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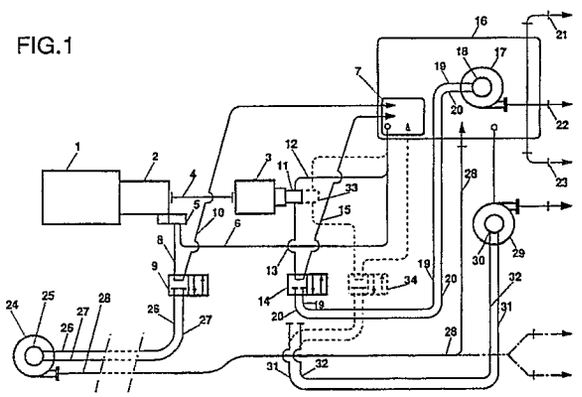
## (54) Mobile firefighting equipment.

(57) A self contained firefighting equipment which may be mounted on a vehicle employs a submerged pump directly mounted on the bottom of a water tank and driven by a first hydraulic motor for delivering water fron the tank through a plurality of dispensing hose outlets. An auxiliary pump hydraulic motor group may be displaced at a distance from the unit by utilizing a pair of flexible tubes for circulating the operating oil to and from the hydraulic motor which is fastened to the pump body and to the pump outlet is connected a water hose for ducting water to the water tank of the unit or to another series of dispensing hose outlets. The auxiliary hydraulic motor-water pump group may be dropped to the bottom of water wells down to a depth of 40 meters for submerging the pump in the bottom water or in any other body of water available. Most preferably there is a third pump driven by a third hydraulic motor capable of delivering water at a high delivery pressure for dispensing water through special high pressure flexible hoses which may be extended for extremely long distances to allow the firefighters to reach fire front positions distant up to 1.000 meters from the unit in rugged areas which may reached only on foot. Each hydraulic motor is driven through a respective hydraulic circuit which comprises a hydraulic pump, a distributor regulator and an operating oil tank. The hydraulic pumps are driven by the engine of the vehicle or by a dedicated auxiliary diesel engine through a plurality of drives.

FIG.1



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# MOBILE FIREFIGHTING EQUIPMENT

The present invention relates to firefighting equipments and in particular to a self-contained firefighting equipment particularly suitable for a mobile truck unit especially designed for fighting bush fires and generally fires in rugged areas lacking of fixed firefighting installations.

The fighting of fires far from purposely equipped built up areas, i.e. lacking of fixed firefighting installations, relies largely on mobile firefighting units, commonly disposed on trucks, which may quickly reach the front of the fire through available dirt roads. Normally such a mobile firefighting unit comprises a water tank, a fixedly mounted pumping group comprising one or more pumps driven by the truck's engine or by a dedicated auxiliary diesel engine and by an arrangement of hydraulic manifolding and connections which permits to the firefighters to hook-up in hoses through which pressurized water drawn from the tank may be delivered at a distance, as well as to hook up hoses for refilling the water tank, by using for the purpose either the same pump (momentarily taken off the service as water delivering puBp) or an auxiliary pump specifically for the filling of the tank which may also be driven by the same engine. These conven tional units, though quite suitable for use in built-up areas or where water taps or surface reservoirs may be readily reached, are poorly suited for operating in scarsely equipped areas and/or where water must be pumped-out of deep wells, because the pumps of these units have a limited ability to draw water from a depth over about eight meters. On the other hand, this is a frequently occurring situation in rural areas. Moreover when fighting against bush-fires, the pos sibility of delivering water through relatively small diameter, high pressure tubes, extendable for relatively long dis tances for reaching relatively far away smoldering fires which may be approached only on foot by the fire fighters would be greatly welcome as a complement to the availability of delivering hoses, designed customarily for relatively high delivery rates.

In conventional mobile units this possibility is limited because of the general requirements which impose the selection of a certain type of relatively high flow rate deliv ering pump having certain characteristics which are hardly suitable to the use of such long flexible delivering tubes which imply a relatively high pressure drop.

