

[54] SCREW LINER

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[22] Filed: Apr. 4, 1973

[21] Appl. No.: 347,886

[52] U.S. Cl. 418/178, 418/201, 418/220, 415/72, 416/224

[51] Int. Cl. F01c 1/16, F01c 21/00, F04c 1/10

[58] Field of Search 418/178, 197, 201-203, 418/220; 415/72, 196; 416/176, 177, 224, 241; 259/97, 104, 191; 198/213

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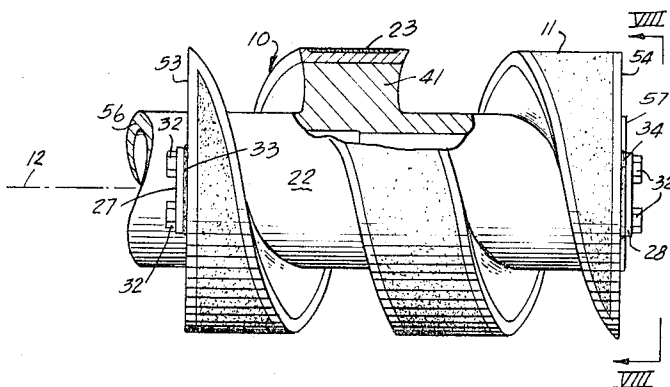
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[57] ABSTRACT

A replaceable flight liner for screw flights in screws of the type adapted for pumping fluid-like material (especially thick, fibrous suspensions) through a casing. The liner is suitable for use on screws subject to short life because of screw flight wear on outside surfaces. It is expected that a plurality of such liners would be worn out before other, more extensive repairs to a pump would be necessary.

