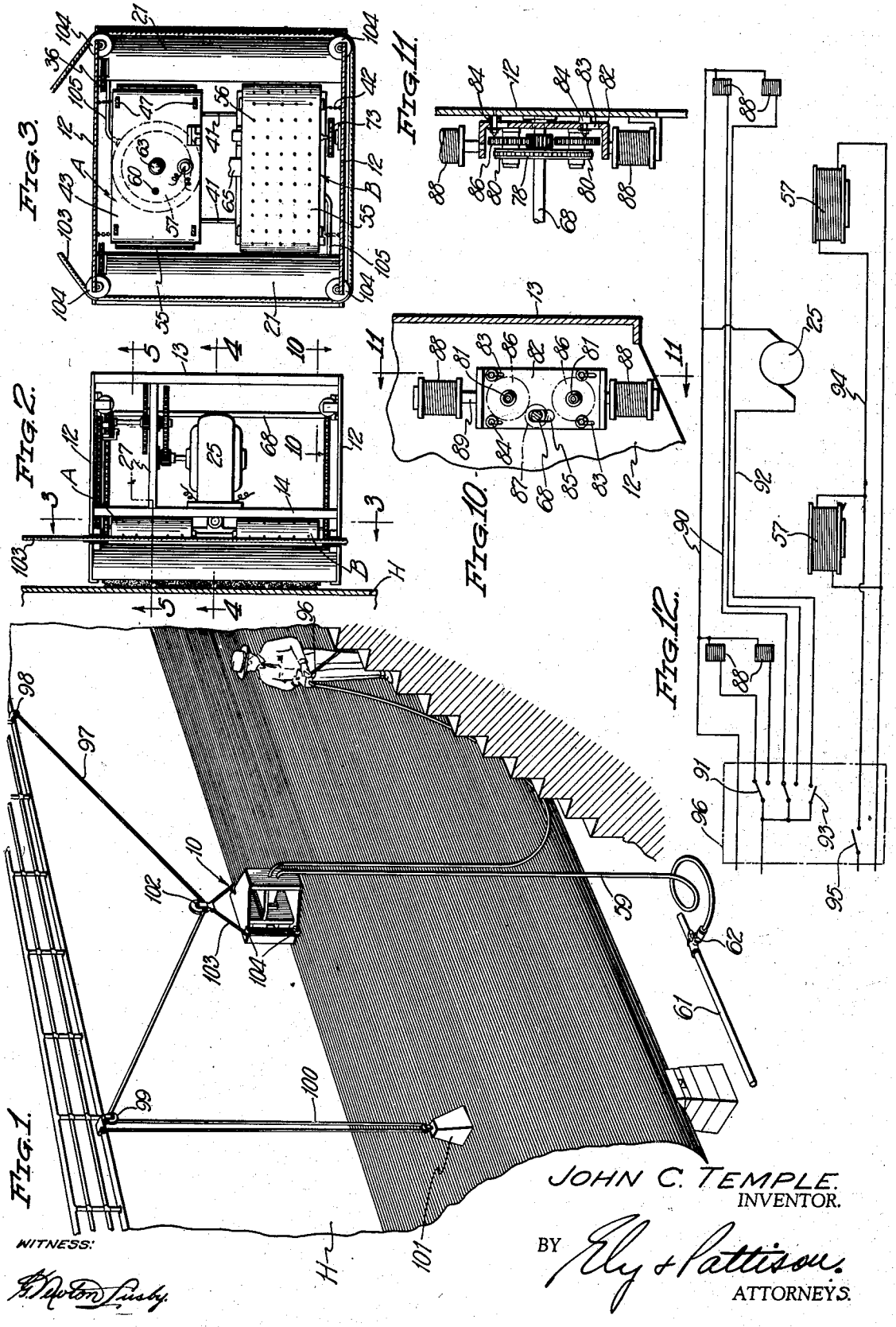
May 24, 1938. J. C. TEMPLE 2,118,276

SURFACING MACHINE

Filed Jan. 29, 1936 3 Sheets-Sheet 1



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SURFACING MACHINE

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FIG. 4.