It has now been found that these limitations and drawbacks of known mobile units may be overcome by employing the firefighting equipment object of the present invention as de fined in the appended claims.

Basically the firefighting equipment of the invention utilizes two or more hydraulic pumps driven through respective primary power take offs of the engine of the vehicle carrying the self-contained equipment or of the transmission organs thereof (gear, speed reducer, etc.). Each hydraulic pump utilizes an operating fluid, normally a suitable mineral oil, contained in a common operating fluid tank, and through an individual hydraulic circuit circulates the oil under pressure through a respective distributor, which is provided with a pair of hydraulic couplings, preferably of the snap on-snap off type preferably with automatic fluid stop means when disconnected, respectively for delivery and return of the fluid, to which two flexible high pressure tubes may be connected for driving an hydraulic motor which in turn drives a respective water pump. In particular a main pump, for de livering water through the high flow rate hoses, is conveniently an immersion pump mounted directly on the bottom of the water tank and on the body of which is fixedly mounted the driving hydraulic motor.

A similar second hydraulic motor water pump assembly is essentially mobile and may be carried at a distance from the firefighting truck by utilizing a pair of flexible tubes for circulating the operating fluid through the hydraulic motor and a standard water hose (UNI 70) connected to the outlet of the pump and extensible together with the two flexible tubes for a considerable length. This second displaceable motorpump group may be dropped to the bottom of a well or of a cistern and it is capable of pumping water to the surface through the hose and to the fire fighting truck for filling the water tank. Alternatively or simultaneously the same dis placeable auxiliary motor pump group may be employed for delivering water pumped up from the underground reservoir through one or more high flow rate delivering hoses, acting alone or in parallel with the normal high flow rate delivering system through other hoses of the water contained in the tank.

Moreover, according to a preferred embodiment of the invention, a third pump, specifically designed for relatively high delivery pressure, which is also driven by a hydraulic motor controlled through a respective distributor of pressur ized operating oil, is fixedly mounted on the truck. While the first two water pumps are preferably of the centrifugal type providing a relatively high flow rate, this third water pump is preferably a piston or gear type pump, specifically designed to provide a high delivery pressure, and is characterized conversely by a relatively low flow rate of about 12 liters per

minute at a delivery pressure which may reach 450 bar.

By means of this special high pressure pump, one or more small diameter high pressure flexible tubes which may be extended for a remarkable length (up to 1 km), are fed with pressurized water for delivering it at a pressure of about 30-50 bar, in locations which may be remarkably distant from the firefighting unit in an effective manner because of the relatively high pressure available through these, dispensers fed by the special high pressure pump.

**Figure 1** is a hydraulic diagram illustrating the equipment of the invention according to a preferred embodiment.

**Figure 2** is a partial plan view showing schematically the arrangement of some of the components of the equipment of Fig. 1.

**Figure 3** is a partial elevation view of the equipment of Fig. 2.

The same parts are indicated with the same numbers in all the figures.

With reference to Fig. 1, the equipment comprises an en gine 1, which may be a dedicated service engine of the fire fighting equipment, preferably a diesel engine, or it may be the same engine of the vehicle onto which the firefighting equipment is mounted, and which may have a power rating of about 70-120 kW. The eventual mechanical gear of the engine is indicated with 2 and an eventual speed reduction group, driven by the axle 4 through a power take-off of the gear 2 is indicated with 3. On a purposely provided drive of the gear 2 is mounted a first hydraulic pump 5, the hydraulic circuit of which comprises an inlet line 6 for drawing ope rating fluid, normally a mineral oil, from an oil tank 7, a delivery line 8 of the pressurized oil to a distributor regulator 9 and a return line 10 to the tank 7 of the operating oil.

