

SURFACE TREATMENT APPARATUS

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5 This invention relates to a surface treatment apparatus and, more particularly to a surface treatment apparatus having painting or sanding means movable over a wide surface area for painting or sanding the exterior surface of a ship hull or the like.

10 Conventionally, painting of the shell surface of a ship hull or the like is carried out by the operator manipulating a rod-like painter gun on a movable foothold. The problem here is that since the shell surface of a hull covers a wide area, painting by the operator is time-consuming and uneconomical.

15 An automatic painting apparatus is known which includes an elongate support, a chain trained around the support over the entire length thereof through sprockets, drive means for reciprocating the chain, and a painter gun mounted in a specified position on the chain. Such apparatus has a difficulty in that if the entire shell surface of a ship hull is to be painted, the length of the support should be the same as the height of the hull, which fact requires the apparatus to be of a large size, thus involving considerable disadvantage in respect of materials cost and maneuverability.

25 It is an object of this invention to provide a surface treatment apparatus which is small in size and easy

to operate but which yet assure an overall surface treatment of a large structure.

The present invention provides a surface treatment apparatus comprising a first support, a second support
5 movably disposed in parallel to the first support and movably carrying a surface treating tool, first engaging track means fixedly mounted to the first support, second
engaging track means fixedly mounted to the second support in parallel to the first engaging track means, engaging
10 wheel means disposed between the two engaging track means in engagement therewith without any slide, drive means moving the engaging wheel means along the first engaging track means to move the second support relative to the
engaging wheel means through the second engaging track
15 means, and transmitting means for converting the movement of the second support relative to the engaging wheel to an identical movement, in terms of distance and direction, of the tool relative to the second support.

In this specification the terms "engaging track means"
20 and "engaging wheel means", are defined as, respectively, an elongate track element and a rotatable element, which elements are in non-slidable interengagement.

According to the above arrangement, since the range of movement of the surface treating tool relative to the
25 first support can be at least three times as great as that of the engaging wheel means relative to the first support, the length of both the first and second supports can be reduced to $1/3$ the height of a structure to which the apparatus is applied. It is thus possible to provide

a surface treatment apparatus which is compact and has improved maneuverability.

According to a preferred embodiment of the invention, the first support is composed of a channel section member and the second support is movably supported in the channel of the first support. This permits the apparatus to be made compact not only lengthwise, but in bulk as well.

According to another embodiment of the invention, the engaging wheel means consists of at least one set of two engaging wheels having different radii and integrally rotatable, of which the smaller is in engagement with the first engaging track means and the larger is in engagement with the second engaging track means. By virtue of this arrangement a smaller displacement of the engaging wheel means can produce a larger displacement of the surface treating tool.

Numerous features and advantages of the invention will be readily understood from the following description of embodiments given with reference to the accompanying drawings, in which:

Fig. 1 is a front view of a surface treatment apparatus representing a first embodiment of the invention;

Fig. 2 is a side view of the same;

Fig. 3 is a sectional view taken on line I-I in Fig. 1;

Fig. 4 is an enlarged front view of the first embodiment showing a

floating body;

Fig. 5 is a side elevation of the same;

Figs. 6a to 6c, inclusive, are views showing the operating principle of the invention;

5 Fig. 7 is a side view of a surface treatment apparatus representing a second embodiment of the invention;

Fig. 8 is a section taken on line II - II in Fig. 7; and

10 Fig. 9 is a schematic view of a surface treatment apparatus according to a third embodiment of the invention.

Throughout the drawings like parts are referred to by like reference numerals.

15 Referring to Figs. 1 through 5, in which a first embodiment of the invention is shown, numeral 1 designates a first support composed of a channel section member having a web 1a and side walls 1b, and numeral 2 represents a second support composed of a channel section member having
20 a web 2a and side walls 2b, the second support 2 being disposed in the channel of the first support 1 so that its web 2a is opposed to the web 1a of the first support 1. A pair of first parallel engaging tracks 3 (e.g. chains or racks) are fixedly mounted on the web 1a of the first
25 support 1 longitudinally thereof. On the web 2a of the second support 2 there are fixedly mounted a pair of second engaging tracks 4 (e.g. chains or racks) in opposed

relation to the first engaging tracks 3. Between the two webs 1a and 1b there is provided a floating body 5 in which a pair of rotary shafts 6 are rotatably supported through bearings 7. Engaging wheels 8 (e.g. sprockets or gears) which engage the first and the second pairs of engaging tracks 3 and 4 respectively are fixedly mounted on each rotary shaft 6 at both ends thereof.

