# United States Patent [19]

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[54] **APPARATUS FOR TREATING CONTINUOUS SURFACES**


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**Related U.S. Application Data**

[62] Division of Ser. No. 828,428, May 19, 1969, Pat. No. 3,627,562.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**118/50.1,** 118/73, 118/305

[51] **Int. Cl.** .....**B05c 5/00,** B05c 9/08

[58] **Field of Search**.....118/305, 50, 207, 50.1, 73; 15/1.7; 114/222; 61/68



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,337,889 | 8/1967 | West | 15/1.7 |
| 3,147,143 | 9/1964 | Kiyoshikontani | 118/305 |
| 3,472,200 | 10/1969 | Gerling | 118/305 X |
| 2,104,062 | 1/1938 | Temple | 118/305 X |

FOREIGN PATENTS OR APPLICATIONS

| | | | |
|---|---|---|---|
| 1,046,826 | 10/1966 | Great Britain | 114/222 |
| 1,092,133 | 11/1967 | Great Britain | 15/1.7 |



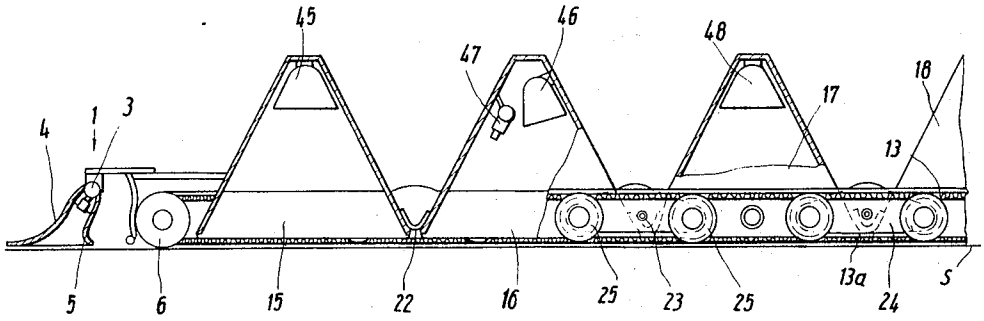
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[57] **ABSTRACT**

A continuous surface is treated by advancing over it an apparatus provided at its leading end with a cleaning device and downstream of the cleaning device with one or more containers which are evacuated and each have an open side facing the just cleaned surface portion in sealing engagement therewith and carrying in its interior a drying and/or applicator device for applying a protective layer to the just cleaned surface portion.