A second hydraulic pump 11 is mounted on a purposely provided power take off of the speed reduction group 3 and the hydraulic circuit thereof is formed by the drawing line 12 from the oil tank 7, the delivery line 13 of the pressurized oil to a respective distributor regulator 14 and the re turn line 15 of the oil to the tank 7. The common operating oil tank 7 is conveniently contained inside the water tank 16 having a much larger volume which may vary between 1.5 and 3 $m^3$ for small size equipment suitable to be carried by light weigth trucks, and between 5 and 10 $m^3$ for equipment designed for heavy vehicles. The tank 7 has external walls direcity in contact with the water contained inside the tank 16 in order to promote dissipation of the heat produced by the pressur ization of the oil in the water. In order to increase the heat exchange capacity, the external walls of the oil tank 7 in contact with the water contained inside the tank 16 may be provided with fins. Alternatively the oil may be circulated through a serpentine immersed in the water contained inside the tank 16.

Each distributor-regulator (9, 14, ...) constitutes the drive and adjustment organ of a respective hydraulic motor driving a respective water pump. For this purpose, each distributor-regulator is provided with a delivery and with a return coupling through which high pressure flexible tubes are connected for circulating the operating oil through the relative hydraulic motor mechanisms. The delivery of the water contained inside the tank 16 through one or more delivery hoses takes place by means of an immersion pump 17, pref erably of the centrifugal type, directly mounted on the bottom of the water tank 16 and driven by the hydraulic motor 18 through which the operating oil circulates through the deliv ery and return conduits 19 and 20 respectively, which are connected to the respective delivery and return couplings of the relative distributor-regulator 14. The delivery of the water may take place, as depicted in the shown example, through three taps for the hoses 21, 22 and 23. Normally the power of this first hydraulic motor pump group may be com prised between about 5 and 25 kW.

The equipment comprises a second water pump group, formed by a second pump 24 having a flow rate capacity of about 1.000 - 1.600 liters per minute, driven by a hydraulic motor 25, mounted directly on the body of the pump 24, which may be carried at a distance from the equipment and may be immersed in a water reservoir. The group may be positioned at a dis tance from the truck by using a pair of flexible tubes, re spectively 26 and 27 for the delivery and return of the operating oil, the extremities of which may be coupled to the respective delivery and return couplings of the distributor regulator 9 and of a flexible hose 28 for ducting the water to the equipment, which hose is also extensible together with the two flexible tubes 26 and 27, by unrolling together from the same drum or by joining together a sufficient number of pieces of tubes and of hose of standard length provided with snap on-snap off couplings. A steel cable (not shown in the figure), may also be employed together with the flexible tubes 26, 27 and 28 and may unroll itself also from the same drum together with the tubes, for sustaining the weight of the group formed by the pump 24 and by the hydraulic motor 25 in order to facilitate the dropping of the group to the bot tom of wells or of water cisterns. The displaceable pump group may be operated at a remarkable distance from the fire fighting unit and is capable of pumping back water to the unit from a depth of up to 40 meters, and of filling a 1.000 liters tank in about 30 seconds.

The pump 24 is preferably a centrifugal pump

similar to the pump 17 and operable while fully immersed in the water. The power of this auxiliary pump group which may be displace able at a distance from the firefighting unit is comprised between 10 and 30 kW.

This group displaceable at a distance from the unit and formed by the pump 24 and by the motor 25 may be used for filling the water tank 16 through the hose 28, or the latter may be directly employed for dispensing water through other auxiliary water delivery hoses connectable thereto, either in parallel to the water delivery system of the primary hoses 21, 22 and 23 or alternatively supplementing or substituting the primary pump when the tank is empty, according to need (the former alternative is schematically indicated in Fig. 1 by dash and point line phantom outline).

