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PATENT SPECIFICATION

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(54) WEAR LINERS FOR ABRASIVE-MATERIAL HANDLING EQUIPMENT

(71) We, SKEGA AKTIEBOLAG, a Swedish Body Corporate of S-930 40 Brsmark, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to liners for abrasive-material handling apparatus:

One aspect of the invention provides a liner for lining an abrasive-material handling apparatus having an abrasive resistant wear surface for engagement with the material handled by said apparatus, which liner comprises a layer of rubber, one side of which provides said wear surface, while the other side is supported by a backing plate, and at least one sheet of abrasive resistant wire mesh embedded in said layer at a constant distance from said wear surface and from said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

Another aspect of the invention provides a liner for a centrifugal pump for pumping abrasive material, which pump includes an impeller between the opposed sidewalls of a case, said case having a volute surrounding said impeller and extending to the pump outlet, said liner being volute-shaped and comprising a layer of rubber adapted to be positioned within and to follow said volute having a generally radially inwardly facing side providing a wear surface for engagement with the abrasive material pumped by said pump when said liner is within said volute and the impeller is operating, the other side of the layer of rubber being supported by a backing plate, and at least one sheet of abrasive resistant wire mesh being embedded within said layer disposed at a constant distance from said wear surface and from

said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

Yet another aspect of the invention provides a centrifugal pump for pumping abrasive material comprising a case having spaced opposed side walls and a volute around the outer peripheries thereof providing an impeller chamber, an impeller and a lining layer of rubber, which lining layer is provided around the inner side of said volute and has a radially inwardly facing side providing a wear surface for engagement with the abrasive material pumped, the other side of the layer of rubber being supported by a backing plate, and at least one sheet of abrasive resistant wire mesh being embedded within said layer and disposed at a constant distance from said wear surface and from said backing plate, said rubber layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and the backing plate.

In the liners hereinafter shown and described, each comprises a layer of rubber in which the wear surface is smooth. When used in this specification, the term "rubber" shall mean any natural or synthetic, resilient rubber-like material.

The size of the wire and the mesh openings are such as to resist breakage from the impact and abrasion of the materials being pumped, such as hard rocks, broken glass including glass bottles, tin cans, wire or pieces of metal. The wire defining the mesh openings protects the rubber therein and prevents the deepening of any areas worn to the sheet and also checks the expansion of such areas. Thus, the mesh sheets provide abrasion resistant wear surfaces.

Where the liners are in hoppers, chutes and the like that take the impact of rocks, aggregate and the like, fed thereto and over

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which such material is moved, the liners are not necessarily in sections in each installation, and they usually are fairly accessible for installation, removal and replacement. The wear surfaces are smooth thereby offering no unusual resistance to fast movement of the materials thereover, and the angle of impact may be thirty degrees and less to expedite such movement. The liners are of rubber, have the wire mesh sheet or sheets embedded therein and bonded thereto, to provide a lining material having the long wear characteristic of hard alloy metals but at a fraction of the cost.

Some embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevational view of a liner for a centrifugal type dredge pump, a portion of the outer case being shown in elevation.

Fig. 2 is an enlarged, fragmentary view along line 2—2 of Fig. 1.

Fig. 3 is an enlarged view of one of the liner sections of the volute portions thereof.

Fig. 4 is an enlarged fragmentary cross sectional view through a portion of the liner showing the wire mesh material therein.

Fig. 5 is a side elevational view of a portion of a bladder type liner separate from the outer case.

Fig. 6 is an elevational view of the liner portion of Fig. 5 as seen from the discharge side.

Fig. 7 is an enlarged cross sectional view along line 7—7 of Fig. 5 in which part of the conventional outer case is shown in broken line, except at the liner-attaching bolt, which is in section.

Fig. 8 is a semi-diagrammatic sectional view showing the impact receiving liners in a chute, hopper and conduit.

One conventional form of pump housing, generally designated 1, includes a weldment comprising a side 3 (Fig. 2) rigid with a volute shaped periphery 4. A door 5 is removably secured by bolts (not shown) to the weldment in opposed relation to side 3. A central opening 6 (Fig. 1) in said door is for a suction pipe, and an opening in the side 3 coaxial with opening 6 is for the impeller shaft.

