

Apparatus for maintaining, repairing, cleaning
and/or painting sides of a ship

The invention relates to an apparatus for
maintaining, repairing, cleaning and/or painting sides
of a ship, which is movable on a longitudinal wall of
a dry dock, comprising a chassis provided with rollers
5 and a container, a control cabin which is provided above
the chassis, at least one internal combustion engine,
hydraulic units, at least one mast which carries the
working platform and/or the working devices at its free
end and which is pivotal about at least one vertical and
10 at least one horizontal axis.

Apparatus of this kind is known from DOS (German
laid-open application) No 28 49 079. In that arrangement,
secured to the chassis or frame structure is a water
receiving container which, at the side associated with
15 the vertical wall of the dock, in the upper region of the
chassis structure, has a water inlet opening which
extends virtually over the entire length of the container.
Arranged opposite the water inlet opening, on the dock
wall, is a dock water pipe provided with a plurality of
20 taps or connecting means. The discharge nozzles of the
connections can be opened by way of a control means
which is fixed to the apparatus and which is influenced
by the level of water in the water container.

US patent specification No 3 951 092 also discloses
25 an apparatus which is movable along the wall of the dock.

and which has a chassis or frame structure which, in the lower region close to the floor of the dock, is provided with a platform; after the water is drained out of the interior of the dock, the paint pump, paint container and other accessory equipment which is to be employed in the paint spraying operation are mounted onto the platform.

Therefore, the above-mentioned equipment is mounted on the lower platform only during the paint spraying operation, and has to be removed therefrom again before the dock is flooded. Therefore, the equipment has to be stored at a position other than on the floor of the dock, when the dock is flooded, and the equipment has to be transported down to the floor of the dock and mounted on the platform of the apparatus, when the equipment is to be used again.

The invention is based on the problem of so improving an apparatus of the above-indicated kind that filling the supply tank for example with diesel oil, hydraulic oil or paint, maintenance of the drive engines, the hydraulic station, the paint spray station and the pressure water station, mounting of the chassis members on the other parts of the apparatus, can all be effected at low cost from the bottom of the dock.

According to the present invention there is provided an apparatus for maintaining, repairing, cleaning and/or painting sides of a ship, which is movably mountable on a longitudinal wall of a dry dock, comprising a chassis mounted on rollers and provided with a container, a control cabin which is provided above the chassis, at least one internal combustion engine, hydraulic units, and a mast which carries a working platform and/or a working device at its free end and which is pivotal about at least one vertical and at least one horizontal axis, wherein the

container, which is water tight, is provided in the lower region of the chassis which is under water when the apparatus is operatively associated with a dry dock and the dock is flooded, the operating units, including one or more of the internal combustion engine, hydraulic units, a pressure water station and/or a paint spray station and supply tank, are arranged in the container, at least one fresh air duct leads into the container, for exhaust gases and consumed cooling air leads out of the container, and the ducts extend into the upper region of the chassis.

In an advantageous embodiment of the invention, the rail associated with the chassis or frame structure is laid on the floor of the dock and the water-tight container is secured to the chassis in the vicinity of the lower rail. By virtue of this arrangement, the water-tight container which received all the essential operating units of the apparatus is positioned at a low level relative to the floor of the dock so that the operating units can be maintained and the supply tank can be filled without the need for additional accessory equipment for overcoming the difference in height between the operating units and the floor of the dock. Assembly and dismantling of the operating units from the floor of the dock is also a very simple operation.