According to a particularly preferred embodiment, the equipment of the invention comprises a third pump 29 driven by a hydraulic motor 30 supplied through the circulation lines for the operating oil 31 and 32. This group may have a power rating comprised between 5 and 10 kW. The same distributorregulator 14 used for driving the hydraulic motor 18 of the main water delivery pump 17 may be utilized for driving, in an alternative, the hydraulic motor 30 of the pump 29 either by uncoupling the lines 20 and 19 by the "quick-action" couplings provided on the body of the distributor-regulator 14, or by providing appropriate flow diverging valves. Alterna tively, as shown in Fig. 1, by the dash line outline, the hy draulic motor 30 of the high pressure pump 29, may be driven by means of a third hydraulic pump 33 and of a relative distributor regulator 34 to the delivery and return couplings of which may be stably coupled the feed line 31 and return line 32 of the hydraulic motor 30.

This third high pressure pump 29, differently from the other two pumps and precisely from the main water delivery pump 17 mounted on the bottom of the water tank 16 and of the auxiliary filling/dispensing pump 24, is a gear type pump or a piston type pump capable of producing a high delivery pressure though with a relatively small flow rate. This third pump 29 is used solely for supplying one or more water di spensing tubes extensible for relatively large distances, made with a flexible tube capable of withstanding a 30 bar pressure and which may be readily wound over a suitable winding drum. The total length of the high pressure tubes may reach about a kilometer by joining together several pieces of tube, each of about 150 meters, in order to reach places along the front of the fire which would not be reacheable by the truck mounted unit itself. The special pump 29 permits a rational utilization of this type of flexible high pressure tubes of relatively small diameter which notably produce a remarkable pressure drop. The water jet at the dispensing nozzle of the tube remains vigorous and through suitable con trols the form of the jet may be readily varied according to need.

In Figures 2 and 3 the location of the main parts which compose the firefighting equipment of Fig. 1 is shown. As it may be observed in the figures. most of the components of the firefighting equipment may be contained in a module which is easily loaded or integrated in the chassis structure of a truck, which is purposely equipped with the necessary drives and hydraulic components described in relation to Fig. 1. The tank module comprises a steel frame 41 onto which a tank 16 bears by means of four or more brackets 44. The tank may be of steel or of aluminum or of other suitable metal and is provided with a manhole 40 and with a load nozzle 28′, to which the load hose 28 previously described in relation to Fig. 1 may be coupled. The tank contains an operating oil tank 7 provided with a load nozzle 39. Two or more winding drums 42 for winding the various hoses and eventually also the flexible high pressure tubes for driving the displaceable auxiliary hydraulic motor-water pump group, may be mounted on a terminal portion of the frame 41. The main water delivering pump 17 is fixed to the bottom of the water tank 16, together with the driving hydraulic motor 18, to which through the lines 19 and 20, which may conveniently terminate with two quick-action couplings 19′ and 20′ mounted through the wall of the tank, the operating oil may be circulated. Water may be delivered through the three taps 21, 22 and 23 to which as many dispensing hoses may be coupled. The oil tank 7 may be conveniently provided with a level indicator 37 and with a drain tap 38. For purely illustrative purposes, the presence of two quick action couplings 35 and 36 is shown on the ex ternal wall of the tank 16, respectively for the return and the delivery of the operating oil contained inside the tank 7. Moreover in Fig. 2 is shown the use of a cooling serpentine of the operating oil 43 through which the oil returning from a distributor-regulator is circulated in order to pro mote the heat exchange with the water normally contained inside the tank 16 and thus more efficiently cooling the oil. The operating oil may also be suitably cooled by employing an external radiator provided with a fan.

To the two couplings 35 and 36 respective manifolds may be connected, each having a suitable number of quick-action (snap on-snap off) type coupling nozzles for arranging the connection thereto of the distributors-regulators which are employed by the firefighting equipment of the invention for driving the distinct hydraulic motors of the respective pumps which are utilized.

