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(54) MACHINERY FOR THE RECOVERY AND REMOVAL OF WASTE OR FLOATING DEBRIS FROM WATERCOURSES

(57) A machine for the recovery of floating material (1, 100) from a waterway (2, 1002) comprises a floating support structure (200, 1200), a capture system (300, 1300) configured to intercept and collect the floating material dragged by the waterway (2, 1002), a transport system (400, 1400) for handling toward a collection point the material coming from the capture system (300, 1300).

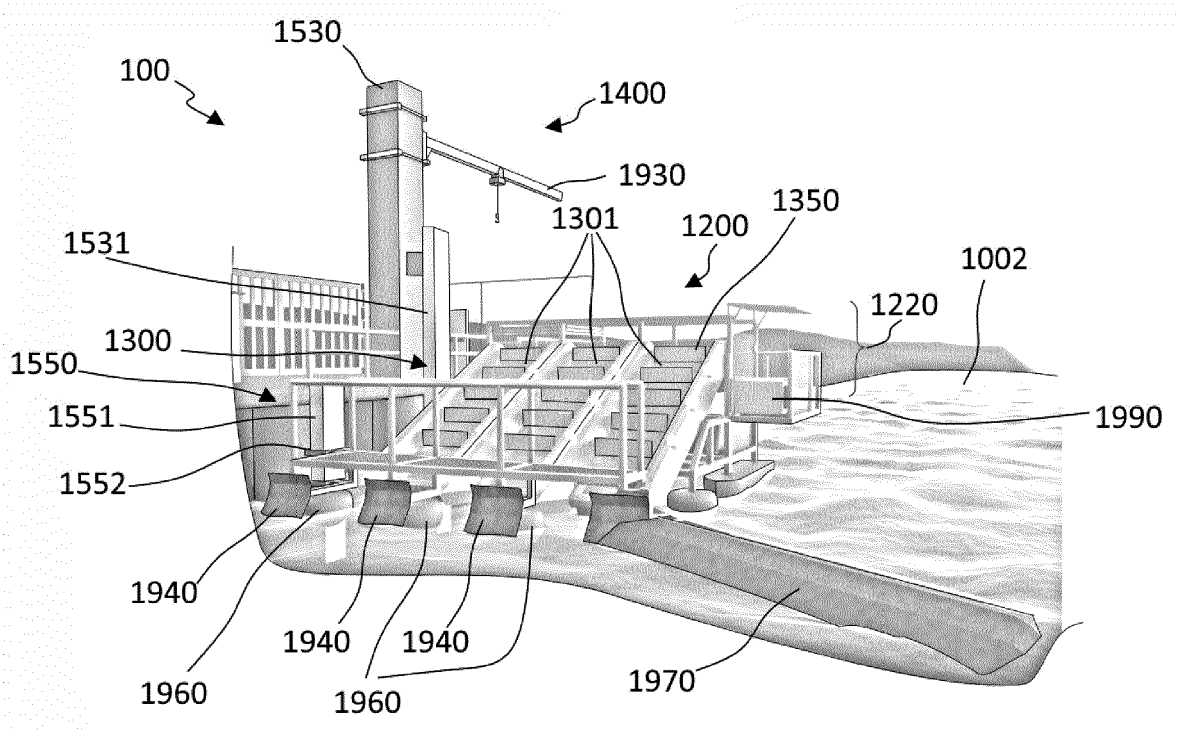

Fig. 13

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Description

[0001] The present invention relates to a machine for removing floating material from a waterway.

[0002] In particular, the present invention relates to a machinery configured to recover and remove floating waste and/or debris, with particular reference to plastic waste, such as containers, packaging or similar, by taking them from a waterway.

[0003] Today we are witnessing the growing phenomenon of tons of plastic waste being spilled into waterways, causing a big environmental emergency due to the pollution produced.

[0004] Once in the seas or oceans, these wastes are constantly exposed to sunlight and, over time, degrade until they decompose into small fragments, invisible to the eye. Therefore we are talking about microplastics, which remain suspended in the water or settle on the seabed causing irreparable damage to the ecosystem. Microplastic, due to its extremely small size, is impossible to be recovered and disposed of and, moreover, it can be inadvertently ingested by aquatic fauna, endangering the life of many species, including that of humans.

[0005] To counter the growing phenomenon of plastic waste in waterways, numerous solutions have been developed that involve the construction of water barriers capable of intercepting and retaining the floating plastic waste to be recovered.

[0006] One of these solutions comprises a floating barrier, tubular in shape, capable of collecting waste by exploiting the motion of the waves.

[0007] A further solution includes a system of fixed nets and low draft boats for the containment and collection of floating and semi-sunken plastic coming from rivers. The nets are installed between the banks of a river, even for long periods, and allow to retain the plastic transported by the rivers to the sea, without being invasive. The system in fact allows the free flow of water without altering its flow rate and speed, as well as the passage of aquatic animals and natural river debris, which belong to the sea. For the collection of plastic waste accumulated in the network, the use of PVC boats specific for shallow waters is envisaged, which provide for the mechanized or manual separate collection of accumulated waste and the subsequent repositioning of the network.

[0008] Document CN 208701635 describes an apparatus for intercepting and recovering floating waste from a river. The device has a portal structure to which a first conveyor belt is connected to take the waste from the water and convey it to a horizontal conveyor belt to deliver it to a collection point. A water mill drives the device.

[0009] This device allows to automate the collection of floating waste from a river but appears limited in its use due to the size of the collection basin as well as the fact that its conformation determines a barrier that hinders the flow of floating debris that could get stuck in the structure itself compromising its functioning.

[0010] Document CN 109577301 describes a further solution for an equipment for the recovery of floating waste comprising a barrier to be installed in the waterway, to divert the floating waste towards a collection device that picks up the waste from the water to convey it to an area recovery.

[0011] Also this solution, similar to the previous one, is limited in its implementation as the barrier constitutes an obstacle, which in fact prevents the possible navigability of the waterway or the outflow of large debris such as logs or similar and, moreover, it does not allow the system to adapt to changes in the hydrometric level of the waterway itself.

[0012] Document CN 206346165 describes a system for the collection of floating waste comprising a system of baskets positioned side by side, aligned transversely to the advancement direction of the waterway and connected side by side along a shaft that can be rotated to rotate the baskets between a collection position, wherein they are partially immersed in water, and an unloading position, wherein they are raised by the water to release the recovered material into special collection containers.

[0013] There is a need to improve the state of the art in the sector of the recovery of floating waste along waterways and, moreover, to overcome the drawbacks indicated above regarding the ability to efficiently recover such waste or floating debris.

[0014] The purpose of the present invention is therefore to allow the recovery of waste or debris floating along a waterway in a simple, reliable, efficient and economical way, within the framework of a technical solution that can be easily installed near the waterway itself and can be integrated into the surrounding environment.

[0015] A further object of the present invention is to create a machine for the recovery and removal of floating waste and/or debris of flexible use and which is easily adaptable to the size of the waterway.

[0016] The specific object of the invention is a machine for recovering floating material from a waterway comprising a floating support structure, which extends along a first direction, wherein the first direction is oriented transversely with respect to a direction of flow of the waterway, a capture system configured to intercept and collect the floating material dragged by the waterway, a transport system configured to selectively handle the material intercepted and collected by the capture system to a collection point, and a system connection configured to define a mobile connection of the support structure to a bank of the waterway, the capture system and the transport system being operationally connected to the support structure, wherein the capture system comprises at least one support frame of at least one collection belt, wherein the at least one frame is rotatably connected to the support structure about an axis of rotation oriented parallel to the first direction, the at least one collection belt being inclined with respect to the support structure and having at least one bottom end configured to be immersed for at least a section in the waterway .

[0017] According to another aspect of the invention,

the connection system can comprise at least one joint configured to allow rotation and/or translation of the support structure of the capture system and of the transport system relative to the bank of the waterway or the connection system can comprise at least one joint configured to allow at least one translation of the support structure of the capture system and of the transport system relative to the bank of the waterway.

[0018] According to a further aspect of the invention, the support structure can comprise at least one support group which extends from a top portion of the support structure and at least one primary flotation device operatively connected to the at least one support group in diametrically positioned opposite the top portion.

[0019] According to an additional aspect of the invention, the capture system can comprise a secondary flotation system operatively connected to a bottom end of the at least one collection belt and configured to ensure a predetermined sinking of the bottom end into the waterway.

[0020] According to another aspect of the invention, the capture system can comprise at least one container, supported by the support structure at a top end of the at least one collection belt and configured to collect inside it material recovered from the at least one collection belt.

[0021] According to a further aspect of the invention, the transport system can comprise a lifting and handling member configured to interact with the at least one container so as to lift it and position it at a predetermined collection point, the lifting member being configured as a crane, wherein the crane can optionally be configured to perform maintenance and/or installation of one or more components of the machine for the recovery of floating material.

[0022] According to an additional aspect of the invention, the connection system can comprise at least one waterfront fastening structure configured to connect the support structure and the capture system to the river bank and wherein the at least one joint is configured to allow at least the translation of the support structure and the capture system along a direction normal to the direction of flow of the waterway and to the first direction.

[0023] According to another aspect of the invention, the waterfront fastening structure can include at least one platform linked to the bank of the waterway, the support structure and the capture system being mobile connected through a sliding connection to at least one platform.

[0024] According to a further aspect of the invention, the waterfront fastening structure can comprise at least one pole configured to be implanted and constrained to the bank of the waterway, wherein the at least one joint is configured as a sleeve in turn configured for be slidably fitted along the at least one pole to connect one end of the support structure to the waterfront fastening structure.

[0025] The specific object of the invention also is a machine for the recovery of floating material from a waterway comprising a floating support structure, a capture system configured to intercept and collect the floating material dragged by the waterway, a system of transport to convey the material intercepted and collected by the capture system to a collection point, and an anchoring system configured to connect the support structure to at least one bank or to the bottom of the waterway, wherein the anchoring system includes tie rods configured to be operatively connected at one end to a respective section of the support structure and at the opposite end to a respective pole tied along a bank of the waterway or to the bottom of the waterway.

[0026] According to another aspect of the invention, the machine for recovering floating material from a waterway may comprise a connection system configured to define a mobile connection of the support structure to a bank of the waterway, wherein the capture system and the transport system are operatively connected to the support structure, and wherein the connection system comprises at least one joint configured to allow rotation and/or translation of the support structure, the capture system and the transport relative to the bank of the waterway.

[0027] According to a further aspect of the invention, the connection system can comprise a fastening structure configured to be fixed to a bank of the waterway, a connection ramp interposed between the fastening structure and the supporting structure, wherein the at least one joint is configured to mutually connect the fastening structure and the connecting ramp.

[0028] According to an additional aspect of the invention, the fastening structure can be configured as a portal structure comprising at least a first column and at least a second column mutually connected to respective top ends by means of a crosspiece, wherein the at least one joint is a connected cylindrical collar movable along the at least one first column or wherein the fastening structure comprises at least one first column configured to be constrained at ground and the at least one joint is a cylindrical collar movably connected along the at least one first column.

[0029] According to another aspect of the invention, the at least one joint can be configured to rotate and translate along the at least one first column.

[0030] According to a further aspect of the invention, the machinery for recovering floating material from a waterway can comprise a damping device connected at one end thereof to the at least one support group, by means of a first hinge, and at a second end thereof opposite the at least one frame of the capturing system, by means of a second hinge, wherein the support structure, the damping device and the capturing system define a frame with variable geometry.

[0031] The advantages offered by the machine for the recovery of floating waste according to the invention are evident.

[0032] In fact, the recovery machine according to the invention allows in a simple, semiautomatic and economical way to recover the floating waste carried by the cur-

rent along the waterway wherein it is installed, even in the context of a flexible use solution and such not to constitute an obstacle barrier, which could hinder the possible passage of boats, guaranteeing the natural flow of the waterway as well as the navigability of the same.

[0033] Furthermore, the recovery machine according to the invention is of the automated or semi-automated type to limit the intervention of operators in charge of its operation, requiring a limited presence of personnel assigned to supervise the machine or for the possible execution of its maintenance'.

[0034] The recovery machine according to the invention can be easily implemented in the vicinity of bridges or similar structures along a waterway, without requiring substantial changes to them.

[0035] Furthermore, the recovery machine according to the invention is able to avoid the accumulation of large debris, such as logs or the like, being able to be moved relative to the waterway itself.

[0036] Furthermore, the recovery machine according to the invention is configured to safeguard any fauna that populates the waterway along which the machinery itself is installed.