The side liner, generally designated 7, extends across the inner surface of side 3, while the volute portion of the liner is formed in sections 8 to 13, the sections 8, 13 defining two of the opposite sides of the outlet. In addition, a nose section 14 is at the acute juncture between sections 12, 13 (Fig. 1). While sections 8, 13 are straight extensions of the volute, they will be called volute sections. A door liner 7' extends across the inner surface of the door 5.

The side and door liner and the volute liners extend completely over the internal

surfaces of the pump housing.

Each of the volute sections of the liner comprises a backing plate 15 and a wear liner 16, the latter facing the impeller chamber. The wear liner and backing plate of each section are correspondingly curved, except sections 8, 13 which are straight, and their concavely curved sides face radially inwardly toward the axis of the impeller which is coaxial with opening 6.

The wear liner 16 of each volute section, is of rubber, and is vulcanized to its backing plate. Nuts 17 on stud bolts 18, that, in turn are secured to the backing plate of each volute section, secure the liner rigidly in their positions within the housing 1. Said bolts 18 extend from the backing plates through the volute portion of the housing for releasably holding the sections against spacers 19 that are along the volute periphery 4.

The side liner 7 and the door liner 7' are respectively secured to the side and door by bolts and nuts corresponding to bolts 18 and nuts 1 as indicated in Fig. 1 by the same numbers.

The wear liners 16 in each volute section in a dredge pump, as illustrated, having a 24 × 24 inch outlet, are of uniform thickness of approximately two inches, while the side and door wear liners are a quarter of an inch less in thickness. These wear liners are of rubber in which several sheets or layers 23, 24, 25 of high carbon steel industrial wire cloth of 0.105 inches diameter and with $\frac{1}{4}$ inch openings are embedded in the rubber before vulcanizing, said layers being parallel with the wearing surface of each liner. The sheet or layer 23 may be $\frac{1}{8}$ inch from said surface, with the sheet 24 spaced $\frac{1}{2}$ inch from sheet 23 and from inner layer 25. The layer of rubber 16 is vulcanized after the steel wire mesh is embedded therein and the backing plate is against the back of layer 16, whereby the wire mesh and the backing plate 15 are substantially inseparably bonded to the rubber. The rubber is preferably cured to 60 Shore durometer hardness, and the same procedure is followed with respect to the door and side liners, both of which may be called side liners.

The adjacent ends of the adjacent pairs of volute sections are complementarily bevelled to engage each other when the volute sections are bolted to the volute portion of the outer case, and the inclination of the bevels at opposite ends of each section are in the same direction so that any one of the volute sections may be removed and replaced independently of the others.

The structure enabling the selective removal and replacement of the volute portions of the liner is important because the wear on the liners is not uniform around the volute. Certain sections may wear thin while others show little wear. Also the selective replace-

ment of sections enables lining the pump with the best combination of lining material for the particular job undertaken.

As an alternative to the form of pump liner arrangement shown in Figs. 1, 2 and 3, the invention may take the form of a bladder type rubber liner, an embodiment of which is illustrated in Figs. 5—7.

Conventional bladder type liners have taken the form of unitary cast alloy iron or steel liners, and also rubber liners that may or may not be split in one or more planes of the volute.

In the present instance the rubber liner used to line a bladder pump is generally designated 28, and is divided into segments along lines 29 (Fig. 5) that extend radially relative to the axis of the impeller (not shown), but which is coaxial with the rings 30. Each segment includes a portion of the volute 31 and side walls 32 (Fig. 7).

The outlet portion 33 of the liner is preferably divided into portions 34, 35 along line 36 (Fig. 5), and the segment 38 that adjoins one of the ends of sections 34, 35 has parallel end edges 39, whereby said segment 38 provide the key segment that may be removed to free any of the others for replacement. Each of the segments, being of U-shape cross sectional contour has a U-shaped backing plate 40 with the rubber wear liner 41 on the inside and vulcanized thereto, and each liner has U-shaped sheets 42 of high carbon industrial wire mesh embedded therein in parallel spaced relation to each other and to the inner wear surface of each segment thereby providing liners having the same wear characteristics as the liners in the Figs. 1—4. Bolts 43 (Fig. 7) are adapted to releasably secure the segments within the pump housing shown in phantom as 26 in the same manner as bolts 18.