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a front view of an apparatus according to the invention,

Figure 2 is a side view of the apparatus,

Figure 3 is a side view of the lower part of the apparatus, on a somewhat larger scale than the view shown in Figure 2,

Figure 4 shows a front view of the lower part of the apparatus,

Figure 5 shows a sectional front view of the middle part of the apparatus,

5 Figure 6 shows a side view of the upper part of the apparatus,

Figure 7 shows a front view of the upper part of the apparatus, and

10 Figures 8 to 10 show a side view and split front views of two further embodiments.

Referring now to Figure 1, as shown therein the apparatus 1 is arranged on a vertical longitudinal wall 41 of a dry dock 4, and is movable in the direction indicated by arrow A. The apparatus serves for
15 maintaining, repairing, cleaning and/or painting sides of a ship and is provided with a chassis or frame structure 10 provided with rollers. A control cabin 11 is provided above the chassis 10. The chassis 10 also carries a mast or boom 5 which at its free end in turn
20 carries any form of working device (not shown), or a working platform and the like. The working platform and the working devices may also be combined together. The mast 5 itself is pivotal about a vertical axis 105 which is illustrated by a dash-dotted line in Figure 1, and
25 is also pivotal about a horizontal axis 205. The mast or boom 5 is moved by a control cylinder unit 305.

Associated with the mast 5 is a parallel linkage assembly 51.

Disposed in the lower region of the chassis 10, which is under water when the dock 4 is flooded, is a water-tight container 12 in which the necessary units 2 (not shown in Figure 1) are disposed. The units 2 are for example one or more internal combustion engines, a hydraulic station, a pressure water station and/or a paint spray station and supply tank. The water-tight container 12 has relatively large entrance hatches 112 so that maintenance operations can be performed on the equipment 2, when the dock is not flooded.

Associated with the intake connecting manifolds (also not shown in Figure 1) of the engines are fresh air ducts 15 which, as shown in Figure 1, are in the form of tubes 115 in the illustrated embodiment. The tubes 115 for the supply of fresh air are arranged in a V-shaped configuration and converge towards each other towards the upper region of the apparatus. Arranged between the fresh air ducts 15 or tubes 115 is a duct 16, in the illustrated embodiment again in the form of a tube 116, which serves for discharge of the exhaust gases and the consumed cooling air. The tube 116 serves as a central support member for the connection between the control cabin 11 and the water-tight container 12.

In the lower region, the water-tight container 12 has travelling rollers 210 by means of which the water-tight container 12 and the entire chassis structure 10 which is constructed thereon are movably supported on a rail 3. The lower rail 3 associated with the chassis 10 may be laid on the floor 40 of the dock or it may be supported on a cantilever mounting bracket arrangement 141 on the vertical wall 41 of the dock, adjacent to the

floor 40 of the dock. This can be clearly seen from Figure 3, as that drawing clearly shows the travelling support arrangement 110 of the apparatus.

The upper rail 30 which is associated with the chassis 10 is secured to the vertical longitudinal wall 41 of the dock and, like the rail 3, preferably extends over the entire vertical wall of the dock. In this way the apparatus 1 can enjoy the maximum length of travel movement, for the purposes of maintaining, repairing, cleaning and/or painting sides of a ship, and can make use of the entire length of the vertical longitudinal wall 41 of the dock so that the boom or mast 5 with its working platform and/or the working device can extend out beyond the wall of the dock. In this connection, it is possible for the floor 40 of the dock to be extended beyond the region of the vertical longitudinal wall 41 of the dock, towards the entrance end of the dock, so that the working range of the apparatus is increased thereby. Therefore, the entire wall 41 of the dock can be utilised for travel movement of the apparatus, as far as the end face or faces of the wall of the dock. The fact that the apparatus has this long possible travel movement means that it is possible to avoid the need for an intermediate boom member or the like.

The fresh air ducts 15 and the exhaust gas or waste air duct 16 are in the form of tubes 115 and 116 forming part of the chassis 10 and thus serve as support members and connecting members between a cantilever mounting structure 17 and a tube member 13 which carries the mast 5, above the structure 17. The tube member 13 is movable

by way of a rotary mounting assembly 113. This will be described hereinafter with reference to Figure 5.

Any number of supply ducts 6 can be taken from the water-tight container 12 to the upper part of the chassis 10 or to an upper water container 42 which is secured to the vertical wall 41 of the dock.