[0037] The present invention will now be described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the Figures of the attached drawings, wherein:

Figure 1 shows a schematic view from above of the machine for the recovery of floating waste according to the invention;

Figure 2 shows a side perspective view of some components of the machine for waste recovery of according to the invention;

Figures 3 and 4 show schematic perspective views, from different angles, of some components of the machine for waste recovery according to the invention;

Figure 5 shows a front perspective view of some components of the machine for waste recovery of Figure 2;

Figure 6 shows a detailed perspective view of some components of the machine for waste recovery according to the invention;

Figure 7 illustrates a detailed perspective view from above of some components for the ground connection of the machinery for waste recovery according to the invention;

Figures 8 and 9 respectively show a perspective view and a front view of a component of the machinery for the recovery of waste according to the invention;

Figure 10 shows a detailed perspective view of some components of the recovery machine according to the invention;

Figure 11 shows a schematic top view of a further version of a component of the recovery machine according to the invention;

Figure 12 shows a perspective view of a further component of the recovery machine according to the invention;

Figures 13 and 17 show front perspective views of a further embodiment of the recovery machine according to the invention, from different angles;

Figure 14 shows a rear perspective view from above of the recovery machine of Figure 13;

Figures 15 and 16 show perspective views of some components of the recovery machine referred to in Figure 13.

[0038] In the Figures identical reference numbers will be used for similar elements.

[0039] With reference to the attached Figure 1, it can be observed that an embodiment of a machine configured to collect floating waste and/or debris transported by a waterway 2, such as a river, is indicated as a whole with 1.

[0040] The machine for the recovery and removal of floating waste and/or debris 1, hereinafter referred to as recovery machine 1 for the sake of brevity, comprises a support structure 200 to which a capture system 300 is operationally connected, configured to intercept floating material, such as waste and/or debris, dragged by the waterway 2 along which the recovery machine 1 and a transport system 400 to convey the intercepted material collected by the capture system 300 to a collection point are installed.

[0041] The recovery machine 1 then comprises an anchoring system 600 configured to connect the support structure 200 to a bank of the waterway 2.

[0042] The support structure 200 is floating to avoid, preferably, the construction of pillars or permanent works which could cause obstacles and prevent the possible navigability of the waterway 2 itself.

[0043] In particular, the support structure 200 comprises a top portion 220 which extends along a first direction 201 and is laterally delimited between a first wall 202 and a second wall 203 (see in particular Figures 2-4).

[0044] According to a preferred embodiment, the top portion 220 is made by means of a grid structure, to allow any water to escape through the top portion 220 itself.

[0045] The top portion 220 defines the top of the support structure 200, along which the waste or debris captured and taken from the waterway 2 and transported to a collection point can be handled, according to methods that will be shown below.

[0046] The support structure 200 then comprises at least one support group, indicated as a whole by 204, which extends along a direction normal to the top portion 220, below it.

[0047] In detail, the at least one support group 204 has a top end connected to the top portion 220 and a respective bottom end connected to a corresponding primary flotation device 205 (see for example Figures 2 and 7).

[0048] In fact, the at least one support group 204 and the corresponding primary flotation device 205 support the top portion 220 of the support structure 200 making

it float on the waterway 2.

[0049] The at least one support group 204 extends from the top portion 220 below it, i.e. the at least one support group 204 is interposed in use between the top portion 220 of the support structure 200 and a respective primary flotation device 205.

[0050] The at least one support group 204 comprises vertical support elements 206, which extend parallel to each other along a direction orthogonal or substantially orthogonal to the direction of advance of the waterway 2, and transverse support elements 207 which are inclined with respect to the advancement direction of the waterway 2 and to the vertical support elements 206. The vertical support elements 206 and the transverse support elements 207 are operatively connected to each other, as better described below.

[0051] With reference to the preferred embodiment illustrated by way of example in the attached Figures 3 and 4, the support structure 200 comprises three support groups 204 aligned with each other, in a spaced position, along the first direction 201.

[0052] It is understood that further versions of the recovery machine 1 are possible comprising a different number of support groups 204 according to the length of the recovery machine 1 along the first direction 201, as well as specific needs, within a flexible use solution.

[0053] According to a preferred embodiment, the at least one support group 204 comprises vertical support elements 206 operatively connected to transverse support elements 207.

[0054] In detail, with reference to the preferred embodiment illustrated in the attached Figures 3 and 4, each of the support groups 204 comprises three vertical support elements 206 which delimit a prism structure with a triangular base, wherein the three vertical support elements 206 are each placed at a vertex of the base triangle.

[0055] Each support group 204 comprises a further vertical support element 208, aligned parallel to the vertical support elements 206 and interposed between two vertical support elements 206. More precisely, the further vertical support element 208 is arranged at the centre line or substantially of the centre line of one side of the triangle which in use faces in counter current along the waterway 2 (in other words along the front side which in use is hit by the current of the waterway 2).

[0056] The further vertical support element 208 extends along a direction normal to the direction of flow of the waterway 2, similarly to what is described in relation to the vertical support elements 206 and allows to further stiffen the at least one support group 204 .

[0057] It is noted that the transverse support elements 207 are connected at one end to the top portion to a respective vertical support element 206 and at their opposite end to the bottom of the further vertical support element 208 (see Figures 3 and 4).

[0058] In practice, the transverse support elements 207 delimit the vertices of a pyramid with a triangular base, the vertex of which is in correspondence with a connection point between each support group 204 and a respective primary flotation device 205.

[0059] Each support group 204 is configured to firmly support the support structure 200, effectively discharging the vertical load acting on it, in the context of an open and light weight solution, that is to say, which has small closed portions that could burden the load acting on the support structure 200 when hit by currents of water or air.

[0060] By way of example, an alternative conformation of a support group 204, not shown in the attached figures, comprises vertical support elements arranged parallel to each other and has no transverse support elements. More in detail, the support group 204 according to this version can have a triangular-based plan development, similarly to the previous version and therefore comprise three vertical support elements. Each of the at least three vertical support elements is positioned in correspondence with a respective of the vertices of the triangle which delimits the plan development of the support group. It should be noted that further versions are possible including a different development in plan and, consequently, a different number of vertical support elements, even in the context of a solution wherein each of the vertical support elements is arranged at a vertex of the polygon that defines the plan development of each support group 204. By way of non-limiting example, an alternative version of a support group 204 can have a plan development with a square or rectangular base and comprise four vertical support elements.

[0061] A preferred embodiment of the at least one primary flotation device 205 (see Figures 8 and 9) comprises a floating body which has a single V-shaped hull, capable of offering a sufficient gliding surface ensuring good stability. trim.

[0062] Each floating body has a longitudinal development axis 209 which, preferably, is oriented parallel or substantially parallel to the current of the waterway 2, thus delimiting, in plan, an angle 210 with the first direction 201 of the support structure 200 (see Figure 1).

[0063] The recovery machine 1 can comprise at least one torsion joint, not shown in the attached Figures, for the connection between the at least one support group 204 and a respective primary flotation device 205.

[0064] More in detail, the at least one torsion joint determines the connection between the individual vertical support elements 206, the further vertical support element 208 of the at least one support group 204 and the respective primary flotation device 205 of the at least a support group.

[0065] By way of non-limiting example, the torsion joint comprises at least one torsion spring, of a type known in the field.

[0066] The at least one torsion joint is configured to allow the torsion of the primary flotation device 205 around a second direction 214 perpendicular to the waterplane, i.e. perpendicular to the longitudinal axis 209 (and therefore to the direction of flow of the waterway 2)

and to the transverse axis of the at least one primary flotation device 205, in such a way as to be able to vary its attitude and adapt to the direction of the waterway 2 (see Figures 5 and 7-9).

[0067] The torsion joint thus configured limits the thrusts that act in the horizontal direction, that is, along a plane on which the direction of advancement of the current of the waterway 2 lies, which are then discharged onto the support structure 200.

[0068] As said, a capture system 300 is operatively connected to the support structure 200.

[0069] The capture system 300 comprises at least one collection belt 301 which can be selectively operated in motion, at least one support frame 302 which supports the collection belt 301, and rotating connecting members for connecting the at least one frame 302 to the support structure 200 (see the detail illustrated in Figure 10).

[0070] According to a preferred embodiment illustrated in the attached Figures (see in particular Figure 10), the rotating connection members comprise a pair of brackets 310 which protrude from one side of the top portion 220, in particular from the second wall 203 (i.e. that is, from the wall facing counter-current with respect to the direction of advance of the waterway 2) and are configured to support the top end 304 of the at least one frame 302, from opposite sides, by means of a rotating connection.

[0071] In this regard, the at least one frame 302 may comprise two pins 311, each of which extends from a respective side of the top end 304, wherein each of the pins 311 engages a respective circular hole 312 made along each of the brackets 310, to thus determine a rotating connection between the support structure 200 and each of the frames 302 included in the recovery machine 1.

[0072] It is understood that according to further embodiments, not illustrated in the attached figures, the rotating connection members can be configured in a different way with respect to what has been described above even within the context of a solution configured to allow at least one rotation of the at least one frame 302 around an axis parallel to the first direction 201 of the support structure 200, to ensure a mobility of the capture system 300 capable of ensuring correct draft even in the presence of a variation in the hydrometric level and in the presence of waves or a rippled free surface.

[0073] In particular, the at least one frame 302 is connected at its top end 304 to one side of the top portion 220 of the support structure 200 and at the opposite end or bottom end 305 to at least one secondary flotation device 306.

[0074] The at least one frame 302 comprises at least a first roller 307, positioned at the top end 304, and at least a second roller 308, positioned at the bottom end 305, around which a collection belt 301 which assumes a known type of ring configuration is placed (see Figure 6).

[0075] The at least one first roller 307 is motorized, for example by an electric motor unit not shown in the attached figures, to determine the movement of the collection belt 301 along the at least one frame 302.

[0076] The secondary flotation device 306 comprises at least one float configured to keep the bottom end 305 submerged for at least a stretch below the free surface of the water and, consequently, to maintain the bottom end of the collection belt 301 also immersed for a predefined distance, so as to guarantee the recovery of floating material in correspondence with the free surface of the waterway 2.

[0077] By way of example, the secondary flotation device 306 can be configured as a float that develops transversely to at least one frame 302.

[0078] Preferably, the collection belt 301 is made of net, in a material resistant to water and wear caused by atmospheric agents, wherein the meshes of the net have a size such as to guarantee the collection of materials of reduced size, even if avoiding an excessive resistance to the flow of water through the meshes themselves. By way of example, but not limited to, the meshes of at least one collection belt 301 can have a width between 2 and 5 mm, optionally equal to 3mm.

[0079] The attached Figure 10 illustrates the collection belt 301 in the form of a net, wherein the width of the mesh has been specially enlarged to highlight the structure of the collection belt 301 itself.

[0080] Optionally, along the at least one collection belt 301, strips (not shown in the attached figures) can be arranged transversely with respect to the at least one collection belt 301 itself. The strips are spaced apart with a constant pitch and define engagement elements to hold the material to be moved towards the transport system 400.

[0081] Optionally, the strips have holes to allow the winding and engagement of at least one collection belt 301 around them, favouring the gripping action exerted by them on the floating material.

[0082] The at least one frame 302 is inclined with respect to the top portion 220 of the support structure 200 so as to define a slide or an inclined collection plane with a slope such as to allow the transfer of the floating material removed from the waterway 2, to the transport system 400.

[0083] Preferably, the inclination between the top portion 220 of the support structure 200 and the at least one frame 302 is equal to an angle 309 delimited between the top portion 220 of the support structure 200 and the collection belt 301, including between 30 and 60 degrees, optionally between 40 and 50 degrees (see Figure 6).

[0084] The attached Figure 5 illustrates a recovery machine 1 comprising a collection system 300 which in turn comprises three collection belts 301 placed side by side in succession along the first direction 201, although it is understood that further embodiments including a number are possible greater or lesser of collection belts 301 according to the size of the waterway 2 along which to install the recovery machine 1.

[0085] It should be noted that the total number of con-

veyor belts 301 included in the capture system 300 is a function of the length required by the recovery machine 1 along the first direction 201, therefore in the context of a flexible use solution whose dimensions (intended as an extension along the first direction 201) can be modified according to specific needs of use (i.e. according to the transversal width of the basin of the waterway 2 wherein to install the recovery machine 1).

[0086] It should be noted that the extension of the support structure 200, of the transport system 400 and of the anchoring system 600 along the first direction 201 can also be modified, as part of a modular solution.

[0087] The recovery machine 1 comprises a damping system interposed between the capture system 300 and the support structure 200.

[0088] More in detail, the shock-absorbing system comprises at least one shock-absorbing device 211, such as a telescopic spring or hydraulic element, connected at one end thereof to a support group 204, by means of a first hinge, and at the opposite end to the at least a frame 302 which extends from the recovery machine 1 in correspondence with said support group 204, by means of a second hinge.

[0089] In particular, the shock-absorbing system comprises a first support 212 which extends from the further vertical support element 208, for the connection of the shock-absorbing system to the support structure 200, and a second support 213 connected to the at least one frame 302 in such a way not to interfere with the at least one collection belt 301.

[0090] The first support 212 is preferably configured as a bracket that protrudes orthogonally or inclined from the further vertical support element 208 (see for example Figures 2, 3 and 4). The second support 213 is instead preferably configured as a "C"-shaped element whose two end arms are connected to the sides of at least one frame 302, through hinged connections.