The firefighting equipment of the present invention be side overcoming the limitations of the traditional equipments offer numerous advantages, which may be easily recognized. The use of a centrifugal pump submerged directly in the water contained inside the tank greatly simplifies the layout and ensures a good hydraulic efficiency for the delivery of water through the high flow rate dispensing hoses. The possibility to operate the auxiliary tank filling/dispensing pump group at a considerable distance from the truck unit and the utilization also for this auxiliary group of a submergible pump driven by a hydraulic motor, permits to easily exploit deep water reservoirs, which may be accessed through wells, beside being perfectly suited to pump water from ponds, channels, cisterns and other similar water reservoirs. The displaceable pump group may act in parallel with the primary delivery pump, and, when the water in the tank has been consumed. in substitution of the primary water dispensing system, without requiring complex maneuvering to the firefighters. Moreover the auxiliary pump group operable at a distance may advanta geously serve for rapidly filling, in succession, the tank of the unit itself as well as the tanks of other units being operated in the area, thus effectively serving as a re fill station.

## Claims

1. A firefighting equipment comprising a water tank, an engine provided with a plurality of drives, a first water delivery pump driven by said engine and capable of feeding pressurized water drawn from said tank to a plurality of delivery outlets for dispensing hoses, at least a second load pump driven by means of said engine suitable to fill said tank with water drawn from a water reservoir, and characterized by comprising

a first hydraulic pump driven through a first drive of said engine and capable of pressurizing an operating fluid drawing it from an operating fluid tank and delivering it to a first distribution-regulation device provided with a delivery outlet and a return outlet and from which distribution regulation device the operating fluid returns to said operating fluid tank through a return conduit;

at least a second hydraulic pump driven through a second drive of said engine and capable of pressurizing an ope rating fluid drawing it from an operating fluid tank and de livering it to a second distribution regulation device provided with a delivery coupling and a return coupling and from which distribution regulation device the operating fluid returns to said operating fluid tank through a return conduit;

a first water delivery pump immersed in the water contained in said water tank, driven by a hydraulic motor me chanically mounted directly on the body of said pump and driven by means of said operating fluid circulated therethrough by means of said first distribution-regulation device thorugh an inlet and an outlet conduits connected to said de livery coupling and return coupling, respectively, said sub merged first delivery pump being capable of feeding water contained in said tank under pressure to said plurality of water delivery outlets for as many dispensing hoses;

at least a second water pump which may be displaced at a distance from the equipment and which may be submerged in a distant water reservoir, driven by a second hydraulic motor mechanically mounted directly on the body of said second water pump and driven by means of said operating fluid circulated therethrough by means of said second distributionregulation device through a pair of flexible tubes for the circulation of the operating fluid, respectively, coupled to said delivery and return couplings of said second distribution regulation device, a flexible hose, extensible along with said pair of flexible tubes of circulation of the operating fluid, being connected to an outlet port of said second pump and capable of ducting the water from said reservoir to said tank.

2. The firefighting equipment according to claim 1, characterized by the fact that it comprises a third water pump driven by a third hydraulic motor, mechanically mounted directly on the body of said pump and driven by a hydraulic circuit comprising a third hydraulic pump driven through a third drive of said engine and a third distributionregulation device for the operating fluid;

said third pump being capable of delivering water taken from said tank at a pressure essentially higher than the delivery pressure of said first and of said second pumps, through at least a first length of a flexible high pressure tube extensible for a length of over one hundred meters from the unit.

3. The equipment according to claim 1, characterized by the fact that the entire firefighting unit is mounted on a vehicle and wherein said second pump may be displaced at a distance from the vehicle for gathering water from a maximum depth of 40 meters and with a flow rate of at least 1.000 liters per minute.