9 Claims, 12 Drawing Figures



SHEET 1 OF 4

Fig. 1

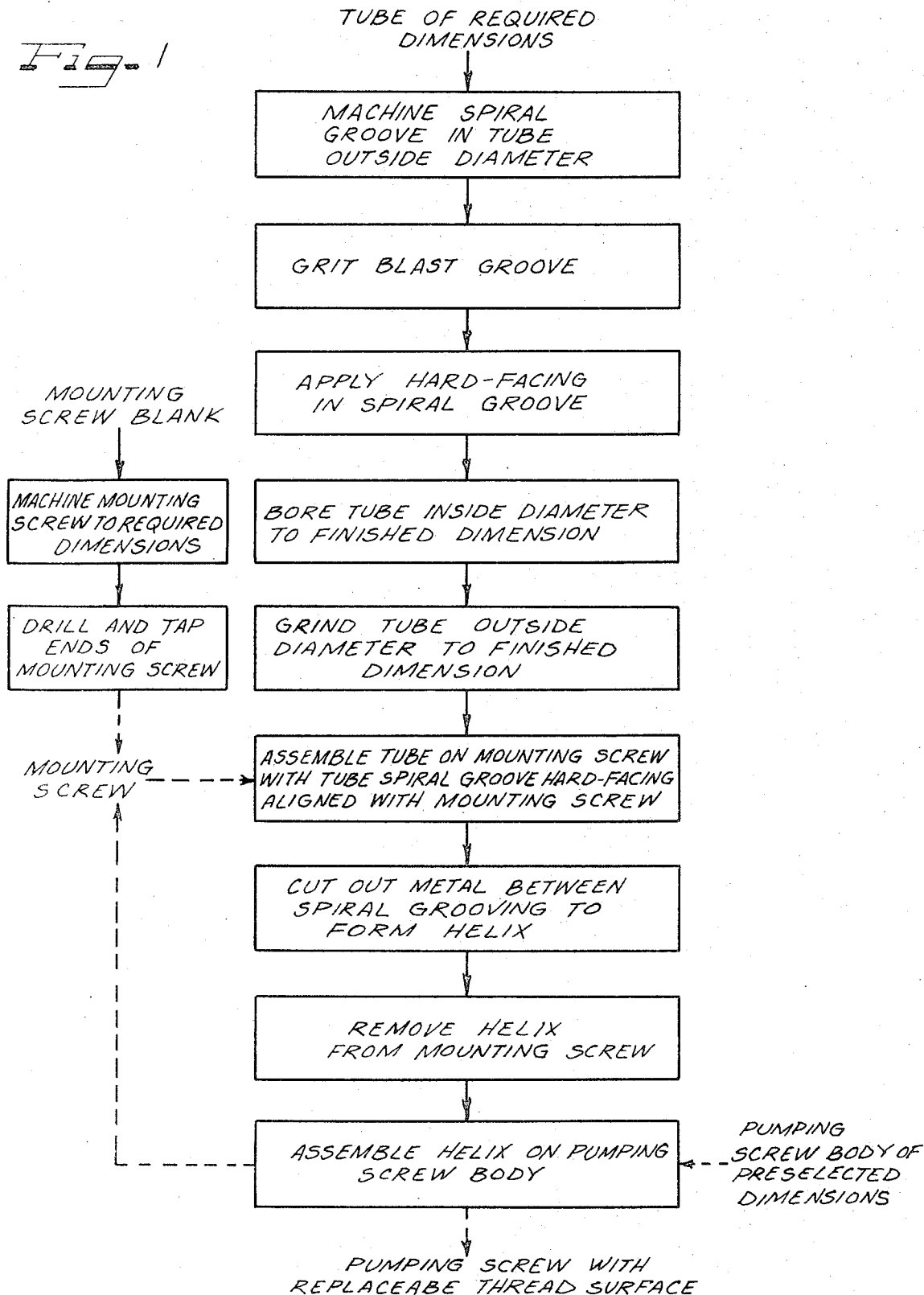


Fig. 2

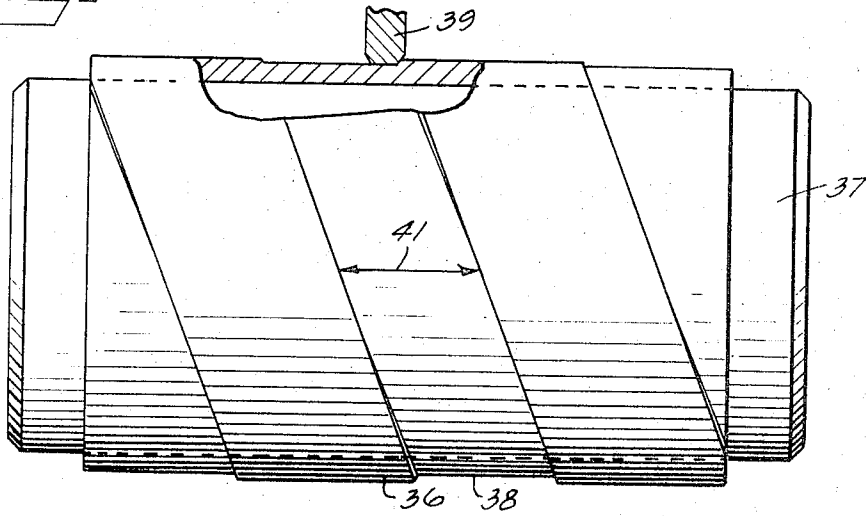


Fig. 3

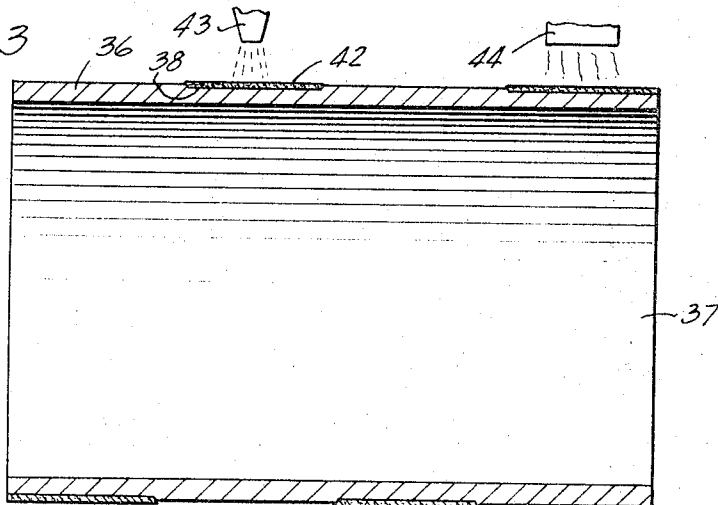
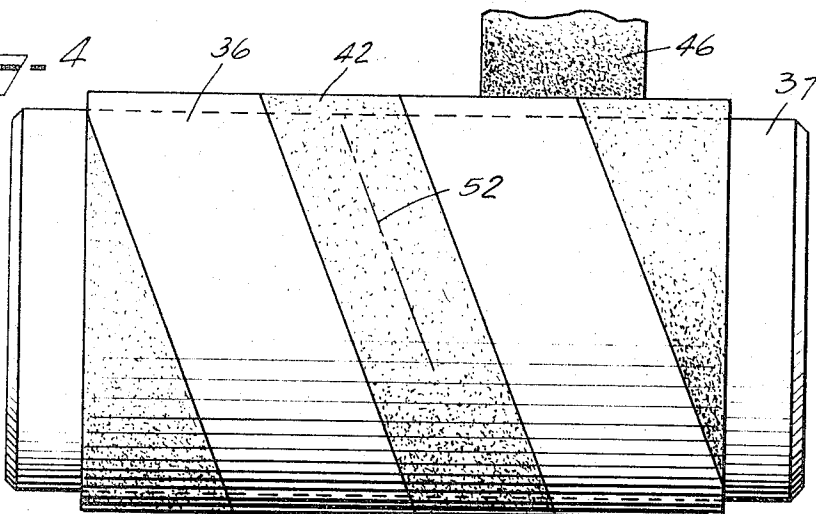
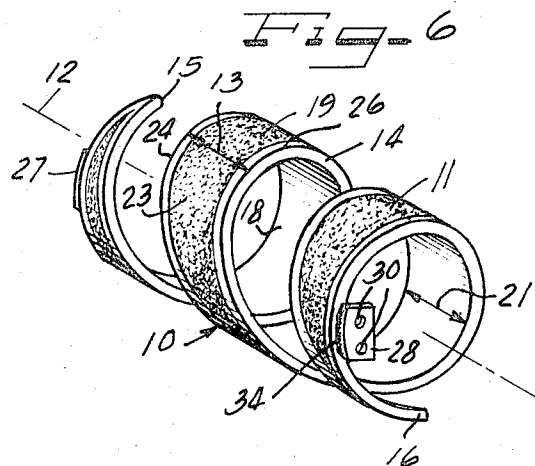