[0091] The damping device 211 is hinged to the first support 212 and to the second support 213 to allow relative movement between the at least one frame 302 on which the at least one collection belt 301 and the support structure 200 is provided.

[0092] The shock-absorbing system allows to limit the stresses transmitted to the support structure 200 following any impact of objects of considerable size and weight against the capture system 300.

[0093] In fact, the catching system 300 and the shock-absorbing system, together with the support structure 200 define a frame with variable geometry to ensure the optimal draft conditions of the catching system 300 while within the scope of a safe use solution.

[0094] In practice, at least a portion of the collection belt 301 is always immersed in the waterway and any fluctuations due to the wave/swirling motion of the waterway 2 can be compensated for the mobility of the capture system 300 which is kept in flotation via the secondary flotation device 306 and the support structure 200 via the at least one primary flotation device 205.

[0095] With reference to what has been described in relation to the support structure 200, it is observed that the primary flotation device 205 and the secondary flotation device 306 are sized in such a way as to balance the weight of the support structure 200, of the capture system 300 and of the transport system 400, so as to ensure the correct positioning of the recovery machine 1 along the waterway 2. In particular, the secondary flotation device 306 is configured to guarantee a predetermined sinking of the collection belt 301 of the capture system 300 for the purposes previously described.

[0096] The transport system 400 of the recovery machine 1 is configured to selectively move the recovered material of the capture system 300 to a collection point along the first direction 201.

[0097] In this regard, the transport system 400 is positioned along the support structure 200 so as to receive the material coming from the capture system 300.

[0098] The transport system 400 is operatively connected to the top portion 220 of the support structure 200, along which it extends.

[0099] The transport system 400 comprises at least one conveyor belt 401 supported by a series of rollers, not illustrated in detail in the attached figures, which are operatively connected to the first wall 202 and to the second wall 203, which rotate around respective axes of rotation oriented transversely (orthogonal) to the first direction 201.

[0100] The support rollers of the at least one conveyor belt 401 can comprise motorized rollers, adapted to control the advancement of the at least one conveyor belt 401 and idle rollers which act exclusively as a support for the at least one conveyor belt 401, according to modalities within the scope of the person skilled in the art which will therefore not be further described.

[0101] The drive of the motorized rollers can occur through electric motors, suitably synchronized with each other, depending on the extension of at least one conveyor belt 401 and the transport system 400 along the first direction 201.

[0102] The transport system 400 can comprise a plurality of conveyor belts 401 arranged in succession along the first direction 201, so as to define a single path of advancement for the material recovered by the capture system 300, within a solution of easy assembly, installation and maintenance.

[0103] By way of example, the attached Figure 10 schematically illustrates two conveyor belts 401 in succession to each other along the first direction 201. It is highlighted how the support structure 200, and in particular the top portion 220 can comprise several modules or sections which they develop along the first direction 201, mutually connected through a rotating connection, for example a double rotating joint 402.

[0104] Preferably, the individual modules have a length compatible with that of the conveyor belt 401, thus allowing to divide the length of the support structure 200 along the first direction 201 into individual portions artic-

ulated to each other.

[0105] The rotating connection allows relative mobility between a first conveyor belt 401 and a subsequent conveyor belt 401 to allow relative mobility between the same and, therefore, of the entire support structure 200 which can flex with respect to the first direction 201, adapting, in order to follow, at least in part, the wave motion of the waterway 2.

[0106] According to a preferred embodiment, the recovery machine 1 comprises a connection system 500 which connects the recovery machine 1 to the bank of the waterway 2.

[0107] Preferably, the connection system 500 is configured to define a mobile connection between the support structure 200 and, consequently, the capture system 300 and the transport system 400, and the bank of the waterway 2.

[0108] In particular, the connection system 500 comprises at least one joint 501 with two degrees of freedom operatively connected to one end of said support structure 200, to allow rotation and translation thereof relative to the bank of the waterway 2, as better described below.

[0109] In detail, the connection system 500 comprises a fastening structure 502 configured to be constrained to a bank of the waterway 2 for the installation of the recovery machine 1, a connection ramp 503 to which the support structure 200 is connected, and the at least one joint 501 which mutually connects the fastening structure 502 and the connection ramp 503.

[0110] With reference to the preferred embodiment illustrated in the attached Figure 7, wherein the capture system 300 has been omitted, the fastening structure 502 is configured as a portal structure comprising at least a first column 504, at least a second column 505 mutually connected at the respective top ends through a crosspiece 506.

[0111] The at least one joint 501 has at least two degrees of freedom to allow the rotation and translation of the connection ramp 503 relative to the fastening structure 502.

[0112] In detail, the at least one joint 501 is configured as a cylindrical collar and is movably connected along the at least one first column 504 to allow rotation and/or translation of the connection ramp 503 relative to an axis 507 which corresponds to the longitudinal development axis of the at least one first column 504 itself.

[0113] Through the connection system 500 it is therefore possible to adjust the angle of inclination 508 of the first direction 201 of the support structure 200 relative to the bank of the waterway 2 to which the recovery machine 1 is connected (see Figure 1).

[0114] With the same length of the support structure 200 along the first direction 201, by adjusting the angle of inclination 508, the transverse section of the waterway 2 from which the floating waste is to be taken is varied. Furthermore, being able to bring the recovery machine 1 closer to the bank, the waterway 2 itself is partially cleared. In this way, a drawback of state-of-the-art recovery equipment is overcome, which involves the construction of permanent structures along the basin of the waterway 2.

[0115] According to alternative embodiments, not illustrated in the attached figures, the fastening structure 502 can comprise a single first column 504 constrained to the ground by means of tie rods, to counteract the stresses and moments to which it is subject in use, ensuring a stable support for the joint 501 and, therefore, for the support structure operatively connected to it.

[0116] Furthermore, the cylindrical collar acts as a sleeve and allows to adjust the operating height of the recovery machine 1, i.e. the distance of the support structure 200 from the ground, or in other words the relative distance between the support structure 200 and the top of the embankment along which the recovery machine 1 is installed.

[0117] It should be noted that being able to vary the operating altitude of the recovery machine 1 allows to keep the capture system 300 in full efficiency, guaranteeing its draft regardless of the variations in the hydrometric level of the waterway 2, for example to compensate for slight variations due to rippling of the free surface of the waterway 2 or more substantial variations in case of flooding or lowering of the waterway 2.

[0118] The recovery machine 1 includes an anchoring system 600, to connect the support structure 200 along the bank of the waterway 2 and keep it in position.

[0119] The anchoring system 600 comprises tie rods 601 configured to be operationally connected at one end to a respective section of the support structure 200 and at the opposite end to a respective pole 602 constrained along the bank of the waterway 2 (see Figure 1).

[0120] Each tie rod 601 is connected to the support structure 200 at a predefined distance so as to uniformly distribute the stresses along the support structure 200 itself.

[0121] It should be noted that the support structure 200, at the top portion 220, includes supports not illustrated in detail in the attached figures, bound to the first wall 202 to which one end of each tie rod 601 is secured.

[0122] By way of example, the supports for the tie rods 601 along the support structure 200 can each comprise a peg or a coupling, for example of an annular shape, to which one end of a respective tie rod 601 is firmly secured. It is highlighted how each support for the tie rods 601 is provided at a distance from the top portion 220 such as not to interfere with the handling of the waste or floating material recovered through the capture system 300 and moved along the transport system 400.

[0123] Each support for the tie rods 601 develops along a direction normal to the top portion 220 (i.e. normal to the direction of flow of the waterway 2 and to the first direction 201).

[0124] At least one of the poles 602, preferably the one positioned along the bank of the waterway 2 which is most distal from the connection system 500, can be motorized and rotatable around its own axis to wind/unwind

the tie rod 601 and determine the rotation of the support structure 200 respectively approaching/moving away from the bank of the waterway 2.

[0125] An alternative embodiment of the fastening system is schematically illustrated in the attached Figure 11 and indicated as a whole with 650.

[0126] This version of the fixing system 650 differs from the previous one in relation to the presence of a single pole 652 to which the tie rods 651 are operationally connected.

[0127] In particular, the pole 652 comprises an assembly of pulleys 655 which differ from each other for the measurement of the respective external diameters, to which the tie rods 651 are connected.

[0128] The assembly of pulleys 655 is comprised between a bottom pulley 656 and a top pulley 657 between which intermediate pulleys 658 are positioned.

[0129] The bottom pulley 656 has a larger outer diameter than that of all the other pulleys included in the assembly of pulleys 655, while the top pulley 657 has a smaller outer diameter than that of all the other pulleys included in the assembly of pulleys 655, which have a progressively decreasing diameter from the bottom pulley 656 to the top pulley 657.

[0130] The term "external diameter" refers to the diameter of the external surface of one of the pulleys included in the assembly of pulleys 655, along which a respective tie rod 651 is wound.

[0131] The attached Figure 11 schematically illustrates the limit positions that can be assumed by the support structure 200. This in fact can be moved between an extracted working position, wherein it is arranged transversely to the waterway 2, and a retracted rest position (illustrated with a dashed line), wherein it is arranged against the bank of the waterway 2.

[0132] The movement of the support structure 200 is controlled by the rotation of the pole 652 to which the single tie rods 651 are connected.

[0133] The presence of a single pole 652 limits the encumbrance of the anchoring system 650 which, instead of extending along a stretch of a bank of the waterway 2, occupies a portion equal to the outer diameter of the bottom pulley 656.

[0134] The attached Figure 11 illustrates four tie rods 651 which define respective connection points 658, 659, 660 and 661 along the first direction 201 of the support structure 200 and the relative paths taken following the rotation of the latter.

[0135] In particular, it should be noted that the pole 652 is arranged along a bank of the waterway 2 in such a position that, with the support structure 200 in the retracted rest position, the tie rod 651 more distal from the connection system 500 is aligned orthogonally or substantially orthogonal to the first direction 201, to determine the complete recall of the support structure 200, leaning it along the side of the waterway 2. It is meant that with the support structure 200 leaned against the bank of the waterway 2 between the support structure 200 and the side there is sufficient space to house the capture system 300 which extends from the top portion 220 of the support structure 200.

[0136] According to an alternative embodiment not shown in the attached Figures, the recovery machine 1 is devoid of the connection system 500 and is constrained in position with respect to the embankments of the waterway 2. According to this embodiment, the anchoring system 600 is configured to firmly constrain the support structure 200 to the bottom of the waterway 2 and, in this regard, includes tie rods fixed to the bottom of the waterway 2. This anchoring system can be preferred over the previous form of realization in the event that the waterway has a high basin crossed by a strong current that could damage the connection system 500, of the mobile type.

[0137] It should be noted that if a fixed type anchoring system is used, the recovery machine 1 can be oriented so as not to hinder the navigability of the waterway 2 and still maintain a passageway for boats.

[0138] The recovery machine 1 comprises an accumulation system 700 positioned downstream of the transport system 400 (see the diagram of Figure 1).

[0139] The accumulation system 700 acts as a collection point for the material recovered from the capture system 300 and moved through the transport system 400.

[0140] By way of example, the accumulation system 700 comprises at least one collection basin, such as a container, possibly of the towable type, into which the recovered material flows.

[0141] Optionally, the recovery machine 1 comprises a system for selecting and pressing the recovered material capable of making a first selection, with reference to the possibility of separating the plastic materials from other materials and a pressing of the plastic material thus selected so as to obtain a compact packaging, easily transportable to subsequent treatment areas not illustrated in the attached figures as they are not the subject of the present invention.

[0142] Optionally, the recovery machine 1 can comprise lifting members, not shown in the attached Figures, operatively connected to the joint 501 to move it along the at least one first column 504, so as to cause the lifting/lowering of the support structure 200, for example to free any bulky floating material stuck in the capture system 300, with reference for example to bulky trunks or objects that are difficult to recover through the capture system 300.

[0143] According to a further aspect of the invention, the recovery machine 1 can comprise a covering system, indicated as a whole with 800, configured to provide a cover at least of the capture system 300 and/or of the transport system 400.

[0144] With reference to the embodiment illustrated by way of example but not of limitation in the attached Figure 12, the covering system 800 comprises at least a first frame 801 operatively connected to the capture system 300 and at least one second frame 802 operatively connected to the support structure 200, and in particular to

the top portion 220, above the transport system 400.

[0145] The covering system 800 comprises at least a first sheet or first cover 803, supported by the at least one first frame 801, above the capture system 300, and/or at least a second sheet or second cover 804 supported by the at least one second frame 802, above the transport system 400.

[0146] The cover system 800 acts as a containment barrier to prevent any waste or floating debris recovered and collected by the capture system 300 and then transported ashore through the transport system 400 from being dispersed by the wind.

[0147] In addition, the at least one first sheet 803 and the at least one second sheet 804 can be decorated to facilitate the integration of the recovery machine 1 also from an aesthetic point of view in the installation environment.

[0148] The recovery machine 1 according to the present invention is capable of achieving the intended purposes, being able to carry out the collection and removal of floating waste or debris from a waterway 2 in an effective and easy way, within a solution of practical use and such as not to constitute a barrier for the normal flow of the waterway or for the possible navigability of the waterway 2 itself.

