July 11, 1961 H. K. SMITH 2,991,568

DIGGER WHEEL, PUMP AND MOTOR UNIT FOR DREDGES

Filed Nov. 19, 1959 3 Sheets-Sheet 1

Fig. 5.

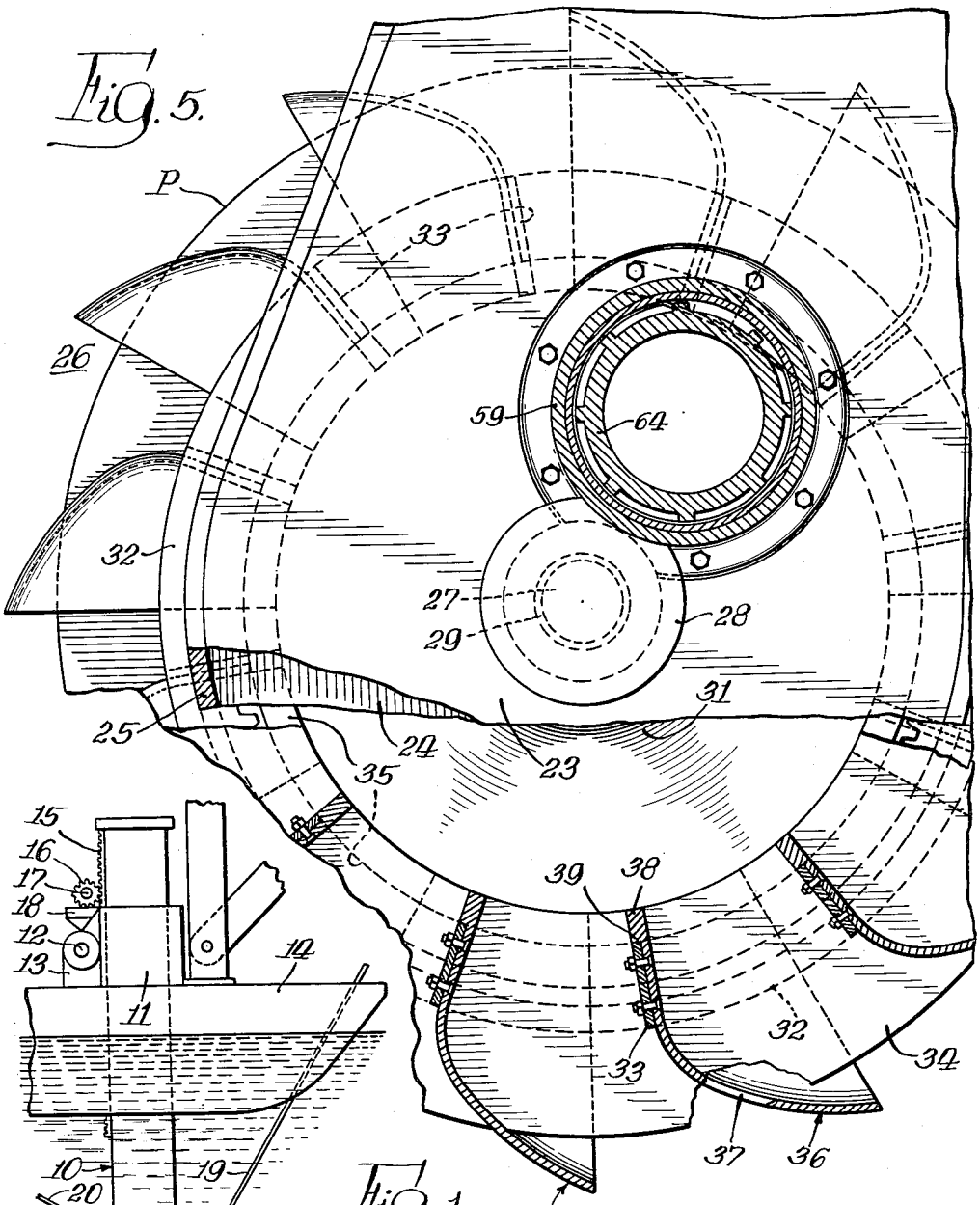


Fig. 1.