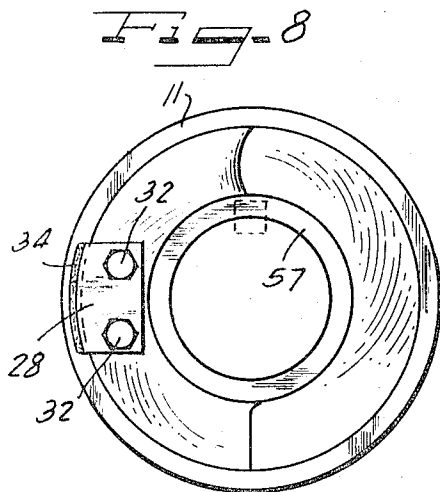
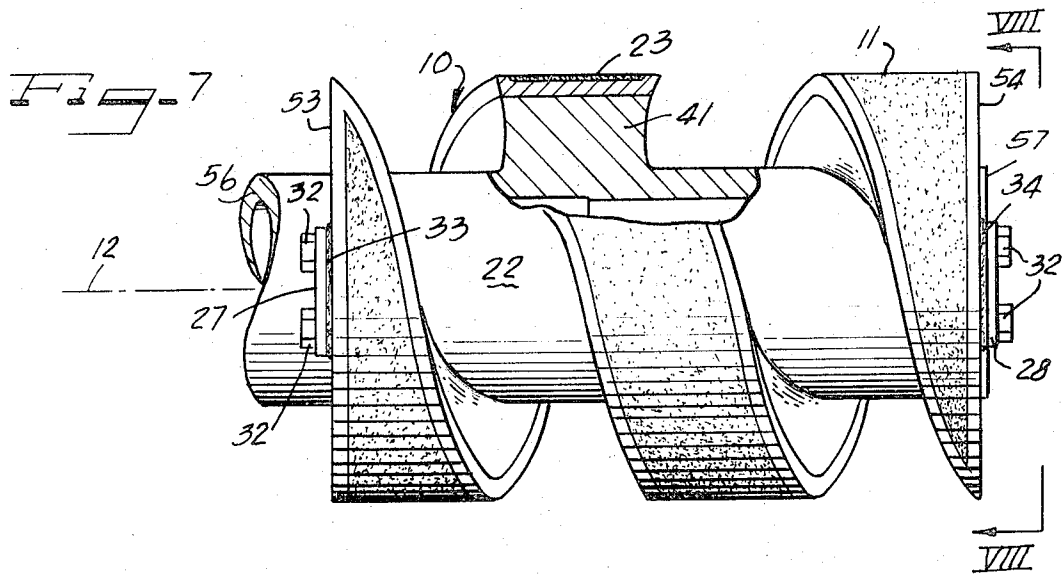
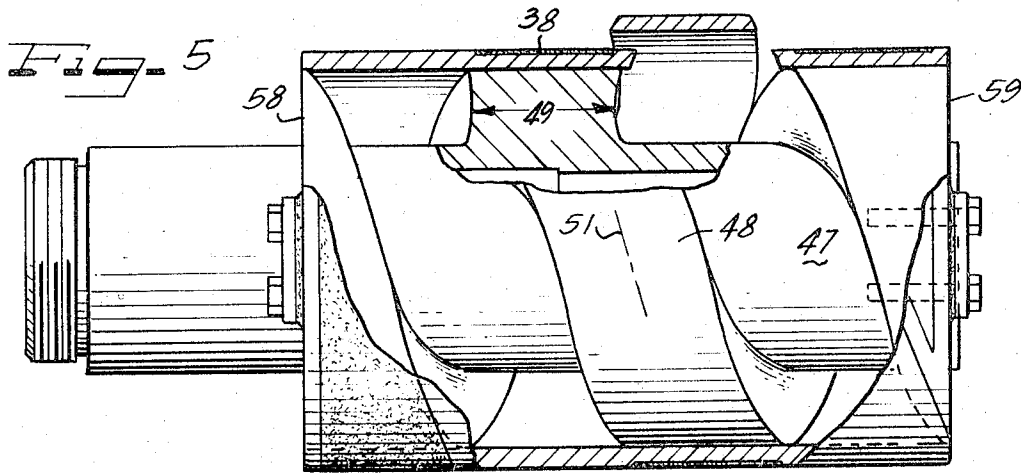
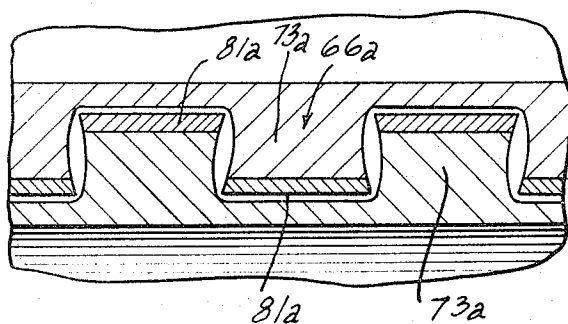
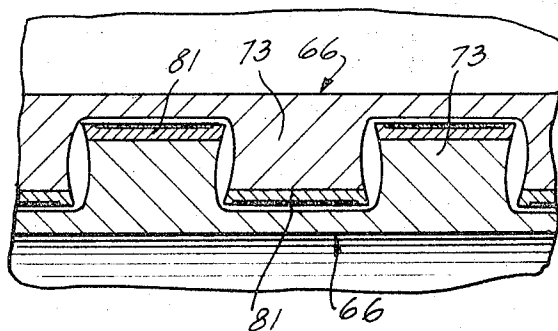
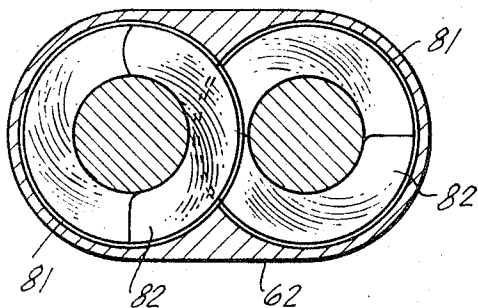
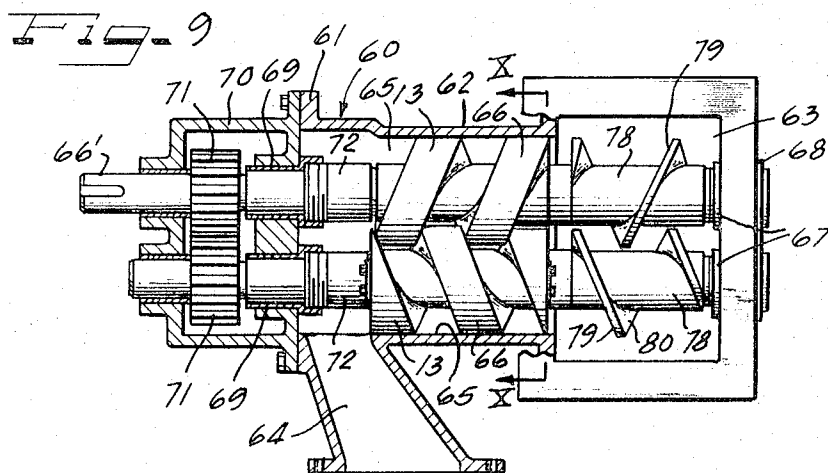