[0149] Furthermore, the structure of the recovery machine 1 is modular, in the sense that by varying the number of collection belts 301 to be arranged side by side along the first direction 201 of the support structure 200 it is possible to adapt the dimensions of the recovery machine 1 to those of a waterway 2, optimizing them.

[0150] In this regard, it must be borne in mind that the support structure 200 is also modular, in order to adapt the overall length of the recovery machine 1 along the first direction 201 according to the size of the waterway 2 along which it is installed.

[0151] In particular, the dimensions of the support structure 200 along the first direction 201 can be varied as a function of the number of top portions 220 supported by respective support groups 204 provided, in turn, with respective primary flotation devices 205 and respective portions of the conveyor belt 401, as well as the secondary flotation device 306 can be made in a modular way, by connecting together a respective plurality of flotation elements.

[0152] The dimensions of the recovery machine 1 can therefore be adapted to those of the waterway 2 wherein the recovery machine 1 itself is to be installed, simply by placing in series a variable number of modules side by side along the first direction 201. The number of such modules varies according to the size of the waterway 2 without having to redesign the recovery machine 1 each time.

[0153] With the expression the size of the waterway 2 is intended to indicate the width of the basin that delimits the waterway 2 itself, which extends along a direction substantially transverse to that of the flow of the waterway 2.

[0154] It is understood that each of the aforesaid modules defines at least a portion of the support structure 200, of the capture system 300 and of the transport system 400 and is configured to be operationally connected to the bank of a waterway 2 or to the bottom of the course of water 2 by the anchoring system 600, in accordance with what has been described above.

[0155] According to an aspect of the present invention, the recovery machine 1 comprises a protection system comprising at least one acoustic and/or visual bollard configured to emit an acoustic and/or visual signal capable of repelling any volatile species that populate the installation area of the recovery machine 1, to prevent them from approaching it and getting entangled for example in the capture system 300.

[0156] The recovery machine 1 can comprise at least one fence capable of delimiting the installation area of the machine 1 itself with the aim of removing the terrestrial fauna and protecting the structure from theft and vandalism; in this sense the presence of security personnel is required.

[0157] The recovery machine 1 comprises a logic unit, not illustrated in detail in the attached Figures, to which the capture system 300, the transport system 400, the anchoring system 600 as well as the possible protection system and/or the storage system 700 if present.

[0158] The logic unit selectively controls the actuation of the at least one collection belt 301 to control its movement when a camera, or suitable detection sensors, detect the presence of a predetermined quantity of floating waste at the bottom portion 305 of the at least one float belt 301. After the actuation of the at least one float belt 301, the logic unit controls the actuation of the conveyor belt 401 to determine the movement of the material recovered by the capture system 300, so to be supplied to the storage system 700.

[0159] In fact, the recovery machine 1 can be selectively operated as part of a solution capable of limiting the energy consumption required for its operation, optimizing it.

[0160] The attached Figures 13-17 show a further embodiment of the waste recovery machinery, indicated as a whole with 100.

[0161] In the following description of the recovery machine 100, the same reference numbers will be used to indicate the components corresponding to those described for the previous embodiment, increasing them by a thousand units.

[0162] The recovery machine 100 differs from the previous embodiment as regards the configuration of the transport system 1400.

[0163] Furthermore, the recovery machine 100 has a different connection system 1500 configured to define a mobile connection between the support structure 1200 and the bank of the waterway 1002 in correspondence with which the installation of the recovery machine 100 is planned.

[0164] The components of the recovery machine 100

will be briefly described below, referring, where possible, directly or implicitly, to the characteristics of the components described for the previous embodiment to simplify their description.

[0165] With reference to what is shown in the attached Figure 13, the recovery machine 100 includes, among other components, a support structure 1200 to which a capture system 1300 is operationally connected, configured to intercept floating material, such as waste and/or debris dragged by the waterway 1002 along which the recovery machine 100 itself is installed and a transport system 1400 configured to convey the intercepted material collected by the capture system 1300 to a collection point.

[0166] As mentioned, the recovery machine 100 then comprises a connection system 1500 configured to connect the support structure 1200, and the capture system 1300 connected to it, at a bank of the waterway 1002.

[0167] The support structure 1200 comprises a top portion 1220, which extends along a first direction 1201 or longitudinal direction (see Figure 14), and is configured to define a support along which at least one container 1900 for collecting the intercepted material and collected by the 1300 capture system, can be arranged, s better described below.

[0168] The support structure 1200 then comprises at least one support group, wholly indicated by 1204, which extends along a direction normal to the longitudinal direction 1201 defined by the top portion 1220, below it.

[0169] The support group 1204 is configured to support the capture system 1300 and at least one container1900.

[0170] Similarly to what is described in relation to the previous embodiment, the at least one support group 1200 has a top end connected to the top portion 1220 and a respective bottom end connected to at least one primary flotation device 1205.

[0171] The at least one support group 1200 is configured as a frame capable of distributing the load determined, at least in part, by the capture system 1300 on the at least one primary flotation device 1205, as well as the load borne by the at least one container 1900.

[0172] The purposes of the primary flotation device 1205 correspond to those described in relation to the primary flotation device 205, to which reference is made for the sake of brevity of explanation.

[0173] By way of non-limiting example, the at least one primary flotation device 1205 includes at least one elongated floating body.

[0174] According to a further version illustrated in the attached Figures 13, 14, 16 and 17, the at least one primary flotation device 1205 comprises several floating bodies operatively connected to each other via the support group 1200.

[0175] The individual floating bodies can have the same conformation and/or size or be different from each other, according to specific needs of use and the distribution of the loads weighing on the support group 1200.

[0176] The capture system 1300 comprises at least one collection belt 1301 which can be selectively operated in motion, at least one support frame 1302 configured to support the at least one collection belt 1301 and rotating connecting members for connecting the at least one frame 1302 to the structure support 1200, according to similar methods described in relation to the previous embodiment to which reference is made.

[0177] Optionally, strips or baffles 1350 are connected along the at least one collection belt 1301, in a transverse position with respect to it (see for example Figure 16 wherein only some of the strips 1350 have been indicated with the respective reference numbers to avoid excessively weight the Figure itself).

[0178] The strips 1350 are positioned spaced apart so as to define engagement compartments along which to retain the material recovered from the at least one collection belt 1301, favouring its transport and preventing it from accidentally falling back into the water following the movement of the at least one collection belt 1301.

[0179] The at least one collection belt 1301 is configured as a ring, as better described below.

[0180] The at least one frame 1302 is operationally connected at its top end 1304 to the top portion 1220 of the support structure 1200 and at its bottom end 1305 to at least one secondary flotation device 1306.

[0181] The configuration of the at least one frame 1302 is the same or substantially the same as that described in relation to the at least one frame 302.

[0182] In practice, the at least one frame 1302 comprises at least a first roller 1307, positioned at the top end 1304, and at least a second roller 1308, positioned at the bottom end 1305, around which the at least a collection belt 1301 to assume a ring configuration (in the attached Figure 16 the first roller 1307 and the second roller 1308 are shown schematically by respective broken lines).

[0183] At least one of the at least one first roller 1307 or the at least one second roller 1308 is motorized to selectively determine the movement of the at least collection belt 1301 relative to the frame 1302, along a ring path.

[0184] The secondary flotation device 1306 comprises at least one float configured to keep the bottom end 1305 at least partially submerged or in the immediate vicinity of the free surface of the water so as to ensure the correct draft of floating material at the free surface of the course of water 1002.

[0185] The recovery machine 100 includes an auxiliary frame 1910 operatively connected to the capture system 1300 at the bottom end 1305.

[0186] According to a preferred embodiment illustrated in the attached Figures 13-16, the auxiliary frame 1910 is shaped like a walkway to allow access to the recovery machine 100 at the bottom end 1305 of the capture system 1300.

[0187] The subframe 1910 is positioned in front of the catching system 1300 or, in other words, it is interposed between the waterway 1002 and the catching system 1300 or, again, upstream of the catching system 1300

along a direction of flow of the waterway 1002.

[0188] By way of example, the auxiliary frame 1910 is configured as a portal structure in front of at least one belt 1301 and is supported below by the secondary flotation device 1306.

[0189] The subframe 1910 is configured not to obstruct the drawing of floating material by the capture system 1300.

[0190] The auxiliary frame 1910, as mentioned, includes at its top portion a walkway configured to allow access to the recovery machine 100 at the bottom end 1305 of the 1300 capture system.

[0191] The auxiliary frame 1910 also acts as a reinforcing element to give a high resistance to the capture system 1300 against any impacts or stresses caused by material of large dimensions and/or mass transported by the waterway 1002, such as for example logs or similar, thus serving as a protective barrier for the 1300 capture system.

[0192] As mentioned, the capture system 1300 includes at least one container 1900, configured for example as a caisson, positioned at the top end 1304 of at least one collection belt 1301.

[0193] More in detail, the at least one container 1900 is supported by the support structure 1200, at its top portion 1220.

[0194] The at least one container 1900 can be of the standardized type to favour the use of traditional transport vehicles for the ground handling of at least one container 1900, when removed from the recovery machine 100.

[0195] It is noted that the at least one container 1900 is positioned at the top end 1304 of the at least one collection belt 1301, so that the material transported by the at least one collection belt 1301 itself falls by gravity inside of the at least one respective container 1900.

[0196] The at least one container 1900 has a top opening 1901 through which the waste material recovered from the capture system 1300 is introduced.

[0197] According to a preferred version of the invention, the at least one container 1900 comprises at least one closing lid 1911 movably connected at the top opening 1901 to selectively occlude the same, for example when the recovery machine 100 is not in operation for prevent the accidental entry of foreign objects into the at least one container 1900.

[0198] The transport system 1400 of the recovery machine 100 is configured to selectively move the material recovered from the capture system 1300 to a predetermined collection point.

[0199] More precisely, the transport system 1400 includes a lifting and handling device configured to interact with at least one container 1900 so that it can be lifted and positioned at a predetermined collection point.

[0200] The lifting and handling member is configured as a crane 1930, preferably of the jib type, carrying at least one lifting hook, not shown in detail, configured for connection to chains or ropes or similar elements which can in turn be connected to the at least a container 1900 to allow its lifting and subsequent handling in a manner within the reach of the person skilled in the art which, therefore, will not be further described.

[0201] With reference to the layout illustrated in the attached Figures, the crane 1930 is provided in a lateral position with respect to the capture system 1300, in proximity to it, although it is understood that alternative embodiments are possible wherein the positioning of the crane 1930 is different, for example in the event that instead of a jib crane, a jib crane and arm or an articulated arm or a crane for port use are provided.

[0202] The attached Figures 13-16 illustrate a recovery machine 100 comprising three collection belts 1301 in a position side by side, along the direction 1201, each operatively connected to a respective container 1900. According to this embodiment, the transport system 1400 it is configured to selectively pick up a container 1900 to be emptied, since it has reached its maximum storage capacity, lifting it and moving it to a predetermined point for its emptying or replacement with another empty container 1900.

[0203] It is understood that the recovery machine 100, similarly to what has been described in relation to the previous embodiment, can comprise a greater or lesser number of belts of 1301, and of relative containers 1900 without any limitation.

[0204] It should be noted that the transport system 1400 comprising at least one crane 1930 is configured to perform a maintenance function of the recovery machine 100. The crane 1930, in fact, is configured to allow lifting and handling not only the at least one container 1900 but possibly, one or more components of the catching system 1300 or of the support frame 1200. In practice, the crane 1930 has dimensions and a load capacity such as to allow the installation or complete or partial removal of the catching system 1300 and/or of the support frame 1200 or of further components of the recovery machine 100 relative to the waterway 1002, thus giving the recovery machine 100 a high operating flexibility without requiring further external equipment or machinery.

[0205] A further embodiment of the machinery 100, not illustrated in the attached Figures, comprises a transport system 1400 configured as a conveyor belt or the like, configured to move the individual containers 1900 along a predetermined path and at least a crane or an articulated arm for picking up the containers 1900 themselves to be replaced or emptied, removing them from this path and replacing them with additional containers 1900 to be filled with the material recovered from the 1300 capture system.

[0206] The recovery machine 100 comprises at least one deflector 1940 positioned at the bottom end 1305 of the at least one belt 1301. The at least one deflector 1940 is positioned forward of the secondary flotation device 1306 to divert the floating waste recalled by the system 1300 and prevent them from getting stuck in correspondence with the secondary flotation device 1306. The at

least one deflector 1940 thus allows to keep free the access to the at least one belt 1301 to which it is operatively associated.

[0207] In addition, synergistically with the subframe 1910, the at least one deflector 1940 allows you to repair the capture system 1300 from the impact of any large waste transported by the waterway 1002, also acting as a protection element.

[0208] As mentioned, the recovery machine 100 includes a connection system 1500 configured to connect the recovery machine 100 itself (and more precisely the support structure 1200 and the capture system 1300) to a bank of a waterway 1002.