Figure 2 shows a side view of the apparatus on a somewhat larger scale than the view shown in Figure 1. Figure 2 shows the manner in which water can be taken from an upper water container 42 which is secured to the dock 4, by way of the water pipe 60 which forms part of the supply ducts 6, so that water can be supplied to the appropriate piece of equipment in the water-tight container 12.

Figure 3 shows the structure of the travelling support arrangement 110 in greater detail. One or more travelling rollers 210 which are arranged one beside the other and which are disposed coaxially are supported on the lower rail 3, being secured thereon by a flange. Horizontally disposed accessory rollers 310 associated with respective ones of the rollers 210 provide for precise guiding in respect of the chassis 10, in particular the water-tight container 12 with its relatively heavy equipment, on the rail 3. Figure 3 shows an example in which the lower rail 3 is arranged on a cantilever mounting bracket arrangement 141 which extends longitudinally in a horizontal direction at a spacing from the floor 40 of the dock. The mounting arrangement 141 is secured to the vertical longitudinal wall 41 of the dock.

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Figure 4 shows a front view of the lower part of the apparatus 1, with an arrangement of equipment therein being illustrated by way of example. The travel support arrangements 110 are provided in the 5 chassis 10 at the right-hand end and the left-hand end of the illustrated apparatus, while the spaces above the arrangements 110 can be used for disposing equipment therein.

The equipment shown in the drawing comprises an 10 internal combustion engine 20, a hydraulic station 22, a pressure water station 21 and a paint spray station 23 with paint containers 24, with those pieces of equipment being used as required. Thus, water may be taken for example from the water container 42 by way of 15 the water pipe 60 to the pressure water station 21 from which the water, which is under a high pressure, is taken to the mast 5 by working conduits (not shown), more particularly, to the working devices on the working platform of the boom or mast, although that is not 20 illustrated. Other agents such as sand or paint can be applied to the ship or sucked off the ship. Any conceivable working operation can be carried out in that way.

The tube 116 serves as an exhaust gas or waste air 25 duct for the equipment disposed in the water-tight container 12, and at its lower end carries a suction intake pipe or connection 216. The tubes 115 with their discharge pipes or connections 315 serve as a fresh air conduit arrangement. It is also possible for conduits to 30 be arranged in the tubes 115 and in the tube 116, in which case the tubes 115 and 116 serve as a stabilising

and support casing for the conduits. The simpler and also the less expensive way is for the tubes themselves to be used as fresh air ducts and exhaust gas and waste air ducts respectively.

- 5 Figure 5 shows the construction of the cantilever mounting arrangement 17 and the connection of the arrangement 17 to the control cabin 11 by way of an exhaust air ring 14.

10 The upper ends of the tubes 115 and 116 are connection by flange means to extension members, more particularly, the tube 115 being connected to an intake flow connection 215 and the tube 116 being connected to an extension tube 316 around which there is disposed a tube member 13, at a spacing therefrom. The tube
15 member 13 serves as a support means for a mounting 50 which carries the mast 5; the mounting 50 is fixedly connected to the tube member 13 (see Figures 1, 2, 6 and 7). The extension tube 316 which extends the central tube 116 carries the mounting structure 17, and it will
20 be appreciated that the tube 116 can also be extended in such a way that there is no need for an extension member 316. The mounting arrangement 17 is secured to that tube, and the intake flow connections 215 for the fresh air tubes 115 are secured to the mounting
25 arrangement 17. The mounting arrangement 17 also carries a stationary ring 117 of a rotary mounting assembly 113, with the tube 13 being connected to the toothed ring 213 of the assembly 113. The central tube 116 or the extension tube 316 thereof can thus be moved, from the
30 control cabin, together with the control cabin, by a per se known arrangement. The control cabin 11 is