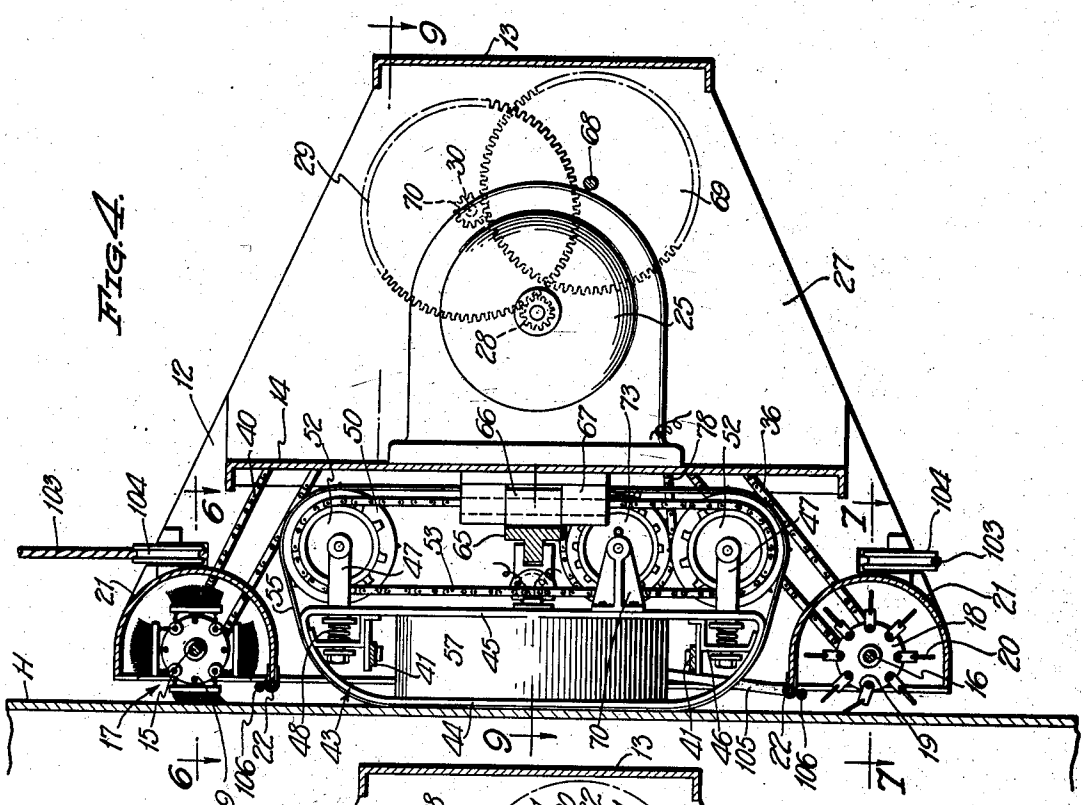
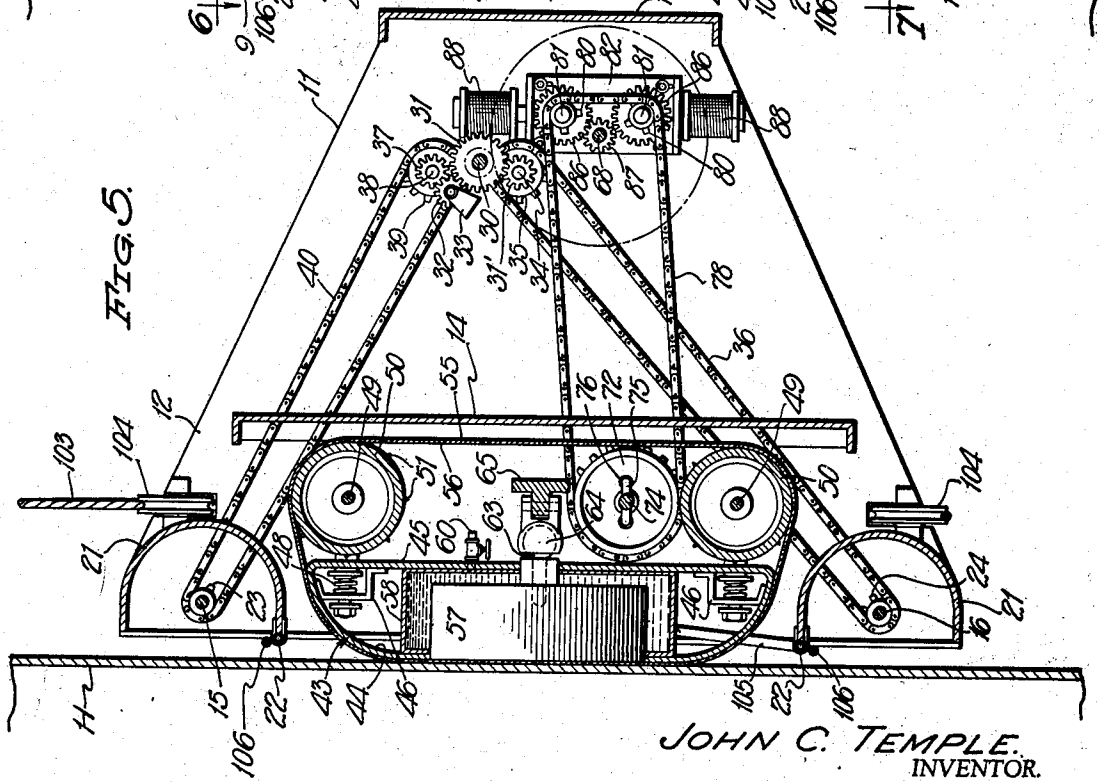


FIG. 5.