Most bladder type pumps incorporate side wall or door liners that are bolted to the associated wall or door, and the liner of this invention can be configured to serve as side wall and door liners in the bladder type pump.

While the foregoing structures are preferable, the rubber liner is not to be limited to any particular type of pump case. Also while natural rubber has been found to be preferable in combination with the wire mesh to which it is bonded, it is to be understood that any rubber-like material exhibiting the characteristics of natural rubber with respect to resistance to wear and adherence to metal, may be utilized.

Referring to Fig. 8, the abrasive material handling equipment comprises a hopper 50, a feed chute 51 feeding abrasive material such as rocks or aggregate 52 into the hopper, and a second feed chute 53 feeding similar material into a vertically extending conduit 54 having an angularly downwardly extending

extension at its lower end. Liner 55 in chute 51; liner 56 in hopper 50; liner 57 in chute 53 and liner 58 at the lower end of conduit at the juncture between the extension 59 and the vertical portion of the conduit are each of the same rubber and wire mesh structure as the layer 16 in that each contains at least one sheet of the wire mesh material.

Fig. 8 is intended to be illustrative of several different places where the liner is adapted to be used. The angles at which the wear liners positioned relative to horizontal are such as to promote a relatively high velocity of the sharp rocks, etc., moreover, both conditions being considered as detrimental to the lining material whether of metal or rubber, and particularly as to rubber.

In actual use in dredging operations, or in abrasive-material handling apparatus, a sharp object such as a sharp rock, a broken bottle or a piece of iron may mutilate the wear surface of the liner to some extent, but the mutilation will stop at the steel mesh and the rubber will not strip away from the sheet. Ultimately the rubber will be worn to the wire mesh in different places but the wear will not continue to the rubber beyond the wire mesh until the latter is worn through. The wire of the mesh protects the rubber within the mesh openings and the rubber within the opening protects the wire.

Due to the greater wear that occurs in certain areas of the liners, only those that are worn through need be replaced, hence many of the sections will remain unchanged thereby further contributing to the extremely low cost per yard of material dredged or handled.

One of the advantages of the invention is the provision of improved rubber liners for use in abrasive handling equipment in positions to receive the impact and wear from the abrasive material handled and the initial and operating costs of which are a small fraction of the initial and operating costs of conventional hard high alloy steel liners in the same positions in the same equipment handling the same materials under the same conditions.

Another advantage of the invention is that the provision of rubber linings in and for centrifugal dredge and slurry pumps are provided in sections that are selectively removable and replaceable in different areas within the pumps subject to wear from impact with and movement of the abrasive material through the pumps.

Another advantage of the invention is the provision of a rubber liner in a conventional centrifugal dredge or slurry pump having the long wear characteristics of hard, high alloy steel.

A still further advantage of the invention is the provision of rubber liners for use in conventional abrasive material handling

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equipment providing wear surfaces therein in engagement with the abrasive material handled by said equipment; and which liners have the long wearing characteristics of conventional hard alloy steels and are suitable for use in handling such materials as hard sharp rocks, broken glass, metal pieces, tin cans or wire.

WHAT WE CLAIM IS:—

1. A liner for lining an abrasive-material handling apparatus having an abrasive resistant wear surface for engagement with the material handled by said apparatus, which liner comprises a layer of rubber, one side of which provides said wear surface, while the other side thereof is supported by a backing plate, and at least one sheet of abrasive resistant wire mesh embedded in said layer at a constant distance from said wear surface and from said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

2. A liner as claimed in claim 1, wherein the mesh openings of said sheet are rectangular and said rubber is vulcanised and cured to 60 Shore durometer hardness.

3. A liner as claimed in claim 2, wherein the mesh openings of said sheet are rectangular and each opening measures $\frac{1}{4}$ by $\frac{1}{4}$ inches.

4. A liner as claimed in any of the preceding claims, wherein said sheet is one of a plurality of sheets of corresponding wire mesh in spaced opposed relation, all embedded in said layer of rubber and each bonded to the rubber.

5. A liner as claimed in any of the preceding claims, wherein positioning means are connected with said layer for positioning it within such apparatus in a position for said engagement with the material handled by said apparatus.