[0209] The connection system 1500 comprises at least one waterfront fastening structure 1502, configured to connect the support structure 1200 and the capture system 1300 to the bank of the waterway 1002 and at least one joint 1501 with at least one degree of freedom, configured to allow at least the translation of the support structure 1200 and of the capture system 1300 along a direction normal to the direction of flow of the waterway 1002 and to the first direction 1201. In other words, the support structure 1200 and the capture system 1300 can be translated along a vertical direction.

[0210] The waterfront fastening structure 1502 comprises at least one platform 1520 to which the support structure 1200 and the capture system 1300 are movably connected through a sliding connection.

[0211] In particular, the support structure 1200 and the catching system 1300 are translationally connected to the waterfront fastening structure 1502 to ensure the correct draft of the catching system 1300 relative to the free surface of the waterway 1002.

[0212] More in detail, according to a preferred embodiment illustrated in the attached Figures 13-17, the waterfront fastening structure 1502 comprises at least one pole 1530 configured to be implanted and constrained to the bank of the waterway 1002 and to act as a fixing between it and the recovery machine 100.

[0213] The at least one joint 1501 is configured as a sleeve or similar element and is configured to be fitted along the at least one pole 1530 or along a further pole 1531 constrained in proximity to the pole 1530 and parallel to the latter (see detail view of Figure 15), to connect one end of the support structure 1200 to the waterfront fastening structure 1502.

[0214] With reference to the embodiment illustrated in the attached Figures 13-17, the waterfront fastening structure 1502 comprises the platform 1520 constrained to the at least one pole 1530 configured to act as a support and collection area for the floating material recovered through the catches 1300 and moved there through the transport system 1400.

[0215] The link system 1500 includes at least one auxiliary joint 1550 configured to provide a further sliding link between the waterfront fastening structure 1502 and the support structure 1200 and/or the capture system 1300 (see Figure 15).

[0216] By way of non-limiting example, the at least one auxiliary joint 1550 comprises at least one auxiliary pole 1551 configured to act as a connection for a respective auxiliary sleeve 1552 which, in turn, is configured to connect one end of the auxiliary frame 1910 and/or of the support structure 1200 to the waterfront fastening structure 1502, to define a translating connection along a translation direction parallel to that determined by the at least one joint 1501.

[0217] With reference to the embodiment illustrated in the attached Figures 13-17, at least two auxiliary poles 1551, each slidingly engaged by a respective auxiliary sleeve 1552 are included in the waterfront fastening structure 1502. Preferably, the two auxiliary poles 1551 are positioned at the opposite sides of the at least one pole 1530, so as to distribute the stresses transmitted by the recovery machine 100 to the waterfront fastening structure 1502 along several connection points.

[0218] The presence of several sliding connection points allows to guide the support structure 1200 relative to the connection system 1500, thus allowing the recovery machine 100 to maintain a correct attitude along the waterway 1002 and to follow any variations in the free surface. In other words, the capture system 1300 and the support structure 1200 can at least translate along a direction normal to the direction of flow of the waterway 1002, i.e. a vertical or substantially vertical direction.

[0219] According to a preferred embodiment of the recovery machine 100, the crane 1930 is operatively connected to a top end of the pole 1530.

[0220] According to an aspect of the invention, the recovery machine 100 comprises at least a cover 1950 for the protection of at least one container 1900 (see for example Figures 14 and 15). The at least one 1950 cover is operationally connected to the support structure 1200 in an elevated position with respect to the top of the at least one container 1900, spaced from the latter.

[0221] The at least one cover 1950 can be removably connected to the support structure 1200, to facilitate access to the at least one container 1900 or, optionally, sliding along a track or a similar structure made on the top of the at least one container 1900, at a distance from the latter.

[0222] The at least one cover 1950 also acts as a protection for the at least one container 1900, preventing liquids or objects foreign to those collected by the capture system 1300 from falling into the at least one container 1900. By way of example, in case of rain, the at least one covering element 1950 prevents rainwater from filling the at least one container 1900 and causing an excessive load on the support structure 1200.

[0223] Similarly to what is described in relation to the previous embodiment, the recovery machine 100 optionally comprises at least one cover system 1800, configured to provide a cover at least of the capture system 1300 (see for example Figure 14).

[0224] The covering system 1800 comprises at least one sheet or a covering element operatively connected

to the at least one belt 1301, above the same in a spaced position. Preferably, the covering system 1800 is connected to at least one frame 1302.

[0225] The 1800 coverage system acts as a containment barrier to prevent any waste or floating debris recovered and collected through the 1300 capture system from being dispersed by the wind as well as external objects from accidentally falling onto at least one belt 1301.

[0226] According to a further aspect of the invention, the collection machinery 100 comprises a walkway 1960 operatively connected to the support structure 1200 and configured to provide a passage in correspondence with at least one container 1900 (see Figure 14).

[0227] In particular, the walkway 1960 is positioned behind the at least one container 1900 with respect to the direction of flow of the waterway 1002 or, in other words, on one side of the at least one container 1900 opposite to the one facing the collection system 1300.

[0228] The walkway 1960 allows access to the support structure 1200 in correspondence with at least one container 1900, to facilitate the correct positioning of the same along the support structure 1200 itself or to allow maintenance to be carried out on board the support structure 1200.

[0229] According to an additional aspect of the invention, the collection machinery 100 comprises at least one bulkhead 1970 (see Figures 13 and 17) installable along the waterway 1002 to act as a conveying element configured to guide the floating material to be recovered towards the collection system 1300.

[0230] The at least one bulkhead 1970 can be installed in proximity to the machinery 100, for example by connecting it operatively to the support structure 1200 and/or to the collection system 1300 or in a distal position with respect to the recovery machine 100, upstream of the same along a direction flow of the waterway 1002, connecting it to a bank of the waterway 1002.

[0231] The at least one bulkhead 1970 is configured to protrude from the free surface of the waterway 1002, for example being of the floating type.

[0232] The connection between at least one bulkhead 1970 and the machinery 100 or the bank of the waterway 1002 can be of the rigid or mobile type, according to methods within the reach of the person skilled in the field that will not be further described.

[0233] It should be noted that the recovery machine 100, similarly to what is described in relation to the previous embodiment, comprises at least one logical calculation unit operatively connected to the capture system 1300 and to the handling system 1400 to control and command the operation of the recovery machine 100 same.

[0234] According to a further aspect of the invention, it is noted that the machinery 100 includes at least one renewable energy source configured to generate the electricity necessary for the operation of the recovery machine 100.

[0235] By way of non-limiting example, the attached Figure 14 illustrates solar panels 1980 installed along the waterfront fastening structure 1502, although it is understood that alternative embodiments are possible comprising further devices configured to generate electricity by exploiting renewable sources, such as air currents (for example a wind-type generator) or the current of the waterway 1002 (for example a hydroelectric-type generator) or a combination thereof.

[0236] The recovery machine 100 optionally comprises at least one electrical generator 1990 installed on board the support structure 1200 and configured to provide an auxiliary electrical power supply to the recovery machine 100.

[0237] The electrical generator 1990, configured by way of example as a generator, is preferably installed along the gangway 1960 so that it can be easily reached.

[0238] With reference to the foregoing, it is clear that the recovery machine 100 is also capable of pursuing the same purposes disclosed in relation to the previous embodiment, thus providing a system for recovering floating waste material from a waterway practical to be use and operate and extremely effective.

[0239] In the foregoing, the preferred embodiments have been described and variants of the present invention have been suggested, but it is to be understood that those skilled in the art will be able to make modifications and changes without thereby departing from the relative scope of protection, as defined by the claims attached.

Claims

1. Machine for the recovery of floating material (1) from a waterway (2, 1002) comprising:

a floating support structure (200, 1200), which develops along a first direction (201, 1201), wherein said first direction (201, 1201) is transversally oriented with respect to a direction along which said waterway (2, 1002) flows,
a capture system (300, 1300) configured to intercept and collect said floating material dragged by said waterway (2, 1002),
a transport system (400, 1400) configured to selectively handle said intercepted material collected by said capture system (300, 1300) towards a collection point,
and a connection system (500, 1500) configured to define a mobile connection of said support structure (200, 1200) to a bank of said waterway (2, 1002),

said capture system (300, 1300) and said transport system (400, 1400) being operatively connected to said support structure (200, 1200), and wherein said capture system (300, 1300) comprises at least one frame (302, 1302) for supporting a collection belt (301, 1301), wherein said at least one frame (302,

1302) is rotatably connected to said support structure (200, 1200) around an axis of rotation oriented parallel to said first direction (201, 1201), said collecting belt (301, 1301) being inclined with respect to said support structure (200, 1200) and having at least one bottom end configured to be immersed for at least a portion in said waterway (2,1002).

2. Machine for the recovery of floating material (1, 100) from a waterway (2, 1002) according to claim 1, wherein said connection system (500) comprises at least one joint (501) configured to allow a rotation and/or a translation of said support structure (200), of said capture system (300) and of said transport system (400) relative to said bank of said waterway (2) or wherein said connection system (1500) comprises a joint (1501) configured to allow at least a translation of said support structure (1200) of said capture system (1300) and of said transport system (1400) relative to said bank of said waterway (1002).

3. Machine for the recovery of floating material (1, 100) from a waterway (2, 1002) according to claim 1, wherein said support structure (200, 1200) comprises at least one support group (204, 1204) which extends from a top portion (220, 1220) of said support structure (200, 1200) and at least one primary flotation device (205, 1205) operatively connected to said at least one support group (204, 1204) in a diametrically opposite position to said top portion (220, 1220).

4. Machine for the recovery of floating material (1, 100) from a waterway (2, 1002) according to claim 1 or 3, wherein capture system (300, 1300) comprises a secondary flotation system (306, 1306) operatively connected to a bottom end (305, 1305) of said collecting belt (301, 1301) and configured to allow a predetermined sinking of said bottom end (305, 1305) into said waterway (2, 1002).

5. Machine for the recovery of floating material (100) from a waterway (1002) according to claim 1, wherein said capture system (1300) comprises at least one container (1900), supported by said support structure (1200) at a top end (1304) of said collection belt (1301) and configured to collect inside it material recovered by said al least one collection belt (1301).

6. Machine for the recovery of floating material (100) from a waterway (1002) according to claim 5, wherein said transport system (1400) comprises a lifting and handling device configured to interact with said at least one container to lift it and position in at a predetermined collection point, said lifting and handling device being configured as a crane (1930), optionally wherein said crane (1930) is configured to perform the maintenance and/or the installation of one or more components of said machine for the recovery of floating material (100).

7. Machine for the recovery of floating material (100) from a waterway (1002) according to claim 2, wherein said connection system (1500) comprises at least one waterfront fastening structure (1502) configured to connect said support structure (1200) and said capture system (1300) to said bank of said waterway (1002) and wherein said at least one joint (1501) is configured to allow at least one translation of said support system (1200) and of said capture system (1300) along a direction orthogonal to a flow direction of said waterway (1002) and to said first direction (1201).

8. Machine for the recovery of floating material (100) from a waterway (1002) according to claim 7, wherein said waterfront fastening structure (1502) comprises at least a platform (1520) constrained to said bank of said waterway (1002), said support structure (1200) and said capture structure (1300) being movably connected by a sliding connection to said at least one platform (1520).

9. Machine for the recovery of floating material (100) from a waterway (1002) according to claim 7 or 8, wherein said waterfront fastening structure (1520) comprises at least one pole (1530) configured to being planted and constrained to said bank of said waterway (1002), wherein said at least one joint (1501) is configured as a sleeve in turn configured to being slidingly sleeved along said at least one pole (1530) to connect an end of said support structure (1200) to said waterfront fastening structure (1502).

10. Machine for the recovery of floating material (1) from a waterway (2) comprising:

a floating support structure (200),
a capture system (300) configured to intercept and collect said floating material carried by said waterway (2),
a transport system (400) configured to selectively handle said intercepted material collected by said capture system (300) towards a collection point, and
an anchoring system (600) configured to connect said support structure (200) to at least one side or to the bottom of said waterway (2), wherein said anchoring system (600) comprises tie rods (601) configured to be operatively connected at one end to a respective section of said support structure (200) and to the opposite end to a respective pole (602) constrained along a bank of said waterway (2) or at the bottom of said waterway (2).

11. Machine for the recovery of floating material (1) from a waterway (2) according to claim 10, comprising a connection system (500) configured to define a mobile connection of said support structure (200) to a the bank of said waterway (2), wherein said capture system (300) and said transport system (400) are operatively connected to said support structure (200), and wherein said connection system (500) comprises at least one joint (501) configured to allow a rotation and/or translation of said support structure (200), of said capture system (300) and of said transport system (400) relative to said bank of said waterway (2).

12. Machine for the recovery of floating material (1) from a waterway (2) according to claim 11, wherein said connection system (500) comprises a fastening structure (502) configured to be constrained to a bank of said waterway (2), a connecting ramp (503) interposed between said fastening structure (502) and said support structure (200), wherein said at least one joint (501) is configured to connect said reciprocally fastening structure (502) and said connecting ramp (503).