The floating body 5 is reciprocated by drive means 9 longitudinally of the supports 1 and 2. More specifically, the floating body 5, being mounted to an endless chain 10 encircling the first support 1 longitudinally thereof and reeved around a suitable number of guide sprockets 11, is moved up and down as the chain 10 is fed by means of drive sprockets 12 connected to a power source such as a hydraulic motor or the like. The floating body 5 is also interlocked with transmitting means 13. That is, the floating body 5 is attached to an endless chain 14 encircling the second support 2 longitudinally thereof and trained around guide sprockets 15 located at the upper and lower ends thereof. A surface treating tool 16 such as a painter gun or abrasive tool is attached to the chain 14 on the side of the second support 2 opposite the floating body 5. Shown at 17 are guide rollers attached to the floating body at both sides thereof.

The first and second supports 1 and 2 are spaced from and rendered longitudinally movable relative to each

other by means of a suitable number of guide rollers 18 mounted on both supports 1 and 2. The relative positions of the first and second engaging tracks 3 and 4 are also regulated by these guide rollers 18.

5 The manner of operation of the apparatus, in the case of painting the shell surface of a ship hull, for example, will now be explained with reference to Figs. 6a to 6c, inclusive. As illustrated in Fig. 6a, the surface treatment apparatus described above is usually
10 tiltably mounted to the front end of a carriage 20 movable on a fixed base 19 along the shell surface of a ship hull, i.e., longitudinally of the ship. The first support 1 is supported at the center thereof on the carriage 20 through rotation drive means 21 (e.g. stepping motor). At an initial
15 stage, the first support 1 is centrally positioned on the shell vertically thereof with the second support 2 held in the same position as the first support 1. The floating body 5 and surface treating tool 16 (painter gun) are centrally positioned on the supports 1 and 2 respectively.
20 If the drive sprockets 12 are actuated by a hydraulic motor to move the floating body 5 upwardly, for example, by a distance ℓ as Fig. 6b shows, then the second support 2 is caused to move upward by a distance ℓ relative to the floating body 5. This means that the second support 2 moves
25 upward by 2ℓ from its original position. The surface treating tool 16 moves upward by ℓ relative to the second support 2. By this is meant that the tool 16 moves 3ℓ upward from its

original position. In other words, if the floating body 5 is moved upward from its initial position by a distance l along the first support 1, the surface treating tool 16 is allowed to move three times that distance or $3l$ from its initial position. Assuming the length of the supports 1 and 2 is L (the length of the engaging tracks 3 and 4 is also L), if the floating body 5 is moved over the full length of the first support 1, the resulting height available for painting work is $3L$, as illustrated in Fig. 6c. It follows that the required length of the supports 1 and 2 is about one third the required height for painting operation.

The second embodiment shown in Figs. 7 and 8 is substantially the same in overall configuration and function as the above described first embodiment, though there are minor differences in constructional details. More specifically, a second support 2 is constructed in the form of a thick plate having side projections 2c which are supported via sliding members 23 in channel section members 22 fixed to the side walls 1b of a channel shaped first support 1 at the opening thereof, so that the first and second supports 1 and 2 are spaced from and longitudinally movable relative to each other. A second engaging track 4 is fixedly mounted on a surface 2d of the second support 2 opposed to a first engaging track 3 fixed to the web 1a of the first support 1. Between the two engaging tracks 3 and 4 there is disposed a floating shaft 5 on which an engaging wheel 8 in engagement with the two engaging tracks 3 and 4

without any slide is rotatably supported through bearings 7. Both ends 5a of the floating shaft 5 are slidably guided on a pair of guide rods 24 extending within the first support 1 in parallel thereto.

5 The manner of operation of the apparatus according to this embodiment is exactly the same as that of the first embodiment, and therefore explanation thereof is omitted to avoid duplication.

10 The third embodiment schematically shown in Fig. 9 is the same in overall configuration as the preceding embodiments, but has a somewhat different feature in that it is provided with a composite engaging wheel comprising a smaller engaging wheel 8a and a larger engaging wheel 8b rotatable integrally therewith. The engaging
15 wheels 8a and 8b both are fixedly mounted on a rotary shaft 6 rotatably mounted on a floating body 5, the smaller wheel 8a being in engagement with a first engaging track 3 only and the larger one in engagement with a second engaging track 4 only. Shown at numeral 12 is a cylinder means
20 for reciprocating the floating body.

