



- (51) International Patent Classification:
A61G 5/00 (2006.01) A61G 5/04 (2013.01)
- (21) International Application Number:
PCT/GB2012/000812
- (22) International Filing Date:
25 October 2012 (25.10.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
1119604.5 12 November 2011 (12.11.2011) GB
1215162.7 24 August 2012 (24.08.2012) GB
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- with amended claims (Art. 19(1))

(54) Title: WHEELCHAIR SYSTEM

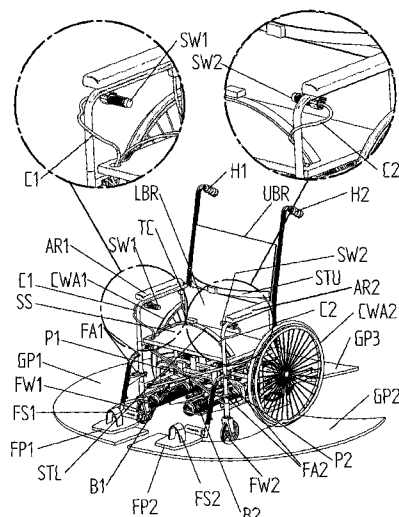


FIGURE 1

(57) Abstract: A controllable submersible system, as shown in Figure 1 of the specification, which, in one variant of the system, involves a modified wheelchair which allows its occupant to descend into, and ascend out of, water, and to travel in the water, at various depths, or on the surface of the water. According to the present invention, a wheelchair is provided with means for, i) propulsion in water, whilst at the surface of the water, and whilst at various depths in the water, and ii) for controllable descent into, and controllable ascent out of, water, for various depths. The invention thus represents an alternative way of using a wheelchair via the utilisation of propulsion units which are normally found on conventional diving equipment and on dive propulsion vehicles. One variant of the invention involves apparatus comprising modifications to a basic National Health Service wheelchair in order to allow the fitting of propulsion units and controls therein, and to allow flexible movement, up and down in the water, and in various directions in the water under full control of the occupant of the wheelchair. This allows the performance of aquabatics, at the surface of, and under, water, in the same way that an acrobat performs such movements on land, and an aerobat performs in the air. The occupant of the submersible wheelchair is thus able to perform dance like movements, and to make performances such as loop-the-loop and barrel roles, etc. These performances are referred to as aquabatics, in the same way that acrobatics are performed on land and aerobatics are performed in the air. The invention also allows the equivalent of synchronised swimming to be performed by wheelchair users.

WHEELCHAIR SYSTEM

This invention relates to a controllable underwater system, wherein variants of the system can either be self-controlled, or remotely controlled.

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When applied to the adaptation of a conventional wheelchair, for use both on land and in water, the invention represents the intention of the Inventor to draw attention to methods of self-representation and to the power of self-narration, in challenging the nexus of power and control that created the "disabled" as "other". One of the aims
10 being to thus reconfigure the preconceptions of some observers, by drawing attention to the presences and absences created by some socio-cultural concepts that have been created around disability, and to the semiotic content associated with the objecthood of the wheelchair. The Inventor also wishes to make people aware of the fact that the wheelchair can also be an object that facilitates fun and freedom.

15

Variants of the system involve the application of the principles of the invention to apparatus other than a wheelchair, but any of the resulting products can be utilised by both disabled, and, able bodied, persons.

20

Inter alia, it will be shown how the present invention provides means for a wheelchair user to descend into, and ascend out of, water, and to travel in water, at various depths, and on the surface of the water, either under their own control, or under the control of at least one other person.

25

According to the present invention, methods, and apparatus, allow use of the system, both on land and in water, for the carrying, and transportation, of at least one person, wherein the apparatus can be propelled on land, and also on the surface of, and under the surface of, water, wherein the method of control of the apparatus is by the utilisation of parts of the said apparatus by at least one person, and wherein the said
30 method of control can be partially, or fully, implemented by at least one occupant of the said apparatus, and wherein the said partial or full control, can, instead, be implemented by at least one person who is remote from the said apparatus, under so called, Attendant Control, wherein, the method of providing movement of the apparatus of the system and its at least, one occupant, on land and in water, is by
35 means of at least one means of propulsion, and wherein at least one method of altering the orientation of the said apparatus in water, is via the operation of at least

one hydroplane, which is located symmetrically on the apparatus, wherein the said hydroplane, can be partially, or fully, controlled by the said, at least one occupant, or by the said, at least one person who is remote from the said apparatus.

5 One variant of the system involves a National Health Service wheelchair, which has been modified and adapted according to, and for the for the purposes of applying, the principles of the invention, whilst another variant of the system involves apparatus which has been purpose-built according to, and for the purposes of applying, the principles of the invention.

10

In both of these variants, the said apparatus has been constructed so that the, at least one occupant, or the at least one person who is remote from the apparatus, can operate, and cause to move, the said apparatus, and its said, at least one occupant, and also control its descent into water, and ascent out of, water, and its motion in water, at various depths, or on the surface of water, wherein the said apparatus is provided with means for, i) propulsion in water, both whilst at the surface of the water, and whilst at 15 various depths in the water, and ii) for controllable descent into, and controllable ascent out of, water, for various depths, wherein the apparatus utilises at least one propulsion unit of a type which is normally found on conventional diving equipment and on dive propulsion vehicles, and wherein the apparatus involves the fitting of two 20 of the said propulsion units and associated controls therein, and allows flexible movement, in three dimensions in the water, under full or partial control of the at least one occupant of the wheelchair, or under the full or partial control of the said at least one person who is remote from the apparatus, so that acrobatics can be performed at the surface of, and under, water, in the same way that an acrobat 25 performs such movements on land, and an aerobat performs in the air, wherein the said, at least one occupant of the apparatus, is thus able to perform dance-like movements, and to make performances such as loop-the-loop and barrel roles, and the like, wherein the said performances can be referred to as aquabatics, in the same way 30 that acrobatics are performed on land and aerobatics are performed in the air.

Where the system involves modifications to a National Health Service wheelchair, each one of two right, and left, hydroplanes, respectively, is attached to the underside of each one of the two right and left, respectively, footrests of the said National 35 Health Service wheelchair, wherein the said footrests have been removed, modified,

and repositioned, so that the re-orientation of the foot pedal assemblies of the said wheelchair results in the planes of the two parallel upper and lower surfaces of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane, which are releasably and firmly attached to them, being at an angle which is greater than zero, with respect to the horizontal, and hence with respect to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane, as viewed from the front, in level flight, are symmetrically orientated at an angle, with respect to the said horizontal, which is greater than zero, wherein this arrangement has been found to aid control of the attached right and left hydroplanes, and hence of the underwater wheelchair, and wherein a value of this angle which allows acceptable control of the underwater wheelchair, has been found to be approximately ten degrees.

Where the system involves apparatus which has been purpose-built, each one of two right, and left, hydroplanes, respectively, is attached to the underside of each one of two right and left, respectively, footrests of the said apparatus, wherein the orientation of the foot pedal assemblies of the apparatus, results in the planes of the two parallel upper and lower surfaces of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane, which are releasably and firmly attached to them, being at an angle which is greater than zero, with respect to the horizontal, and hence to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane, as viewed from the front, in level flight, are symmetrically orientated at an angle, with respect to the said horizontal, which is greater than zero, wherein this arrangement has been found to aid control of the attached right and left hydroplanes, and hence of the apparatus, and wherein a value of this angle which allows acceptable control of the apparatus, has been found to be approximately ten degrees.

In the case of both the apparatus involving the modified National Health Service wheelchair, and, the purpose-built apparatus, two of the conventional, battery powered propulsion units, known as Pegasus Thrusters, which are normally used by divers, have been adapted and fitted to the said apparatus, together with their respective batteries, by means of a specially designed framework, in order to provide propulsion for the underwater wheelchair system, wherein each one of the two right and left, specially shaped hydroplanes, respectively, is at least under the control of the

right and left foot, respectively, of the said at least one, occupant, and wherein one specially shaped hydroplane which is located symmetrically, at the rear of the apparatus, is under the control of at least one hand of the, at least one occupant, at least via at least one gear change mechanism and Bowden Cable link, which have
5 been adapted from use on a mountain bicycle to use on the said apparatus.

The electrical supply from each of the said batteries, and hence to each of the said propulsion units, respectively, is independently controlled by means of each one, of a pair of right, and left, spring-loaded push-button switches, respectively, which can
10 each be operated, independently, by pushing them into the on position, by means of the movement of them, by the outside of each right, and left, thigh region, respectively, of the, at least one occupant, whilst the occupant is seated in the apparatus, wherein the said propulsion units are provided with electrical power from the said batteries, by means of waterproof cabling. These said switches can be in
15 any positions on the said apparatus, which allow control of it.

Where the apparatus is to be used by persons who are limbless, and/or lack the ability to implement control by direct use of parts of their body, the said apparatus can be adapted to incorporate mechanisms which drive the said hydroplanes via the use of
20 so-called sip-puff switches, which are operated by the mouth; alternatively, other devices which can be operated by means of the tongue, or by means of the eyes, or by means of any other part of the human body, can be utilised for controlling the apparatus, wherein such devices can be used instead of, or in addition to, the said push-button switches.

25 In a practical working example of the invention, which has been successfully demonstrated by the Inventor, the said hydroplanes have been constructed from acrylic material, wherein the two hydroplanes which are operated by the feet of the, at least one occupant, and the third, and rear, hydroplane, which is operated by the said
30 hand of the said occupant, are each specially designed, arranged, and orientated, for aesthetic purposes, and so as to allow the occupant to perform aquabatics.

The at least one occupant of the apparatus is able to enter a swimming pool, or to enter the sea, or any other region of water, whilst the wheels of the said apparatus are
35 used for support, and are under the control of the at least one occupant, or the at least

one person who is remote from the apparatus, either by means of separate wheel driving apparatus, or at least by means of one of the hands of the said, at least one occupant, and wherein the said occupant is able to move on the floor of a swimming pool, or the bed of the sea, or other region of water, if sufficiently flat, and to utilise the apparatus of the invention to move in the water and at the surface of the water, at least under the control of the at least one occupant, or the at least one person who is remote from the apparatus.

Other means of propulsion and control of the said apparatus can involve a water jet; also known as a hydrojet or pump jet, in addition to, or in place of, the propulsion units mentioned hereinbefore, wherein such systems can provide more flexible control of the apparatus, and wherein either a ducted propeller having a nozzle which can be adjusted so as to be orientated into any desired direction, is utilised, or a centrifugal pump provided with a nozzle which is similarly adjustable, is utilised, wherein such systems are commonly used in jet skis, pleasure boats, military water-based vehicles, and ferries, wherein the range of flexibility of control which can be available is then only limited by the number, and power, of such systems, and the cost.

The said apparatus is constructed so as to be neutrally buoyant, so that it floats on its own, for instance due to the use of buoyancy material such as expanded foam used in swim floats, and spray foam, wherein such material can be incorporated into parts of the apparatus; for instance, directly under the seat, and wherein, in addition, a buoyancy bag normally used by divers, together with associated inflation controls and equipment, are used on the apparatus, wherein, for instance, in the apparatus of the said invention, a horseshoe shaped, Halcyon Dive Wing, has been used in conjunction with other dive control equipment, so that, by use of this equipment, the said, at least one occupant, can compensate for the effects of varying hydrostatic pressure, with depth.

For reasons of safety, quick-release belts, and quick-release straps, respectively, hold the, at least one occupant, and their feet, respectively, in the apparatus, wherein, there can be at least two, such quick-release belts, and wherein waterproof lighting is used on the apparatus for the purposes of aiding the said occupant, and of showing the apparatus, and its path in the water, to others, wherein this is particularly useful for

persons such as divers, and other safety personnel, who are assisting the said occupant of the apparatus.

The method of control of the apparatus can be via means, wherein either, the at least
5 one occupant, or, the at least, one person who is remote from the apparatus, can make
use of a radio, or sonar, link, with two-way communication and control, between the
functional components of the said apparatus and the equipment which is operated by,
and under the Attendant Control of, a person experienced in the use of the apparatus,
when that person is on land, or in, or under, the water, wherein the said
10 communication and control can be implemented whether there is an occupant in the
wheelchair or not, wherein, in the latter case, the situation becomes robotic, and is
particularly useful for the purposes of training and demonstration, particularly for the
purpose of testing and safety, and wherein it will also encourage confidence in would
be, users of the apparatus, wherein an Attendant can, alternatively, guide the
15 apparatus by means of a source of radiation such as visible radiation from a torch, or
invisible radiation such as infra-red radiation, by utilisation, in the construction of the
apparatus, means for sensing such radiation, together with corresponding means for
controlling the apparatus.

20 In the apparatus of the invention, special arrangements are made for allowing the
apparatus to be used in water of different density, so that it will function in water
generally used for swimming; for example that used in swimming baths, and also in
sea water, wherein one aspect of this is that all materials utilised in the construction
and use of the apparatus are resistant to corrosion or degradation, so that they can
25 withstand chemicals which are naturally present in sea water and those which are
present in the water used in swimming baths, and elsewhere, and wherein the
apparatus can thus, for instance, be constructed from Stainless Steel, or from
Titanium, or any metal or alloy, or material, for instance, carbon fibre, or from
engineering plastics, which will be resistant to corrosion, with due regard for the need
30 to cater for the corresponding change in weight of the apparatus, wherein, Titanium
has a lower density than that of Stainless Steel, and wherein, in general, the use of
low density corrosion resistant alloys for construction, is suggested.

All parts of the system are waterproof, in order to ensure continual functionality, and
35 to maintain electrical safety, wherein resistance to corrosion is essential, and wherein

this will be assisted by the use of waterproof paints; especially those intended for underwater use, and in particular, those used for sea water applications, wherein variants of the apparatus will ensure portability, and transportability, in order to allow it to be utilised world-wide, wherein, with the application of appropriate design,
5 plastics having engineering properties are utilised in construction.

As an alternative to the said means of propulsion having a fixed orientation because the occupant of the apparatus uses the said three hydroplanes to control the orientation of the apparatus, it is also possible to have attitude control of the means of
10 propulsion, by mounting them in devices which are themselves mounted on the apparatus, wherein the orientation of the means of propulsion can then be fully adjusted by the said occupant of the apparatus, about three axes which are at right angles with respect to one another, thereby providing greater flexibility in the manoeuvrability of the apparatus, wherein this attitude control of the means of
15 propulsion is particularly relevant to use by limbless persons in those situations where they are unable to operate the hydroplanes, wherein the technology involved in the implementation of the said system herein referred to, can utilise the methods used in the control the orientation of a satellite dish, or the like, wherein this method of control of the apparatus lends itself to programmable control of the aquabatics to be
20 performed, and is particularly suited to training, and to Attendant Control.

The invention thus represents an alternative way of using a wheelchair, via the utilisation of propulsion units, and other apparatus, which are normally found on conventional diving equipment and on dive propulsion vehicles, and via the utilisation
25 of additional apparatus.

The invention also allows the equivalent of synchronised swimming to be performed by wheelchair users, and allows them to take part in many other activities normally only participated in by able-bodied persons. However; it is pointed out that the
30 principles of the invention, as herein applied to a wheelchair, can also be applied to any form of seating arrangement, or arrangement which allows a person, or object, or living thing, to be securely and releasably held within it, in order to allow the said performances to be made in water. Thus, although a National Health Service wheelchair has been adapted according to the principles of the invention, as herein
35 described, other designs of wheelchair can be adapted to function according to the

principles of the invention, and purpose built wheelchairs can be constructed so that the occupant is able to move on land, on the surface of, and under, water, as herein described.

5 A foam based material has also been used to provide a backrest for the occupant of the wheelchair, and removable plastic panels are located at the right and left sides of the wheelchair, under the arm rests, AR1, and AR2, respectively (see the diagram in Figure 1) but, for reasons of clarity in the diagrams, these panels are not shown. It is also to be noted that, in order to reduce the complexity of the diagrams, some of the
10 nuts and bolts which are used to hold components of the invention together, have not been shown.

In order to describe the invention in more detail, reference will now be made to the accompanying diagrams in which:

15

Figure 1 shows a three-dimensional diagram of externally visible embodiments of the invention, as viewed from the front.