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SURFACING MACHINE

Filed Jan. 29, 1936 3 Sheets-Sheet 3

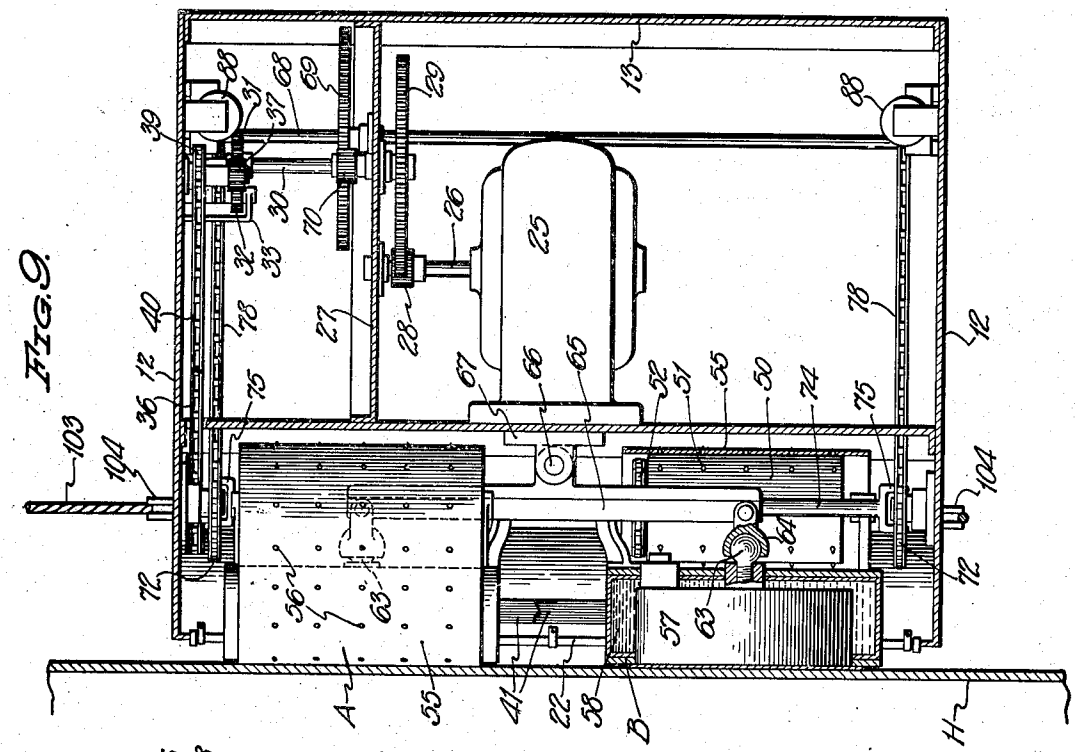

FIG. 9.

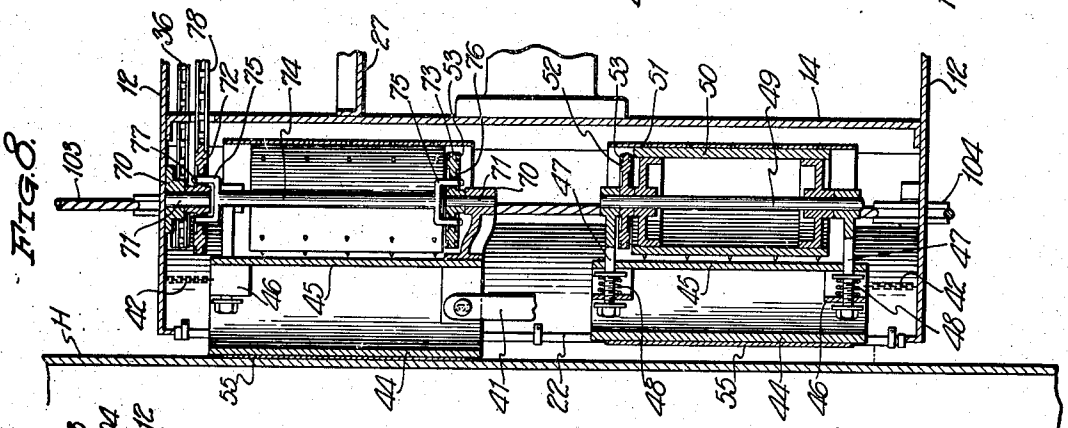

FIG. 8.