Fig. 4







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SCREW LINER

BACKGROUND OF THE INVENTION

1. The Field of the Invention

This invention relates generally to pumps adapted for the pumping of fluid-like material, particularly material comprising a suspension of thick fibrous matter with matted concentrations of fibrous content, such as high density paper pulp stock, Athabasca froth (which contains sand), etc., and more particularly to screws for such pumps which are known to have a relatively short duty life because of wear on the outside circumferential surfaces of the screw flights.

2. The Prior Art

The problem solved by the present invention assumes importance in certain types of pumps, such as in the high density, twin rotary screw pumps used for pumping high density paper pulp stock, fluids containing abrasives, and the like where the conventional screws wear rapidly and replacement screws tend to be costly, involving also the replacement of related parts. The state of the prior art is represented by my prior U.S. Pat. No. 2,994,562.

SUMMARY OF THE INVENTION

A replaceable flight liner which is hard surfaced is made by a novel combination of processing steps. The liner is then mounted on a pumping screw and the resulting assembly, combined into a pump, for a preferred example, one of the rotary twin screw type adapted to pump thick fibrous suspensions. The liner may be formed of metal which has been hard surfaced in selected areas.

More particularly, such a liner utilizes a spirally extending, elongated rigid strip having generally radial symmetry with respect to a longitudinal axis. The longitudinal, axially extending average outer strip width is generally greater than the thickness thereof except at opposite end regions. The strip has generally parallel, opposed inner and outer faces, with the inner face being adapted to mate in face-to-face engagement with the circumjacent flight surfaces of a pumping screw. Demountable mounting means secured to opposite end portions of said strip adapt the strip for mounting on the pumping screw.

Other and further advantages and features of the present invention will become manifest to those versed in the art upon making reference to the detailed description and accompanying drawings in which preferred embodiments incorporating the principles of the present invention are shown by way of illustrative examples.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings wherein like reference numerals indicate like or corresponding parts;

FIG. 1 is a process flow diagram illustrating one method of making an embodiment of a replaceable flight liner of this invention;

FIG. 2 illustrates the machining of a spiral groove in appropriate tube stock in making a replaceable flight liner by the process diagrammed in FIG. 1;

FIG. 3 illustrates the hard surfacing of the grooved stock prepared as shown in FIG. 2;

FIG. 4 illustrates the finishing of the outer surface of the hard surfaced tube of FIG. 3;

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FIG. 5 illustrates the tube product of FIG. 4 mounted on a mounting screw and a cutting operation under way to form a product replaceable flight liner of this invention;

FIG. 6 shows a perspective view of the replaceable liner produced in FIG. 5 after removal from the mounting screw;

FIG. 7 illustrates the replaceable liner of FIG. 6 mounted on a pumping screw body of preselected dimensions;

FIG. 8 is an end elevational view taken along the line 8—8 of FIG. 7;

FIG. 9 is a longitudinal sectional view through a rotary twin screw pump assembly employing helical intermeshing left hand and right hand screw bodies which are each fitted with an embodiment of a replaceable liner;

FIG. 10 is a vertical sectional view taken along the line 10—10 of FIG. 9;

FIG. 11 is an enlarged detail view in longitudinal section illustrating the manner in which the screw bodies of the pump assembly of FIG. 9 intermesh; and

FIG. 12 is a view similar to FIG. 11 but illustrating the screw bodies fitted with a replaceable liner which is not hard surfaced.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 6, there is seen an embodiment of a replaceable flight liner of this invention herein designated in its entirety by the numeral 10. Liner 10 is adapted for use in combination with screw flights in screws of the type adapted for pumping fluid-like material through a casing member housing such screw, all as more particularly hereinafter described.

