem of dust abatement in all those situations characterised by mobility or temporariness, i.e. where the application of traditional fixed or semi-fixed plants would cause the above-illustrated drawbacks.

[0023] However, it is understood that the invention must not be considered limited to the particular arrangement illustrated above, which represents only an exemplifying embodiment thereof, but that a number of variants are possible, all within the reach of a person skilled in the field, without having to depart from the scope of the invention, which is only defined by the following claims.

Claims

1. Wheeled portable water jet machine for dust abatement, **characterised in that** it comprises a support frame (1) provided with at least one pair of idle wheels (R), whereon there are housed an internal combustion engine (M), a high-pressure pump (P) actuated by said engine (M), a water distribution arm (B) and a nozzle-holding head (3) fixed at the top of said arm (B), and **in that** there are furthermore provided water supply means of said pump (P) and one or more connection pipes (T) of the delivery of said

pump to corresponding nozzles (4) housed in said nozzle-holding head (3).

2. Wheeled portable water jet machine as claimed in claim 1), wherein said distribution arm (B) is rigidly fastened to said support frame (1), wherefrom it extends in a sub-vertical position.

3. Wheeled portable water jet machine as claimed in claim 2), wherein said nozzle-holding head (3) is mounted on the distribution arm (B) so as to be able to rotate about the longitudinal axis of the arm and/or incline upwards and downwards in a vertical plane around a pin (6) perpendicular to such axis, to direct the water jet into a preset position.

4. Wheeled portable water jet machine as claimed in claim 3), wherein the pin (6), on which the nozzle-holding head (3) is pivoted, is fastened to a first pair of brackets integral with a plate (7), in turn fastened to the top of the distribution arm (B) in a plane perpendicular to its longitudinal axis and rotatable around such axis with respect to the arm (B).

5. Wheeled portable water jet machine as claimed in claim 4), wherein the inclination of the nozzle-holding head (3) around the pin (6) is adjusted by a rocker arm system (11), and wherein said rocker arm
is centrally pivoted (at 12) to a second pair of brackets projecting from the plate (7);
it is fastened at one end (14) to the nozzle-holding head (3) in correspondence of a slit-shaped hole thereof;
and it is actuated at the other end (13) through a flexible wire controlled by a first actuator (16).

6. Wheeled portable water jet machine as claimed in claim 4), wherein said plate (7) is caused to rotate by rotating a rod (8) coaxial with it which extends along arm (B) and which is connected at the base thereof to the fixed hinge of a connecting rod (8) the free end of which is controlled by a second actuator (10).

7. Wheeled portable water jet machine as claimed in claim 1), wherein said connection pipes (T) are alternately connected to the delivery of said pump through a distribution valve actuated by a third actuator.

8. Wheeled portable water jet machine as claimed in claim 5), 6) or 7), wherein said first, second and third actuator are electric, possibly radio-controlled actuators, and/or manually-actuated levers.

9. Wheeled portable water jet machine as claimed in any one of the preceding claims, wherein said distribution arm (B) builds an angle smaller than 90° to the horizontal and preferably ranging between 60° and 85°.

10. Wheeled portable water jet machine as claimed in any one of the preceding claims, wherein the height from the ground of said nozzle-holding head (3) ranges between 1.8 and 2.5 m.

11. Wheeled portable water jet machine as claimed in any one of the preceding claims, wherein the rotation angle of said nozzle-holding head (3) around the longitudinal axis of distribution arm B is of $\pm$ 60° or preferably of $\pm$ 45° to the longitudinal centre line of the machine.

12. Wheeled portable water jet machine as claimed in any one of the preceding claims, wherein the inclination angle of said nozzle-holding head (3) around said pin (6) is of 15° downwards and of 60°, or preferably of 30°, upwards with reference to the position of the axis of the nozzles (4) with respect to the horizontal plane.