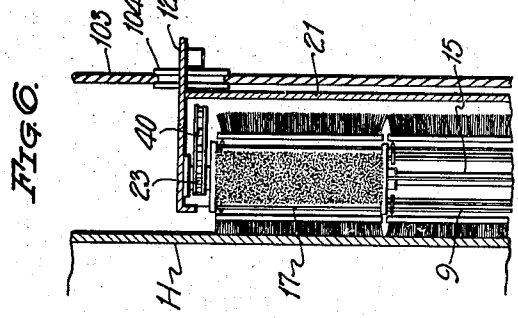

FIG. 6.

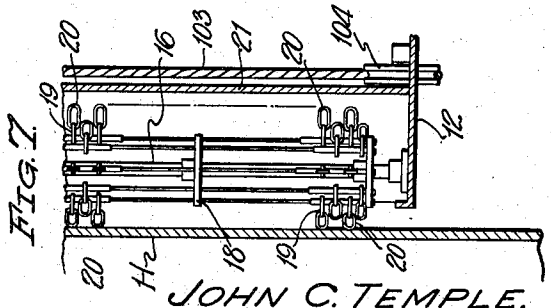

FIG. 7.

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UNITED STATES PATENT OFFICE

2,118,276

SURFACING MACHINE

John C. Temple, New York, N. Y.

Application January 29, 1936, Serial No. 61,291

12 Claims. (Cl. 114—222)

This invention relates to surfacing machines and constitutes an improvement over the surfacing machine set forth in my co-pending application Serial No. 54,186, filed December 13, 1935.

One of the main objects of this invention resides in a machine especially adapted for the cleaning of metallic surfaces, and has particular reference to such a machine for the scaling, brushing and washing and/or painting of the sides of a ship's hull.

Another feature of the invention is to provide a novel means of causing the machine to adhere to a vertical or inclined metallic work surface and for propelling and remotely controlling the machine over such surface.

A further feature of the invention is the provision of a means for accommodating the passage of the machine over the lapped joints and rivet heads of a ship's hull or the like metallic structure, while adhered thereto by an electromagnetic force.

A still further object of the invention is to provide a machine of the character above referred to in which the electromagnets for causing the machine to adhere to the metallic work surface are enclosed in a water jacket and kept cool by the passage of water through the jacket, which water is subsequently sprayed on the work surface for washing purposes.

A further feature of the invention is to provide a novel means for suspending the surfacing machine in operating position relative to a vertically disposed work surface and by which the suspended machine may be remotely controlled to turn the same to a position to move vertically or horizontally over a surface to be worked upon.

With these and other objects in view, the invention resides in the certain novel construction, combination and arrangement of parts, the essential features of which are hereinafter fully described, are particularly pointed out in the appended claims, and are illustrated in the accompanying drawings, in which:

Figure 1 is a perspective view of my improved surfacing machine in use upon a ship's hull.

Figure 2 is a vertical sectional view on the machine.

Figure 3 is a vertical sectional view on the line 3—3 of Figure 2.

Figure 4 is a horizontal sectional view on the line 4—4 of Figure 2.

Figure 5 is a horizontal sectional view on the line 5—5 of Figure 2.

Figure 6 is a detail horizontal sectional view on the line 5—5 of Figure 6.

Figure 7 is a detail horizontal sectional view on the line 7—7 of Figure 4.

Figure 8 is a fragmentary vertical sectional view taken on two different planes.

Figure 9 is a vertical sectional view on the line 9—9 of Figure 4.

Figure 10 is a sectional elevational view of the electrically operated gear shift mechanism.

Figure 11 is a detail vertical sectional view on the line 11—11 of Figure 10.

Figure 12 is a diagrammatic view of the electric control circuits.

Referring to the drawings by reference characters, the numeral 10 designates my improved metallic surfacing machine in its entirety which in rear end elevation appears square or rectangular and includes a frame 11 composed of spaced parallel side walls 12—12 and a connecting rear end wall 13. Bridging the side walls 12—12 inwardly of the front end of the frame and disposed parallel with respect to the rear end wall 13, is a cross wall or partition 14. Bridging the side walls 12—12 and journaled therein are driven shafts 15 and 16, the same being in spaced alinement adjacent the front open sides of the frame structure. Mounted on the shaft 15 is a rotary brush element 17, consisting of a multiple of independent brushes flexibly connected to a carrying frame 9 and extending radially therefrom. During rotation of the shaft 15, the brushes are thrown outwardly by centrifugal force into wiping contact with the surface being cleaned or painted. Mounted on the shaft 16, is a surface scaling element 18, the same consisting of a frame 19 carrying a number of radially extending chain links 20 which are thrown outwardly by centrifugal force during rotation of the shaft 16 for striking contact with the metallic surface to be scaled and cleaned. By reason of the flexible nature of the brush element 17 and scaling element 18, the said elements may pass over any irregularities which may be present on the surface being worked upon. Surrounding the inner sides of the rotary elements 17 and 18 are semi-circular shaped shields 21 which bridge opposite side walls 12—12 and are supported thereby. The inner edges of the shields 21 support water spray pipes 22 through which water is adapted to pass for spraying upon the metallic surface to be cleaned. Fixedly secured to the shafts 15 and 16 at one of their ends, are small sprocket wheels 23 and 24 respectively.