20 Figure 2 shows a three-dimensional diagram of externally visible embodiments of the invention, as viewed from above and from the rear.

Figure 3 shows a three-dimensional diagram of externally visible embodiments of the invention, as viewed from underneath.

25 Figure 4 shows a three-dimensional diagram of the main functional components of the invention, as viewed generally from the front, with some components removed, and with some components enlarged, for the purposes of aiding interpretation of the diagrams.

30 Figure 5 shows a three-dimensional diagram of the main functional components of the invention, with some components enlarged, and with particular emphasis placed on those components which involve locking the pedals to the wheelchair.

35 Figure 6 shows a three-dimensional diagram of the main functional components of the invention, with some components enlarged, and with particular emphasis placed on

some of the components which involve locking the pedals to the wheelchair, and those components which provide power to, and control of, the propellers of the propulsion units.

5 Figure 7 shows a three-dimensional diagram of the main functional components of the invention, with some components enlarged, and with particular emphasis placed on some of the components which involve fixing of the power supply, batteries, and propulsion units, to the wheelchair.

10 Figure 8 shows a three-dimensional diagram of the assembly which carries the batteries and propulsion units, and also shows how this assembly is fixed to the wheelchair.

15 Figure 9 shows a three-dimensional diagram of the assembly which carries the batteries and propulsion units, with some components removed to more clearly show the method of fixing the to the wheelchair.

Figure 10 shows a three-dimensional diagram of those sub-components which allow the batteries and propulsion units, to be fixed to the wheelchair.

20

Figure 11 shows a three-dimensional diagram of a particular orientation of the batteries, and propulsion units, located on their mounting plates, but with the batteries slid away from the propulsion units, so that the battery terminals, and the power supply terminals of the propulsion units can be seen.

25

Figure 12 shows a three-dimensional diagram of a particular orientation of the batteries, and propulsion units located on their mounting plates, but with the batteries slid away from the propulsion units, so that the battery terminals, and the power supply terminals of the propulsion units can be seen.

30

Figure 13 shows a three-dimensional diagram of a particular orientation of the batteries, and propulsion units, with one of the battery and propulsion unit combinations located on its mounting plate, and partially separated, and the other battery and propulsion unit completely separated from the mounting plate, so that the

power supply terminals of the propeller drives and the supply sockets of the batteries can be seen.

5 Figure 14 shows a three-dimensional diagram of the main functional components of the invention, with the left foot pedal assembly ready to be located on the frame of the wheelchair, whilst the right foot pedal assembly is already locked in place on the frame.

10 Figure 15 shows a three-dimensional diagram of the main functional components of the invention, with the left foot pedal assembly ready to be located on the frame of the wheelchair at two points, and ready to be rotated and locked in place, by means of the locking arrangement which is shown in enlarged form, whilst the right foot pedal assembly is locked in place on the frame.

15 Figure 16 shows a three-dimensional diagram of the main functional components of the invention, with the left foot pedal assembly located on the frame of the wheelchair at two points, and locked in place, by means of the locking arrangement which is shown in enlarged form, whilst the right foot pedal assembly is locked in place on the frame.

20

Figure 17 shows a three-dimensional diagram of the underwater wheelchair, as viewed from the rear, with a Halcyon Dive Wing buoyancy device, and compressed gas cylinder, attached to it.

25 It is pointed out, with reference to the following Figures, that some parts have been omitted in order to make the diagrams clearer. Thus Figure 1 shows most of the parts of the underwater wheelchair as viewed from the front, whilst successive Figures show fewer components, but in greater clarity.

30 It is also pointed out, with reference to the following diagrams, that, in order to better show the various component parts of the underwater wheelchair, the width of the seating area is somewhat greater than is actually the case. Consequently, the dimensions of some of the other components of the underwater wheelchair are also correspondingly greater.

With reference to Figure 1, which represents a three-dimensional view, an underwater wheelchair system, 1, is provided with two electrically powered propulsion units, P1, and P2, respectively (not clearly visible in this Figure but more easily seen in later Figures) each supplied with a battery, B1, and B2, respectively.

5

The electrical supply to each battery, B1 and B2, respectively, and hence to each of the propulsion units P1, and P2, respectively, is independently controlled by means of each one, of a pair of spring-loaded push-button switches, SW1, and SW2, respectively, which can each be operated, independently, by pushing them into the
10 “on” position, by means of the outside of each right and left, thigh region, respectively, of the occupant, whilst the occupant is seated in the underwater wheelchair. The propulsion units, P1, and P2, respectively, are provided with electrical power by means of cables, C1, and C2, respectively.

15 Front pedal mounting assemblies, FA1, and FA2, respectively, allow the hydroplane, and foot pedal, assemblies, GP1, GP2, and FP1, FP2, respectively (each of the identifiers, FA1, and FA2, referring to both the upper, and the lower, parts of the front pedal mounting assembly, in each case) to be mounted on the vertically orientated front tubular members of the wheelchair. It is pointed out that the mounting
20 assemblies, FA1, and FA2, are described in more detail later, with reference to Figures 14, 15, and 16. It is also pointed out that an earlier filing used the word Aquaplane for GP1, and GP2, when the word hydroplane, should have been used.

However, it is pointed out that one meaning of the term aquaplane, refers to the surface
25 action of a board moving over water, and that this could well apply to the wheelchair if it is moving such that the Perspex (acrylic) parts, GP1, and GP2, are skimming over the surface of the water, so that the occupant is above the water. By definition, a hydroplane is a fin like device enabling a submarine to rise and fall.

30 The underwater wheelchair system also has, hand holds, H1, and H2, and an upper backrest, UBR adjacent to a lower backrest, LBR, with arm rests AR1, and AR2. It is to be noted that, whilst backrests, UBR, and LBR, appear to be rigid, as shown in the diagram, they are actually flexible, and ideally, waterproof. An inflatable buoyancy bag (not shown in any of the Figures, 1 to 16, inclusive, but shown in Figure 17, as
35 item HDW) is firmly, and removably, attached to the underwater wheelchair by means

of straps. This buoyancy bag provides means for compensating for the increase in hydrostatic pressure on the underwater wheelchair, and its occupant, with depth. The buoyancy bag utilised for this purpose, is known as a Halcyon Dive Wing, and this is used in association with other control equipment.

5

A schematic representation of the Halcyon Dive Wing and other components used on the underwater wheelchair, is shown in Figure 17, to be described later.

Conventional, large wheel assemblies, CWA1, and CWA2, and small front wheel assemblies, FW1, and FW2, allow for conventional use of the wheelchair on land, and a support seat, SS, made from rigid material (in one variant, 5 ply, treated wood) serves as a necessary source of rigidity in order to prevent the wheelchair from collapsing, which would occur if there was no rigidity, because the buoyancy offered by the occupant of the underwater wheelchair, which is a consequence of their buoyancy equipment, together with the buoyancy bags and other materials, pulls the wheelchair upwards, thereby balancing the weight of the wheelchair, and would thus cause it to close, inwardly, in the absence of the said rigidity. A more recent variant of the underwater wheelchair utilises an aluminium plate, having two protruding end lips which are formed at right angles with respect to the plane of the plate, so that the plate can be removably bolted to the two right and left, upper horizontal tubular structural members of the underwater wheelchair.

The angle of descent into water, and the ascent out of water, of the wheelchair, and the direction of movement in, and under, the water, is controlled by means of the two hydroplanes, GP1, and GP2, and a third hydroplane, GP3, wherein all three hydroplanes, GP1, GP2, and GP3, are made from Perspex (acrylic) or other suitable material, and are independently operated. Thus each of the hydroplanes GP1, and GP2, is attached to the underside of each one of the two original footrests of the conventional wheelchair which have been removed and repositioned, as shown in the diagram.

This re-orientation of the foot pedal assemblies of the conventional National Health Service wheelchair, results in the planes of the two parallel upper and lower services of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane, being at an angle which is greater than zero,

with respect to the horizontal, and hence to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane are symmetrically orientated at an angle with respect to the horizontal which is greater than zero, as viewed from the front. This has been found, by the Inventor, to aid control of the
5 attached right and left hydroplanes, and hence of the underwater wheelchair. A value of this angle which allows acceptable control of the underwater wheelchair, has been found to be approximately ten degrees.

The third hydroplane, GP3, is controlled by means of a third control, TC, which is
10 described with reference to Figure 2, and is based upon a hand-operated gear-change assembly, which has been adapted from use on a mountain bicycle, so that it can be used on the underwater wheelchair.

Foot pedals FP1, and FP2, respectively, each have foot straps, FS1, and FS2,
15 respectively, which allow the feet to remain in place whilst operating the hydroplanes, GP1, and GP2, respectively, but which also allow the occupant to remove the feet safely, as necessary. One variant utilises Velcro or other suitable material, having a graspable tag, which allows the occupant to quickly open the foot straps as necessary, by grasping the tag. It is pointed out that it is extremely important to ensure that the
20 straps, FS1, and FS2, are firmly attached to the foot pedals, and that the feet remain firmly within their confines, so that the occupant of the underwater wheelchair can operate the hydroplanes, GP1, and GP2, properly.

It is pointed out, that although the seat backs are shown as separate pieces in the
25 accompanying diagrams, they are, in fact, formed as one piece of material that folds when the handles of the conventional wheelchair fold down for ease of transportation of the wheelchair.

The two propulsion units, P1, and P2, and their respective batteries, B1, and B2,
30 respectively, are mounted on the underside of the wheelchair, by means of a specially constructed support system, to be described later, with reference to other diagrams. This system allows the fixing plate normally used to mount a propulsion unit and battery to a conventional diving kit, to be attached to the wheelchair, wherein, in the apparatus of the invention, two such propulsion units, are mounted side by side, as
35 shown. This provides better control of the wheelchair by the occupant. Cables, C1,

and C2, respectively, allow the occupant of the wheelchair to control the delivery of electrical power from the batteries, B1, and B2, respectively, to each of the propulsion units, P1, and P2, respectively, via push-button switches, SW1, and SW2, respectively.

- 5 It is pointed out that other variants can have push-button switches in any positions which facilitate control of the wheelchair, and that so-called sip-puff switches, which are operated by mouth, can be utilised for controlling the underwater wheelchair. This is particularly relevant for use of the underwater wheelchair by persons who are limbless. In such cases, the apparatus is adapted to incorporate mechanisms which
10 drive the hydroplanes via sip puff switches, accordingly.

It is pointed out that the principles of the invention are not limited to only being applicable to National Health Service wheelchairs, and that they can thus be applied to any type of wheelchair, and to any type of seating device or to any type of body
15 holding device. Moreover, specially designed dual-purpose apparatus can be constructed so that it functions as described in the foregoing and following description, and so that it also functions with further flexibility in construction, transportation, assembly and disassembly, and in operation.

- 20 It is pointed out that means can be provided for allowing programmable control of the movement of the underwater wheelchair so that the occupant can, if desired, utilise pre-programmed routines which have either been developed and then recorded for such use; or pre-designed. This is particularly useful for teaching purposes, and for allowing those with a range of limited functionality, for example, those who have lost
25 limbs, to use the underwater wheelchair. This aspect of the invention can utilise microprocessor technology, which is particularly useful for allowing remote, manual and automatic, valve control, for the purposes of properly controlling the supply of air or any other gases, or fluids, required for the effective, and safe, control, and use, of the underwater wheelchair, and for the control of any functional components which
30 involve the supply, and utilisation of, electricity, and for the control of any other aspects of the invention.

It is also possible to have a radio, or sonar, link, with two-way communication and control, between the functional components of the underwater wheelchair and the
35 equipment under the control of a person experienced in the use of the underwater

wheelchair, when that person is on land, or in, or under, the water, remote from the occupant. Such communication and control can be implemented whether there is an occupant in the wheelchair or not. In the latter case, the situation becomes robotic, and is particularly useful for training and demonstration; particularly for the purpose of testing and safety. It will also encourage confidence in would be, users of the underwater wheelchair. There will, of course, be a need to cater for the change in weight of the underwater wheelchair if there is no occupant, and to carry out tests, wherein either a dummy representing a person, or an object; where both are of comparable weight and size, is used instead of a human occupant. This also applies where other means and apparatus for maintaining buoyancy are utilised. The above mentioned methods of control come under the general description of, Attendant Control, which is applied in all cases of profound disability.

It is pointed out that whilst control of the Pegasus motors used for providing thrust, is via push button switches, other forms of control based upon a feedback loop between motor and controller, under the overall control of the occupant of the wheelchair, or, if control is so-called Attendant Control, under overall control of the Attendant, can be used. Here, smoother control of the thrust provided by the Pegasus motors is possible.

It is pointed out that the hydroplanes themselves can be operated by means of motors in a similar manner.

Such attitude control can be utilised with or without the movement of the three hydroplanes, but it is pointed out that the use of the three hydroplanes, allows a simpler and less costly route to aquabatics, and allows the occupant of the wheelchair a more human level of contact with the apparatus when performing in the wheelchair.

With reference to Figure 2, which represents a three-dimensional view, one means of control of the third hydroplane, GP3, by the occupant of the wheelchair, who, for the sake of brevity, will be referred to as the occupant, is via a mechanism based upon the use of a Bowden Cable link, BCL, between a conventional, seven-speed, gear lever control, GLC, which is normally utilised on mountain bicycles for changing gear, and the hydroplane, GP3. In the current application, the occupant "ratchets up" the mechanism to any one of its seven positions, and this "ratcheting" pulls the third

hydroplane, GP3, upwards, about two parallel hinges, HGS1, and HGS2, against the restraining force offered by a loop of elastic, or an extension spring, FL, which forms a flexible link between the fixed bracket, FB, and an anchor point, AP, on the left side of the underwater wheelchair, wherein the elastic, or spring, FL, is attached to a
5 convenient part, AP, of the frame of the wheelchair, as shown.

Then, by operating another lever on the gear lever control, GLC, which releases a pawl within the ratchet mechanism, which, when in its standby position, prevents the ratchet from moving, the occupant can cause the third hydroplane, GP3, to move downwards,
10 in a series of seven, separate steps, by utilising the restoring force inherent in the spring, FL.

For brevity, other components are not described again, since they have already been described with reference to Figure 1.

15 It is pointed out, that when the occupant is seated in, and strapped into, the wheelchair, the air bottle and other components (none shown in the diagram) which form part of the diving kit of the occupant, are positioned behind the occupant over the back of the wheelchair, with due allowance for the correct location of the buoyancy bag, HDW, which is described later, with reference to Figure 17.

20

With reference to Figure 3, which represents a three-dimensional view, this shows a view of the underwater wheelchair system, 3, as seen from underneath. Other parts are as already described with reference to earlier Figures and will therefore not be described again.

25

With reference to Figure 4, which represents a three-dimensional view, this shows the main functional components, 4, of the invention, with some components enlarged. Thus, curved, tubular cross-brackets, CB1, and CB2, are both welded, at their ends, to semi-circular cross-sectioned, end brackets, BR1, right, and BR2, left, which are bolted
30 to the lower horizontal tubular structural elements of the wheelchair as shown. It is to be noted that although the curved end brackets, BR1, and BR2, are shown bolted to the lower horizontal tubular structural elements of the wheelchair, in the working prototype, each is, in fact, attached by means of a threaded stud, which is welded to each lower horizontal tubular structural element and locked in place by means of a nut.
35 Curved tubular, cross-brackets, CB1, and CB2, respectively, each have blocks, 5, and

7, and 6, and 8, respectively, welded to them in the positions shown, and these blocks are bolted to V shaped plates, V1, and V2, (bolts not shown in the diagram) into which battery, and propulsion unit, mounting plates (described with reference to later diagrams) can be mounted, and locked in place. It is pointed out that although parts, 5, 6, 7, and 8, are shown as blocks, one working variant of the invention utilises sections of right-angled iron, cut to the appropriate length, for each part.

With reference to Figure 5, which represents a three-dimensional view, this shows the main functional components of the invention, with some components enlarged, and serves to show how the hydroplane and pedal units are mounted on the frame of the wheelchair.