Flight liner 10 is seen to employ a spirally extending elongated, rigid strip 11 which has generally radial symmetry with respect to a longitudinal axis 12. The longitudinal, axially extending average outer width 13 of strip 11 is generally greater than the thickness 14 thereof except at opposite end regions 15 and 16 thereof. Strip 11 has generally parallel, opposed inner and outer faces 18 and 19, respectively. The inner face 18 has a radius and a longitudinal, axially extending average inner width 21. The inner face 18 is adjusted to be in face-to-face engagement with the circumferential outermost flight surfaces of a pumping screw 22 (FIG. 7).

A hard surfacing or hard facing 23 of metal, metal oxides, such as chrome oxide, non-metallic ceramic, or the like is placed on and in the outer face 19 and such hard facing continuously extends over the mid region of outer face 19 generally between the opposed, longitudinally adjacent, axially extending respective edge regions 24 and 26 of outer face 19.

Hard facing, for purposes of forming a flight liner 10, may be accomplished by any convenient technique or composition; see for example, the discussion of hard facing methods and materials in the Metals Handbook, 8th Edition, Vol. 1 pp 820-833 published by the American Society for Metals (1961). In FIG. 3, for instance, is illustrated a spray welding procedure which involves spraying and fusing of hard faced alloys in powdered form. The surface of the base metal is first thoroughly cleaned and then shot blast with an abrasive. Sprayed deposits may be conveniently fused with an oxyacetylene torch or by placing the sprayed part in a furnace. A technique of spraying and continuously fusing may

be used. Many nickel and cobalt-base alloys (groups 4A and 4B) lend themselves to spray welding techniques.

A demountable mounting means is secured to each longitudinally opposite end portion of strip 11 and such means is adapted to secure strip 11 to a prechosen pumping screw (such as screw 22 in FIG. 7) in fixed spatial relationship. This mounting means is generally radially positioned so as not to extend outwardly of outer face 19 in liner 10. For example, in liner 10, this mounting means comprises a pair of end plates, 27 and 28 respectively, each one being welded to a different longitudinally opposite end region 15 and 16 of strip 11 (see, for example welded joints 33 and 34 respectively in FIGS. 7 and 8) and adapted to be in face to face engagement with a different longitudinally opposite generally radially extending end portion (in screw 22, shoulders 29 and 31, respectively), of a prechosen pumping screw (such as screw 22) when flight liner 10 is functionally positioned on such a screw (such as screw 22). End plates 27 and 28 and such a pumping screw (such as screw 22) have when so functionally positioned together substantially aligned bores 30 (bores not shown in screw 22) adapted for receipt of mounting bolt means (such as bolts 32) extending thereinto (see FIGS. 7 and 8).

Preferably in liner 10, strip 11 has an average inner width 21 which is generally substantially greater than the thickness 14 of strip 11 (that is, has a width 21 at least 5 times the thickness 14) but greater or lesser such ratios may be employed if desired as those skilled in the art will appreciate. Also preferably in a liner 10, while the average inner width 21 may be slightly less than the average outer width 13, the respective widths 13 and 21 are not critical from the standpoint of this invention, selection of a width 13 or 21 being determined by the particular end use situation for which a particular liner 10 is constructed in accordance with the wishes of the user.

A liner 10 may be made by any convenient procedure. However, for purposes of the present invention one preferred process of manufacture therefor will now be described by reference to FIGS. 1-5. Process steps are shown in the self-explanatory boxes of the flow chart of FIG. 1 which FIGS. 2-5 illustrate individual steps. Thus, tube stock 36, appropriately mounted on a mandrel 37 of a lathe (not shown but see FIG. 2), has a spiral groove 38 cut therein, as by means of a cutter 39. Observe the tube 36 has an internal diameter approximately equal to the outside diameter of the circumferentially extending flight portions of a prechosen pumping screw (not shown in FIG. 2, but see, for example, flight 41 of screw 22 in FIG. 7), and having an outside diameter preferably about equal to the predetermined sum of the depth of said flight portions of said prechosen pumping screw 22 plus the strip 11 wall thickness. The longitudinal, axially extending width 41, and location of groove 38 on tube 36 is such as to cause groove 38 to lie over mid portions of circumferentially extending side regions of flight 41 of screw 22 if tube 36 were to be mounted circumferentially over screw 22.

The next operation is to clean and grit blast spiral groove 38. Any conventional grit blasting procedure and/or apparatus may be employed herein.

Next, one applies hard-facing material over and into spiral groove 38 to an extent such that, after the appli-

cation operation is completed, the groove 38 is filled with hard facing material to a depth at least equal to the depth of groove 38. While, as indicated earlier any conventional hard facing procedure and/or apparatus may be employed herein, FIG. 3 here illustrates a hard facing operation of the spray molding type wherein hard facing composition is first spray deposited, as from a nozzle 43 into groove 38, filling same, and then thereafter the deposit heated and fused to the surface of groove 38 as with a torch 44.

Next, the inside walls of tube 36 are bored to a predetermined internal diameter, the exact tolerance in any given embodiment being dependent, as those skilled in the art will appreciate, upon the particular screw on which the product liner is to be used, the equipment in which the resulting screw assembly fitted with this liner is to be mounted, the conditions of operation, and the like. Thereafter it is convenient to shape, as by grinding, the outside walls of tube 36, including the hard surfaced spiral area, to a predetermined outside diameter, the exact dimensions, as for the inside diameter being dependent upon various similar use considerations. Any convenient procedure may be used in these operations. FIG. 4 illustrates a grinding operation on tube 36 using a grinding wheel 46.