Fixedly supported by the cross partition wall 14 is an electric motor 25, the armature shaft 26 thereof being disposed parallel to the shafts 15 and 16. The end of the motor shaft 26 is

journaled in bearings supported by a partition wall 27 which bridges the space between the rear end wall 13 and the partition wall 14, the said wall 27 being disposed parallel to the side walls 12 as best seen in Figure 9 of the drawings. The drive shaft 26 carries a driving pinion 28 which is in constant mesh with a large gear 29 fixed to one end of a counter shaft 30, the said shaft 30 having its bearing in the partition 27 and the adjacent end wall 12. Also fixed to the counter shaft 30 is a driving gear 31 which is in constant mesh with a gear 31' and an idler gear 32. The idler gear 32 is mounted in a bearing 33 extending from the adjacent side walls 12 whereas the gear 31' is fixed to a stub shaft 34 having its bearing in the adjacent side wall 12 and which shaft also carries a sprocket wheel 35. A sprocket chain 36 passes over the sprocket wheel 35 and over the smaller sprocket wheel 24 for the purpose of imparting rotation to the scaling element 18 from the drive shaft 30. The idler gear 32 is in mesh with a gear 37 fixed to a stub shaft 38 having its bearing supported by the adjacent side wall 12, and also fixed to the stub shaft 38 is a sprocket wheel 39. A sprocket chain 40 passes over the sprocket wheel 39 and over the sprocket wheel 23 whereby rotation may be imparted to the brush element 17 by power from the shaft 30. By the system of gearing hereinbefore described, the sprocket chains 36 and 40 will impart rotation to the shafts 16 and 15, respectively, to rotate the rotary cleaning elements 18 and 17 in opposite directions. The direction of rotation of the cleaning elements is at all times outwardly so as to throw any particles scraped or brushed from the metallic surface outwardly of the machine rather than inwardly thereof.

Flexibly supported at the open front of the frame 11 is a pair of electromagnetic traction units A and B, the same being disposed in spaced parallel relation, the inner adjacent ends of the units being joined by links 41 whereas the outer ends of the units are connected to adjacent side walls 12 by short lengths of chain 42. These flexible connections are connected to a part of each unit which is stationary so as not to interfere with the mechanical operation thereof. These flexible connections maintain operating alinement but permit of the relative inward and outward movement of traction units relative to each other to enable the units to adjust themselves to uneven metallic surfaces, such as the lapped plates of a ship's hull or the passing of the units over rivets which are employed for securing the metallic plates together. The flexible connection between the traction units A and B include additional supporting means which will presently be explained.

In view of the fact that both of the traction units A and B are of identical construction, a description of one will suffice for the other. Each traction unit includes an elongated frame 43 comprising an outer guide shoe 44 and a flat inner wall 45. The brackets 46 which are fixed to the frame 43 at opposite ends coact with the inner wall 45 for yieldably supporting pairs of bearing arms 47, while springs 48 act to normally force the bearing arms 47 inwardly, there being suitable stops for limiting the movement of the bearing arms in opposite directions. Journaled in the sets of bearing arms 47 are alined shafts 49 and fixed to the shafts are rollers 50 having radially extending teeth 51 extending from the peripheries thereof. Fixed to the inner ends of the shafts 49 are sprocket wheels 52, which sprocket wheels are joined by an endless sprocket chain 53 which passes therearound. By reason of this sprocket connection between the spaced alined shafts 49, both of said shafts will turn simultaneously in the same direction when power is imparted to the sprocket chain 53 in a manner to be presently explained.

Passing over the outer surface of the shoe guide 44 and around the rollers 50 is a flexible traction element 55, the same having openings 56 therein to receive the radially extending teeth 51 whereby the rollers 50 may impart a positive movement to the flexible traction element. The endless traction element 55 may be constructed of metal such as thin sheet metal of sufficient flexibility as to pass around the rollers 50 or the traction elements may be of a semi-metallic or non-metallic material of greater friction qualities than metal. The inner surface of the endless traction element may be lubricated to reduce friction and wear between the same and the parts over which it moves. The resilient bearing brackets 46 which connect the rollers 50 with the frame 43 tend to take up any slack which may occur in the flexible traction element and serve to hold the flexible traction element taut at all times.