Thus, with further reference to Figure 5, and with particular reference to the two enlarged views to the left of the diagram, the front right, tubular section, 9A (using the convention of right and left as viewed by the occupant seated in the wheelchair) which carries the right foot pedal, FP1, and right hydroplane, GP1, has a welded extension, 10, having a part, 11, which is rotatable about a fulcrum bolt, 12, and which also has a hole, 13, which allows part, 9A, with its extensions, to be mounted on pin, 14, formed on a mounting part, 15, which is an extension formed on the front right vertical tubular structural member of the wheelchair, wherein part, 15, extends in two opposite directions, with its upper and lower surfaces having parallel planes which are at right angles with respect to the axis of the front right, vertical tubular structural member of the wheelchair, and thereby serves as the lower mounting platform of the two mounting platforms for the right hand foot pedal.

With further reference to the enlarged views to the left of the diagram in Figure 5, protrusion, 16, formed on part, 11, when gripped, and moved, allows part, 17, having its own curved slot, to be pushed under the head of bolt, 18, whilst resting over a curved slot (not shown in the diagram) formed in welded extension, 10, so that, whilst part, 17, is held in place under, the head of bolt, 18, but over, the said curved slot, a nut (not shown in the diagram) on the end of bolt, 18, can be tightened, thereby locking the right, pedal assembly, FP1, and hydroplane, GP1, in place. It is pointed out that, in the working prototype, bolt, 18, is actually a hexagonal headed, threaded, stud.

With yet further reference to Figure 5, and with reference to the enlarged views on the right of the diagram, these show how the extension, 19, formed at the upper end of front left tubular section, 9B, is mounted on the upper mounting platform of the two mounting platforms for the left hand foot pedal of the underwater wheelchair.

5 Extension, 19, has a hole, 20, through which mounting pin, 21, on platform, 22, passes, wherein platform, 22, is formed on the left vertical tubular structural member of the wheelchair, and extends outwards, horizontally, at right angles with the axis of this front left vertical tubular structural member, and is vertically above a lower platform, which is similar to platform, 15, described earlier, with reference to the mounting of

10 the right hand foot pedal assembly. It is pointed out that the upper mounting platform formed on section 9B, is similar to the one formed on section 9A, and therefore needs no further description.

With reference to Figure 6, which represents a three-dimensional view, the lower left enlarged view, 23, shows the mounting assembly for the right, foot pedal, FP1, and hydroplane, GP1. Two of the other enlarged views show the battery, B1, with its associated plug, 24, and cabling, 25, and battery, B2, with its associated plug, 26, and cabling, 27. The remaining enlarged views, 28A, and 28B, respectively, show the push-button switches, SW1, and SW2, respectively. Other parts have already been

15 described with reference to earlier Figures, and so need not be described again.

20

With reference to Figure 7, which represents a three-dimensional view, this shows an enlarged view of the components already described with reference to earlier Figures, thereby adding clarity, and therefore needs no further description.

25

With reference to Figure 8, which represents a three-dimensional view, this shows an enlarged view of the components already described with reference to earlier Figures. It can be seen that Holed lugs, L1, and L2, which are welded, or otherwise formed, on the right, and left, horizontal tubular members, respectively, of the wheelchair, as

30 shown, have cross-bracing members (not shown in the diagram) bolted to them, and these are described later, with reference to Figure 16.

With reference to Figure 9, which represents a three-dimensional view, this shows the batteries, B1, and B2, respectively, and the propulsion units, P1, and P2, respectively,

35 mounted on their respective mounting plates, 29, and 30, which are themselves locked

into slots, such as slot, 36, shown for mounting plate, 29, by means of spring-loaded locking pins (not shown in the diagram). These slots are formed on the undersides of the V shaped plates, V1, and V2, respectively, which were previously described with reference to Figure 4, and which are shown in Figure 8.

5

With further reference to Figure 9, it can be seen that this shows the V-shaped plate, V1, in front elevation. It can thus be seen how mounting plate, 29, carrying its associated battery, B1, and propulsion unit, P1, can be slid into plate, V1, whilst plate, V1, is itself bolted to parts, 5, and 6 (shown in Figure 8) wherein it can then be locked
10 in place with spring-loaded pins (not shown in the diagram).

It is pointed out, with reference to Figure 9, that the smaller diagram at the top left of the diagram, shows part, V1, having a curved, rather than V-shaped, upper surface, and shows the lower part of part, 5, shown to the right of the of this diagram of V1, having
15 a curved, rather than V-shaped, lower surface. These alternative versions of part, V1, and part, 5, represent the present versions of the parts utilised in a working prototype of the invention, wherein the said curvature is a consequence of using a part, V1, which was originally constructed so that it fits the contour of a compressed gas cylinder which is used as part of standard diving equipment having a propulsion unit,
20 in this case a Pegasus Thruster, wherein the compressed gas cylinder is strapped on the back of the diver. Part, 5, is similar to parts, 6, 7, and 8, and all of these parts are shown in Figure 8. Other parts are as already described with reference to earlier diagrams, and so will not be described again.

25 With reference to Figure 10, which represents a three-dimensional view, this is similar to Figure 9, but with parts, V1, and V2, removed, to allow the uppermost parts of mounting plates, 29, and 30, to be seen. Other parts are as already described with reference to earlier diagrams, and so will not be described again.

30 With reference to Figure 11, which represents a three-dimensional view, this is similar to Figure 10, but shows batteries, B1, and B2, respectively, moved away from their respective propulsion units, P1, and P2, respectively, thereby exposing the pairs of positive and negative terminals of the plugs, 31P, and 32P, respectively, on P1, and P2, respectively, and the sockets, 31S, and 32S, respectively, on the batteries, B1, and B2,

respectively. Other parts are as already described with reference to earlier diagrams, and so will not be described again.

5 With reference to Figure 12, which represents a three-dimensional view, this is similar to Figure 11, and shows batteries, B1, and B2, moved away from the propulsion units, P1, and P2, but is shown as viewed from a different direction, thereby showing more clearly, sockets, 31S, and 32S. Other parts are as already described with reference to Figure 11, and so will not be described again.

10 With reference to Figure 13, which represents a three-dimensional view, this is similar to Figure 12, and shows battery, B1, moved away from propulsion unit, P1, but with battery unit, B2, and propulsion unit, P2, both moved away from mounting plate, 30, thereby revealing the locking holes and the general shape, and configuration, of mounting plate, 30. Figure 13, also shows the slots, SB2, and SP2, respectively,
15 which are formed on the upper surfaces of battery unit, B2, and propulsion unit, P2, respectively, so that these parts can be fixed to plate, 30. Other parts are as already described with reference to earlier diagrams, and so will not be described again.

20 With reference to Figure 14, which represents a three-dimensional view, this shows the underwater wheelchair as viewed from the front, and the enlarged view to the right of the diagram shows the left foot pedal, FP2, with it associated tubular member, 9B, ready to be dropped over the upper and lower pins of the left foot pedal support system. It is to be noted that the left hydroplane, GP2, is missing from this diagram for reasons of clarity, but it is, of course, already bolted to the underside of the left foot
25 pedal assembly, FP2, when being fitted, wherein the left conventional large wheel assembly, CWA2, which utilises quick-release and assemble, technology, is not in place until the foot pedal assembly has been fitted. This also applies to the fitting of the right foot pedal assembly. Other parts are as already described with reference to earlier diagrams, and so will not be described again.

30

With reference to Figure 15, which represents a three-dimensional view, this shows the underwater wheelchair as viewed from the front, and the enlarged view to the right of the diagram shows the left foot pedal assembly, FP2, with its associated tubular member, 9B, dropped over the upper and lower pins of the left foot pedal support
35 system. It is to be noted that the left hydroplane, GP2, is missing from this diagram

for reasons of clarity, but it is, of course, already bolted to the underside of the left foot pedal assembly, FP2, when being fitted, wherein the left conventional large wheel assembly, CWA2, is not in place until the foot pedal assembly has been fitted. Other parts are as already described with reference to earlier diagrams, and so will not be
5 described again.

With reference to Figure 16, which represents a three-dimensional view, this shows the underwater wheelchair as viewed from the front, and the enlarged view to the right of the diagram shows the left foot pedal assembly, FP2, with its associated tubular
10 member, 9B, dropped over the upper and lower pins of the left foot pedal support system, and then rotated towards the centre of the wheelchair and locked in position by means of the relevant nuts, and bolts, and other components. It is to be noted that the left hydroplane, GP2, is now shown in the diagram.

15 It is, however, pointed out that the need to remove the conventional large wheel assemblies, in order to fit the foot pedal assemblies, is only dictated by the size and shape of the left and right hydroplanes, and that later variants of the design of these, has allowed the foot pedal assemblies to be fitted without the removal of the conventional large wheel assemblies. Moreover, designs of the said hydroplanes can
20 involve lockable hinging, and the utilisation of countersunk nut and bolt holes, in order to ensure the smooth flow of water over the hydroplanes, or can involve other non-water flow disturbing means, in order to ensure smooth flow of water over the hinged regions, wherein such designs assist in the smooth motion of the said hydroplanes, and allow them to be constructed in the form of more than one part, and
25 wherein the said hydroplanes can thus be more easily manufactured to any desired specification, and can thus be more easily assembled and disassembled, and transported.

It is pointed out that tubular member, 9B, has a slit in a section of its lower part, which
30 allows the vertical, right angled extension of the left foot pedal assembly, FP2, to be inserted into it, so that the nut and bolt assembly, TB2, can be tightened, thereby locking the foot pedal assembly, FP2, in the desired orientation. There is a similar arrangement of nut and bolt assembly, TB1, which allows the right foot pedal assembly, FP1, to be locked in place into tubular member, 9A.

With further reference to Figure 16, it is pointed out that, for reasons of clarity in the diagrams, the cross-bracing members, 33, and 34, with their lockable nut (not shown) and bolt, 35, located at their centre points, are only shown in Figure 16. Also, similar cross-bracing members are fitted to the rear of the wheelchair but are not shown in any of the diagrams. These cross-bracing members serve to allow the wheelchair to be folded, when the rigid seat, part, SS, shown in Figure 1, has been removed, and when all relevant locking nuts and bolts have been released. These parts do, of course, serve to maintain rigidity, and therefore to prevent the underwater wheelchair from collapsing when used under water, wherein the buoyancy of the occupant tends to raise the wheelchair and would otherwise cause it to fold inwards. The retention of this feature of collapsibility, forms the basis of other variants of the underwater wheelchair which is portable, thereby making the wheelchair more easily transportable.

With reference to the three-dimensional, partially schematic, diagram shown in Figure 17, this shows the underwater wheelchair as viewed from the rear, and is intended to demonstrate the use of an inflatable buoyancy control device, HDW, known as a Halcyon Dive Wing, which is strapped to the wheelchair by means of adjustable straps not shown in the diagram). A cylinder of breathing gas, GC, which is also used for inflation purposes, is shown strapped to the Halcyon Dive Wing, HDW, by means of strap, ST, and thus the Halcyon Dive Wing, HDW, together with control equipment operated by the occupant of the underwater wheelchair, enables the occupant to compensate for the effects of changing hydrostatic pressure on the occupant, and on the underwater wheelchair, with depth in the water.

The occupant thus keeps the wheelchair buoyant, via the buoyancy of their diving suit, and the aforementioned Halcyon Dive Wing, HDW, which, together, balance the weight of the air bottle, batteries, motors, and other parts of the assembly, which are utilised on the wheelchair, and the weight of the wheelchair itself. When diving, the occupant adjusts the equipment in order to make themselves neutrally buoyant at the surface. During diving, air is forced into, and vented from, the diving suit of the occupant, and the buoyancy control device, HDW, in order to allow for the varying compression of the diving suit of the occupant of the underwater wheelchair, and to allow for the other effects of changing hydrostatic pressure, with depth, as diving takes place.

It is pointed out that the invention can be adapted so that it can be used in the sport of surface wheelchair racing, and for associated display performances, and that variants of the invention can involve the assembly of parts which have been specially designed and manufactured so that they can be easily removed from storage, and transported, and then assembled, to provide a safe configuration for the intended applications, and so that they can be easily, and quickly, disassembled for subsequent transportation and storage.

Also, whilst the invention herein described, refers mainly, to the modifications made to a National Health Service wheelchair, the principles of the invention can be applied to any device which has been constructed for supporting, carrying, or holding at least one person, or object, so that the said device can be used for transportation on land, and for the performance of diving, and aquabatics, in water. It is therefore not limited only to use on wheelchairs. Also, the invention is not limited to the use of hydroplanes which are designed only as described, herein, and other designs can involve specially shaped hydroplanes, for example those which possess curvature, which can thus improve the manoeuvrability of the underwater wheelchair, the efficiency with which it is operated, and its aesthetic qualities.

CLAIMS

1. A system which involves methods, and apparatus, wherein the apparatus can be used both on land and in water, and can carry at least one person, wherein the apparatus can be propelled on land, and also on the surface of, and under the surface of, water, wherein the method of control of the apparatus is by the utilisation of parts of the said apparatus by at least one person, and wherein the said method of control can be partially, or fully, implemented by at least one occupant of the said apparatus, and wherein the said partial or full control, can, instead, be implemented by at least one person who is remote from the said apparatus, under so called, Attendant Control, wherein, the method of providing movement of the apparatus of the system and its at least, one occupant, on land and in water, is by means of at least one means of propulsion, and wherein at least one method of altering the orientation of the said apparatus in water, is via the operation of at least one hydroplane, which is located symmetrically on the apparatus, wherein the said hydroplane, can, be partially, or fully, controlled by the said at least one occupant, or by the said, at least one person who is remote from the said apparatus.
2. A system as claimed in claim, 1, wherein the said apparatus is a National Health Service wheelchair, which has been modified and adapted for the purposes of applying the principles of the invention to the said system.
3. A system as claimed in claim, 1, wherein the said apparatus has been purpose built for the purposes of applying the principles of the invention to the said system.
4. A system as claimed in claim, 2, or claim 3, wherein the said apparatus has been constructed so that the, at least one occupant, or the at least one person who is remote from the apparatus, can operate, and cause to move, the said apparatus, and its said, at least one occupant, and also control its descent into water, and ascent out of, water, and its motion in water, at various depths, or on the surface of water, wherein the said apparatus is provided with means for, i) propulsion in

water, both whilst at the surface of the water, and whilst at various depths in the water, and ii) for controllable descent into, and controllable ascent out of, water, for various depths, wherein the apparatus utilises at least one propulsion unit of a type which is normally found on conventional diving equipment and on dive propulsion vehicles, and wherein one variant of the said system involves the fitting of two of the said propulsion units and associated controls therein, and allows flexible movement, in three dimensions in the water, under full or partial control of the at least one occupant of the wheelchair, or under the full or partial control of the said at least one person who is remote from the apparatus, so that acrobatics can be performed at the surface of, and under, water, in the same way that an acrobat performs such movements on land, and an aerobat performs in the air, wherein the said, at least one occupant of the apparatus, is thus able to perform dance-like movements, and to make performances such as loop-the-loop and barrel rolls, and the like, wherein the said performances can be referred to as aquabatics, in the same way that acrobatics are performed on land and aerobatics are performed in the air.

5. A system as claimed in claim, 2, and claim 4, wherein each one of two right, and left, hydroplanes, respectively, is attached to the underside of each one of the two right and left, respectively, footrests of the said National Health Service wheelchair, wherein the said footrests have been removed, modified, and repositioned, so that the re-orientation of the foot pedal assemblies of the said wheelchair results in the planes of the two parallel upper and lower surfaces of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane, which are releasably and firmly attached to them, being at an angle which is greater than zero, with respect to the horizontal, and hence with respect to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane, as viewed from the front, are symmetrically orientated at an angle with respect to the said horizontal, which is greater than zero, wherein this arrangement has been found to aid control of the attached right and left hydroplanes, and hence of the underwater wheelchair, wherein a value of this angle which allows acceptable

control of the underwater wheelchair, has been found to be approximately ten degrees.