13. Machine for the recovery of floating material (1) from a waterway (2) according to claim 12, wherein said fastening structure (502) is configured as a portal structure comprising at least a first column (504) and at least one second column (505) connected to each other at respective top ends by means of a crossbar (506), wherein said at least one joint (501) is a cylindrical collar movably connected along said at least one first column (504) or wherein said fastening structure (502) comprises at least one first column (504) configured to be constrained to the ground and said at least one joint (501) is a cylindrical collar movable connected along said at least one first column (504).

14. Machine for the recovery of floating material (1) from a waterway (2) according to claim 11, wherein said at least one joint (501) is configured to rotate and translated along said at least one column (504).

15. A machine for recovering floating material (1) from a waterway (2) according to claim 10, comprising a damping device (211) connected at one of its first ends to said at least one support group (204), by means of a first hinge, and at a second ends opposite to said at least frame (302) of said capture system (300), by means of a second hinge, wherein said support structure (200), said damping device (211) and said capture system (300) define a variable geometry frame.

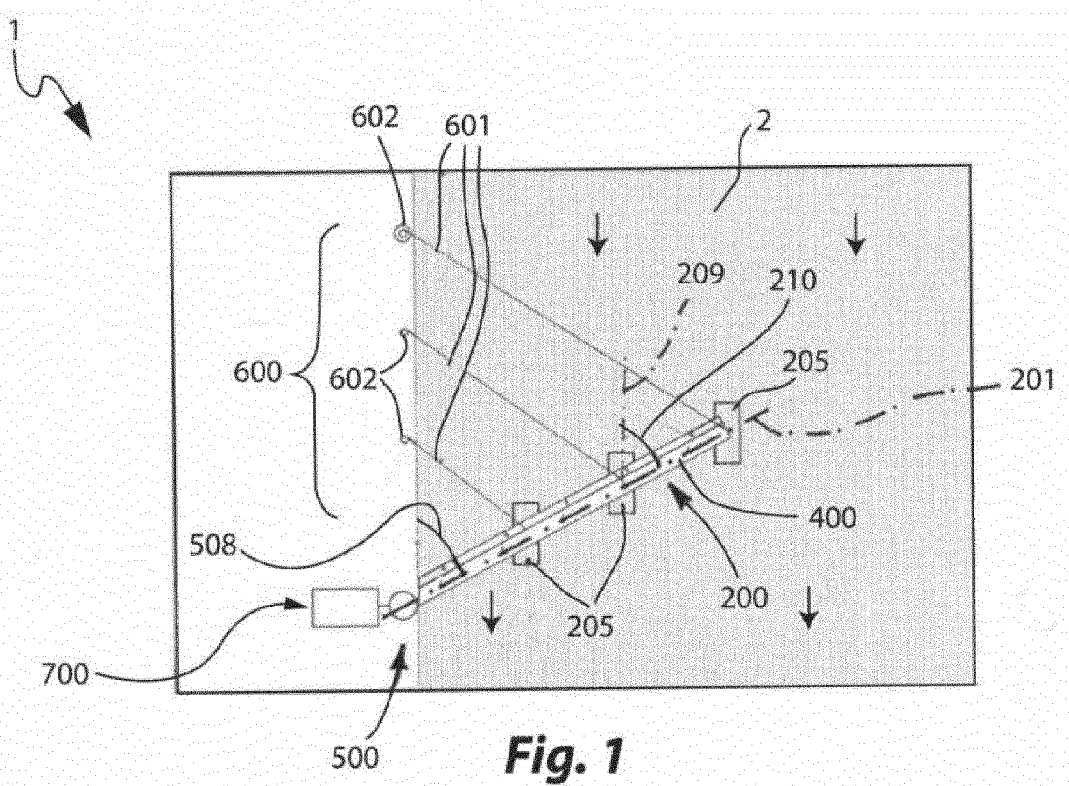
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Fig. 1

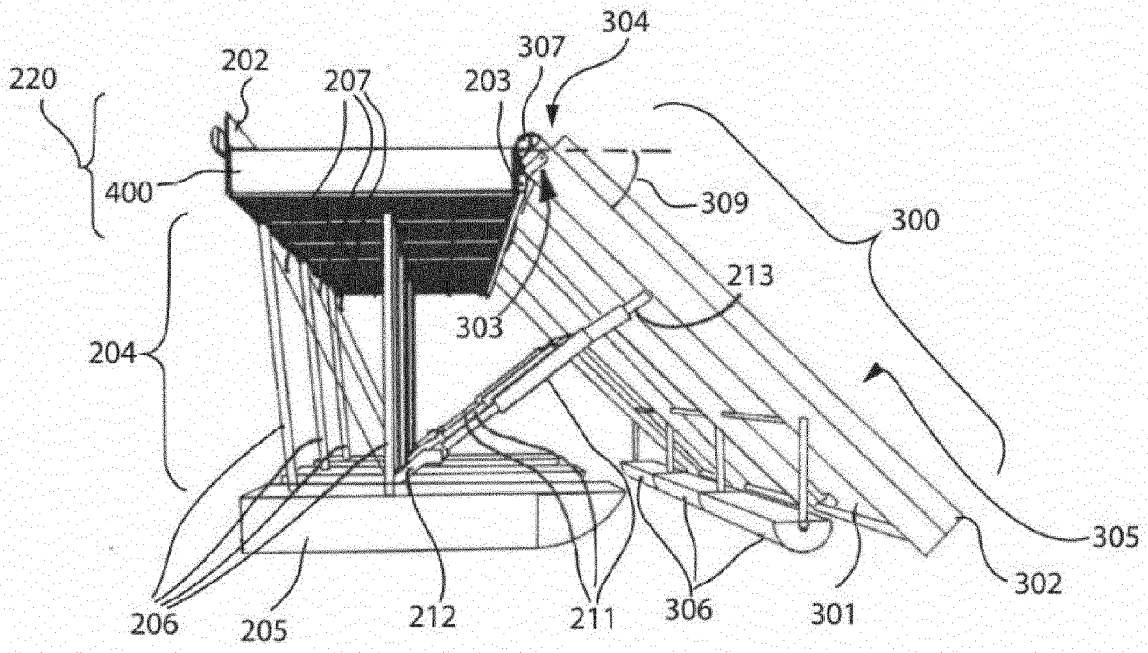
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Fig. 2

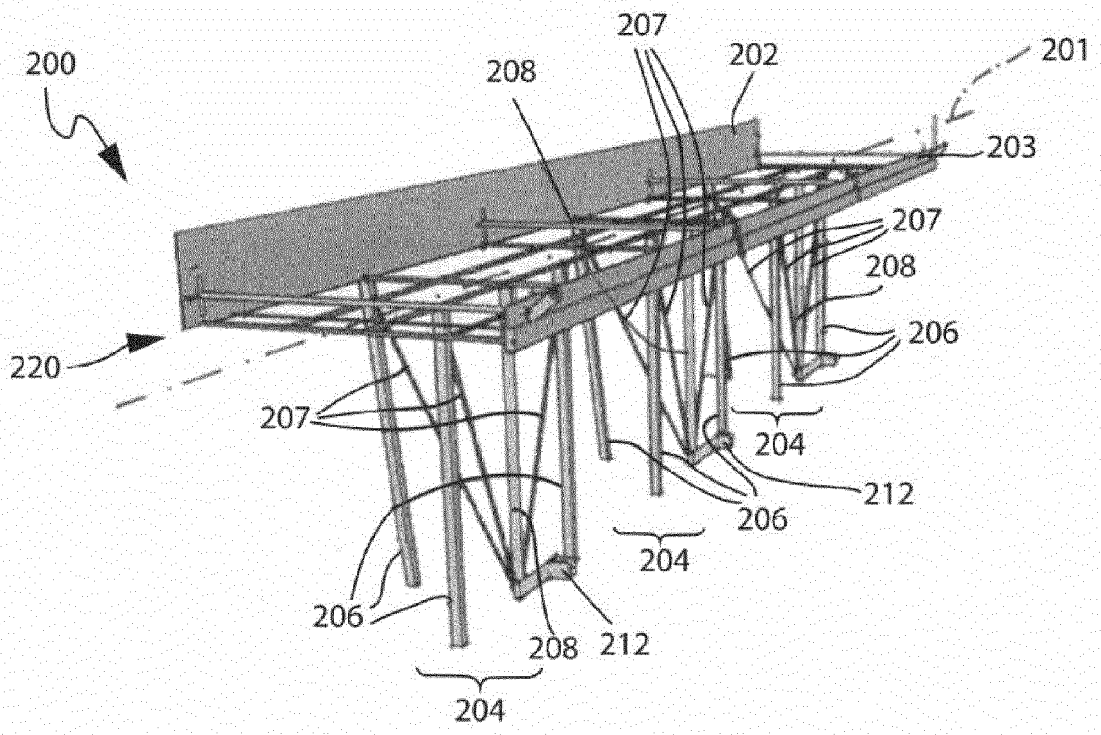
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Fig. 3

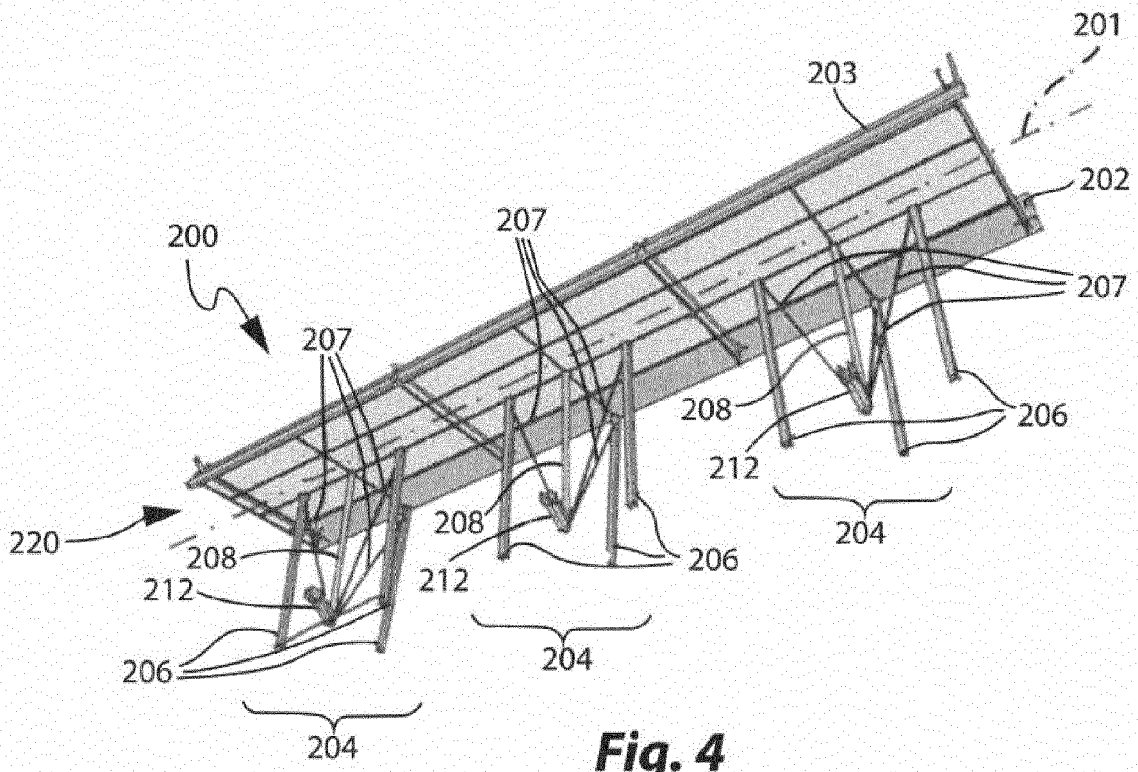
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Fig. 4

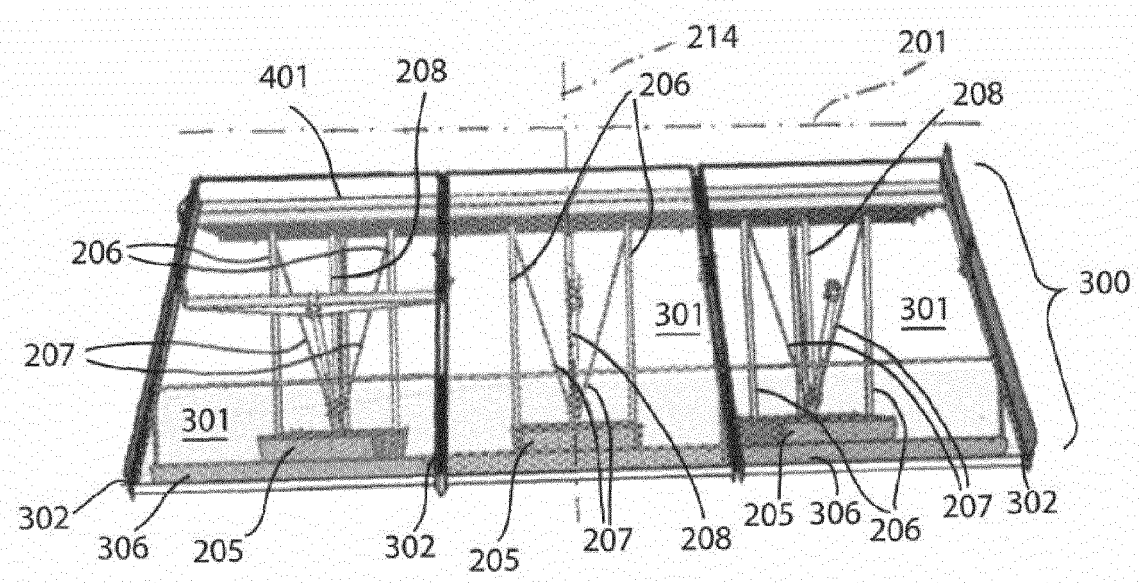
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Fig. 5