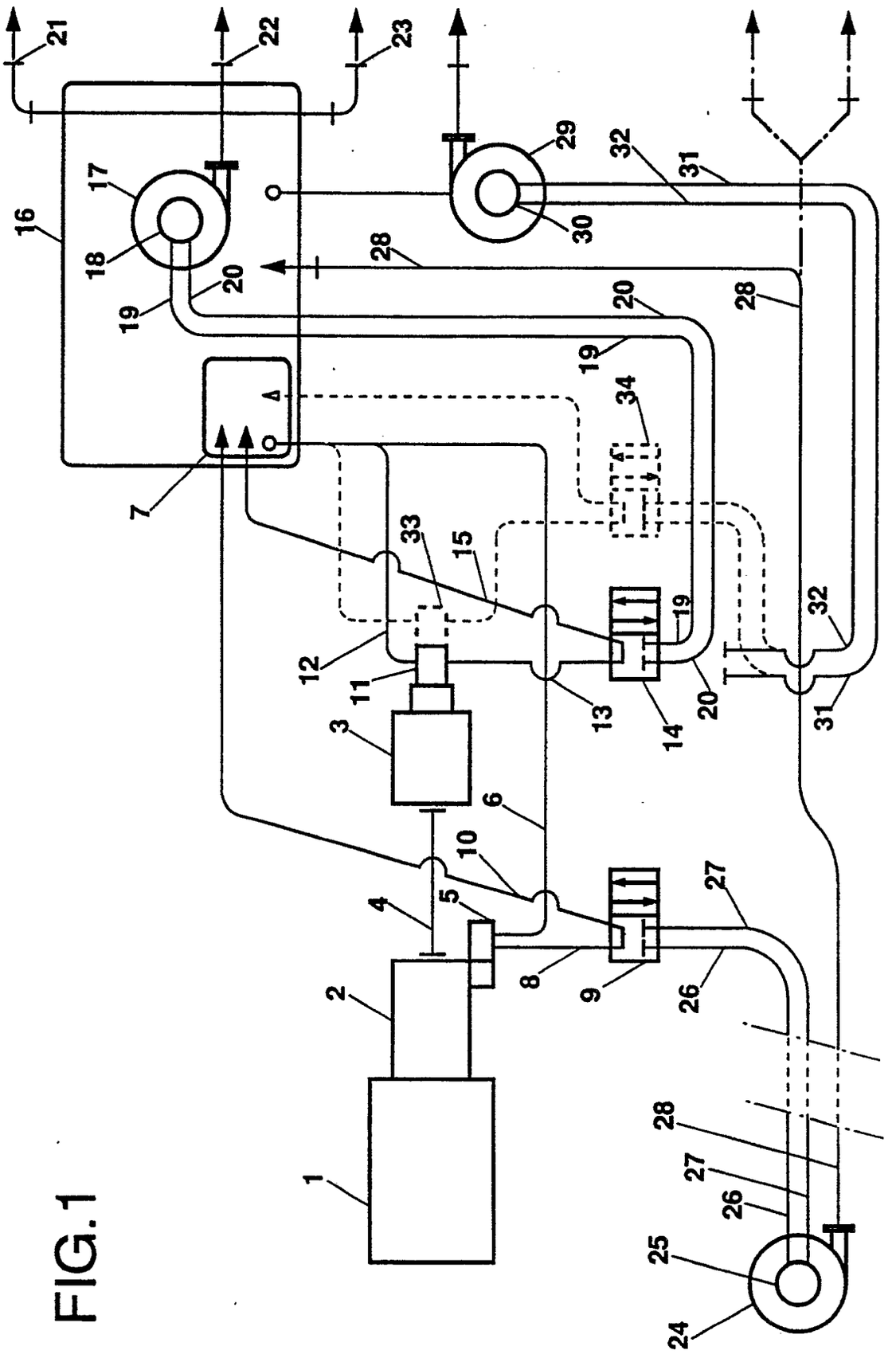
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