**19 Claims, 3 Drawing Figures**



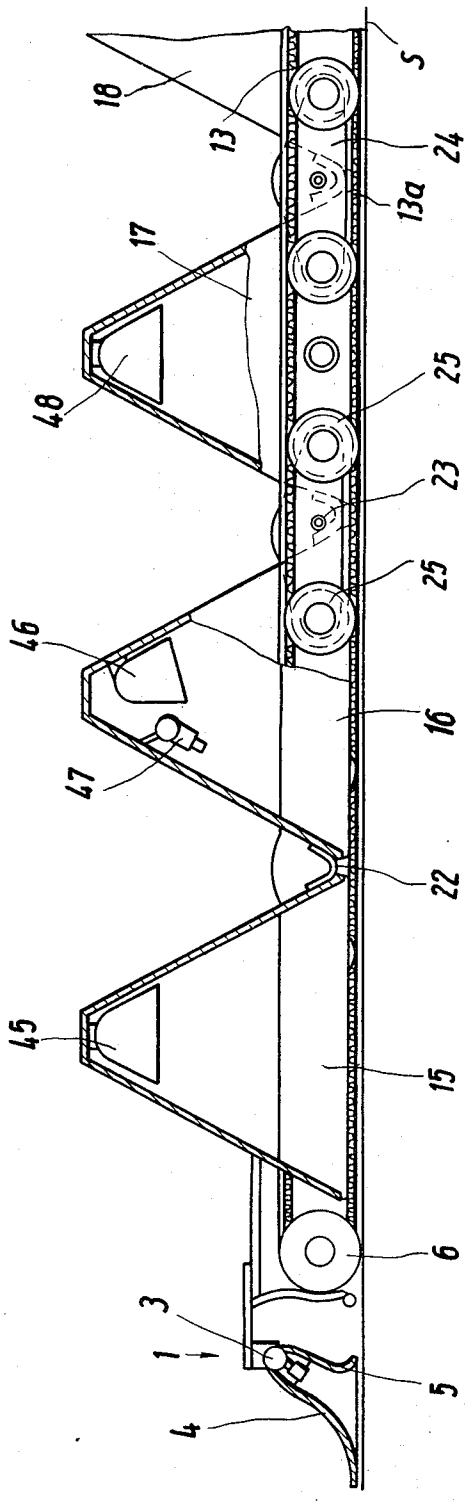



Fig. 1

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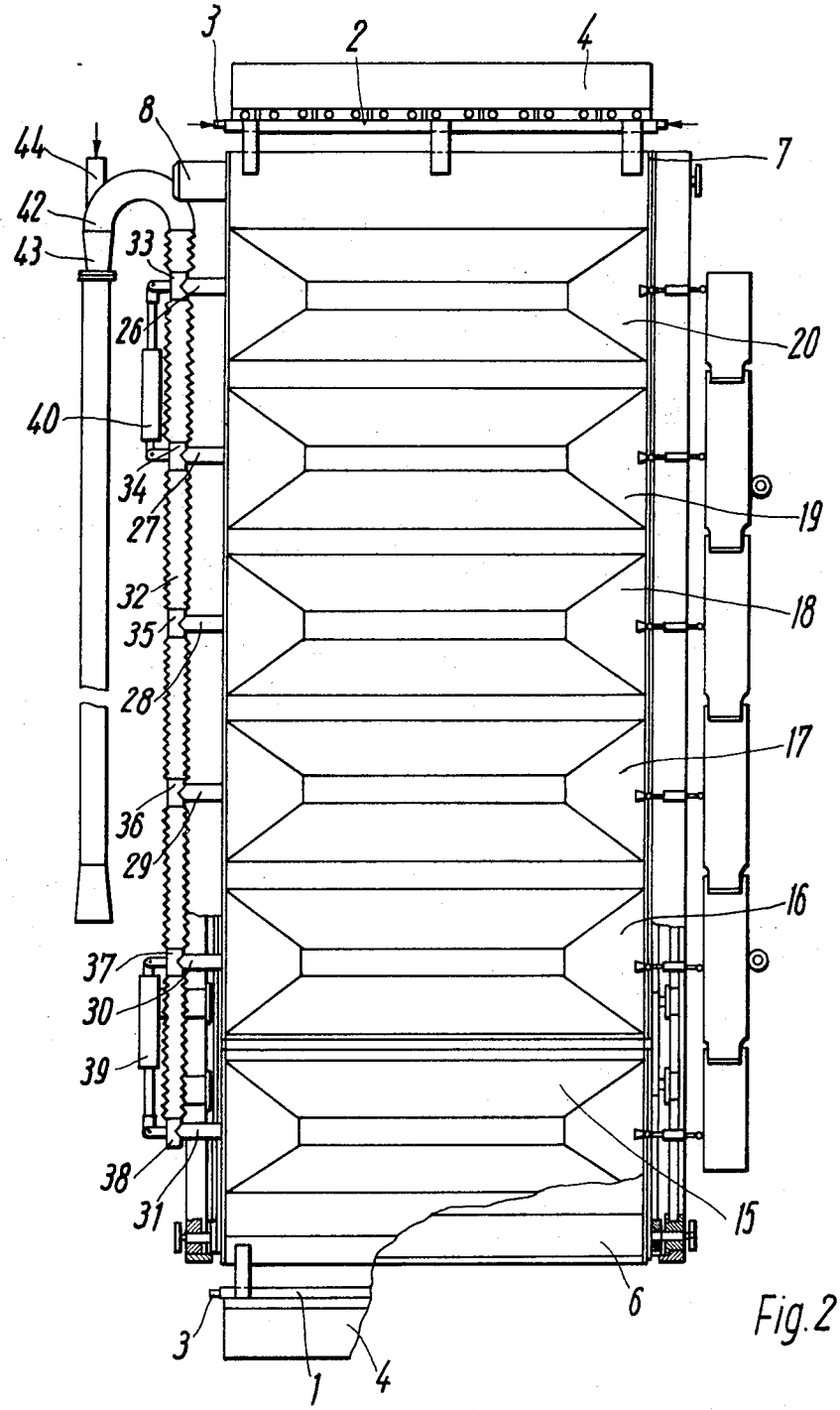