- 5 6. A system as claimed in claim, 3, and claim 4, wherein each one of two right, and left, hydroplanes, respectively, is attached to the underside of each one of two right and left, respectively, footrests of the said apparatus, wherein the orientation of the foot pedal assemblies of the apparatus, results in the planes of the two parallel upper and lower surfaces of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane, which are releasably and firmly attached to them, being at an angle which is greater than zero, with respect to the horizontal, and hence to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane, as viewed from the front, are symmetrically orientated at an angle with respect to the said horizontal, which is greater than zero, wherein this arrangement has been found to aid control of the attached right and left hydroplanes, and hence of the apparatus, wherein a value of this angle which allows acceptable control of the apparatus, has been found to be approximately ten degrees.
- 10
- 15
- 20 7. A system as claimed in claim 5, and claim 6, wherein, two of the conventional, battery powered propulsion units, known as Pegasus Thrusters, which are normally used by divers, have been adapted and fitted to the said apparatus, together with their respective batteries, by means of a specially designed framework, in order to provide propulsion for the underwater wheelchair system, and wherein each one of the two right and left, specially shaped hydroplanes, respectively, is at least under the control of the right and left foot, respectively, of the said at least one, occupant, and wherein one specially shaped hydroplane which is located symmetrically, at the rear of the apparatus, is under the control of at least one hand of the, at least one occupant, at least via at least one gear change mechanism and Bowden Cable link, which have been adapted from use on a mountain bicycle to use on the said apparatus.
- 25
- 30

8. A system as claimed in claim 7, wherein the electrical supply from each of the said batteries, and hence to each of the said propulsion units, respectively, is independently controlled by means of each one, of a pair of right, and left, spring-loaded push-button switches, respectively, which can each be operated, independently, by pushing them into the on position, by means of the movement of them, by the outside of each right, and left, thigh region, respectively, of the, at least one occupant, whilst the occupant is seated in the apparatus, wherein the said propulsion units are provided with electrical power from the said batteries, by means of waterproof cabling.
9. A system as claimed in claim 8, wherein the said switches can be in any positions on the said apparatus, which allow control of it.
10. A system as claimed in claim 9, wherein so-called sip-puff switches, which are operated by the mouth, or wherein other devices which can be operated by means of the tongue, or by means of the eyes, or by means of any other part of the human body, can be utilised for controlling the apparatus, wherein such devices can be used instead of, or in addition to, the said push-button switches, wherein this method of control is particularly relevant for use of the apparatus by persons who are limbless, and/or lack the ability to implement control, by direct use of parts of their body, and wherein the apparatus of the said system is adapted to incorporate mechanisms which drive the said hydroplanes via the use of such sip-puff switches, or via the use of the other said devices, accordingly.
11. A system as claimed in claim 10, wherein the said hydroplanes are constructed from acrylic material, wherein the two hydroplanes which are operated by the feet of the at least one occupant, and the third, and rear, hydroplane, which is operated by the said hand of the said occupant, are each specially designed, arranged, and orientated, for aesthetic purposes, and so as to allow the occupant to perform aquabatics.
12. A system as claimed in claim 11, wherein the said at least one occupant of the apparatus is able to enter a swimming pool, or to enter the sea, or any other

region of water, whilst the wheels of the said apparatus are used for support, and are under the control of the at least one occupant, or the at least one person who is remote from the apparatus, either by means of separate wheel driving apparatus, or at least by means of one of the hands of the said, at least one occupant, and wherein the said occupant is able to move on the floor of a swimming pool, or the bed of the sea, or other region of water, if sufficiently flat, and to utilise the apparatus of the invention to move in the water and at the surface of the water, at least under the control of the at least one occupant, or the at least one person who is remote from the apparatus.

10

13. A system as claimed in any preceding claim, wherein, other means of propulsion and control of the said apparatus can involve a water jet; also known as a hydrojet or pump jet, in addition to, or in place of, a propulsion unit mentioned therein, wherein such systems will provide more flexible control of the apparatus, and wherein either a ducted propeller having a nozzle which can be adjusted so as to be orientated into any desired direction, is utilised, or a centrifugal pump provided with a nozzle which is similarly adjustable, is utilised, wherein such systems are commonly used in jet skis, pleasure boats, military water-based vehicles, and ferries, wherein the range of flexibility of control which will be available is then only limited by the number, and power, of such systems, and the cost.

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14. A system as claimed in any preceding claim, wherein the said apparatus is constructed so as to be neutrally buoyant, so that it floats on its own, for instance due to the use of buoyancy material such as expanding foam used in swim floats, and spray foam, wherein such material can be incorporated into parts of the apparatus; for instance, directly under the seat, and wherein, in addition, a buoyancy bag normally used by divers, together with associated inflation controls and equipment, are used on the apparatus, wherein, for instance, in the working apparatus of the said invention, a horseshoe shaped, Halcyon Dive Wing, has been used in conjunction with other dive control equipment, so that, by use of this equipment, the said, at least one occupant, can compensate for the effects of varying hydrostatic pressure, with depth.

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- 15 15. A system as claimed in any preceding claim, wherein for reasons of safety, quick-release belts and quick-release straps, respectively, hold the at least one occupant and their feet, respectively, in the apparatus, wherein, there can be at least two, such quick-release belts, and wherein waterproof lighting is used on the apparatus for the purposes of aiding the said occupant, and of showing the apparatus, and its path in the water, to others, wherein this is particularly useful for persons such as divers, and other safety personnel, who are assisting the said occupant of the apparatus.
- 10 16. A system as claimed in any preceding claim, wherein the method of control of the apparatus can be via means, wherein either, the at least one occupant, or, the at least, one person who is remote from the apparatus, can make use of a radio, or sonar, link, with two-way communication and control, between the functional components of the said apparatus and the equipment which is operated by, and under the Attendant Control of, a person experienced in the use of the apparatus, when that person is on land, or in, or under, the water, wherein the said communication and control can be implemented whether there is an occupant in the wheelchair or not, wherein, in the latter case, the situation becomes robotic, and is particularly useful for the purposes of training and demonstration, particularly for the purpose of testing and safety, and wherein it will also encourage confidence in would be, users of the apparatus, wherein an Attendant can guide the apparatus by means of a source of radiation such as visible radiation from a torch, or invisible radiation such as infra-red radiation, by utilisation, in the construction of the apparatus, means for sensing such radiation, together with corresponding means for controlling the apparatus.
- 20 17. A system as claimed in any preceding claim, wherein special arrangements are made for allowing the apparatus to be used in water of different density, so that it will function in water generally used for swimming; for example that used in swimming baths, and also in sea water, wherein one aspect of this is that all materials utilised in the construction and use of the apparatus are resistant to corrosion or degradation, so that they can withstand chemicals which are naturally present in sea water and those which are present in the water used in

swimming baths, and elsewhere and wherein the apparatus can thus, for instance, be constructed from Stainless Steel, or from Titanium, or any metal or alloy, or material, for instance, carbon fibre, or from engineering plastics, which will be resistant to corrosion, with due regard for the need to cater for the corresponding
5 change in weight of the apparatus, wherein, Titanium has a lower density than that of Stainless Steel, and wherein, in general, the use of low density corrosion resistant alloys for construction, is suggested.

18. A system as claimed in any preceding claim, wherein all parts of the system are
10 waterproof, in order to ensure continual functionality, and to maintain electrical safety, wherein resistance to corrosion is essential, and wherein this will be assisted by the use of waterproof paints; especially those intended for underwater use, and in particular, those used for sea water applications, wherein variants of the apparatus will ensure portability, and transportability, in order to allow it to
15 be utilised world-wide, wherein, with the application of appropriate design, plastics having engineering properties are utilised in construction.

19. A system as claimed in any preceding claim, wherein, instead of the said means
20 of propulsion having a fixed orientation because the occupant of the apparatus uses the said three hydroplanes to control the orientation of the apparatus, it is also possible to have attitude control of the means of propulsion, by mounting them in devices which are themselves mounted on the apparatus, wherein the orientation of the means of propulsion can then be fully adjusted by the said occupant of the apparatus, about three axes which are at right angles with respect
25 to one another, thereby providing greater flexibility in the manoeuvrability of the apparatus, wherein this attitude control of the means of propulsion is particularly relevant to use by limbless persons in those situations where they are unable to operate the hydroplanes, wherein the technology involved in the implementation of the said system herein referred to, can utilise the methods used in the control
30 and orientation of a satellite dish, or the like, wherein this method of control of the apparatus lends itself to programmable control of the aquabatics to be performed, and is particularly suited to training, and to Attendant Control.

20. A system as claimed in any preceding claim, which involves the assembly of parts which have been especially designed and manufactured so that they can be easily removed from storage, and transported, and then assembled, to provide a safe configuration for the intended applications, and so that they can be easily,
5 and quickly, disassembled for subsequent transportation and storage.
21. A system as claimed in any preceding claim, which involves a device which has been constructed for supporting, carrying, or holding at least one person, or object, so that the said device can be used for transportation of the said at least
10 one person or said object, on land, and for transportation in water, and to allow the performance of diving, and aquabatics, in water.
22. A system as claimed in any preceding claim, which is not limited to the use of hydroplanes which are designed only as described, herein, wherein other designs
15 can involve specially shaped hydroplanes, for example those which possess curvature, which thus improve the manoeuvrability of the underwater wheelchair, the efficiency with which it is operated, and its aesthetic qualities.
23. A system as claimed in any preceding claim, wherein the designs of the said
20 hydroplanes can involve lockable hinging, and the utilisation of countersunk nut and bolt holes, in order to ensure the smooth flow of water over the hinged regions of the hydroplanes, or can involve other non-water flow disturbing means, in order to ensure smooth flow of water over the hinged regions, wherein such designs assist in the smooth motion of the said hydroplanes, and allow them
25 to be constructed in the form of more than one part, wherein the said hydroplanes can thus be more easily manufactured to any desired specification, and can thus be more easily assembled and disassembled, and transported.
24. Methods and apparatus, arranged and constructed to operate substantially as
30 hereinbefore described with reference to any one of the embodiments illustrated in Figures 1 to 17, of the accompanying drawings.

AMENDED CLAIMS

received by the International Bureau on 12 March 2013 (12.03.2013)

1. A controllable underwater wheelchair (1) which can be used both on land and in water, for the carrying, and transportation, of at least one person, wherein the wheelchair can be propelled both on land, and also on the surface of, and under the surface of, water, and wherein the method of control is by the utilisation of parts of the wheelchair by at least one person, wherein the said method of control can be partially, or fully, implemented by at least one occupant of the said underwater wheelchair, and wherein the said partial or full control, can, instead, be implemented by at least one person who is remote from the said underwater wheelchair, under so called, Attendant Control, wherein, the method of providing movement of the controllable underwater wheelchair (1) and its at least, one occupant, on land, is by conventional means, for example, either by means of separate wheel driving apparatus, or at least by means of one of the hands of the said, at least one occupant, engaging with one of the conventional large wheel assemblies (CWA1) or (CWA2) and wherein the said occupant is thereby also able to move on the floor of a swimming pool, or on the bed of the sea, or on the bed of another region of water, if sufficiently flat, and to utilise the apparatus of the invention to move in the water and at the surface of the water, at least under the control of the at least one occupant, or the at least one person who is remote from the underwater wheelchair, wherein the method of providing movement of the wheelchair and its at least, one occupant, in water, is by means of at least one means of propulsion, wherein one means is by use of a conventional thruster (P1 or P2) of the type used by divers, and wherein at least one method of altering the orientation of the said apparatus in water, is via the operation of at least one hydroplane, exemplified by hydroplanes (GP1, GP2, and GP3) which is located symmetrically on the apparatus, wherein the said hydroplane, can be partially, or fully, controlled by the said, at least one occupant, or by the said, at least one person who is remote from the said apparatus, wherein that remotely located person utilises any known means for implementing remote control of the controllable underwater wheelchair (1).

2. A controllable underwater wheelchair (1) as claimed in claim 1, wherein the said at least one person who is remote from the wheelchair, can make use of a radio, or sonar, link, with two-way communication and control, between the functional components of the said underwater wheelchair and the equipment which is operated by, and under the Attendant Control of, the said at least one person who is experienced in the use of the wheelchair and the equipment, when that person is on land, or in, or under, the water, wherein the said communication and control can be implemented whether there is an occupant in the wheelchair or not, wherein, in the latter case, the situation becomes robotic, and is particularly useful for the purposes of training and demonstration, particularly for the purpose of testing and safety, and wherein it will also encourage confidence in would be, users of the underwater wheelchair, wherein an Attendant can, alternatively, guide the wheelchair by means of a source of radiation such as visible radiation from a torch, or invisible radiation such as infra-red radiation, by utilisation, in the construction of the underwater wheelchair, means for sensing such radiation, together with corresponding means for controlling the underwater wheelchair (1).
3. A controllable underwater wheelchair (1) as claimed in claim 2, wherein the said wheelchair is either a conventional wheelchair which has been modified and adapted for the purposes of applying the principles of the invention, or is a wheelchair which has been purpose built, so that, in either case, the, at least one occupant, or the, at least one person who is remote from the wheelchair, can operate, and cause to move, the said wheelchair, and its said, at least one occupant, and also control its descent into water, and ascent out of, water, and its motion in water, at various depths, or on the surface of water, wherein the said wheelchair is provided with means for, i) propulsion in water, utilising thrusters, (P1, and P2) both whilst at the surface of the water, and whilst at various depths in the water, and ii) for controllable descent, by means of controlled hydroplanes (GP1, GP2, and GP3) into, and controllable ascent out of, water, for various depths, wherein the wheelchair utilises at least one propulsion unit (P1, or P2) of a type which is normally found on conventional diving equipment and on dive propulsion vehicles, and wherein one variant of the said controllable underwater

wheelchair (1) involves the fitting of two of the said propulsion units (P1, and P2) and associated controls (SW1, and SW2) therein, and allows flexible movement, in three dimensions in the water, under full or partial control of the at least one occupant of the controllable underwater wheelchair (1) or under the full or partial control of the said at least one person who is remote from the wheelchair, so that acrobatics can be performed at the surface of, and under, water, in the same way that an acrobat performs such movements on land, and an aerobat performs in the air, wherein the said, at least one occupant of the controllable underwater wheelchair (1) is thus able to perform dance-like movements, and to make performances such as loop-the-loop and barrel roles, and the like, wherein the said performances can be referred to as aquabatics, in the same way that acrobatics are performed on land and aerobatics are performed in the air.

4. A controllable underwater wheelchair (1) as claimed in claim 3, wherein each one of two right, and left, hydroplanes, (GP1, and GP2) respectively, is attached to the underside of each one of the two right, and left, respectively, foot pedal assemblies (FP1, and FP2) of the said controllable underwater wheelchair (1) wherein the said foot pedal assemblies have been removed, modified, and repositioned, so that the re-orientation of the foot pedal assemblies of the said wheelchair, results in the planes of the two parallel upper and lower surfaces of each right and left foot pedal, and hence the planes of the two parallel upper and lower surfaces of each right and left hydroplane (GP1, and GP2) respectively, which are releasably and firmly attached to them, being at an angle which is greater than zero, with respect to the horizontal, and hence with respect to the local horizontal ground plane of the Earth, in the same way that the wings of a fixed wing aeroplane, as viewed from the front, are symmetrically orientated at an angle with respect to the said horizontal, which is greater than zero, wherein this arrangement has been found to aid control of the said attached right and left hydroplanes (GP1, and GP2) and hence of the controllable underwater wheelchair (1) wherein a value of this angle which allows acceptable control of the controllable underwater wheelchair (1) has been found to be approximately ten degrees.

5. A controllable underwater wheelchair (1) as claimed in claim 4, wherein, two of the conventional, battery powered propulsion units (P1, and P2) which are normally used by divers, have been adapted and fitted to the said wheelchair, together with their respective batteries (B1, and B2) by means of a specially designed framework, consisting of structural components (BR1, BR2, CB1, and CB2) and supporting members (5, 6, 7, and 8) which are connected to components (V1, and V2) and to components (29, and 30) in order to provide propulsion for the controllable underwater wheelchair (1) and wherein each one of the two right and left, specially shaped hydroplanes (GP1, and GP2) respectively, is at least under the control of each right and left foot, respectively, of the said at least one, occupant, and wherein one specially shaped hydroplane (GP3) which is located symmetrically, at the rear of the apparatus, is under the control of at least one hand of the, at least one occupant, at least via at least one gear change mechanism (GLC) and Bowden Cable link (BCL) which have been adapted from use on a mountain bicycle to use on the said controllable underwater wheelchair (1).
6. A controllable underwater wheelchair (1) as claimed in claim 5, wherein the electrical supply from each of the said batteries (B1, and B2) and hence to each of the said propulsion units (P1, and P2), respectively, is independently controlled by means of each one, of a pair of right, and left, spring-loaded push-button switches (SW1, and SW2) respectively, which can each be operated, independently, by pushing them into the on position, by means of the movement of them, by the outside of each right, and left, thigh region, respectively, of the, at least one occupant of the controllable underwater wheelchair (1) whilst the occupant is seated in it, wherein the said propulsion units (P1, and P2) are provided with electrical power from the said batteries (B1, and B2) by means of waterproof cabling (C1, and C2).
7. A controllable underwater wheelchair (1) as claimed in claim 6, wherein the said switches (SW1, and SW2) can be in any positions on the said controllable underwater wheelchair (1) which allow control of it.