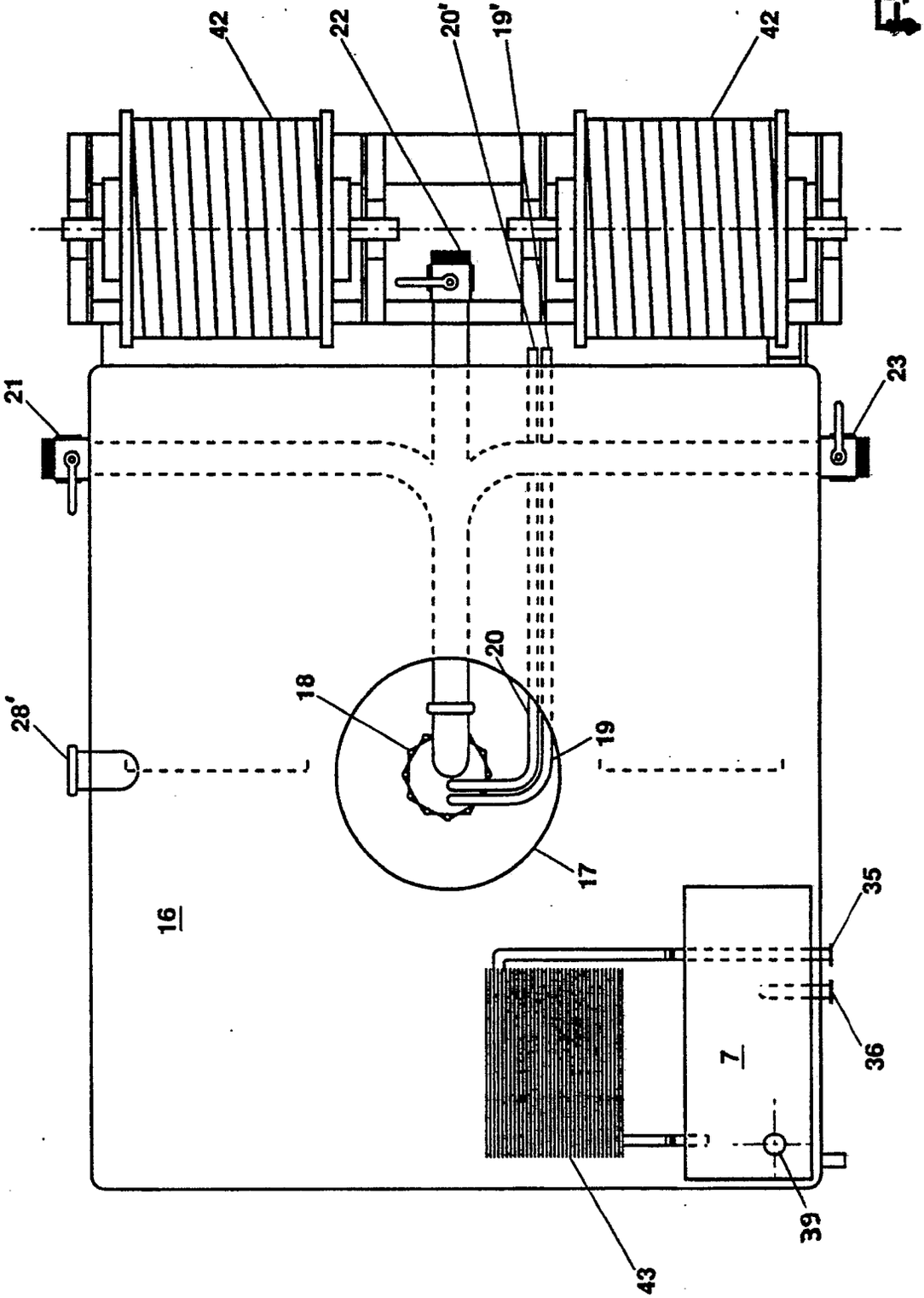
FIG.1