Fig. 2

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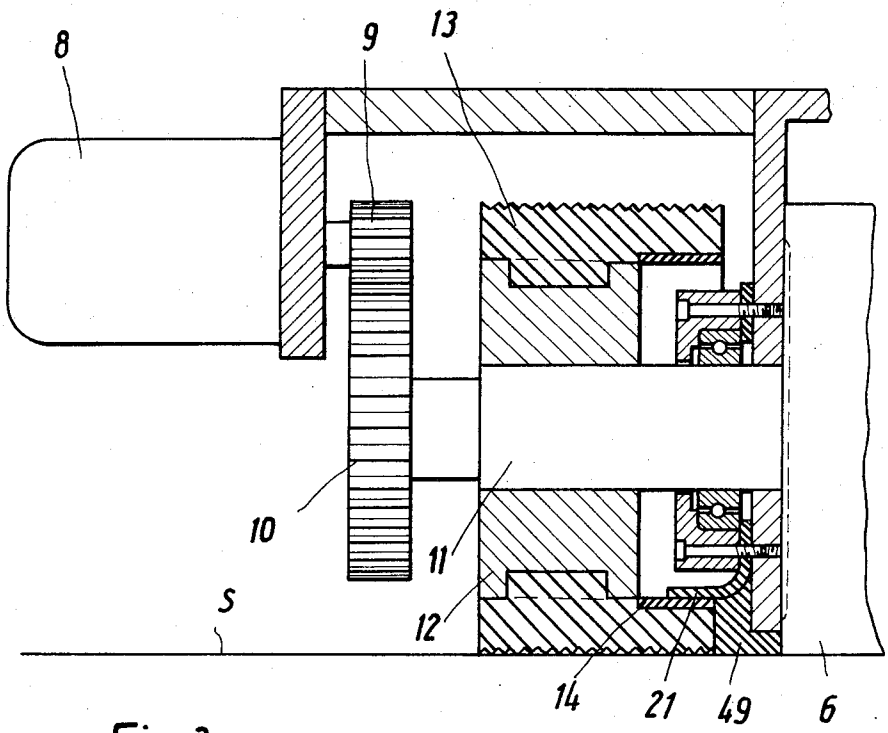



Fig. 3

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# APPARATUS FOR TREATING CONTINUOUS SURFACES

This application is a division of application Ser. No. 828,428 entitled "Method and Apparatus for Treating Continuous Surfaces", filed May 19, 1969 now U.S. Pat. No. 3,627,562.

## BACKGROUND OF THE INVENTION

The present invention relates generally to the treatment of continuous surfaces, and more particularly to the treatment of large-area continuous surfaces. Still more specifically, the invention relates to an apparatus for treating large-area continuous surfaces.

There are many applications where it is necessary not only to clean a surface but subsequently to provide it with a protective coating so as to protect it against rust or the like. This is true particularly in the case of ships where the outer surface of the hull must be so treated, but also on large tanks, and other structures. Known constructions for treating such surfaces utilize high-pressure spray tubes which, when the cleaning operation of the surface is completed, can be converted to apply to the cleaned surface a protective coating. However, not only is the necessary conversion, and subsequently the re-conversion for cleaning purposes, quite expensive, but also these devices can be used only in conjunction with surfaces which are not in contact with liquids at the time the protective coating is applied.

This is an obvious disadvantage because such climatic conditions as rain, frost, high humidity in the ambient air or the like frequently make the use of these known devices for obtaining cleaning and/or a protective coating impossible, or at least impair the quality of the work which they perform. In the case of ships where large surface areas are ordinarily under water, the problem of applying the protective coating is virtually unsolved. Of course, it is possible to remove the ship from the water, that is to put it in drydock. However, there is more and more of a tendency in the shipping industry to avoid as much as possible the time which a ship must spend in dock, by carrying out the necessary maintenance relative to cleaning and coating of the hull surfaces while the ship is afloat.

## SUMMARY OF THE INVENTION

The present invention aims to overcome the disadvantages existing in the art.

More particularly, the present invention has as an object to provide an improved apparatus for treating continuous large-area surfaces.

Still more particularly, it is an object of the present invention to provide such an apparatus wherein cleaning and coating follow one another immediately.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of my invention resides in an apparatus for treating continuous surfaces with which I first subject successive surface portions to a cleaning treatment, establish an evacuated volume of space contiguous with each freshly cleaned surface portion while I subject the next successive surface portion to the cleaning treatment, and apply a protective coating to the respective freshly cleaned surface portion within the evacuated volume of space.



My apparatus comprises a cleaning device which will be described in more detail subsequently, and one or more containers having an open side facing and fluid-tightly contacting the surface being treated, these containers being evacuated. The purpose of such evacuation is two-fold, namely, on the one hand it allows the apparatus to adhere to the surface which is being treated, even if the surface is under water, and on the other hand the fact that the space contiguous with a respective surface portion undergoing treatment is evacuated, provides for improved efficiency in coating.