The next operation involves rigidly mounting the so prepared tube 36 on and over a preformed mounting screw 47 which is separately previously machined for the purpose and which has a flight 48 similar to that of the pumping screw 22 on which the product lever is to be mounted, except that the longitudinal, axially extending widths 49 of flight 48 of mounting screw 47 are generally smaller (narrower) than those of the flight 41 of screw 22 the center line of flight 48 being substantially identical to that of flight 41. The center line 52 of said hard faced groove 38 is aligned with the center line 51 of circumferential outermost surfaces of the flight 48 of the mounting screw 47. FIG. 5 illustrates this operation as well as the next one.

After mounting, one cuts out and removes the portions of tube 36 which lie between flight 48 to form the helix comprising a strip 11. Finally, this helix is removed from said preformed mounting screw. During the cutting operation, it is desirable to cut a groove using light cuts and to use a parting tool to remove the groove section, thereby to minimize any risk of damage to the desired helix being formed and form a strip 11 having side edges of desired contour.

In mounting the so prepared tube on screw 47, it is convenient and preferred to affix to the tube 36 the mounting means which is to be employed in assembling the product liner to the body of a screw such as screw 22. While any convenient mounting technique may be employed, one preferred such means is illustrated in FIG. 5 (see also FIGS. 6-8 above described). Thus, such a mounting technique involves bolting one each of a pair of end plates 27 and 28, respectively, to a different opposite end shoulder 53 and 54 respectively, of the preformed mounting screw 22, said end plates 27 and 28 being below the outer circumferential surface of the helix. Each end plate 27 and 28 is secured to the helix by a direct bonding, such as welding or the like.

Preferably, in a liner 10, the spiral groove 38, if present has a depth of not more than about one half the thickness 14 thereof. Preferably also in a liner 10, the hard surfacing 42 has a thickness not greater than

about one half the thickness 14 thereof. Preferably also in a liner 10, the inner surface 18 is slightly narrower longitudinally than the outer surface 19, and the contour of the side edges such as 14 of strip 11 is such as to match, or act as a continuation of, the contour of the radially extending surface portions of the flight of the preselected pumping screw (such as flight 41 of screw 22) on which the liner 10 is to be mounted.

Those skilled in the art will appreciate that while a screw assembly of a liner 10 and screw 22 represents a very much preferred form of the present invention, one can also prepare a screw assembly of this type without hard facing the liner and that this latter form of assembly can be useful in circumstances where a mild wear environment is contemplated or where a short use life is adequate. A screw assembly of this invention can have right or left handed screw flights.

A liner 10 is particularly well adapted for use with a pumping screw body such as screw body 22 which has a single, spirally extending flight 41 whose circumferentially located, peripheral edge portions are parallel to the axis 56 of screw body 22, the depth of flight 41 being preferably at least as great as the average width of the circumferential edge portions of flight 41. In such a screw body, 22 shaft means 56 and 57, respectively, are axially associated with each opposite end portions of screw body 22 and define together therewith with a pair of generally radially extending shoulders 53 and 54, respectively. The mounting screw body 47 has a similar pair of shoulders 58 and 59, respectively.

To demount a completed liner 10 from a mounting screw 47, bolts 32 are removed, liner 10 is screwed from screw 47 and then screwed onto screw 22, and bolts 32 are positioned in place, the same bore sizes and positions, respectively, for bolts 32 being employed on each of screws 47 and 22 for ease and accuracy, particularly in aligning the liner 10 on the flight 41 of screw 22.

Since the primary region of wear on the exposed surface 19 of strip 11 tends to be in the mild portions of such surface, the hard surface composition 42 is positioned there and the edges 24 and 26 are formed of the stock of tube 36 which aids in cutting spiral strip 11 from tube 36 in manufacture.

Utilization of a screw assembly of this invention in a pump is illustrated by FIGS. 9-11. Here a pump 60 having a hollow, open ended casing 61 is mounted on a suitable base 62.

Near one end, said casing 61 is shown with an upwardly-opening fluid intake chamber 62 of relatively large cross-sectional area. This intake chamber 63 provides, for the entering fluid's containment, a pair of opposite downwardly-convergent side walls, connected at their lower ends by a bottom wall. Near its other end, said casing 61 has a laterally-opening fluid discharge portion 64.

Between said intake and discharge portions 63 and 64, the hollow casing 61 is of generally uniform cross-section such as to provide, for reception of the pump's two screws, a pair of parallel side-by-side interior bores 65, 65 in the usual slightly overlapping relation. These overlapping bores 65, 65 at their opposite ends, open into the casing's intake and discharge portions 63 and 64 respectively. Passing concentrically through the bores 65, 65 are the pump's two screw-carrying shafts or rotors 66, 66. These rotors 66, 66 extend across the

pump's intake chamber 63, and are here shown as having their proximate ends journaled in suitable bearings 67, 67 provided by a plate 68 attached to the pump casing 61 and serving to close the end thereof that provides the pump intake 63.

At their other ends, the screw-carrying shafts or rotors 66, 66 are journaled in suitable bearings 69, 69 provided as here shown by a gear housing 70 which is attached to the pump casing 61 and serves to close at the end adjacent to the pump's discharge 64. Within the housing 70, said shafts or rotors 66, 66 carry the usual intermeshing gears 71, 71, by which rotation, as imparted to an extension 66 of one such shaft, is transmitted at the same speed, but in opposite direction, to the other shaft or rotor.