FIG.2



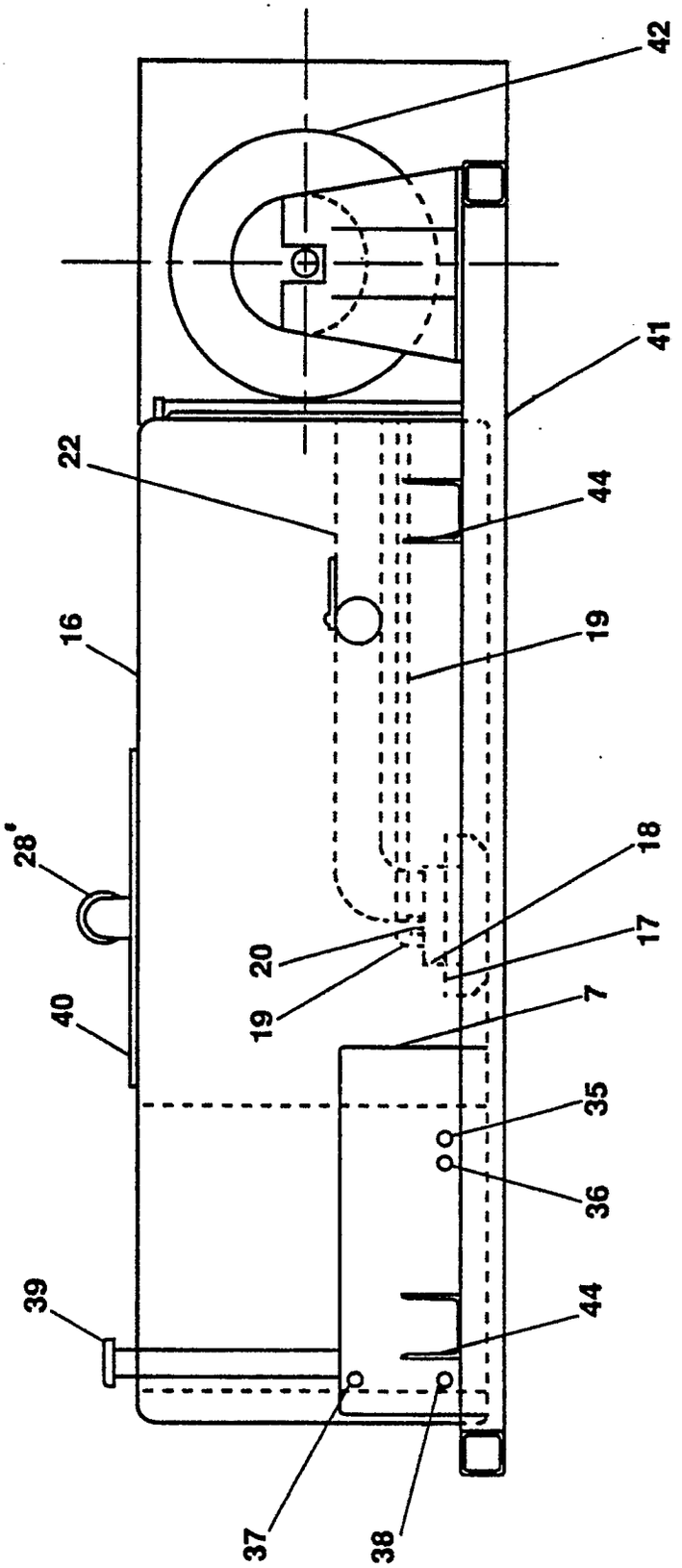



FIG.3

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0282

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| A | US-A-3 770 060 (FORSYTH ET AL.)<br>* column 2, lines 14 - 31; figure 1 * | 1,3 | A 62<br>C 25/00<br>A 62 C 27/00 |
| A | FR-A-2 589 401 (DION-BIRO)<br>* claim 1; figure 1 * | 1,3 | |
| A | EP-A-0 098 055 (ENTERRA CO.) | | |
| A | DE-A-2 656 835 (MAGIRUS-DEUTZ AG) | | |
| A | DE-A-3 825 651 (ROSENBAUER INTERNATIONAL GMBH) | | |

| TECHNICAL FIELDS SEARCHED (Int. Cl.5) |
|---|
| A 62 C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of search | Examiner |
|---|---|---|
| The Hague | 28 January 91 | DIMITROULAS P. |

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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