The vapor pressure existing in the evacuated space is so low that a very rapid drying effect is obtained which if desired, or if necessary, can be further improved by the use of drying means, such as infrared radiators or other drying devices. At the same time the surface—or rather the surface portion—being treated has imparted to it an elevated temperature and this, in conjunction with the fact that the protective coating material is usually heated to substantially 90°C at high pressure, further aids in rapid hardening of the applied layer of coating.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary partly sectioned side elevational view illustrating an apparatus according to the present invention;

FIG. 2 is a plan view of the apparatus of FIG. 1; and

FIG. 3 is a detail view, on an enlarged scale, of the apparatus shown in FIGS. 1 and 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, it will be seen that in the exemplary illustrated embodiment (compare particularly FIG. 2) the apparatus comprises two cleaning devices 1 and 2. These are located at opposite ends of the apparatus and in this embodiment the apparatus can move in opposite directions with the respectively leading cleaning device 1 or 2 being used for effecting cleaning of successive surface portions in the path of the apparatus. Of course, it is possible to provide only a single cleaning device.

The cleaning devices 1 and 2 are identical, and FIG. 1 shows that the cleaning device 1, which is thus representative of both of the cleaning devices, comprises a high pressure spray conduit 3 which is fed with water under high pressure, and guide baffles 4 and 5 which extend forwardly from the conduit 3 and engage the surface S which is to be cleaned. It should be noted that in FIG. 1 there is no actual contact shown between the baffles 4 and 4, or any of the other constituent components of the apparatus, and the surface S. The reason for this is simply to provide a clearer illustration; it will be understood that normally there will be such contact. Water under high pressure, or another suitable cleaning fluid, is ejected from the conduit 3 of the respective

cleaning device against a respective surface portion of the surface S, and serves to clean such surface portion.

Located intermediate the cleaning devices 1 and 2, as most clearly shown in FIG. 2, are sealing cylinders 6 and 7 which contact the surface S and roll along the same when the apparatus is in use. The rollers 6 and 7 are driven, for instance via an oil motor 8. The pinion gear 9 of the motor 8 cams with a gear wheel 10 which is mounted on the shaft 11 which latter in turn is rigid with the associated cylinder 6 or 7.

As best seen in FIG. 3, each shaft 11 further carries at opposite axial ends of the respective cylinder 6 or 7 two profiled rollers 12 around which there is trained an endless belt 13. These belts are located at opposite lateral sides of the apparatus, as evident from FIG. 2. As shown in FIG. 3, the outer circumference of each of the rollers 12 is provided with a guide groove and the belts 13 are each provided with a projection received in the guide groove so as to locate each belt in predetermined position with respect to associated rollers 12 and to prevent it from axial shifting relative to these rollers. A portion 14 of each belt 13 extends axially beyond the respective rollers 12 and inwardly towards the single—or, as in the illustrated embodiment, the several—evacuable containers 15, 16, 17, 18, 19 and 20. The portion 14 of each endless belt 13 cooperates with a stationary sealing means 21 provided on the evacuable containers, and additionally with a sealing strip 49 which is also secured to the evacuable containers. The material of the sealing means 21 and the sealing strip 49 can of course be chosen so as to be compatible with the material of the respective endless belt 13, or at least the portion 14 thereof, in the sense of obtaining minimum friction and thereby a long service life of the thus-provided seal. It is emphasized that if the surface S has uneven portions, this will not adversely affect the just-described sealing arrangement because such uneven portions will act only upon the outwardly directed major surface of the respective belt 13 which passes over them. No strain is exerted upon the sealing arrangement per se.