 In the present instance, the relation between the distance of movement D_f of the floating body 5 from the initial position thereof and the distance of movement D_t of the surface treating tool 16 from the initial position
25 thereof is represented by the following equation.

$$D_t = D_f + \frac{R_2}{R_1} D_t + \frac{R_2}{R_1} D_t$$

where, R_1 : radius of smaller wheel

R_2 : radius of larger wheel

Assuming that the smaller wheel 8a and larger wheel 8b both
5 consist of gears or sprockets having the same module and
their respective numbers of teeth are Z_1 and Z_2 , $\frac{R_2}{R_1}$ in
the above equation may be replaced by $\frac{Z_2}{Z_1}$.

Although the composite engaging wheel 8 is
fixedly mounted on the rotary shaft 6 of the floating body
10 5 in this embodiment, it may be rotatably mounted on such
a floating shaft as shown in the second embodiment. Further
as in the case of the first embodiment, a pair of composite
engaging wheels may be fixedly mounted on each of a plurality
of rotary shafts which may be rotatably mounted on a floating
15 body. In such a case there should naturally be provided a
pair of first engaging tracks and a pair of second engaging
tracks.

The three embodiments described above in no way
exclude one another, but may be combined in various ways.
20 It is to be understood, therefore, that the scope of the
present invention is determined by the appended claims
only.

Claims

1. A surface treatment apparatus comprising
a first support, a second support movably disposed in
parallel to the first support and movably carrying a
5 surface treating tool, first engaging track means ^(as hereinbefore defined) [fixedly
mounted to the first support, second engaging track means
fixedly mounted to the second support in parallel to the
first engaging track means, engaging wheel means ^(as hereinbefore defined) [disposed
between the two engaging track means in engagement there-
10 with without any slide, drive means for moving the
engaging wheel means along the first engaging track means
to move the second support relative to the engaging wheel
means through the second engaging track means, and trans-
mitting means for converting the movement of the second
15 support relative to the engaging wheel means to an
identical movement, in terms of distance and direction,
of the tool relative to the second support.

2. An apparatus as defined in claim 1, wherein
said drive means includes a loop extending around the
first support in parallel to the first engaging track
means and incorporating the engaging wheel means, and a
5 motor for reciprocating the loop around the first support.

3. An apparatus as defined in claim 1 or 2,
wherein said transmitting means includes a loop extending
around the second support in parallel to the second engaging
track means and incorporating, on opposite sides of the
5 second support respectively, the engaging wheel means and
the surface treating tool.



4. An apparatus as defined in claim 3, wherein said loop includes a chain trained around sprockets rotatably mounted to both ends of the second support.

5. An apparatus as defined in claim 1, wherein said first support consists of a channel section member, and said second support is longitudinally movably guided in the channel of the channel section member.

6. An apparatus as defined in claim 5, wherein the second support is spaced from and rendered movable in the first support by means of a plurality of guide rollers mounted on the first support and/or the second support.

7. An apparatus as defined in claim 5, wherein the second support is spaced from and rendered movable in the first support by a plurality of sliding members arranged between said two supports.

8. An apparatus as defined in claim 5, wherein the second support consists of a channel section member arranged in the channel of the first support so that the webs of both supports are opposed to each other, and the
5 first and second engaging track means are fixed to the webs of the first and second supports respectively.

9. An apparatus as defined in claim 1, wherein said engaging wheel means includes at least one engaging wheel fixedly mounted on at least one shaft rotatably mounted to a floating body which is movably guided along
5 the two engaging track means between the two supports.



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10. An apparatus as defined in claim 1, wherein said engaging wheel means includes at least one engaging wheel rotatably mounted on a floating shaft slidably mounted on a pair of guide rods extending in parallel to
5 the two engaging track means.

11. An apparatus as defined in claim 1, wherein the first and second engaging track means each comprise a pair of engaging tracks engaged by at least a pair of engaging wheels constituting said engaging wheel means.

12. An apparatus as defined in claim 1, wherein said engaging wheel means comprises at least two engaging wheels having different radii and integrally rotatable, of which the smaller wheel is in engagement with the first
5 engaging track means and the larger wheel is in engagement with the second engaging track means.

13. A surface treatment apparatus substantially as described herein with reference to, and as illustrated in, Figures 1 to 6a, b and c, or these Figures as modified by Figures 7 and 8, or Figure 9 of the accompanying drawings.



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