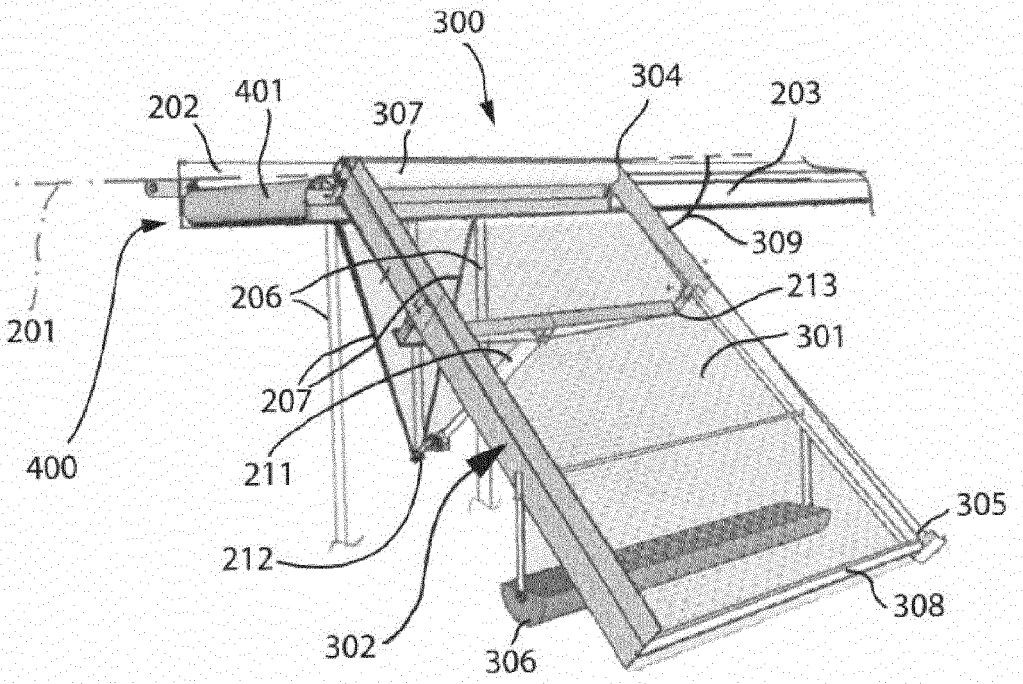
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Fig. 6

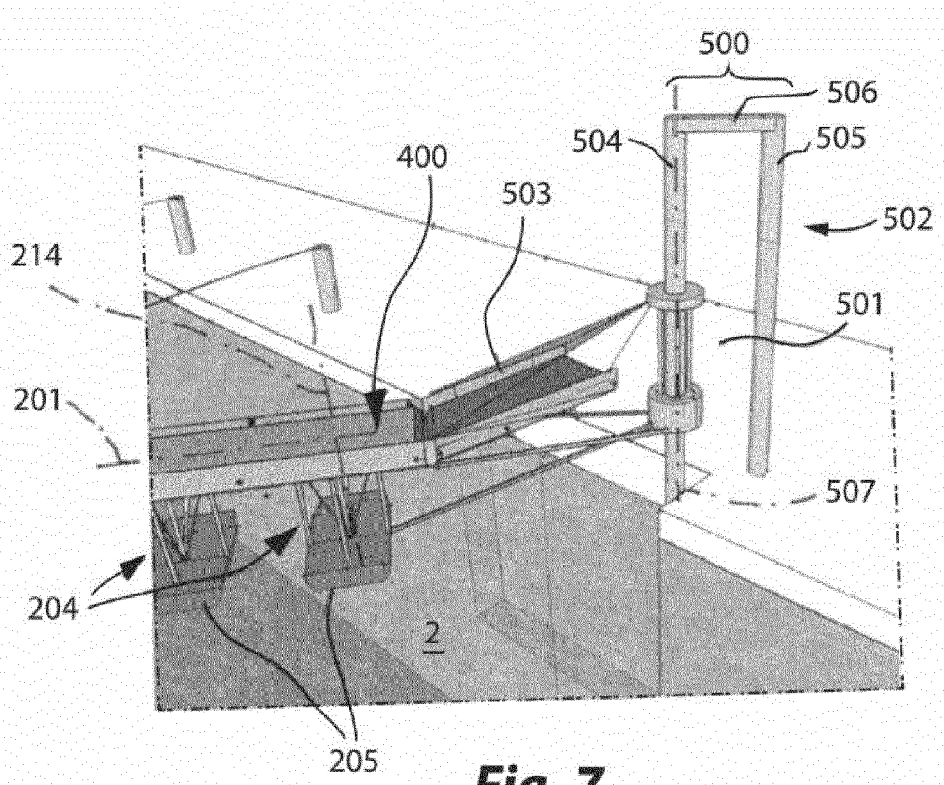
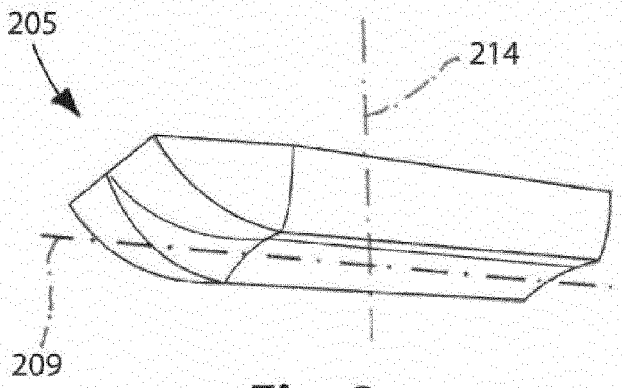


Fig. 7



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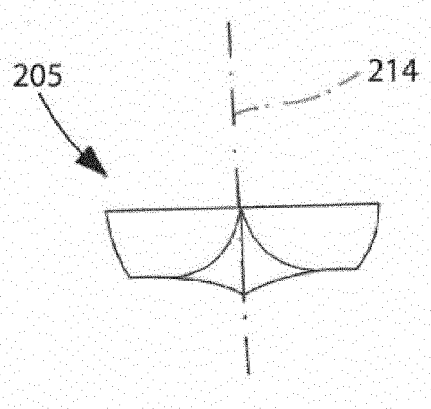

Fig. 9

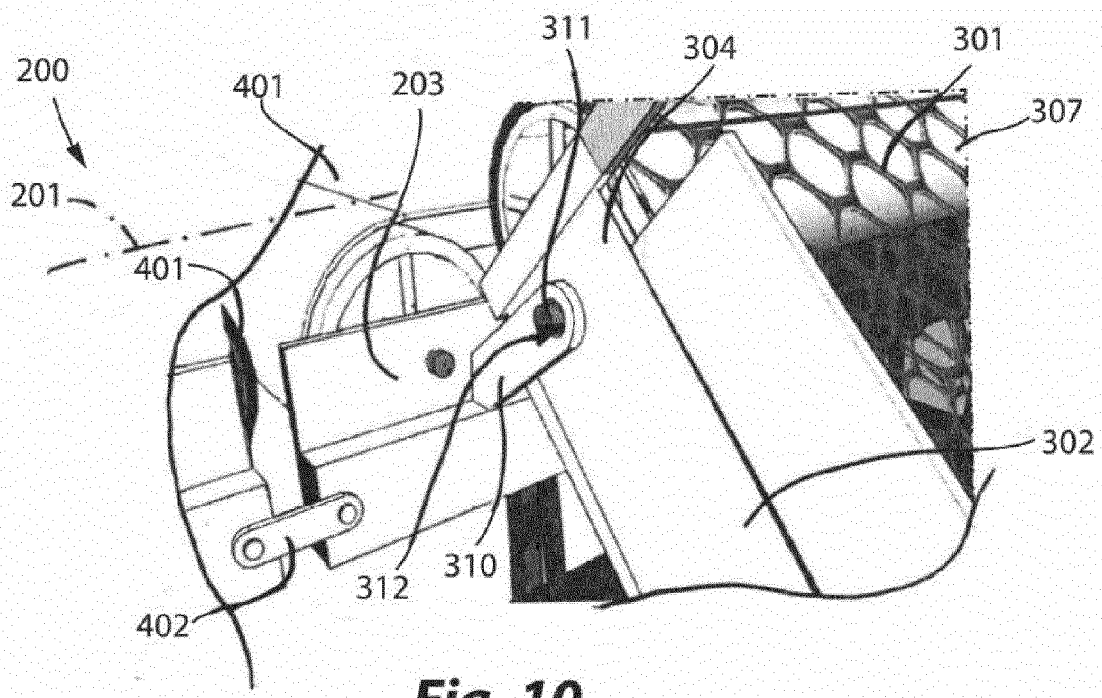
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Fig. 10

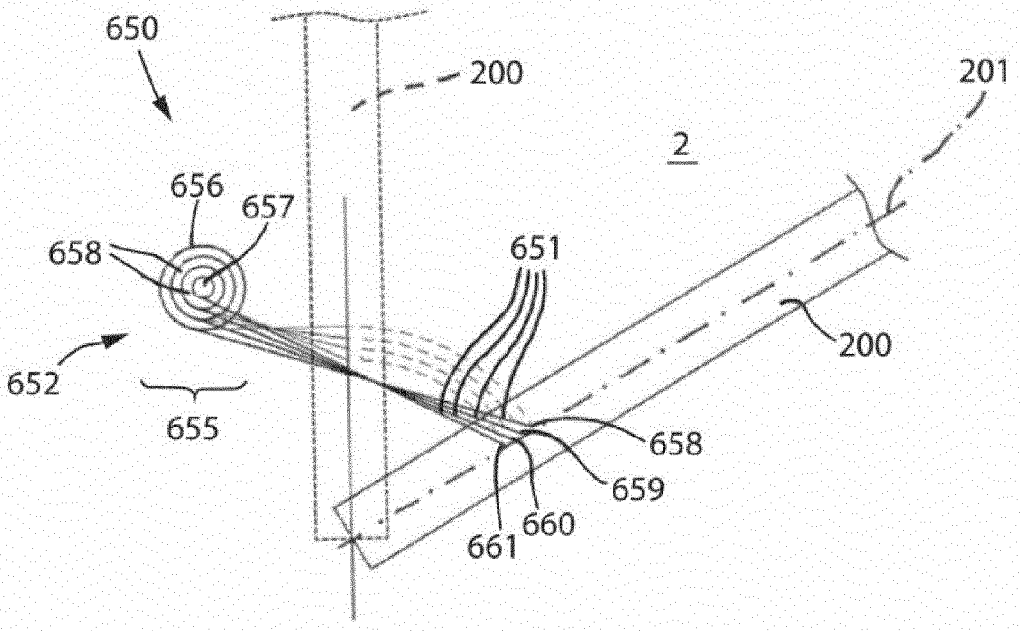
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Fig. 11