As shown in FIG. 2, and also in FIG. 1, the evacuable containers 15–20 each have an open side facing the surface S to be treated. They may be of very different cross-sectional configurations, for instance in the illustrated embodiment they are of trapezoidal cross-section. Strips 22 of rubber or synthetic plastic elastomeric material connect the adjacent containers to one another, that is the container 15 to the container 16, the container 16 to the container 17, and so on, so that the adjacent containers are articulately secured to one another. In the illustrated embodiment (compare FIG. 1) the containers 15, 16, 17, 18 and 19 are each provided with shafts 23 which extend transversely to the elongation of the apparatus, that is transversely to the direction of movement of the apparatus. At the opposite end portions of these shafts 23, which extend laterally beyond the respective containers, the shafts 23 turnably carry supporting plates 24 which in turn are provided with supporting rollers 25. The upper and lower stringer of each belt 13 are supported by the rollers 25 and the latter press the lower stringer 13*a* against the surface S which is to be treated. Thus, the endless belt 13 together with the cylinders 6 and 7 constitute a sealing frame which assures that the containers 15–20—once evacuated—can be maintained in evacuated condition. With respect to the shaft 23 it is emphasized that while these extend across the entire width and laterally beyond the respective containers 15–19, it is also possible to provide only short shaft sections extending laterally from opposite sides of the respective containers, and also to modify the roller arrangement by providing the supporting plates 24 with more than two supporting rollers.

FIG. 2 shows that a plurality of evacuating conduits 26, 27, 28, 29, 30 and 31 are each associated with one of the containers 15–20. All of the conduits 26–31 communicate with an exhaust conduit 32 which, in the illustrated embodiment, is composed of a plurality of elastic—for example of corrugated—conduit sections or hose sections each of which has its opposite ends fluid-tightly connected with a tubular connector whose interior not only communicates with the respectively associated sections, but also with the interior of the respective conduits 26–31, or rather with the interior of that particular one of the conduits with which it is associated. The tubular connectors are identified with reference numerals 33, 34, 35, 36, 37 and 38 respectively and, as shown in FIG. 2, each communicates with one of the conduits 26–31.

Because the sections of the exhaust conduit 32 are flexible and elastic they permit adjustment of the positions of the containers 15–20, and FIG. 2 shows that one such possibility resides in the provision of a pair of cylinder-and-piston arrangements 39 and 40, preferably of the double-acting type, of which the arrangement 39 is associated with the containers 15 and 16 and the arrangement 40 is associated with the containers 19 and 20. These arrangements 39 and 40 permit selection of the direction of movement of the apparatus during its operation.

As further shown in FIG. 2, a curved connecting portion 42 connects the terminal section of the exhaust conduit 32 with an injector nozzle 43 to which water or another liquid is supplied under high pressure through the inlet 44 in the direction of the arrow. This arrangement operates on well-known ejector principle in that the stream of water under pressure which passes through the nozzle 43 creates a suction, aspirating air from the interior of the containers 15–20 and evacuating the same.

FIG. 1 shows that the containers 15–20 may be provided in their interior with drying means alone, with an applicator device in conjunction with drying means or, and this is not particularly illustrated, with an applicator device by itself. In the illustrated embodiment, the container 15 which is closest to the cleaning device 1, is provided only with a drying device 45 in form of an infrared radiator or the like. Analogously, but not shown in FIG. 1, the container 20 which is directly adjacent to the cylinder 7, is provided with a similar drying device. The container 16, which is arranged subsequent to the container 15, that is which is downstream of the container 15 if the apparatus in FIG. 1 moves towards the left, is provided with a similar drying device 46 and additionally with an applicator device 47 for applying the coating material to the surface A. The construction of the devices 45 and 46, as well as of the applicator device 47, may be entirely conventional and is well known to those skilled in the art. Again, the container

17 is provided with a drying device 48 analogous to the devices 45 and 46. Container 18 is provided with a drying device (not illustrated) similar to the one in container 17, and container 19 is outfitted in the same manner as container 16, namely with a drying device similar to the one identified with reference numeral 46 in FIG. 1, and with an applicator device similar to the one identified with reference numeral 47 in FIG. 1. It must be kept in mind that in the illustrated embodiment the apparatus is intended to be capable of performing its intended function with equal facility regardless of whether it moves towards the left-hand in FIG. 1, or towards the right-hand side. For this reason it is essentially a mirror-symmetrical construction.

Of course, the illustrated device is exemplary only and it is possible, for example, to utilize only a single or two of the containers. For instance, if only a single container is used then it may contain the device 46 and 47 shown in conjunction with the container 16 in FIG. 1. Also, if two containers are used, then the leading one which is directly adjacent to the respective sealing cylinder 6 or 7, may be either outfitted in the same manner as the container 15, that is with the drier 45, whereas the next one may be outfitted in the same manner as the container 16 in FIG. 1, while the leading container may be outfitted analogously to container 16 in FIG. 1 and the trailing one or next following one may be outfitted in the same manner as the container 17 in FIG. 1.

In any case, the construction according to the present invention, as well as the method according to the invention, are characterized by great versatility, and by the fact that they are capable of treating large surface areas rapidly and thoroughly, particularly with respect to the application of the protective coating.