Fixed to and integral with the frame 43 and extending through an opening in the guide shoe portion 44 is an electromagnet 57 having an outer front face flush with the plane of the outer face of the guide shoe 44, and is welded or secured thereto in a water tight manner. A water jacket 58 surrounds the side and back surfaces of the magnet and leading to the water jacket is a water pipe line 59 which is in the form of a flexible hose, the same connecting with a nipple 60 extending inwardly from the frame 43. By reference to Figure 1 of the drawings, it will be seen that the hose 59 connects with a water supply pipe 61 while a valve 62 is provided for regulating the flow of water from the pipe line 61 to the hose 59. The frame 43, water jacket 58, and electromagnet 57 are integrally connected together so as to be water tight and movable as a unit. Extending inwardly from this integral construction is a ball 63 forming one part of a ball and socket joint, the ball being seated in a socket member 64, which socket member is pivotally connected to one end of a rocker arm 65. The ends of the rocker arm 65 are connected with the respective units A and B, while the mid-portion of the rocker arm is pivoted as at 66 to a bracket 67 fixedly secured to the partition wall 14. The rocker arm constitutes a support and coacts with the flexible connections hereinbefore mentioned to permit relative movement between the traction units A and B.

Each traction unit is driven from a common source of power produced by the motor 25 by providing a drive shaft 68 which is journaled in bearings in the opposite side walls 12. Fixed to the shaft 68 is a large gear 69 which meshes with a smaller gear 70 fixed to the countershaft 30. It will thus be seen that power may be transmitted from the motor 25 through the meshing gears 28, shaft 30, and thence through the meshing gears 70 and 69. Whereas the shaft 68 is driven by the motor in one direction only, means is provided whereby power may be transmitted therefrom to the respective traction units A and B to cause said traction units to move in the same direction, or in opposite directions. Each traction unit is provided with an individual reversible power transmission mechanism and a description

of one such mechanism will suffice for the other.

Mounted in a pair of alined bearings 70, are stub shafts 71. One of the bearings 70 is fixedly supported by an end wall 12 while the other bearing is supported by the inner wall 45 of the frame 43. Fixed to the stub shaft 71 which has its bearing attached to the end wall 12, is a sprocket wheel 72, while fixed to the other stub shaft 71 is a sprocket wheel 73. This sprocket wheel 73 engages the sprocket chain 53 and constitutes the driving sprocket for the said chain 53. A connecting shaft 74 disposed in axial alinement with the stub shafts 71 has its opposite ends provided with forks 75 which pass through slots 76 in the respective sprocket wheels 72 and 73. Pins 77 pass transversely through the outer ends of the forks for securing the forked ends of the respective sprocket wheels and in view of the fact that the openings 76 are larger than the arms of the forked ends, the shaft 74 may have a slight relative movement with respect to the sprockets and forms a flexible drive connection which is necessary in view of the fact that the traction units A and B have yielding movement relative to the side walls 12 and to each other. A sprocket driven chain 78 passes over the sprocket wheel 72 to impart rotation to the shaft 74, which rotation is imparted to the sprocket 73 for the purpose of driving the chain 53. The sprocket chain 78 also passes around a pair of alined sprocket wheels 80, which sprocket wheels are spaced and are mounted in alinement upon stub shafts 81, the said stub shafts extending outwardly from a gear shifting frame 82. The frame 82 is mounted for a limited sliding movement and is provided with elongated slots 83 through which the shanks of headed studs 84 pass, the said studs extending inwardly from a supporting end wall 12. The frame 82 is provided with an elongated slot 85 for the passage of the common drive shaft 68. Also fixed to the stub shafts 81 are gear wheels 86 either of which may be operatively brought into mesh with the drive gear 87 fixed to the drive shaft 68 by reason of the sliding action which may be imparted to the frame 82. For the purpose of sliding the frame 82 to move a selected gear 86 into mesh with the driving gear 87, a pair of solenoids 88 are provided. The cores 89 of the solenoids are connected to opposite ends of the frame 82. By energizing only one of the solenoids 88, the plate may be shifted in one direction to cause one of the gears 86 to mesh with the gear 87 and by energizing the other solenoid 88, the frame 82 may be shifted to bring the other gear 86 into meshing engagement with the driving gear 87. By this shifting action the chains 78 may be driven in either direction for controlling the direction of travel of the flexible traction element 55.