fixedly connected to the tube 13, with the interposition of an exhaust air ring 14, and is mounted on the tube 116 or on the extension tube member 316, in the upper region thereof, by way of a ball bearing assembly 313. The ring 14 is disposed around and at a spacing from the upper end of the tube 116 or the extension tube member 316. The upper end of the central tube 116 or the extension tube member 316 thereof opens into the exhaust air ring 14 which is provided with radially extending intermediate or partitioning walls 114. As already mentioned, the ring 14 is fixedly connected to the rotatably mounted tube member 13 to which the mast 5 is in turn secured. The ring 14 thus carries the control cabin 11 which is also moved with the tube member 13 and the mast 5 when the drive and motion means act on the toothed ring 213 in order to produce a pivotal movement of the mast 5; the mast 5 may be movable beyond 180°. The mounting arrangement 17 is in the form of a hollow member, possibly an annular hollow member, and forms the upper end of the V-shaped chassis structure 10. Upper edges of the tubes 115 or the intake flow connecting means 215 thereof must be disposed at such a high level that no water can flow into the tubes from the top, when the dock 4 is flooded.

Figure 6 again shows the upper part of the apparatus, on a somewhat larger scale. Figure 6 also shows the upper mounting of the chassis structure.

Disposed on the mounting arrangement 17 is a fixture or attachment 217 which can carry the drive means for upper travel rollers 410 or an upper travel

roller 410. The upper travel roller or rollers 410 bears against the upper rail 30, with the upper roller or rollers 410 bearing against the vertical limb portion of the upper rail 30. The upper rail 30 is in turn secured to an upper fender/⁴³ which extends along the longitudinal wall 41 of the dock and on which the water container 42 already mentioned above can be disposed. The pipe 60 has a pipe bend which extends into the water tank 42 and, when the apparatus 1 travels horizontally, the upper bend 160 of the pipe moves in the tank 42 so that water can be sucked out of the tank, and can be supplied for example under pressure by the pressure water station 22 to the working device (not shown) which is disposed at the free end of the mast 5.

Figure 7 shows a front view of the upper region of the apparatus. Figure 7 shows that it is possible for the intake flow connecting means 215 to be provided with a cover means 415 in order to prevent rain from falling into the upper openings of the intake flow connecting means 215. A rail 7 may also be arranged on the upper surface of the vertical wall 41 of the dock, as can be seen from Figures 6 and 7, for example so as to be able to move the crane for loading the ships. The upper rail 7 can also possibly be used by the apparatus 1, although it is better to use only the rails 3 and 30 for the apparatus 1 so that the loading crane and the apparatus can be displaced independently of each other and do not interfere with each other. For example it is possible, as a precautionary measure, to install an automatically operating bilge or drainage pump for dealing with any accidents, for pumping the water-tight container 12 empty if for example water has nonetheless

penetrated into the container, for example due to a leak. The water-tight container forms the bottom stiffening strut of the chassis structure and corresponds to a closed unit or cell.

5 The apparatus can be used for carrying out a very wide range of working operations, such as maintenance, repair, cleaning and/or painting sides of a ship, or removing seaweed and the like from the ship by suction. The supply and discharge conduits required for such
10 purposes are not shown in the drawings, except for the water pipe 60, and such conduits can be arranged from the outset on the apparatus 1, depending on the particular supply purpose and the work to be carried out, or they may be brought up separately for the
15 respective operation to be performed.

The essential point is that the supply and discharge conduits are taken in a water-tight manner to the pieces of equipment 2 disposed within the water-tight container 12, and are maintained in a water-tight
20 condition as far as the highest level of water in the dock when in a flooded condition, or up to the working platform or working devices. However, that does not represent any problem, by virtue of fitting casing tubes and the like.

25 Figure 8 shows another very important embodiment. This embodiment shows that it is possible for the tubes 115 and 116 to be arranged at displaced positions relative to each other, with the tube 116 which serves as the central support member, for carrying exhaust gases
30 and consumed cooling air, being disposed with its longitudinal axis

displaced from the plane containing the longitudinal axes of the tubes 115 for the supply of fresh air, whereby the toothed ring

213 with the rotary mounting assembly and the tube member 13, the exhaust air ring 14 and the control cabin 11 are automatically positioned with their central plane in front of the central plane of the tubes 115 which provide for the supply of fresh air. This arrangement provides that, even when the mast or boom 5 is in a lowered position, it is possible for it to move in a horizontal plane over an angle of pivotal movement which is much greater than 180° .