Keyed, pinned or otherwise suitably secured to rotors or shafts 66, 66 are sleeves or hubs 72, 72 which provide, within the bores 65, 65, the pump's two intermeshing screws. These in each case take the usual form of a continuous external helical rib 73 on each hub 12, that meshes with the oppositely-rotating external helical rib 73 of the other hub 72. The outer circumferential peripheral surfaces of these helical ribs 73, 73 have ample and adequate clearance with their respective bores 65, 65. Preferably, both radial side or flank surfaces of each rib 73 are concave in cross-section, as best shown in FIG. 11.

Intermeshing pumping screws of this general construction are well known in the art. Also well known is their capacity, when rotated oppositely, to obtain a constant pulseless pumping flow, axially through their bores 65, 65, of all kinds of liquids and/or liquid suspensions of fibrous material that are supplied to the intake chamber 3.

The particular pump 60 here exemplified is equipped with means to eliminate any clogging or blocking of channels between the helical ribs 73. Thus, those portions of the pump's two rotors or shafts 66, 66 which extend across the intake chamber 63 have keyed or otherwise secured thereto, the illustrated companion sleeves 78, 78. Each sleeve 78, from end to end, provides a set or series of elongated rib-like projections 79, 79. These are so disposed and arranged, in end-to-end relation, as to follow a generally helical path on the sleeve's outer surface. This helical path here has a somewhat greater lead or pitch than that of the associated rotor's pumping screw.

The leading end of each projection 79, in the direction of its rotor's rotation, has here a generally rectangular shoulder or surface 80, that rises substantially at right angles from the cylindrical surface of the sleeve 78. There is a very appreciable clearance between the two sets of projections 79, 79, and there is a very appreciable spacing or clearance between said projections 79, 79, and the side and bottom walls of the intake chamber 63, but the constant rotation of the two sets of projections 79, 79, creates a very desirable turbulence in any thick fibrous suspension that is supplied or delivered to the screw-pump's intake chamber 63. In addition, the relatively large pitch or lead of the side surfaces of projections 79 urges the material at all times in the direction of the pumping rotors 66, 66 and prevents suspended fibrous content from settling against the bottom and sides of the intake chamber 63. Such a pump construction is shown and described, for example, in Zalis U.S. Pat. No. 2,994,562.

Pump 60, as shown for example in FIGS. 10 and 11, has its oppositely rotating rotors 66 each equipped with a replaceable liner 81. Each such liner 81 is formed and constructed in the manner above described in relation to FIGS. 1-6, one such liner 81, however, being right handed and the other left handed; and each such rotor 66 (comprising, in assembled combination, a pumping screw body 82 and liner 81) is formed and assembled generally as described earlier in relation to FIGS. 6-8, one such rotor 66, however, being right handed and the other left handed (each rib 73 being faced with a liner 81).

In operation of pump 60, the counter rotational movements of the respective rotors 66 provides a species of continuous camming action operative upon the respective liners 81 which functions to retain the liners 81 in a desired centered configuration on the circumferential surfaces of ribs 73, all as those skilled in the art will readily appreciate.

While a much preferred form of pump 60 utilizes liners 81 which have been hard surfaced in the manner described above in relation to liner 10, it will be appreciated that a pump 60 may be constructed with liners 81A assembled with rotors 66A without such hard surfacing, as illustrated in FIG. 12, as when a pump 60 is to be utilized in a less demanding application where ribs 73A faced with liners 81A are subject to wear at a slower rate. Any convenient twin-screw pump may be employed when utilizing an embodiment of a replaceable liner of this invention as those skilled in the art will appreciate.

Numerous modifications of the present invention and its various aspects may be apparent to those skilled in the art without departing from the spirit and scope of the invention, and it is to be understood I wish to claim all such modifications as may be reasonably and properly included within the scope of the appended claims.

I claim:

1. A replaceable flight liner for screw flights in screws of the type adapted for pumping fluid-like material through a casing member housing such screw, said flight liner comprising —

A. a spirally extending, elongated rigid strip having

1. generally radial symmetry with respect to a longitudinal axis.
2. a longitudinal, axially extending average outer width generally greater than the thickness thereof except at opposite end regions thereof,
3. generally parallel, opposed inner and outer faces,
4. said inner face having a radius and a longitudinal, axially extending average inner width adapted to make said inner face be in face-to-face engagement with the circumjacent flight surfaces of a pumping screw,

B. hard surfacing means integrally imbedded in said outer face and continuously extending over the mid region thereof generally between opposed, longitudinally adjacent, axially extending edge regions thereof, and

C. demountable mounting means secured to each longitudinally opposite end portion of said strip and adapted to secure said strip to the pumping screw in fixed spatial relationship, said mounting

means being radially positioned so as not to extend outwardly of said outer face.

2. The flight liner of claim 1 wherein said strip has an average inner width which is generally substantially greater than the thickness thereof.

3. The flight liner of claim 1 wherein said hard surfacing has a thickness not greater than one half the thickness of said strips.

4. A replaceable flight liner for screw flights in screws of the type adapted for pumping fluid-like material through a casing member housing such screw, said flight liner comprising —

A. a spirally extending, elongated rigid strip having

1. generally radial symmetry with respect to a longitudinal axis,
2. a longitudinal, axially extending average outer width generally greater than the thickness thereof except at opposite end regions thereof,
3. generally parallel, opposed inner and outer faces,
4. said inner face having a radius and a longitudinal, axially extending average inner width adapted to make said inner face be in face-to-face engagement with the circumjacent flight surfaces of a pumping screw,

B. hard surfacing means integrally imbedded in said outer face and continuously extending over the mid region thereof generally between opposed, longitudinally adjacent, axially extending edge regions thereof, and

C. demountable mounting means comprising a pair of end plates, each one welded to a different longitudinally opposite end region of said strip and adapted to be in face-to-face engagement with a different longitudinally opposite generally radially extending end portion of the pumping screw when said flight liner is functionally positioned on the pumping screw, said end plates having bores adapted to be functionally positioned in substantially aligned relationship with corresponding bores in the screw for receipt of mounting bolt means extending therethrough.