8. A controllable underwater wheelchair (1) as claimed in claim 7, wherein so-called sip-puff switches, which are operated by the mouth, or wherein other devices which can be operated by means of the tongue, or by means of the eyes, or by means of any other part of the human body, can be utilised for controlling the controllable underwater wheelchair (1) wherein such devices can be used instead of, or in addition to, the said push-button switches (SW1, and SW2) wherein this method of control is particularly relevant for use of the wheelchair by persons who are limbless, and/or lack the ability to implement control by direct use of parts of their body, and wherein the said controllable underwater wheelchair (1) is adapted to incorporate mechanisms which drive the said hydroplanes (GP1, GP2, and GP3) via the use of such sip-puff switches, or via the use of the other said devices, accordingly.
9. A controllable underwater wheelchair (1) as claimed in claim 8, wherein the said hydroplanes (GP1, GP2, and GP3) are constructed from acrylic material, wherein the two hydroplanes (GP1, and GP2) which are operated by the feet of the at least one occupant, and the third, and rear, hydroplane (GP3) which is operated by the said hand of the said occupant, via gear change mechanism (GLC0 and Bowden Cable link (BCL) are each specially designed, arranged, and orientated, for aesthetic purposes, and so as to allow the occupant to perform aquabatics.
10. A controllable underwater wheelchair (1) as claimed in claim 9, wherein the said at least one occupant of the controllable underwater wheelchair (1) is able to enter a swimming pool, or to enter the sea, or any other region of water, whilst the wheels (CWA1, and CWA2) of the said controllable underwater wheelchair (1) are used for support, and are under the control of the at least one occupant, or the at least one person who is remote from the wheelchair, either by means of separate wheel driving apparatus, or at least by means of one of the hands of the said, at least one occupant, engaging with at least one of the said wheels (CWA1, and CWA2) and wherein the said occupant is able to move on the floor of a swimming pool, or the bed of the sea, or other region of water, if sufficiently flat, and to utilise the thrusters (P1, and P2) of the controllable underwater wheelchair (1) to move in the water and at the surface of the water, at least under the control

of the at least one occupant, or the at least one person who is remote from the controllable underwater wheelchair (1).

- 5 11. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein, other means of propulsion and control of the said controllable underwater wheelchair (1) can involve a water jet; also known as a hydrojet or pump jet, in addition to, or in place of, the propulsion units (P1, and P2) mentioned therein, wherein this will provide more flexible control of the controllable underwater wheelchair (1) and wherein either a ducted propeller
10 having a nozzle which can be adjusted so as to be orientated into any desired direction, is utilised, or a centrifugal pump provided with a nozzle which is similarly adjustable, is utilised, wherein such systems are commonly used in jet skis, pleasure boats, military water-based vehicles, and in ferries, wherein the range of flexibility of control which will be available is then only limited by the
15 number, and power, of such systems, and the cost.
12. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein the said apparatus is constructed so as to be neutrally buoyant, so that it floats on its own, for instance due to the use of buoyancy material such as
20 expanded foam used in swim floats, and spray foam, wherein such material can be incorporated into parts of the wheelchair; for instance, directly under the seat (SS) and wherein, in addition, a buoyancy bag, normally used by divers, together with associated inflation controls and equipment, are used on the wheelchair, wherein, for instance, in a working example of the controllable
25 underwater wheelchair (1) a horseshoe shaped, Dive Wing (HDW) has been used in conjunction with other dive control equipment, so that, by use of this equipment, the said, at least one occupant, can compensate for the effects of varying hydrostatic pressure, with depth.
- 30 13. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein for reasons of safety, quick-release belts (STU, and STL) and quick-release foot straps (FS1, and FS2) respectively, hold the at least one occupant, and their feet, respectively, in the controllable underwater wheelchair (1)

wherein, there can be at least two, such quick-release belts, and wherein waterproof lighting is used on the apparatus for the purposes of aiding the said occupant, and of showing the controllable underwater wheelchair (1) and its path in the water, to others, wherein this is particularly useful for persons such as divers, and other safety personnel, who are assisting the said occupant of the controllable underwater wheelchair (1).

14. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein special arrangements are made for allowing it to be used in water of different density, so that it will function in water generally used for swimming; for example that used in swimming baths, and also in sea water, wherein one aspect of this is that all materials utilised in the construction and use of the controllable underwater wheelchair (1) are resistant to corrosion or degradation, so that they can withstand chemicals which are naturally present in sea water and those which are present in the water used in swimming baths, and elsewhere, and wherein the controllable underwater wheelchair (1) can thus, for instance, be constructed from Stainless Steel, or from Titanium, or any metal or alloy, or material, for instance, carbon fibre, or from engineering plastics, which will be resistant to corrosion, with due regard for the need to cater for the corresponding change in weight of the wheelchair, wherein, Titanium has a lower density than that of Stainless Steel, and wherein, in general, the use of low density corrosion resistant alloys for construction, is suggested.

15. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein all parts are waterproof, in order to ensure continual functionality, and to maintain electrical safety, wherein resistance to corrosion is essential, and wherein this will be assisted by the use of waterproof paints; especially those intended for underwater use, and in particular, those used for sea water applications, wherein variants of the controllable underwater wheelchair (1) will ensure portability, and transportability, in order to allow it to be utilised worldwide, wherein, with the application of appropriate design, plastics having engineering properties are utilised in construction.

16. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein, instead of the said means of propulsion (P1, and P2) having a fixed orientation because the occupant of the wheelchair uses the said three hydroplanes (GP1, GP2, and GP3) to control the orientation of the controllable
5 underwater wheelchair (1) it is also possible to have attitude control of the means of propulsion, by mounting the propulsion units (P1, and P2) in devices which are themselves mounted on the controllable underwater wheelchair (1) wherein the orientation of the means of propulsion can then be fully adjusted by the said occupant of the controllable underwater wheelchair (1) or by the said at least
10 person who is remote from the wheelchair, about three axes which are at right angles with respect to one another, thereby providing greater flexibility in the manoeuvrability of the controllable underwater wheelchair (1) wherein this attitude control of the means of propulsion is particularly relevant to use by limbless persons in those situations where they are unable to operate the hydroplanes, wherein the technology involved in the implementation of the said
15 controllable underwater wheelchair (1) herein referred to, can utilise the methods used in the control and orientation of a satellite dish, or the like, wherein this method of control of the wheelchair lends itself to programmable control of the aquabatics to be performed, and is particularly suited to training, and to
20 Attendant Control.
17. A controllable underwater wheelchair (1) as claimed in any preceding claim, which involves the assembly of parts which have been especially designed and manufactured so that they can be easily removed from storage, and transported,
25 and then assembled, to provide a safe configuration for the intended applications, and so that they can be easily, and quickly, disassembled for subsequent transportation and storage.
18. A controllable underwater wheelchair (1) as claimed in any preceding claim,
30 which has been constructed for carrying an object, for example a dummy representing a person, of comparable weight and size, which is used instead of a human occupant, for the purposes of testing, on land, and in water, in order to

simulate, and test, the performance of diving, and aquabatics, in water, wherein this is particularly useful for Attendant control.

- 5 19. A controllable underwater wheelchair (1) as claimed in any preceding claim, which is not limited to the use of hydroplanes (GP1, GP2, and GP3) which are designed only as described, herein, wherein other designs can involve specially shaped hydroplanes, for example those which possess curvature, and which thus improve (i) the manoeuvrability of the controllable underwater wheelchair (1) (ii) the efficiency with which it is operated, and (iii) its aesthetic qualities.
- 10 20. A controllable underwater wheelchair (1) as claimed in any preceding claim, wherein the designs of the said hydroplanes (GP1, GP2, and GP3) can involve lockable hinging, and the utilisation of countersunk nut and bolt holes, in order to ensure the smooth flow of water over the hinged regions of the hydroplanes,
- 15 or can involve other non-water-flow disturbing means, in order to ensure smooth flow of water over the hinged regions, wherein such designs assist in the smooth motion of the said hydroplanes (GP1, GP2, and GP3) and allow them to be constructed in the form of more than one part, wherein the said hydroplanes (GP1, GP2, and GP3) can thus be more easily manufactured to any desired
- 20 specification, and can thus be more easily assembled and disassembled, and transported.

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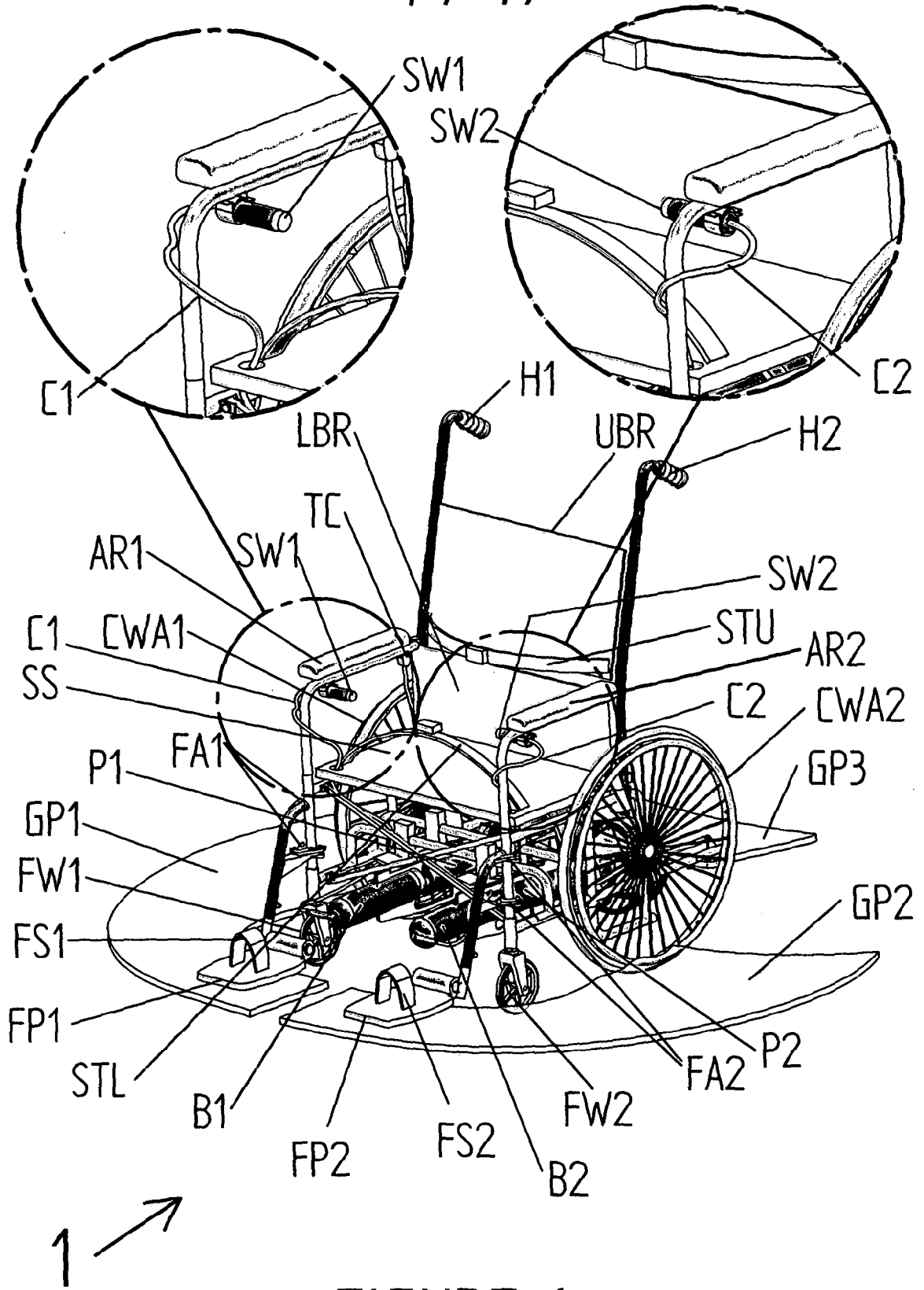


FIGURE 1

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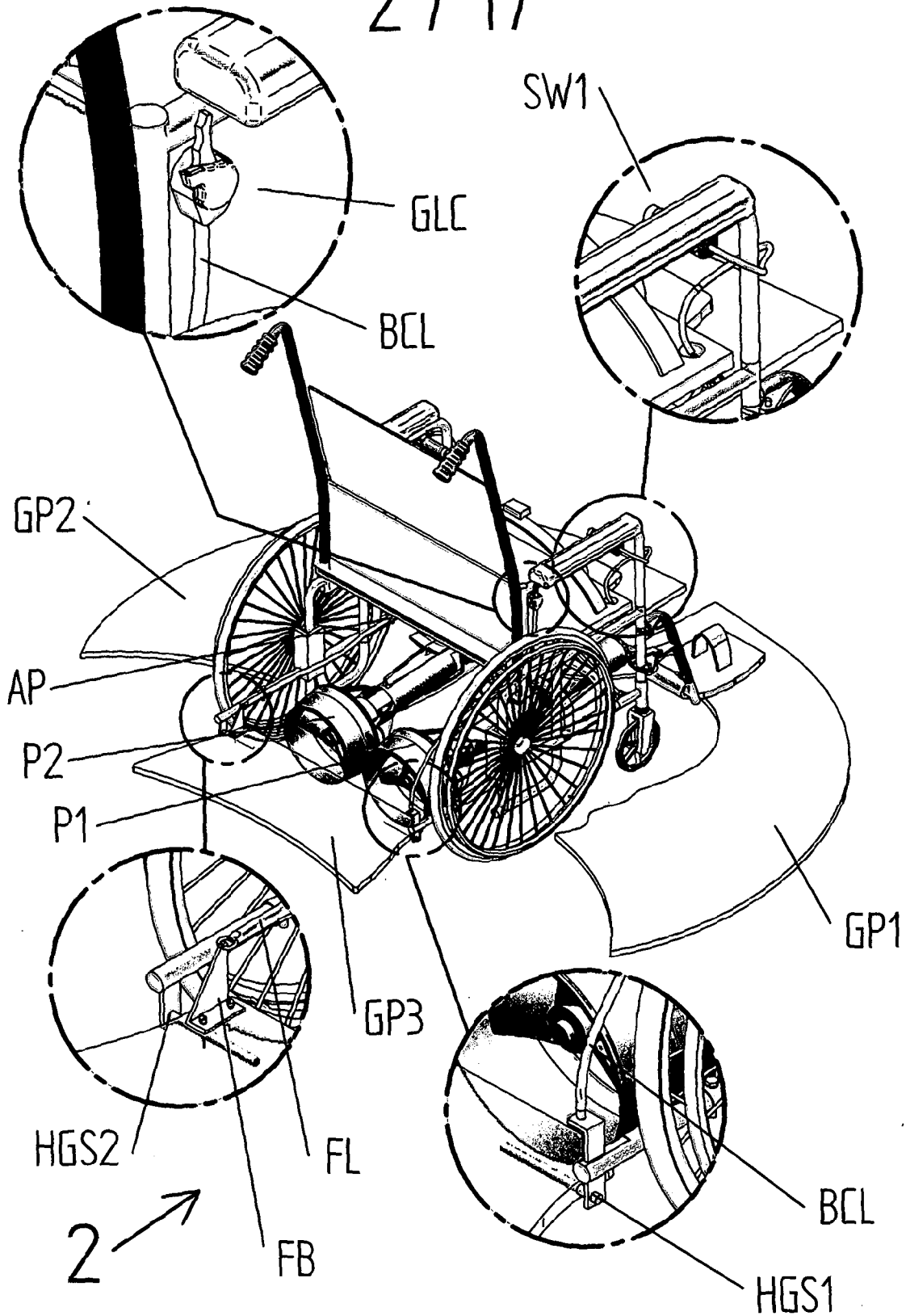