Figure 8 also shows a possible form of the drive arrangement for moving the entire apparatus, in particular the water-tight container 12 on which the rest of the apparatus is built. Similarly to a winch drive, the drive for moving the apparatus may be by way of a traction cable, a chain or a link belt 80. The movement of the apparatus itself may be produced in two ways, either by pulling on the chain, cable or link belt 80, by means of a winch (not shown) or the like, or by the rotary drive motion of the wheel 81 which can be in the form of a chain wheel, cable pulling wheel or the like (the rotary drive is not shown).

This kind of drive 8 is to be considered as being given by way of example. The cable 80, chain or the like is passed around direction-changing rollers 82 and 83.

Figure 9 clearly shows the drive 8. Figure 9 shows a front view of the lower region of another embodiment. In this case also the container 12 is again provided with entrance hatches 112, with the necessary equipment, namely, at least one internal combustion engine, hydraulic

units and the like, being disposed within the container 12. In this embodiment, the travel support arrangements 110 are of a somewhat more complicated construction in order to hold the container 12 reliably to the floor, and the mooring action by the drive chain 80, the traction cable or a link belt also gives the apparatus a hold on the rail 3. In this embodiment, a support tube 118 is connected by way of a swing or pivot bearing 18 to the centrally disposed tube 116. When the apparatus includes an intermediate boom or jib member, which is shown in Figure 10, the support tube 118 is necessary to support the intermediate boom in its vertical pivotal axis. Figure 9 also shows that it is possible for the lower parts of the tubes 115 to be fitted onto the side surfaces 212 of the container 12, and for those lower parts of the tubes 115 to be provided with openings 515 which extend over virtually the entire height of the side surfaces 212 in order to provide a sufficient flow section for the air flowing into the container. The incoming air moves to the middle region of the container 12 where it is sucked in by the suction intake connection 216; a fan blade 416 may be associated with the intake connection 216.

Figure 10 shows an embodiment which also forms part of the embodiment of Figure 9, namely, being the upper region thereof. In this embodiment, instead of the mounting 50, there is an intermediate boom or jib member 150 which is fixedly connected to the tube member 13, with the cabin 11 again being carried by way of the exhaust air ring 14. Therefore, with the tube member 13, the cabin 11 and the ring 14, the intermediate boom 150 forms a pivotal unit which is again movable by way of the rotary mounting assembly 113.

Provided at the end of the intermediate boom 150 is a vertical pivot axis means 52 which is supported by the support tube 118 and which is also pivotal by motion elements 53 in a vertical direction, by virtue of the horizontal axis 205. It will be seen that in this embodiment also the water tank 42 is arranged above the fender 43 so that water can be taken from the tank 42 by way of the pipe 60 and fed to the corresponding pieces of equipment in the container 12.

10 A relatively large insulating plate 111 can also be arranged below the control cabin 11 so that the waste air and in particular the exhaust gases cannot pass into the control cabin 11. The insulating plate 11 is also intended to eliminate an accumulation or build-up of heat in the upper region. It is also possible for the cover means 414 to be in the form of filters.