5. A screw assembly adapted for pumping fluid-like material through a casing member housing said screw, said screw assembly comprising

A. a screw body having a single, spirally extending flight whose circumferentially located, peripheral edge portions are parallel to the axis of said screw body, the depth of said flight being at least as great as the average width of said edge portions thereof,

B. shaft means axially projecting from opposite end portions of said screw body and defining together with each such opposite end portions of said screw body, a pair of generally radially extending shoulders,

C. a spirally extending, elongated, rigid strip circumferentially extending about said screw body, said strip having

1. a width generally greater than the thickness thereof,
2. generally parallel, opposed inner and outer faces,
3. said inner face being in face to face engagement with said peripheral edge portions, and
4. hard surfacing means integrally imbedded in its outer face and continuously extending over the

mid-region thereof generally between opposed, longitudinally adjacent, axially extending edge portions thereof, and

- D. demountable mounting means secured to each longitudinally opposite end portion of said strip and adapted to secure said strip to said prechosen pumping screw in fixed spatial relationship to said screw body at said shoulder.

6. The screw assembly of claim 5 wherein the interrelationship between said screw body and said strip is such that said strip has a width which is substantially greater than the thickness thereof.

7. A screw assembly adapted for pumping fluid-like material through a casing member housing said screw, said screw assembly comprising

- A. a screw body having a single, spirally extending flight whose circumferentially located, peripheral edge portions are parallel to the axis of said screw body, the depth of said flight being at least as great as the average width of said edge portions thereof,

B. shaft means axially projecting from opposite end portions of said screw body and defining together with each such opposite end portions of said screw body, a pair of generally radially extending shoulders,

C. a spirally extending, elongated, rigid strip circumferentially extending about said screw body, said strip having

1. a width generally greater than the thickness thereof,
2. generally parallel, opposed inner and outer faces,
3. said inner face being in face to face engagement with said peripheral edge portions, and

D. demountable mounting means secured to each longitudinally opposite end portion of said strip and adapted to secure said strip to said prechosen pumping screw in fixed spatial relationship to said screw body at said shoulder, said demountable mounting means comprising a pair of end plates, each one welded to a different longitudinally opposite end portion of said strip and adapted to be in face to face engagement with a different one of said shoulders when said strip is functionally positioned on said screw body, said end plates and said shoulders, respectively, when so functionally positioned having substantially aligned bores adapted for receipt of mounting bolt means extending thereinto.

8. Apparatus adapted for rotary screw pumping of thick fibrous suspensions containing matted concentrations of fibrous content comprising

- A. a casing having parallel, overlapping bores,
- B. oppositely rotating rotors extending axially of said bores and providing continuous helical intermeshing pumping flights within said bores,
- C. an intake chamber for said pump associated with said casing and communicating with said bores and across which said rotors are extended, said intake chamber having side and bottom walls adapted to contain on entering such suspension, and

D. a replaceable liner facing the circumferentially located peripheral edge portions of each of said pumping flights, each of said liners comprising

1. a spirally extending, elongated rigid strip having generally parallel, opposed inner and outer faces, said inner facing having a radius and a longitudinal, axial extending width adapted to make said inner face be in face to face engagement with said peripheral edge portions, each strip having hard surfacing means integrally imbedded in its said outer face and continuously extending over the midregion thereof generally between opposed, longitudinally adjacent axially extending edge regions thereof, and

2. mounting means at each longitudinally opposite end portion of said strip and adapted to demountably secure said strip to the rotor associated with each of said flights, respectively.

9. Apparatus adapted for rotary screw pumping of thick fibrous suspensions containing matted concentrations of fibrous content comprising

- A. a casing having parallel, overlapping bores,
- B. oppositely rotating rotors extending axially of said bores and providing continuous helical intermeshing pumping flights within said bores,

C. an intake chamber for said pump associated with said casing and communicating with said bores and across which said rotors are extended, said intake chamber having side and bottom walls adapted to contain on entering such suspension, and

D. a replaceable liner facing the circumferentially located peripheral edge portions of each of said pumping flights, each of said liners comprising

1. a spirally extending, elongated rigid strip having generally parallel, opposed inner and outer faces, said inner face having a radius and a longitudinal, axial extending width adapted to make said inner face be in face to face engagement with said peripheral edge portions, and

2. mounting means at each longitudinally opposite end portion of said strip and adapted to demountably secure said strip to the rotor associated with each of said flights, respectively,

E. each rotor having a single, spirally extending flight whose circumferentially located, peripheral edge portions are parallel to the axis of said rotor, the depth of said flight being at least as great as the average width of said edge portions thereof,

F. each rotor further having shaft means axially projecting from opposite end portions thereof such that there is defined at such end portions a pair of generally radially extending shoulders, and

G. said mounting means for each of said liners comprising a pair of end plates, each one being welded to a different longitudinally opposite end portions of said strip and being adapted to be in face to face engagement with a different one of said shoulders when said strip is so engaged with its associated flight on each rotor, said end plates and said shoulders having substantially aligned bores adapted for receipt of mounting bolt means thereinto extending.

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