6. A liner as claimed in any one of claims 3 to 5, wherein the wire of said sheet is round and of 0.105 inches in diameter.

7. A liner for a centrifugal pump for pumping abrasive material, which pump includes an impeller between the opposed sidewalls of a case, said case having a volute surrounding said impeller and extending to the pump outlet, said liner being volute-shaped and comprising a layer of rubber adapted to be positioned within and to follow said volute having a generally radially inwardly facing side providing a wear surface for engagement with the abrasive material pumped by said pump when said liner is within said volute and the impeller is operating, the other side of the layer of rubber being supported by a backing plate and at least one sheet of abrasive

resistant wire mesh being embedded within said layer disposed at a constant distance from said wear surface and from said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

8. A liner as claimed in claim 7, wherein said liner has spaced opposed radially inwardly extending portions adjacent said sidewalls, which portions have substantially opposedly facing wear surfaces, and at least one sheet of abrasive resistant wire mesh embedded in each of said portions parallel to its wear surface.

9. A liner as claimed in claim 7 or claim 8, wherein the rubber of the liner is vulcanised and cured to 60 Shore durometer hardness, the mesh of said sheet being rectangular and each measuring $\frac{1}{4}$ by $\frac{1}{4}$ inches, the diameter of the wire of said mesh being 0.105 inches.

10. A liner as claimed in any one of claims 7 to 9, wherein said volute liner is substantially U-shape in cross sectional contour with sides of said U extending radially inwardly relative to said wear surface, said sheet of wire mesh extending into and being embedded in the sides of said U and being bonded to the rubber of said sides.

11. A liner as claimed in any of the claims 7 to 10, wherein said liner is transversely divided into a plurality of separate, adjoining sections, securing means being provided on each of said sections for securing them in said case in adjoining relationship.

12. A liner as claimed in any of the preceding claims, wherein said backing-plate is vulcanized to said layer of rubber.

13. A liner as claimed in any of the preceding claims, wherein the wire mesh in each sheet is of steel.

14. A centrifugal pump for pumping abrasive material comprising a case having spaced opposed side walls and a volute around the outer peripheries thereof providing an impeller chamber, an impeller and a lining layer of rubber, which lining layer is provided around the inner side of said volute and has a radially inwardly facing side providing a wear surface for engagement with the abrasive material pumped, the other side of the layer of rubber being supported by a backing plate, and at least one sheet of abrasive resistant wire mesh being embedded within said layer and disposed at a constant distance from said wear surface and from said backing plate, said rubber layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and the backing plate.

15. A centrifugal pump as claimed in claim 14, wherein a face lining of the vulcanized

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5 equipment providing wear surfaces therein in engagement with the abrasive material handled by said equipment; and which liners have the long wearing characteristics of conventional hard alloy steels and are suitable for use in handling such materials as hard sharp rocks, broken glass, metal pieces, tin cans or wire.

WHAT WE CLAIM IS:—

10 1. A liner for lining an abrasive-material handling apparatus having an abrasive resistant wear surface for engagement with the material handled by said apparatus, which liner comprises a layer of rubber, one side of which provides said wear surface, while
15 the other side thereof is supported by a backing plate, and at least one sheet of abrasive resistant wire mesh embedded in said layer at a constant distance from said wear surface and from said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

20 2. A liner as claimed in claim 1, wherein the mesh openings of said sheet are rectangular and said rubber is vulcanised and cured to 60 Shore durometer hardness.

25 3. A liner as claimed in claim 2, wherein the mesh openings of said sheet are rectangular and each opening measures $\frac{1}{4}$ by $\frac{1}{4}$ inches.

30 4. A liner as claimed in any of the preceding claims, wherein said sheet is one of a plurality of sheets of corresponding wire mesh in spaced opposed relation, all embedded in said layer of rubber and each bonded to the rubber.

35 5. A liner as claimed in any of the preceding claims, wherein positioning means are connected with said layer for positioning it within such apparatus in a position for said engagement with the material handled by said apparatus.

40 6. A liner as claimed in any one of claims 3 to 5, wherein the wire of said sheet is round and of 0.105 inches in diameter.