For selectively controlling the energizing of the solenoids 88, four separate solenoid circuits are necessary, each being designated 90. Switches 91 are provided for closing the solenoid circuits 90. These circuits are shown in Figure 12 together with a motor circuit 92 controlled by a switch 93. Electromagnets 57 of the two traction units A and B are arranged in a single circuit 94 controlled by a switch 95. For convenience, the switches 91, 93, and 95 may be mounted within a box 96 which may be held in the hand of an operator to control the several circuits during operation of the machine and as illustrated in Figure 1 of the drawings.

Bearing in mind that the driving mechanism of the two traction units A and B may be operated in the same direction or in reverse directions permits travel of the machine back and forth without turning or by operating one traction unit in one direction and the other in a reverse direction, the same work against each other when in contact with a metallic surface to be cleaned, thus tending to cause the machine to turn around without traveling in any particular straight away direction. I make use of this action for changing the direction of travel of the machine as will be presently explained.

In Figure 1 of the drawings, I have illustrated the invention in use upon a ship's hull H, usually constructed of metal lapping plates, although this detail has not been shown in Figure 1. For suspending the machine 10 in operative position against the side of the hull H, I provide a suspension loop, formed by anchoring one end of a cable 97 to the bulwark of the ship as at 98, the cable 97 passes over a pulley 99 also connected to the bulwark of the ship, and the remaining portion of the free end of the cable is looped and secured to provide a counterbalance weight loop 100, from which a counterbalance weight 101 is suspended. Slidable over the cable 97 between the anchorage 98 and the pulley 99, is a trolley 102, which trolley supports a depending sling or loop 103 which passes over grooved pulleys 104 which are rotatably mounted in the four corners of the frame structure 11. The grooved rollers 104 are all mounted in the same plane, and are so located that they are disposed at one side of the plane of the center of balance of the machine so that the overbalance thereof will cause the traction units A and B to operatively contact the surface being worked upon, at which time the rotary cleaning elements 17 and 18 will be disposed in operative contact with such surface. By driving the traction units A and B in the same direction, the machine will be caused to move straight along the surface being worked upon. In Figure 1 of the drawings, the machine is moving horizontally along the side of the ship's hull H, but should an occasion arise where it is desired to turn the machine to a position at right angles to that shown, one of the traction elements may be operated reverse to the other, causing the machine 10 to turn in the suspending sling 103.

During operation of the machine, the magnetic force set up by the electromagnet 57 of the two traction units tends to cause the machine to adhere to the sides of the metallic surface being worked upon and is spaced therefrom by the endless flexible element 56. As before mentioned, the element 56 is driven and constitutes a propeller for each traction unit.

Water from the water jacket 58 is carried to the spray pipes 22 by connecting pipes 105, thus the water after being used for cooling the magnets 57 is utilized for surface washing purposes, for it is sprayed from the pipes 22 onto the surface being cleaned.

Whereas I have shown in the drawings, rotary elements 17 and 18 for brushing and scaling a metallic surface, the said elements may be interchangeable and the machine equipped with two rotary brush elements similar to the brush elements 18 and the machine utilized for painting metallic surfaces. When used for painting, paint may be sprayed onto the surface from spray pipes 106 arranged adjacent and parallel to the water spray pipes 22. The pipes 106 may be connected to a source of paint supply as explained in the co-pending application hereinbefore mentioned. When the machine is to be used for painting pur-

poses, the same may be constructed with magnets of the permanent type in lieu of the electro-magnets 57 which necessitate cooling by water. It will be appreciated that it would not be desirous to spray water upon a surface during a painting operation. However, if water cooled electro-magnets 57 are used, the water from the water jackets may be piped away through an exhaust hose instead of passing to the spray pipes 22.

Although I have specifically mentioned and have shown in the drawings, the machine for use in connection with the cleaning of a ship's hull, it will be understood that other metallic structures may be scaled, cleaned, and painted by the use of this machine.

While I have shown and described what I consider to be the most practical embodiment of the invention set forth hereinbefore, I wish it to be understood that various changes of construction and in materials may be resorted to if desired, as come within the scope of the appended claims.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a machine of the class described, a chassis, a pair of spaced apart electro-magnets mounted on said chassis and having flat outer faces, a pair of driven endless flexible magnetic conductor traction elements arranged in parallel relation, one of the leads of the endless traction elements respectively passing over the outer flat faces of the electromagnets and adapted to engage a metallic surface over which the machine is adapted to travel.

2. In a machine of the class described, a pair of spaced electro-magnets having flat outer faces, means flexibly connecting said electro-magnets together for permitting relative movement therebetween, a pair of driven endless flexible traction elements arranged in parallel relation, one of the leads of the endless traction elements respectively passing over the outer flat faces of the electro-magnets.