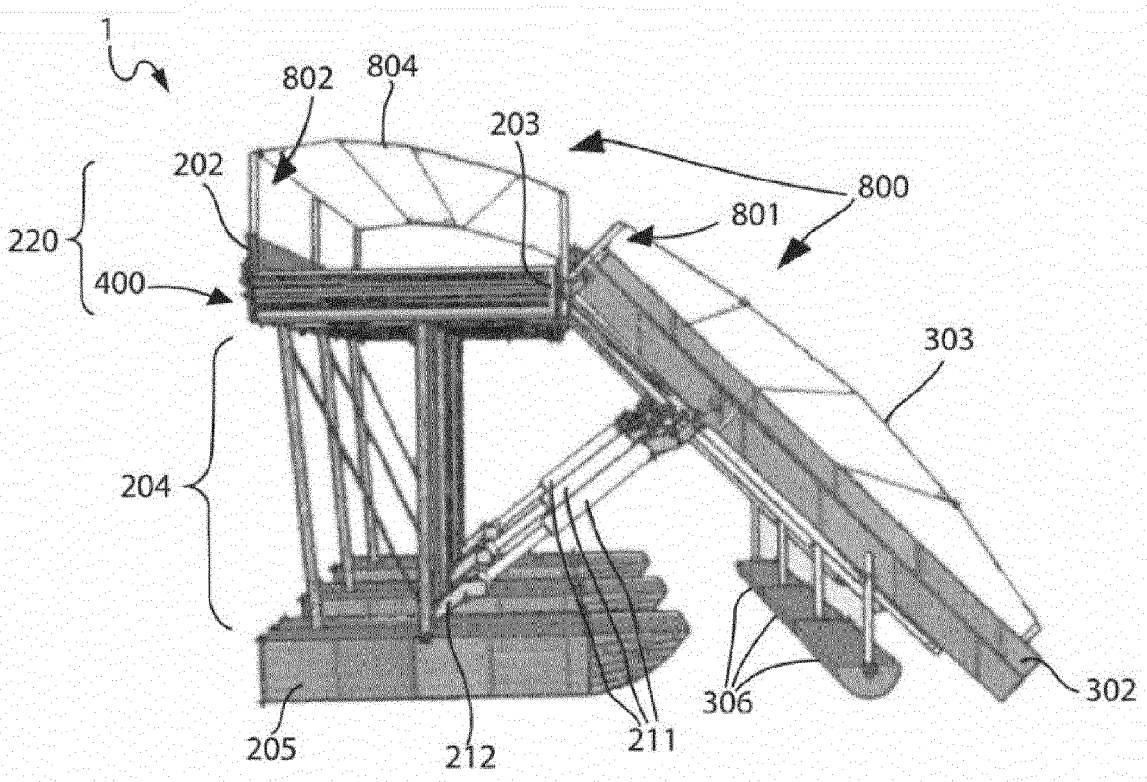

Fig. 12

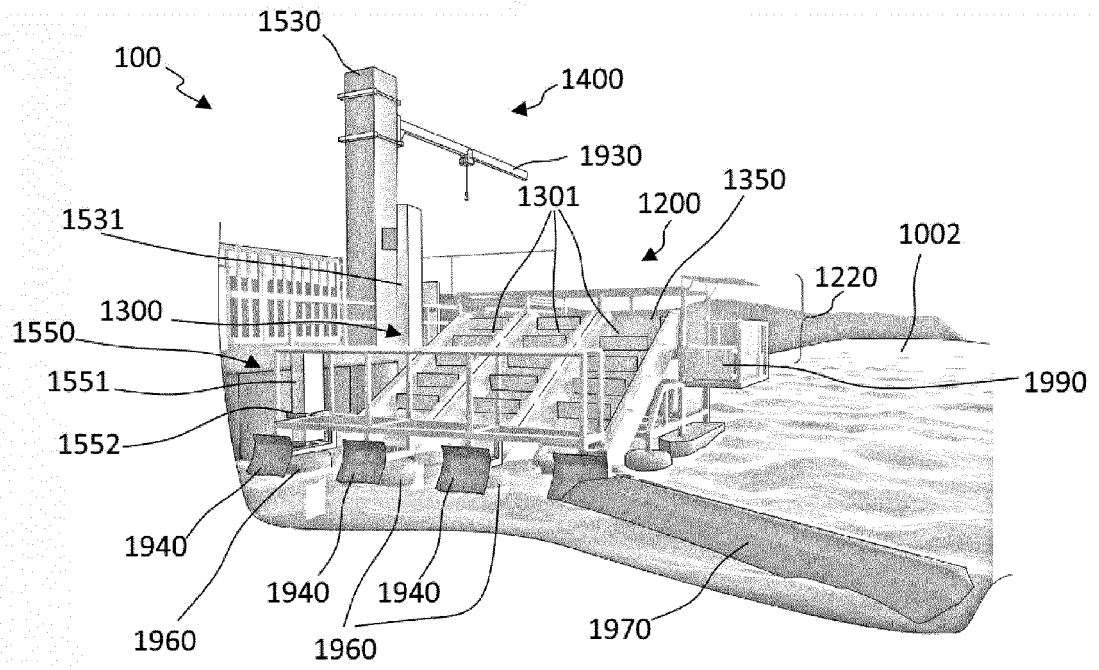
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Fig. 13

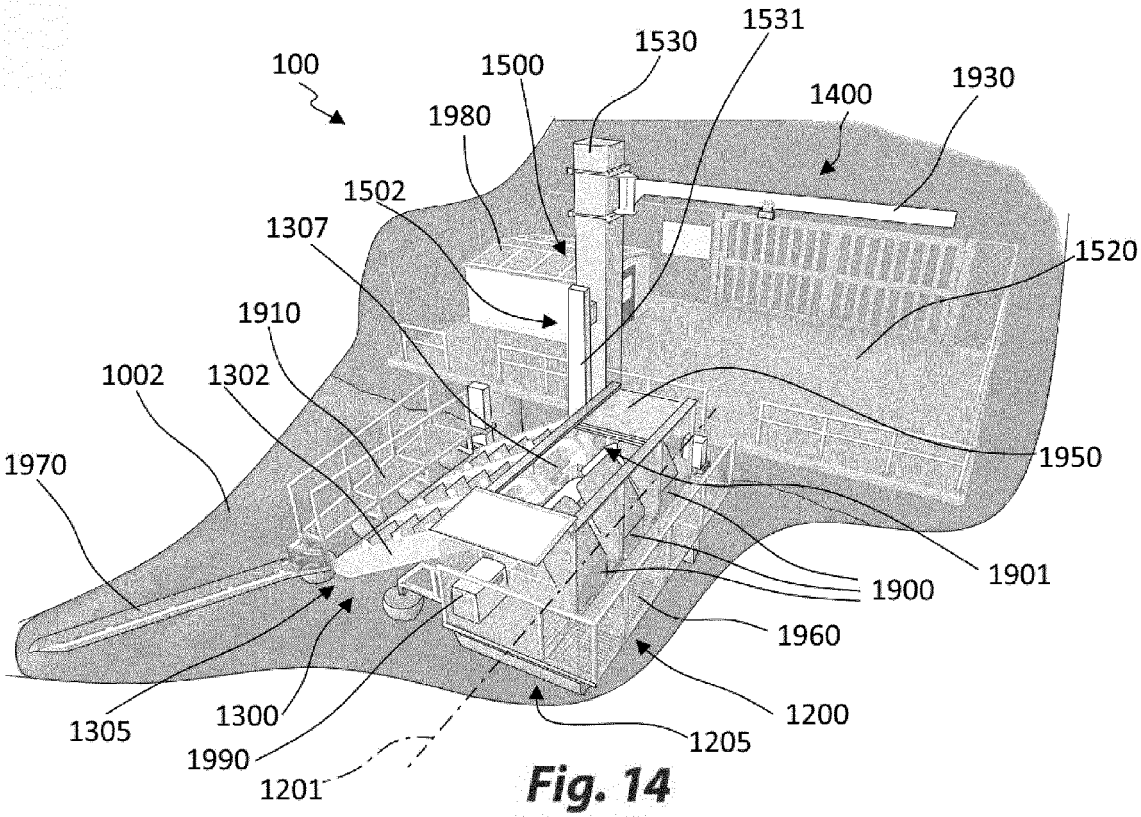
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Fig. 14

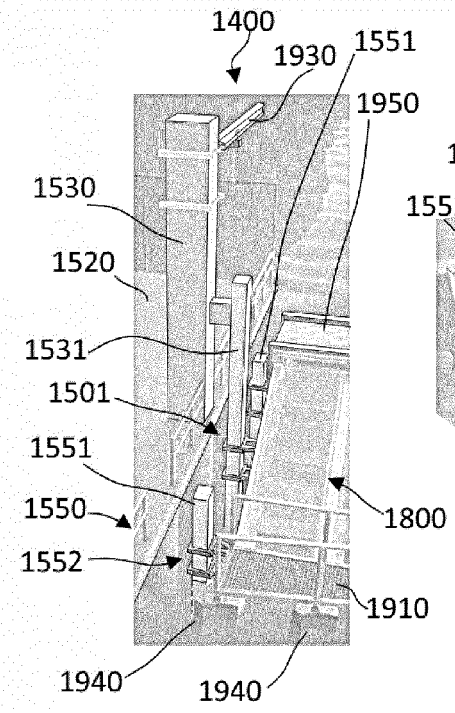

Fig. 15

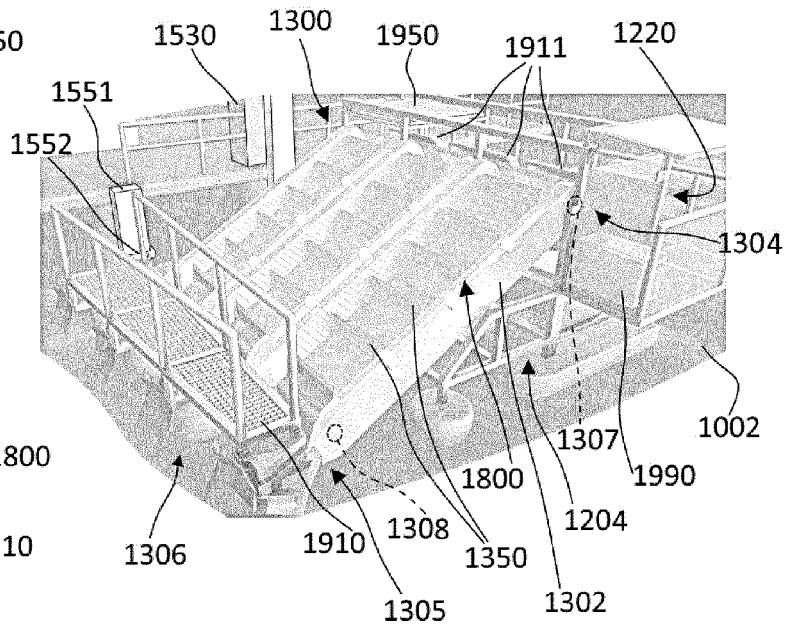

Fig. 16

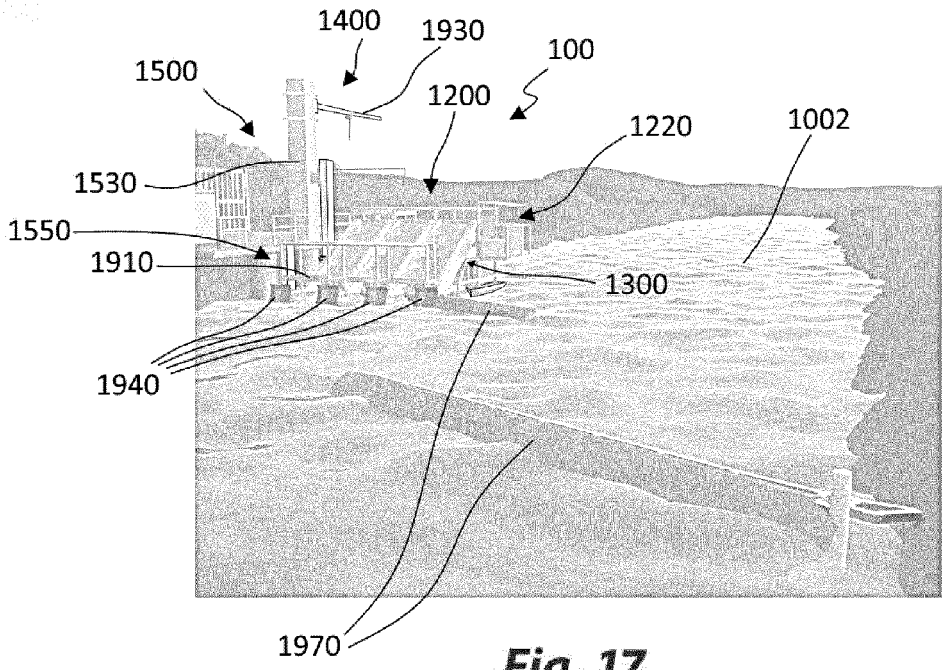

Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 8162

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 6 117 336 A (SACHSE MARVIN H [US]) 12 September 2000 (2000-09-12) * column 3, line 17 - column 5, line 33; claims; figures * -----	10,11,14 1,7-9, 12,13	INV. E02B15/08
A,D	CN 208 701 635 U (WENZHOU SILIN IND DESIGN CO LTD) 5 April 2019 (2019-04-05) * the whole document * -----	1,7-10	
A	KR 100 953 300 B1 (MON JAE HYUN [KR]) 20 April 2010 (2010-04-20) * paragraph [0037] - paragraph [0043]; figures 1-4,9 * -----	1,2, 7-11,13, 14	
A	KR 101 099 107 B1 (SAM AN CORP [KR]; WOO JIN STEEL WORKS CO LTD [KR]) 26 December 2011 (2011-12-26) * paragraphs [0099], [0100], [0104]; figure 1 * -----	6	

TECHNICAL FIELDS SEARCHED (IPC)

E02B
E02C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 February 2021	Fordham, Alan

CATEGORY OF CITED DOCUMENTS

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02-02-2021

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CN 208701635 U	05-04-2019	NONE	
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- CN 109577301 **[0010]**
- CN 206346165 **[0012]**