FIGURE 2

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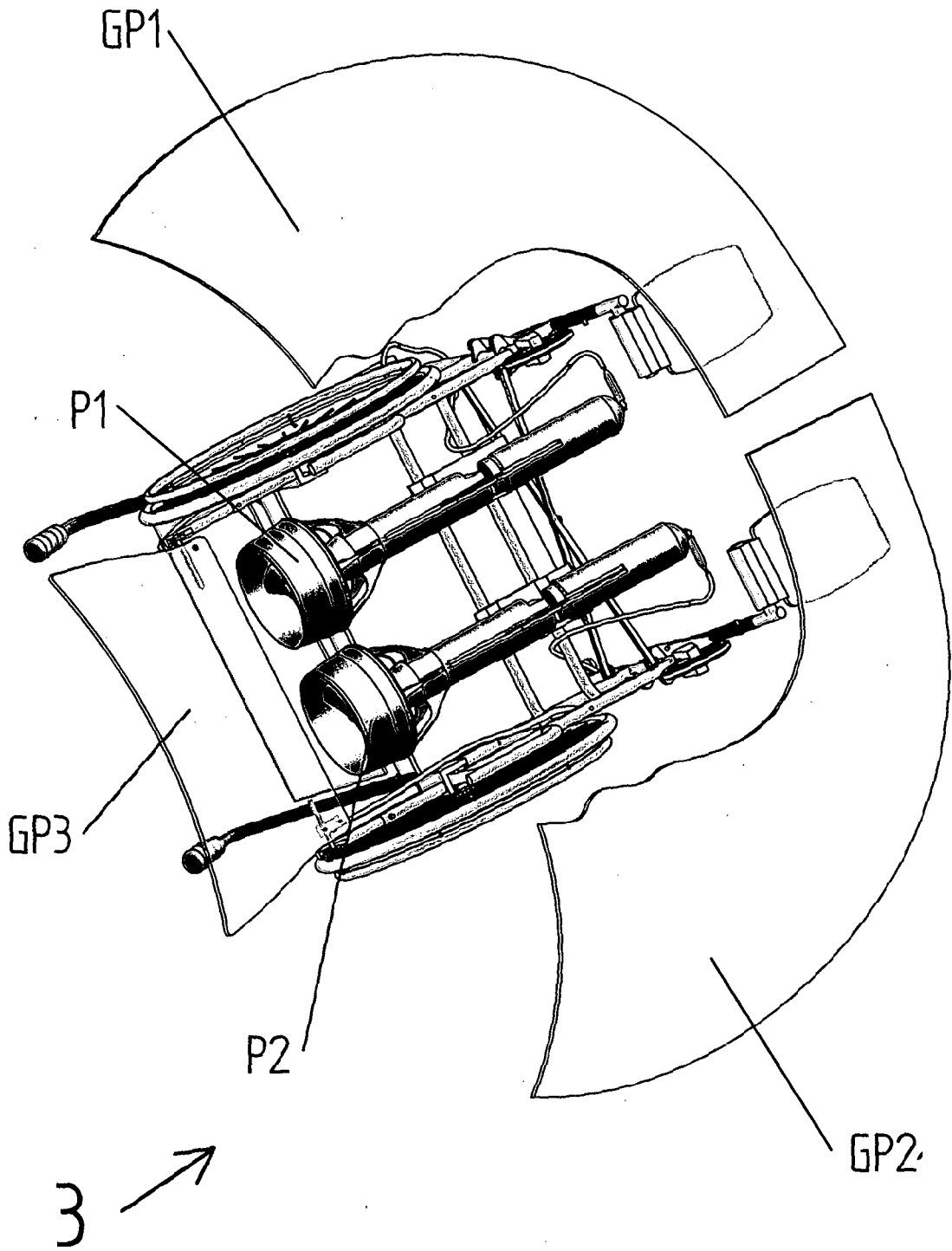


FIGURE 3

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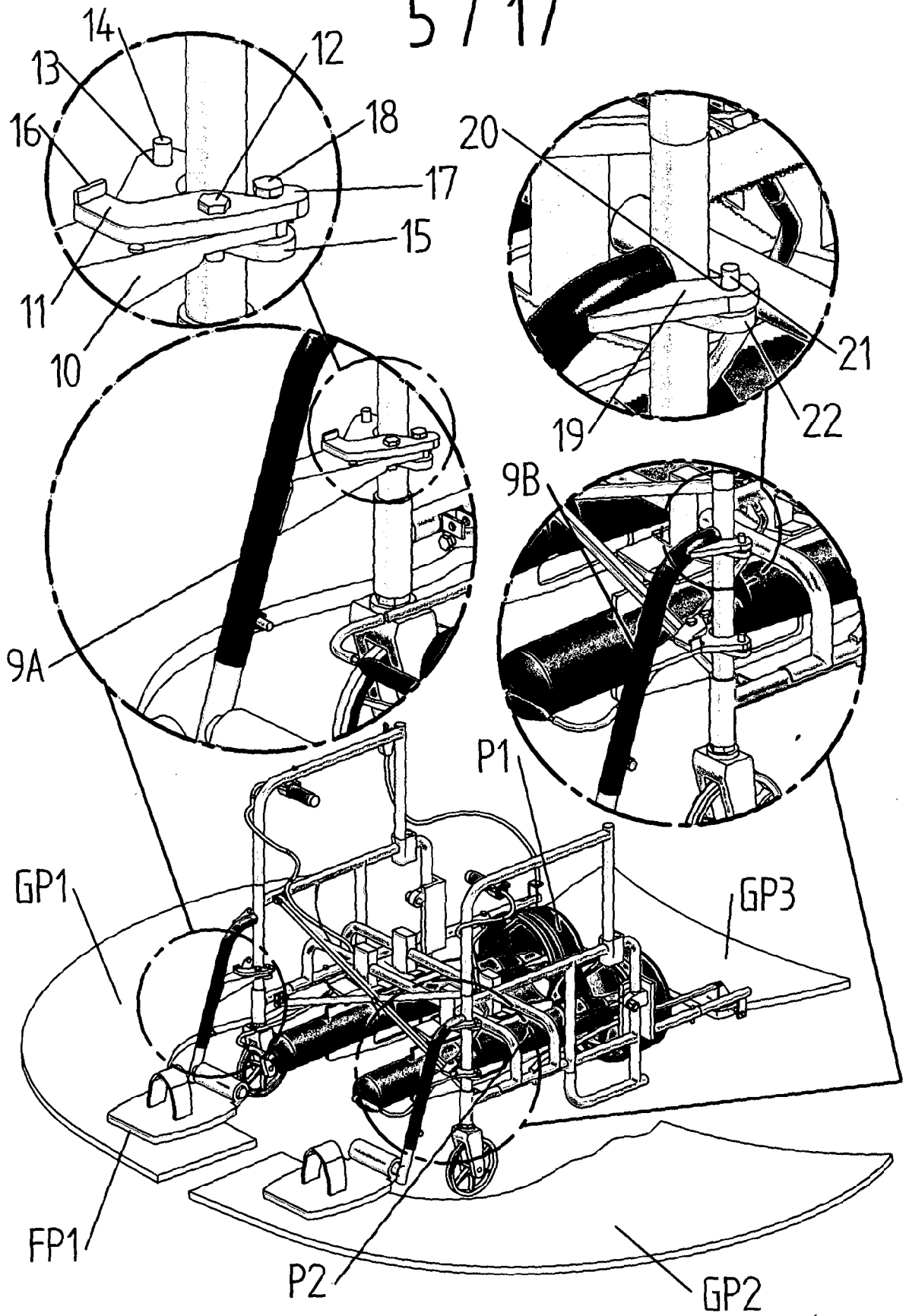


FIGURE 5

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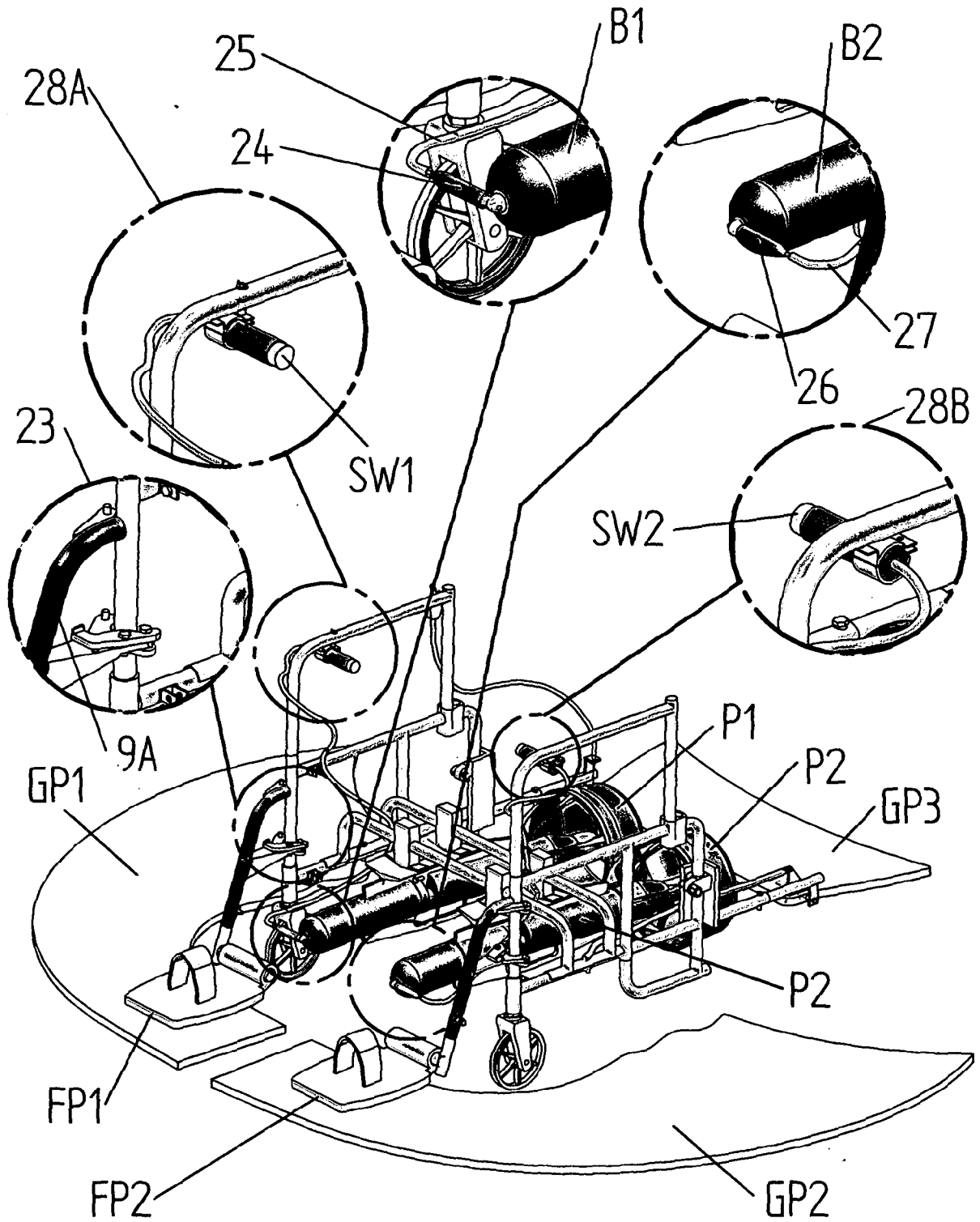


FIGURE 6

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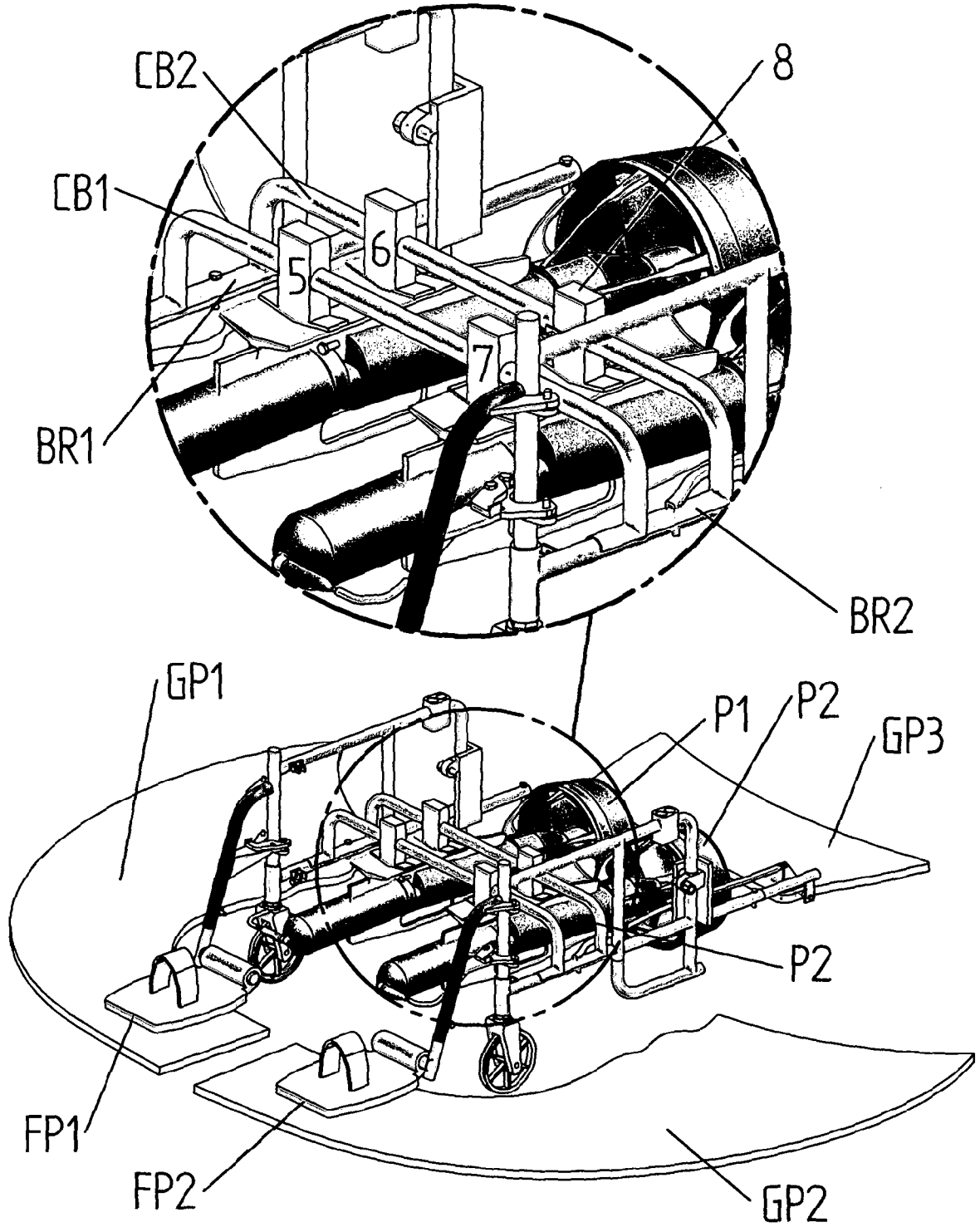