In use, the apparatus according to the invention will be lifted in suitable manner so that it will be juxtaposed with the surface to be treated. For instance, a crane or other lifting device can be utilized, and this may be located on the structure having the surface which is to be treated, or it may be located spaced from the structure, for instance on a dock if the structure is a ship. Other possibilities include the use of holding magnets which are tiltably mounted and whose contacting of the surface to be treated—and current supply if they are electromagnets—can be controlled in dependence upon pressure conditions in the sense that the magnets are caused to grip the surface to be treated in the event that the vacuum in the various containers should collapse and in order under such circumstances to prevent the apparatus from falling off the surface S.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for treating continuous surfaces, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. An apparatus for treating continuous surfaces, comprising first means movable over a surface to be treated and operative for establishing an evacuated volume of space contiguous with respective surface portions of said surface; second means adjacent to said first means but outside said space, said second means being operative for subjecting a surface portion to a cleaning treatment preliminary to establishment of said evacuated volume of space contiguous to the thus freshly-cleaned surface portion; and additional means located at least in part in said volume of space and operative for applying a protective coating to the respective freshly-cleaned surface portion with which said volume of space is contiguous.

2. An apparatus as defined in claim 1, wherein said second means comprises at least one cleaning device.

3. An apparatus as defined in claim 2, wherein said first means comprises at least one evacuable container having an open side arranged to be fluid-tightly juxtaposed with the respective freshly cleaned surface portion.

4. An apparatus as defined in claim 3, wherein said cleaning device is secured to and carried by said container.

5. An apparatus as defined in claim 3, wherein said additional means comprises an applicator device arranged in said container.

6. An apparatus as defined in claim 5; and further comprising drying means operative for drying the applied protective coating.

7. An apparatus as defined in claim 6, wherein said drying means comprises a drying device also arranged in said container.

8. An apparatus as defined in claim 6; further comprising an additional evacuable container similar but arranged subsequent to the first-mentioned one; and wherein said drying means comprises a drying device arranged in said additional container and operative for drying the applied protective coating when the open side of said additional container is juxtaposed with the coated surface portion.

9. An apparatus as defined in claim 6; further comprising an additional evacuable container similar to but preceding the first-mentioned one; and wherein said drying means comprises a first drying device arranged in said additional container, and a second drying device arranged in the first-mentioned container together with said applicator device.

10. An apparatus as defined in claim 3, said cleaning device and container being movable in a predetermined path along the surface, and said container having a leading end and a trailing end; and further comprising a pair of rotatable sealing cylinders extending transversely of said path and beyond said container and being respectively arranged downstream of said leading end and upstream of said trailing end, and a pair of endless belts each located laterally beyond said container in parallelism with said path and trained around said cylinders, said cylinders and one stringer of each of said belts being arranged to fluid-tightly engage said surface.

11. An apparatus as defined in claim 10; further comprising a plurality of rollers respectively associated with said cylinders and one of said belts, with the latter being trained around the associated reversing rollers.

12. An apparatus as defined in claim 11; further comprising drive means operatively associated both

with said cylinders and with said rollers for rotating the same.

13. An apparatus as defined in claim 12; and further comprising cooperating positioning means provided on said rollers and said belts for positioning and maintaining each belt in predetermined relationship relative to the associated rollers.

14. An apparatus as defined in claim 10; and further comprising sealing means provided on said container and operative for preventing the entry of fluid from exteriorly of said container in cooperation with said one stringer of each of said belts.

15. An apparatus as defined in claim 10; and further comprising support means operatively associated with said belts and including shaft means provided on said container and projecting to opposite lateral sides thereof transversely to said path, supporting rollers mounted on said shaft means, and supporting plates extending laterally of said belts in the direction of said path and engaging and supporting said belts.

16. An apparatus as defined in claim 3, said first means comprising at least one additional container similar to the first-mentioned container; said additional means comprising at least one drying device and at least one applicator device for said protective coating, arranged in said additional container; and further comprising adjusting means associated with said containers and operative for adjusting the position of said containers relative to one another.

17. An apparatus as defined in claim 16, said adjusting means comprising at least one double-acting piston-and-cylinder arrangement.

18. An apparatus as defined in claim 3; and further comprising evacuating means associated with and operative for evacuating said container.

19. An apparatus as defined in claim 18, wherein said evacuating means comprises ejector pump means operative for evacuating the interior of said container in response to development of a suction head resulting from passage of a stream of water under pressure through said pump means.

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