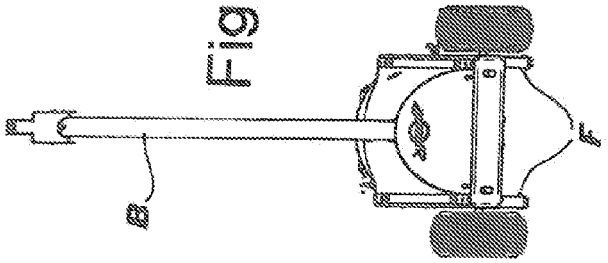
13. Wheeled portable water jet machine as claimed in any one of the preceding claims, wherein said water supply means consist of a fitting to a water supply hose and/or of an on board water tank.

14. Wheeled portable water jet machine as claimed in any one of claims 1) to 13), wherein said frame (1) is furthermore provided with support means consisting of fixed feet (F).

15. Wheeled portable water jet machine as claimed in any one of claims 1) to 13), wherein said wheels (R) are motorised, and said frame furthermore comprises support means consisting of small, swivelling idle wheels, the motion of said wheels (R) being preferably accomplished through dedicated and independent electric motors for each individual wheel.

16. Wheeled portable water jet machine as claimed in 15), wherein said wheels (R) are replaced by caterpillars.

Fig. 2



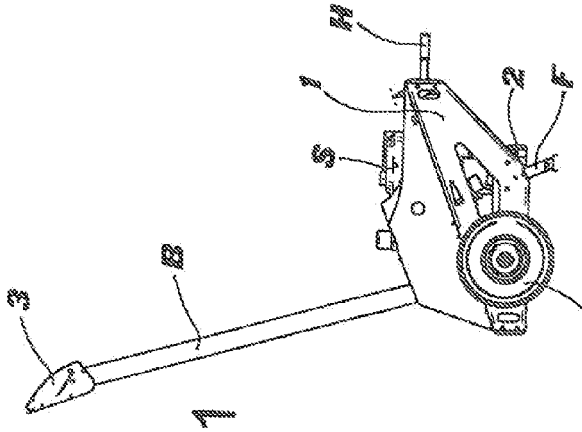


Fig. 1

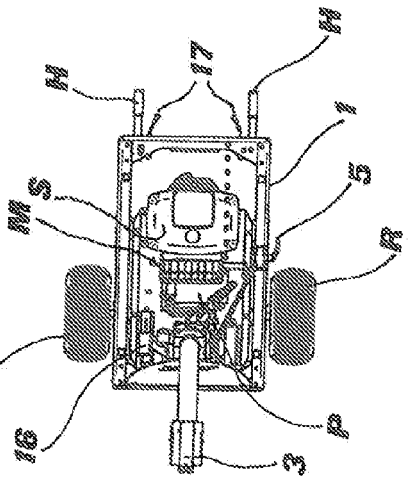


Fig. 3

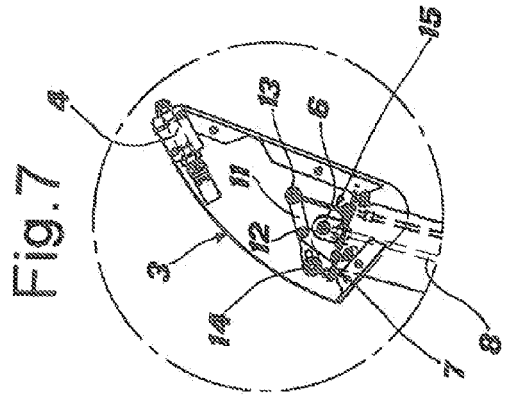


Fig.7

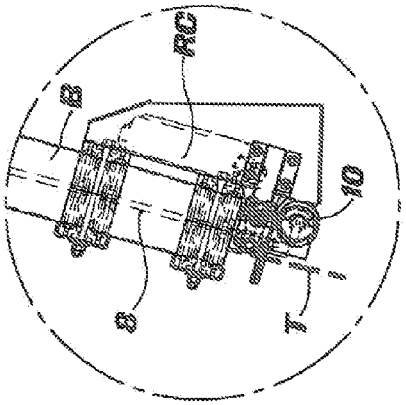


Fig.8

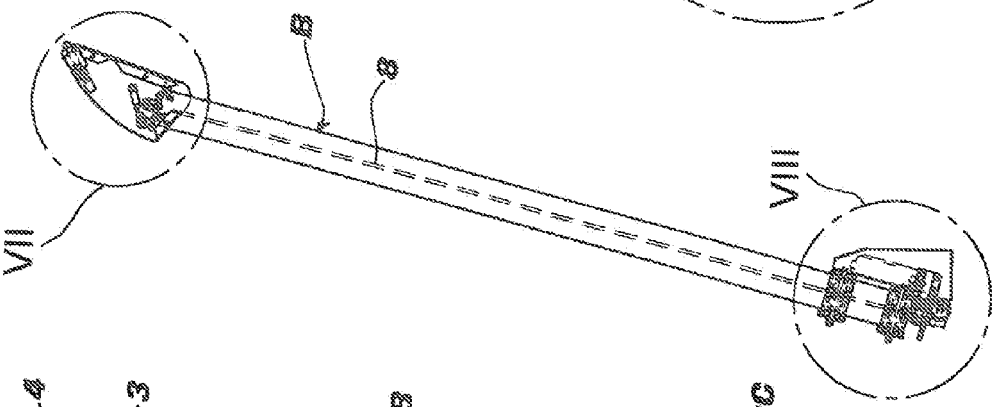


Fig.6

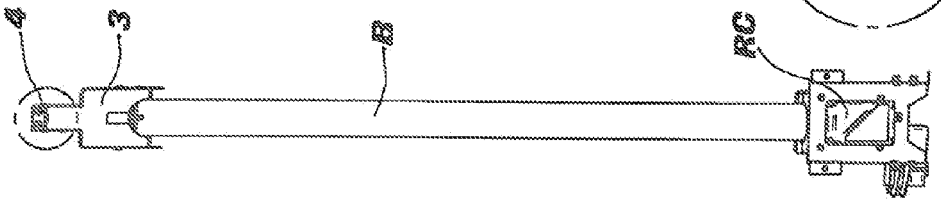


Fig.5

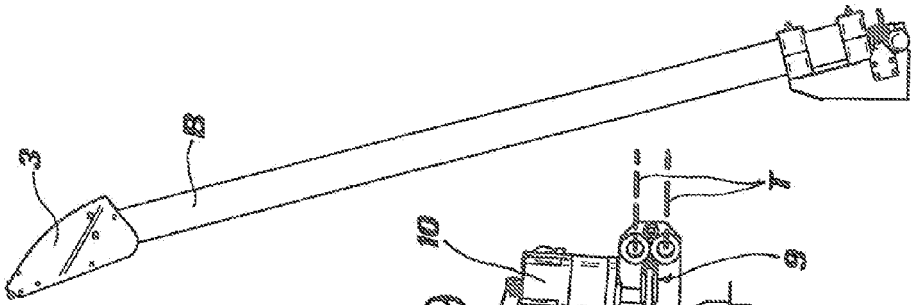


Fig.4

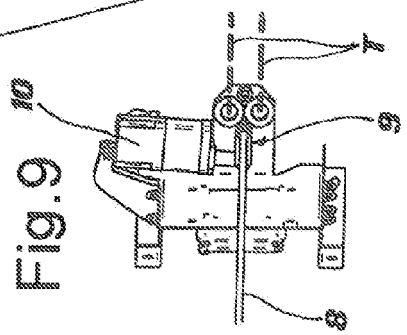


Fig.9

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 2496

DOCUMENTS CONSIDERED TO BE RELEVANT

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A62C B62B B05B A01M B08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 June 2011	Rente, Tanja

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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