3. In a machine of the class described, a pair of spaced electro-magnets having flat outer faces, a pair of driven endless flexible traction elements arranged in parallel relation, one of the leads of the endless traction elements respectively passing over the outer flat faces of the electro-magnets, and means for selectively controlling the movement of said driven endless flexible elements for simultaneous movements in the same direction or in reverse directions.

4. In a machine of the character described, a chassis, a pair of alined driven rollers mounted on said chassis, a guide shoe mounted on said chassis, an endless flexible traction element passing over said rollers and guide shoe and adapted to engage a metal surface over which the machine is adapted to travel, and an electro-magnet having its outer end extending through said guide shoe to expose the same to said traction element during its passage thereover.

5. In a machine of the character described, a chassis, a pair of alined driven rollers mounted on said chassis, a guide shoe mounted on said chassis, an endless flexible traction element passing over said rollers and guide shoe and adapted to engage a metal surface over which the machine is adapted to travel, an electro-magnet having its outer end extending through said guide shoe to expose the same to said traction element during its passage thereover, a cooling chamber surrounding the inner end and sides of said electro-magnet, and means for passing a cooling medium through said cooling chamber to maintain said electro-magnet in a cool condition.

6. A machine for working upon the outer surfaces of a metal ship's hull or the like comprising in combination, a frame body having rotatable work surfacing elements journaled therein, a pair of spaced electro-magnets flexibly connected together and flexibly connected to said frame body, said electro-magnets adapted to be disposed in close proximity to a metallic work surface, and a pair of flexible parallel endless driven traction propelling elements passing over the respective electro-magnets for maintaining the same in spaced relation to a metallic work surface.

7. A machine for working upon the outer surface of a metal ship's hull or the like comprising in combination, a frame body having rotatable work surfacing elements journaled therein, a pair of spaced electro-magnets flexibly connected together and flexibly connected to said frame body, said electro-magnets adapted to be disposed in close proximity to a metallic work surface, and a pair of flexible parallel endless driven traction propelling elements passing over the respective electro-magnets for maintaining the same in spaced relation to a metallic work surface, and counter-balance means for suspending the machine with the tractive lead of the endless traction propelling elements in working contact with a metallic surface to be worked upon.

8. In combination, a surfacing machine having parallel driven traction units, means for selectively controlling the direction of travel of said traction units relative to each other, means for suspending said surfacing machine with the traction units in tractive contact with a work surface and for guiding the machine over a work surface, and means on the surfacing machine and engaged by the suspending means for causing said machine to turn relative to the suspending means to change the direction of travel of the machine when the traction units are traveling in reverse direction.

9. In combination, a surfacing machine having parallel driven traction units, means for controlling the direction of travel of said traction units relative to each other, means for suspending said surfacing machine with the tractive units in tractive contact with a work surface and for guiding the machine over a work surface, and means for causing said machine to turn relative to the suspending means to change the direction of travel of the machine when the traction units are traveling in reverse directions, said last named means including sets of grooved pulley wheels on opposite sides of said surfacing machine, and a flexible loop connected to the suspending means and passing over said grooved pulley wheels.

10. In combination, a flexible suspension cable having slack therein, a trolley movable over said suspension cable, a flexible loop depending from said trolley, a surfacing machine having parallel driven traction units, means for selectively controlling the direction of travel of said traction units relative to each other, and sets of grooved pulley wheels at the opposite sides of the surfacing machine over which said flexible loop passes, said pulley wheels being arranged in the same transverse plane, counterbalance means tending to take up the slack in said suspension cable, and means for causing the traction units to tractively

contact a surface to be worked upon by said surfacing machine.

11. In a machine of the class described, a frame structure, a pair of electro-magnetic traction units arranged in spaced parallel relation, each electro-magnetic traction unit including a magnet, and an endless driven magnetic conductor traction propelling element passing over said magnet and adapted to engage a metal surface over which the machine is adapted to travel, means for flexibly connecting said traction units together in supported position upon said frame structure, and means for selectively driving said traction units simultaneously in the same direction or simultaneously in reverse directions.

12. In a machine of the class described, a frame structure, a pair of traction units arranged in spaced parallel relation, means for flexibly connecting said traction units together in supported position upon said frame structure, and means for selectively driving said traction units simultaneously in the same direction or simultaneously in reverse directions, each of said traction units including a pair of alined driven rollers, a guide shoe disposed at one side of said rollers and an endless flexible traction band passing over said guide shoe and rollers, and electro-magnets associated with the traction leads of the respective flexible traction bands of the pair of traction units for setting up an electro-magnetic force to effect a tractive contact of the traction leads of the traction bands with a metallic surface during use of the machine over such surface.

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