FIGURE 7

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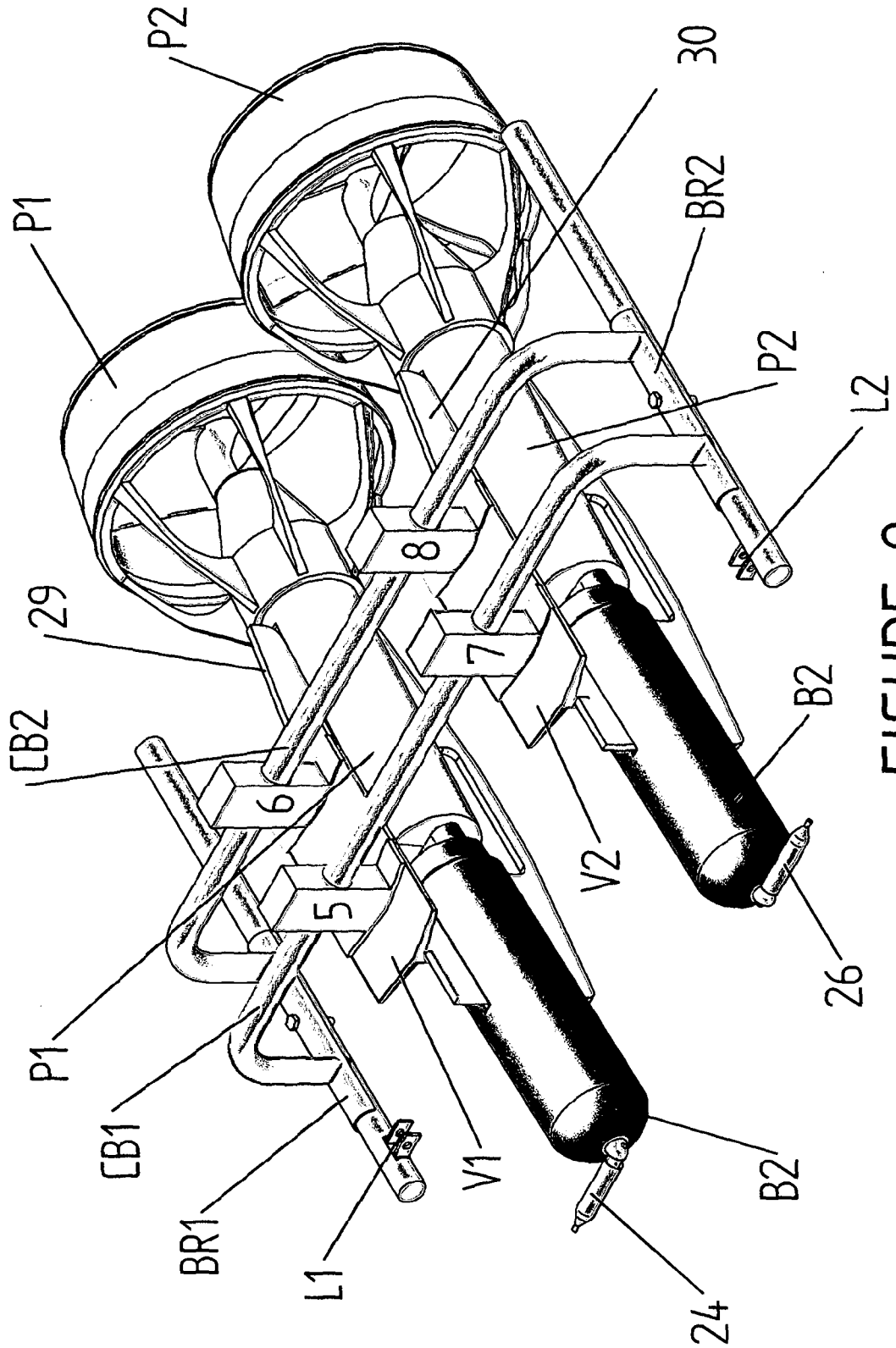


FIGURE 8

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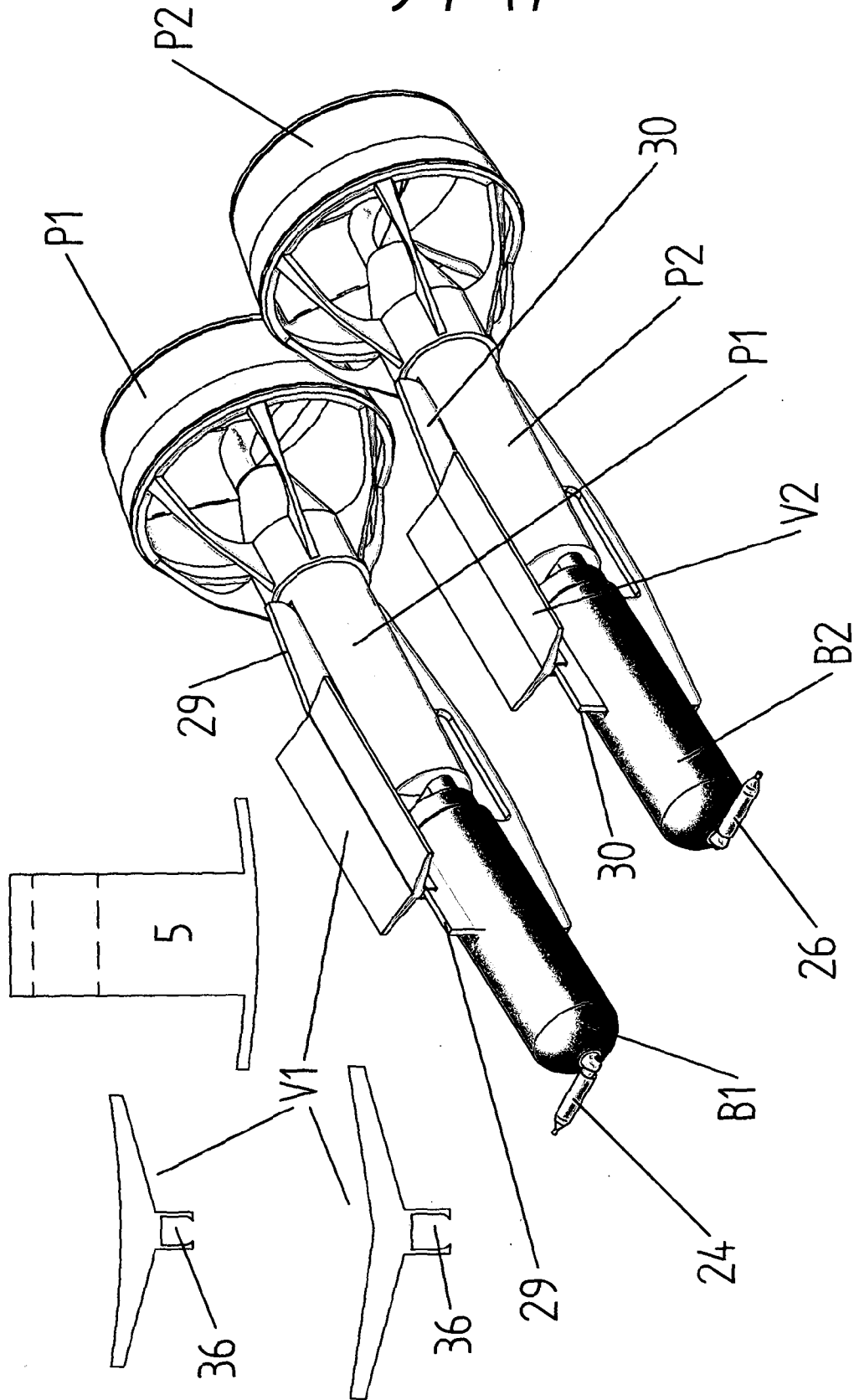


FIGURE 9

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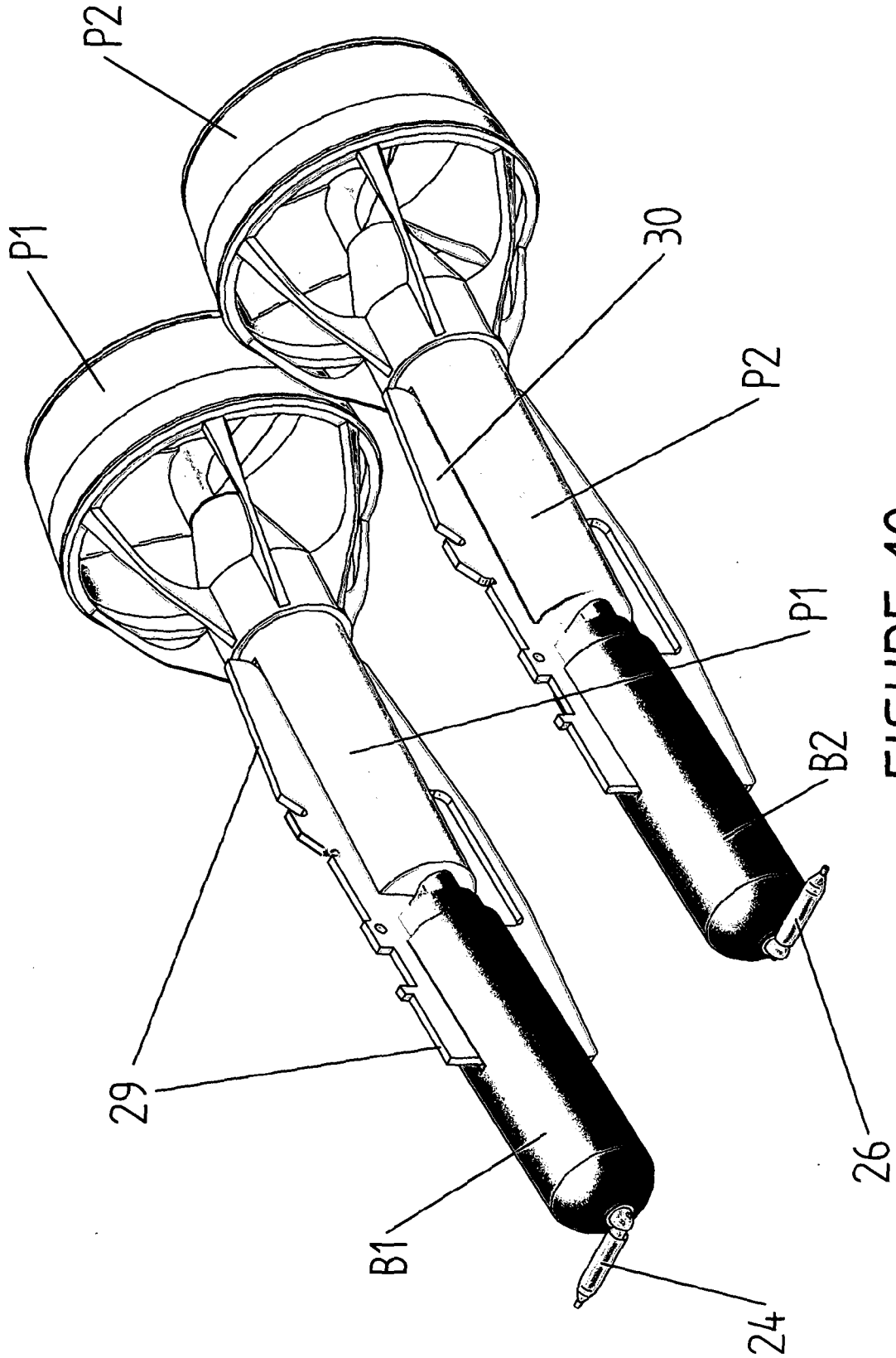


FIGURE 10

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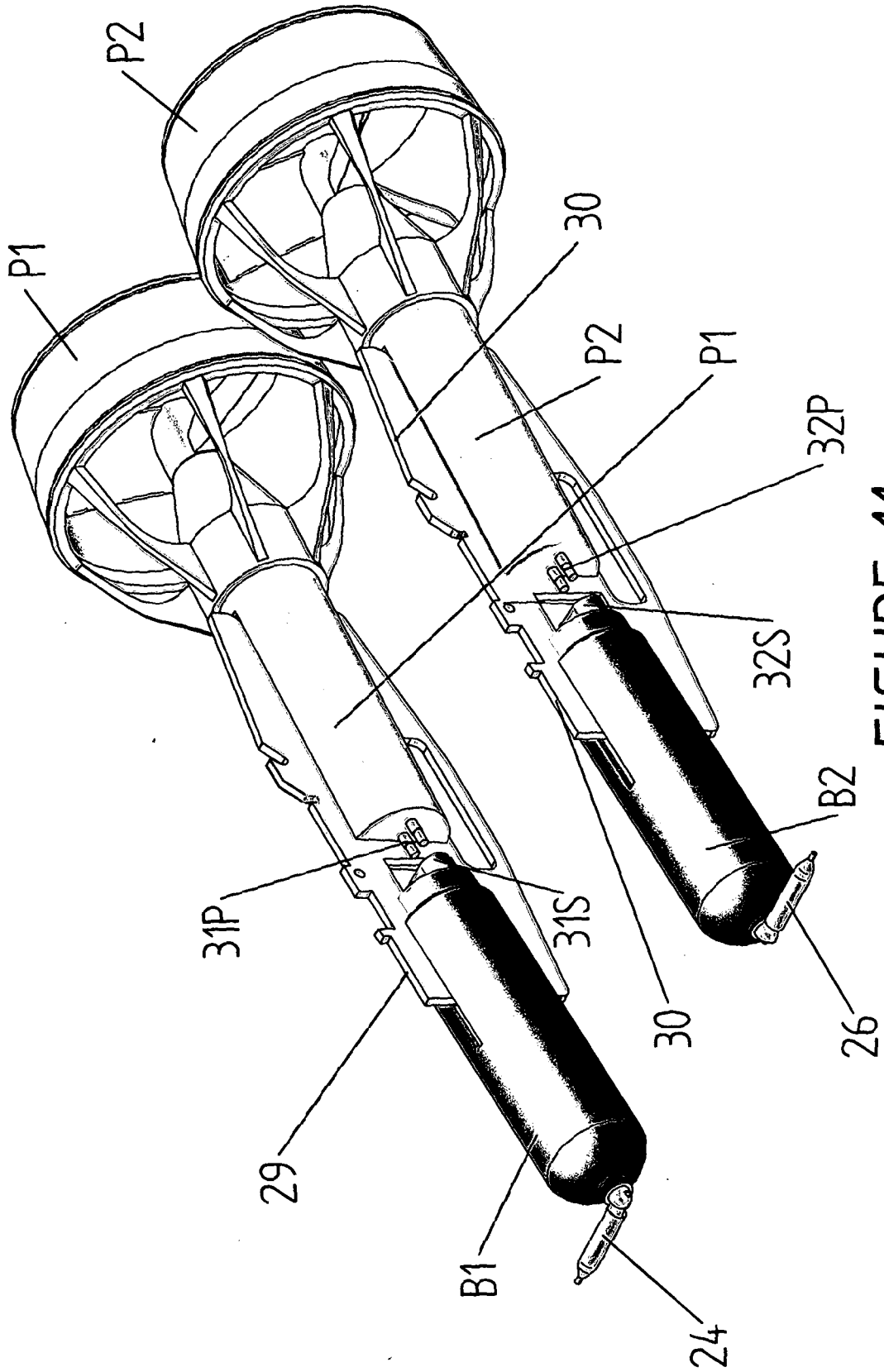