45 7. A liner for a centrifugal pump for pumping abrasive material, which pump includes an impeller between the opposed sidewalls of a case, said case having a volute surrounding said impeller and extending to the pump outlet, said liner being volute-shaped and comprising a layer of rubber adapted to be positioned within and to follow said volute having a generally radially inwardly facing side providing a wear surface for engagement
50 with the abrasive material pumped by said pump when said liner is within said volute and the impeller is operating, the other side of the layer of rubber being supported by a backing plate and at least one sheet of abrasive

resistant wire mesh being embedded within said layer disposed at a constant distance from said wear surface and from said backing plate and providing a mesh surface for resisting wear from abrasion upon wear of said liner to said mesh surface, the rubber of said layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and said plate.

8. A liner as claimed in claim 7, wherein said liner has spaced opposed radially inwardly extending portions adjacent said sidewalls, which portions have substantially opposedly facing wear surfaces, and at least one sheet of abrasive resistant wire mesh embedded in each of said portions parallel to its wear surface.

9. A liner as claimed in claim 7 or claim 8, wherein the rubber of the liner is vulcanised and cured to 60 Shore durometer hardness, the mesh of said sheet being rectangular and each measuring $\frac{1}{4}$ by $\frac{1}{4}$ inches, the diameter of the wire of said mesh being 0.105 inches.

10. A liner as claimed in any one of claims 7 to 9, wherein said volute liner is substantially U-shape in cross sectional contour with sides of said U extending radially inwardly relative to said wear surface, said sheet of wire mesh extending into and being embedded in the sides of said U and being bonded to the rubber of said sides.

11. A liner as claimed in any of the claims 7 to 10, wherein said liner is transversely divided into a plurality of separate, adjoining sections, securing means being provided on each of said sections for securing them in said case in adjoining relationship.

12. A liner as claimed in any of the preceding claims, wherein said backing-plate is vulcanized to said layer of rubber.

13. A liner as claimed in any of the preceding claims, wherein the wire mesh in each sheet is of steel.

14. A centrifugal pump for pumping abrasive material comprising a case having spaced opposed side walls and a volute around the outer peripheries thereof providing an impeller chamber, an impeller and a lining layer of rubber, which lining layer is provided around the inner side of said volute and has a radially inwardly facing side providing a wear surface for engagement with the abrasive material pumped, the other side of the layer of rubber being supported by a backing plate, and at least one sheet of abrasive resistant wire mesh being embedded within said layer and disposed at a constant distance from said wear surface and from said backing plate, said rubber layer being bonded to the wires of said mesh and to the backing plate and constituting the only connection between the sheet of wire mesh and the backing plate.

15. A centrifugal pump as claimed in claim 14, wherein a face lining of the vulcanized



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rubber is positioned over each of the oppositely facing surfaces of said side walls, each having at least one sheet of wire mesh embedded therein and parallel with the inwardly facing surface thereof.

5 16. A centrifugal pump as claimed in claim 14 or claim 15, wherein said sheet of wire mesh is one of a plurality of sheets of corresponding wire mesh in spaced relation, all
10 embedded in said layer of rubber and each bonded to the rubber.

17. A centrifugal pump as claimed in any of the claims 14 to 16, wherein said wire mesh of each sheet is of steel.

15 18. A centrifugal pump as claimed in any of the claims 14 to 17, wherein the backing plate is vulcanized to said layer of rubber and removably secured to and within said case.

20 19. A centrifugal pump as claimed in any of the preceding claims 14 to 18, wherein each one of the mesh openings of each wire mesh sheet is rectangular and the rubber of said lining layer is vulcanized and cured to 60 Shore durometer hardness.

20. A centrifugal pump as claimed in any 25 of the preceding claims 14 to 19, wherein the liner is associated with at least one of said side walls.

21. A liner for lining an abrasive-material handling apparatus substantially as herein- 30 before described with reference to and as illustrated in the accompanying drawings.

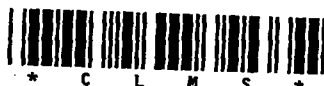
22. A liner for a centrifugal pump for pumping abrasive material substantially as 35 hereinbefore described with reference to and as illustrated in Figures 1 to 7 of the accompanying drawings.

23. A centrifugal pump for pumping abrasive material substantially as hereinbefore 40 described with reference to and as illustrated in Figures 1 to 7 of the accompanying drawings.

SKEGA AKTIEBOLAG

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