It is important that the tube member 13 which serves as the central tube, with the cabin 11 and the travel support arrangement, can be in the form of a standard assembly, possibly also with the water-tight container 12 which forms the bottom transverse strut, so that the above-mentioned standard assembly can always be used and can be converted or changed as required and in particular may be equipped with different pieces of equipment. The fresh air which flows into the container 12 from the outside collects in the central part of the container 12 and from there is conveyed away into the region of the exhaust air ring 14, by way of the suction intake pipe connection 260, with the discharge flow of air possibly being actively assisted by a fan blade assembly 416 or the like; all the components of the

arrangement are to be so disposed as to ensure that
—water cannot get into the container, even under
severe weather conditions. A low degree of vacuum
can be produced in the container 12 by the fan blade
5 arrangement or by any other kind of blower, so that
there is no possibility of short-circuiting of the
flow of air anywhere in the system. The suction intake
filters of the respective engines should be disposed
as close as possible to the places at which the fresh
10 air is discharged into the container, that is to say,
close to the side surfaces 212, in the region of which
the fresh air is introduced into the container. In
addition, the insulating plate 111 serves as a baffle
plate or deflector and rapidly distributes the exhaust
15 gases and waste air to the ambient atmosphere.

CLAIMS:

1. Apparatus for maintaining, repairing, cleaning and/or painting sides of a ship, which is movably mountable on a longitudinal wall of a dry dock, comprising a chassis mounted on rollers and provided with a container, a control cabin which is provided above the
5 chassis, at least one internal combustion engine, hydraulic units, and a mast which carries a working platform and/or a working device at its free end and which is pivotal about at least one vertical and at least one horizontal axis, wherein the container, which is water tight, is provided in the lower region of the chassis which
10 is under water when the apparatus is operatively associated with a dry dock and the dock is flooded, the operating units, including one or more of the internal combustion engine, hydraulic units, a pressure water station and/or a paint spray station and supply tank, are arranged in the container, at least one fresh air duct leads
15 into the container, a duct for exhaust gases and consumed cooling air leads out of the container, and the ducts extend into the upper region of the chassis.
2. Apparatus according to claim 1, wherein the rollers are movable on rails mountable on or adjacent to the dry dock bottom,
20 the water-tight container being secured to the chassis so as to be in the vicinity of the rails when mounted as aforesaid.
3. Apparatus according to claim 1 or claim 2, wherein the container is provided with an automatically operating drainage pump.
4. Apparatus according to claim 1, wherein the fresh air
25 duct or ducts and the exhaust gas or exhaust air duct are tubes forming part of the chassis itself.



5. Apparatus according to claim 4, wherein the tubes for the fresh air are arranged in the manner of an inverted V-shape, and the tube for discharging the exhaust gases and the consumed cooling air is provided centrally between the tubes for the fresh air.

5 6. Apparatus according to claim 5, wherein a cantilever mounting structure is secured to the central tube, the intake flow connections of the fresh air tubes being fixed to the mounting structure and the mounting structure carrying a stationary ring of a rotary mounting assembly, to a toothed ring of which mounting assembly there is
10 connected a tube member which is disposed concentrically around the central tube or an extension tube and to which the mast is secured.

7. Apparatus according to claim 6, wherein the upper end of the central tube or the extension tube thereof opens into an exhaust air ring which is provided with radially extending intermediate
15 walls and is connected to rotatably mounted, concentrically disposed tube member.

8. Apparatus according to claim 7, wherein the exhaust air ring carries the control cabin.

9. Apparatus according to claim 6 or claim 7, wherein the
20 mounting structure is in the form of a hollow body and forms the upper end of the inverted V-shape chassis.

10. Apparatus according to claim 7, claim 8, or claim 9 when appended to claim 7, wherein an insulating plate is arranged below the control cabin and above the exhaust air ring, to act as
25 a protective plate for the control cabin.

11. Apparatus according to claim 10, wherein the tubes forming the fresh air duct are displaced relative to the central tube so that their longitudinal axes lie in a plane displaced from the longitudinal axis of the central tube which serves as a central support member with
30 the tube member fitted thereon.



12. Apparatus according to anyone of claims 1 to 11, wherein a fan or fan blade is arranged in a suction intake pipe of the exhaust duct or above the same, for actively conveying the exhaust gases or the waste air.

13. Apparatus for maintaining, repairing, cleaning and/or painting sides of a ship, substantially as hereinbefore described with reference to Figures 1 to 7, or Figures 8 to 10 of the accompanying drawings.

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