FIGURE 11

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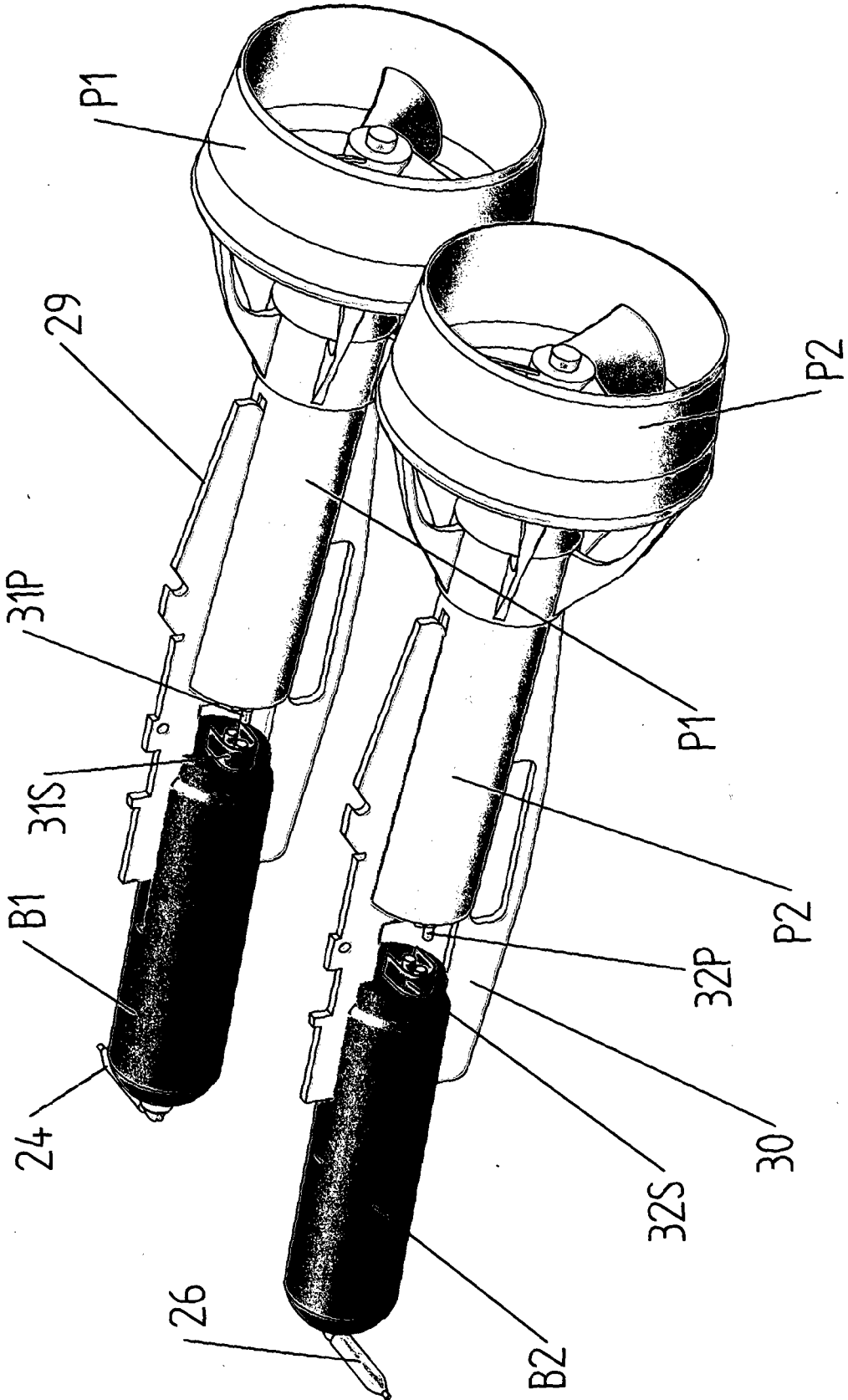


FIGURE 12

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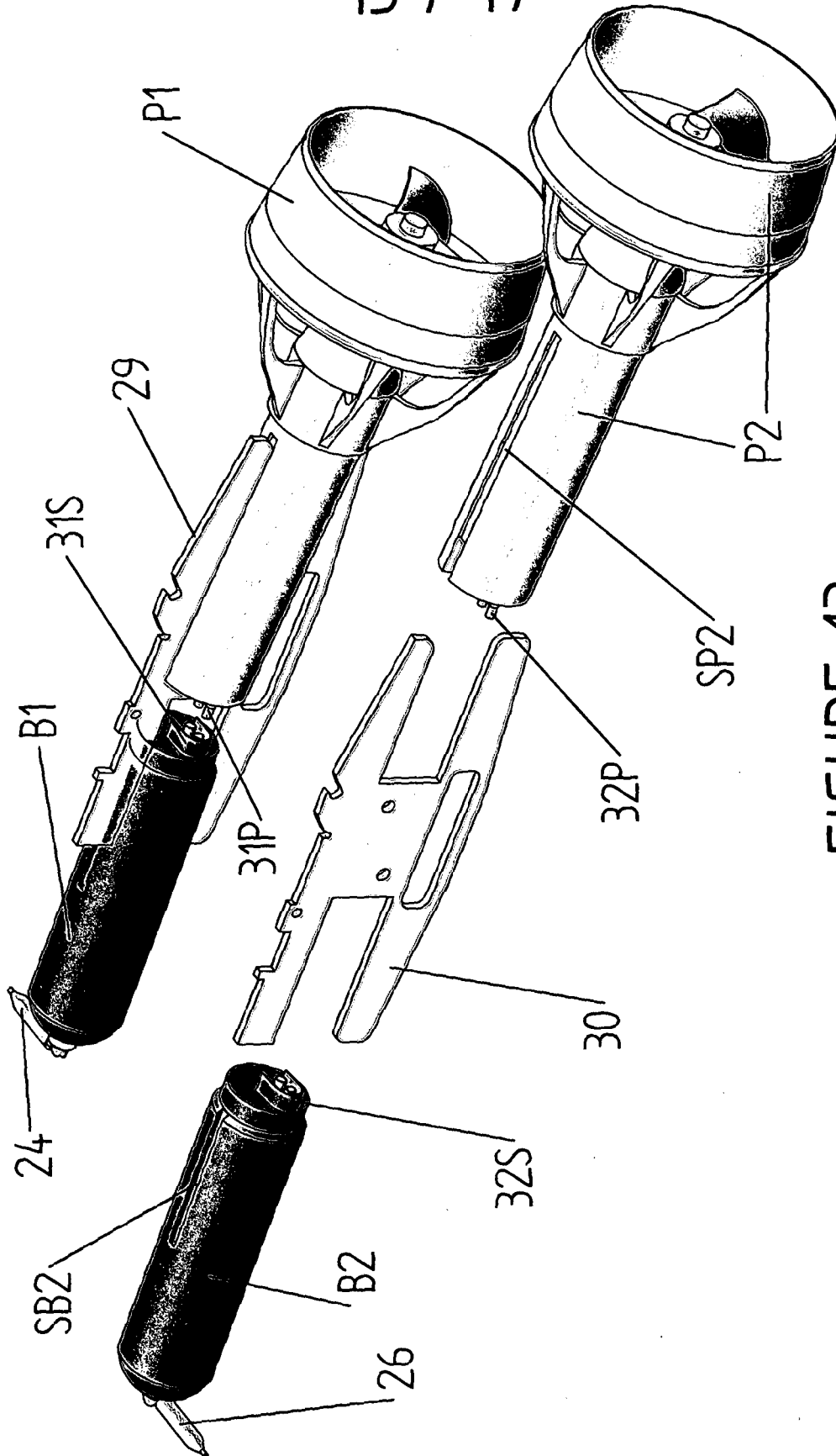


FIGURE 13

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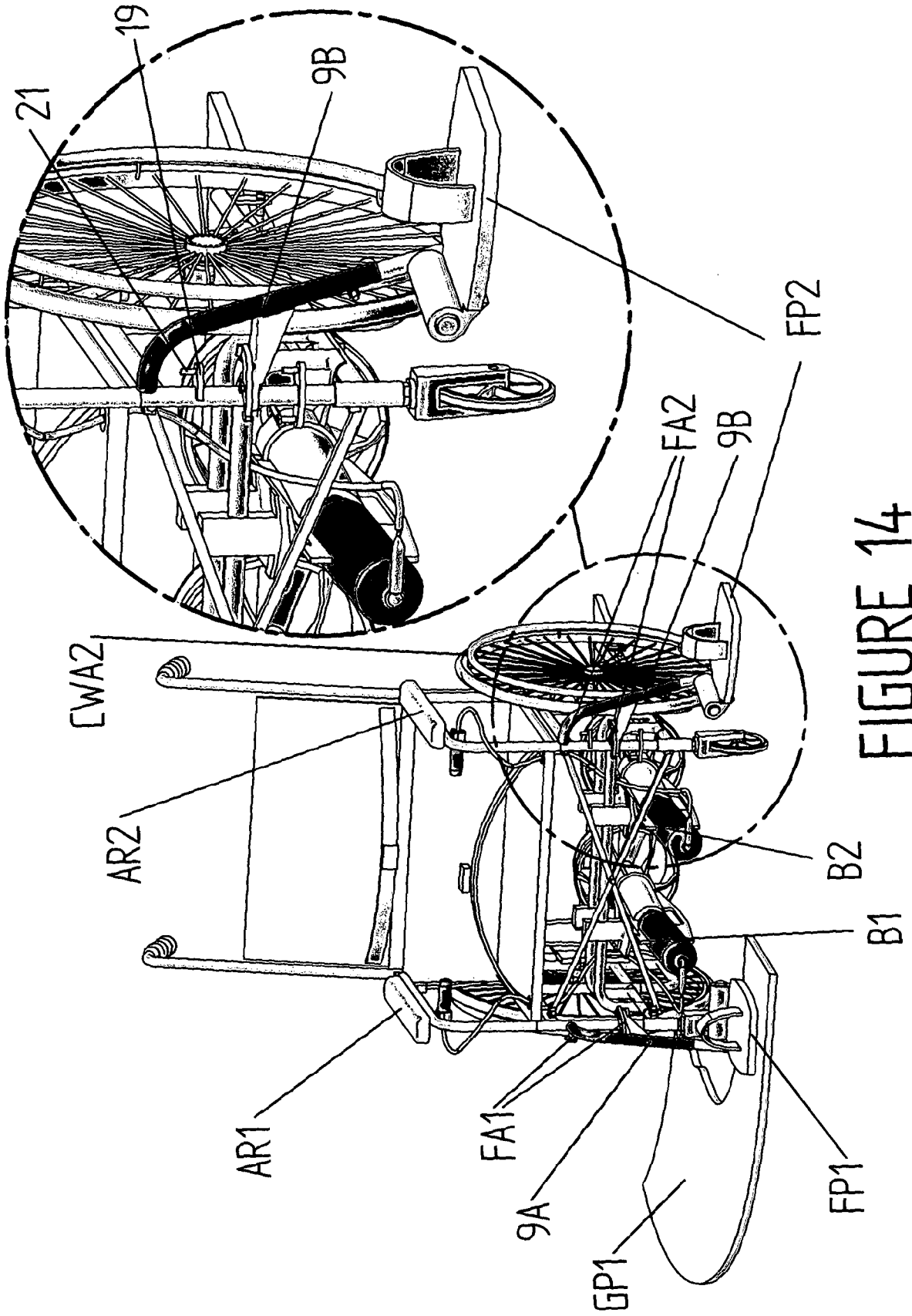


FIGURE 14

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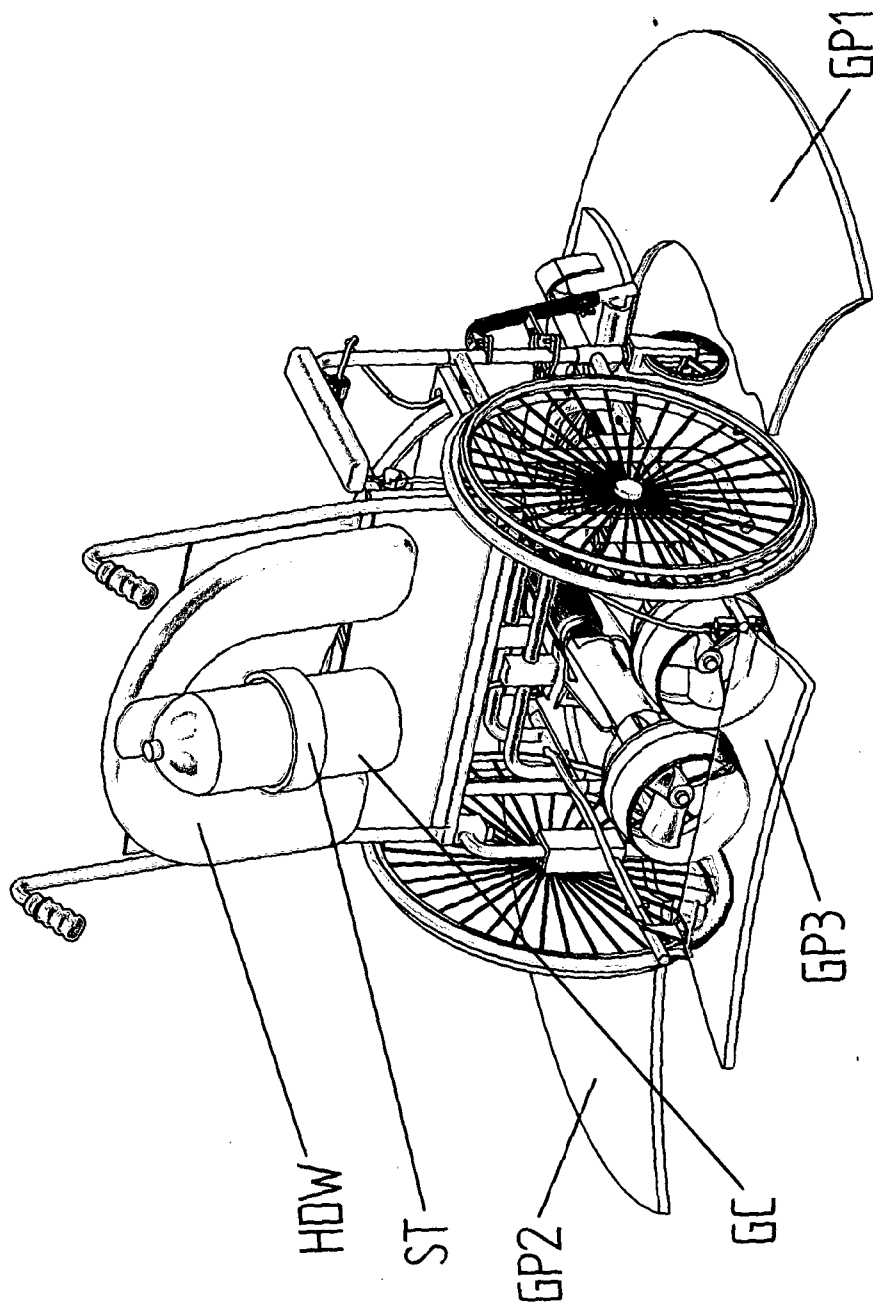


FIGURE 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2012/000812

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A61G5/00 A61G5/04
 ADD.

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)
 A61G B63B B63G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 700 648 A (TREFETHERN GEORGE M ET AL) 20 October 1987 (1987-10-20) figures column 2 - column 8 -----	1-23
X,P	Zoe Kleinman: "Underwater wheelchair put to test ahead of Paralympics", BBC News Technology, 27 August 2012 (2012-08-27), XP055053845, online Retrieved from the Internet: URL:http://www.bbc.co.uk/news/technology-19389396 [retrieved on 2013-02-19] the whole document ----- -/--	1-23

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

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 19 February 2013	Date of mailing of the international search report 26/02/2013
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Edlauer, Martin
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2012/000812

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: **24(completely); 1-23(partially)**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 24(completely); 1-23(partially)

Present claim 1 encompasses systems defined only by their desired function, contrary to the requirements of clarity of Article 6 PCT, because the result-to-be-achieved type of definition does not allow the scope of the claim to be ascertained. The fact that any system could be screened does not overcome this objection, as the skilled person would not have knowledge beforehand as to whether it would fall within the scope claimed, except for the system disclosed in the description, see pages 11-23. Undue experimentation would be required to screen systems randomly. This non-compliance with the substantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search for claim 1. The search of claim 1 and its dependent claims 2-23 was consequently restricted to an underwater wheelchair system (reference 1 in the figures). Claim 24 contains a reference to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2012/000812

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/056193 A1 (LOEFSTRAND MIKAEL [SE]; ZOUCE AB [SE]) 20 May 2010 (2010-05-20) page 9, line 33 - page 10, line 3 figures	1-23
A	----- US 6 073 958 A (GAGNON BRIAN [US]) 13 June 2000 (2000-06-13) the whole document	1-23
A	----- FR 2 902 075 A1 (D HENIN JEAN PIERRE [FR] D'HENIN JEAN PIERRE [FR]) 14 December 2007 (2007-12-14) the whole document	1-23
A	----- US 5 291 846 A (DAVIS JR FREDERICK B [US]) 8 March 1994 (1994-03-08) the whole document	1-23

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2012/000812

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4700648	A	20-10-1987	NONE

WO 2010056193	A1	20-05-2010	EP 2355764 A1 17-08-2011
			US 2011276233 A1 10-11-2011
			WO 2010056193 A1 20-05-2010

US 6073958	A	13-06-2000	NONE

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