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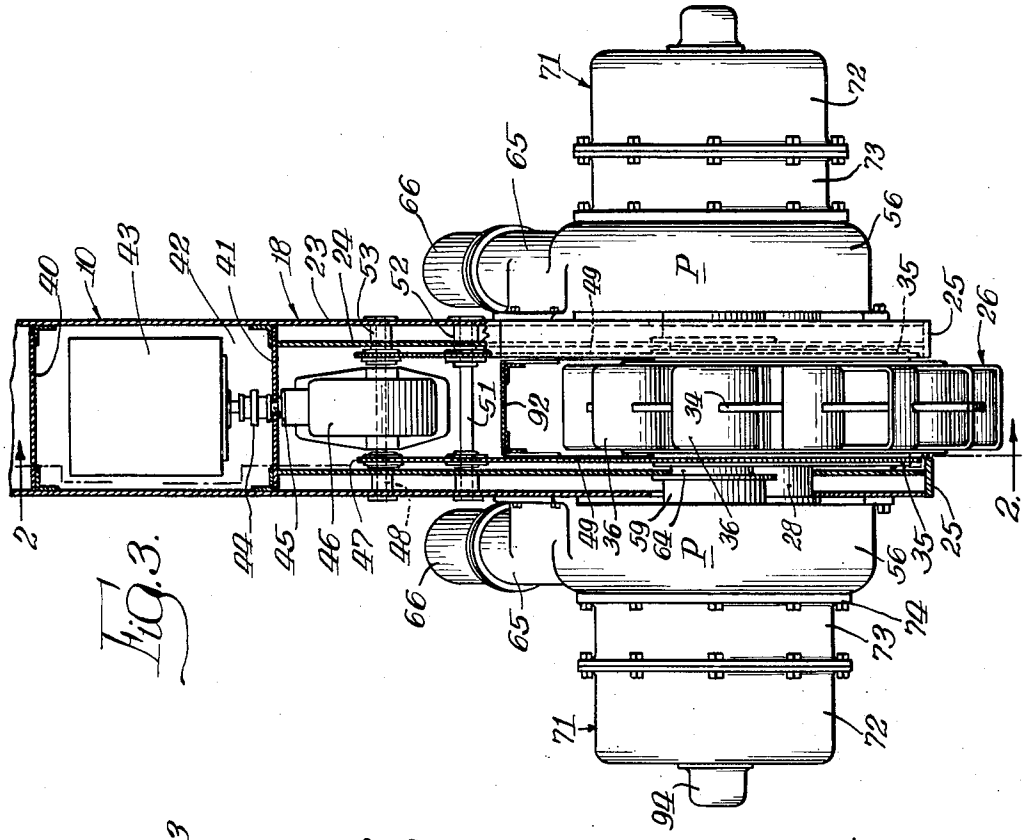


FIG. 3.

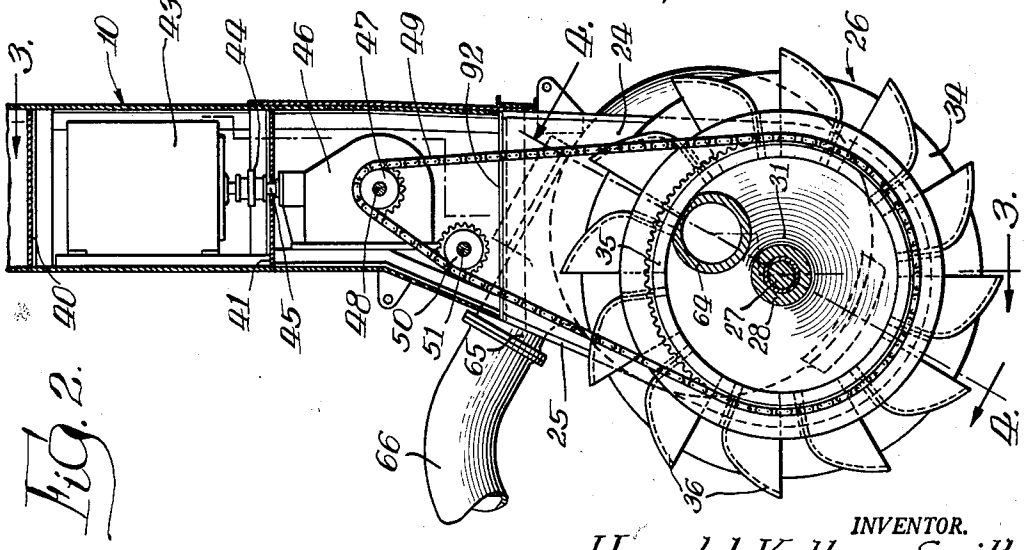


FIG. 2.

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DIGGER WHEEL, PUMP AND MOTOR UNIT FOR DREDGES

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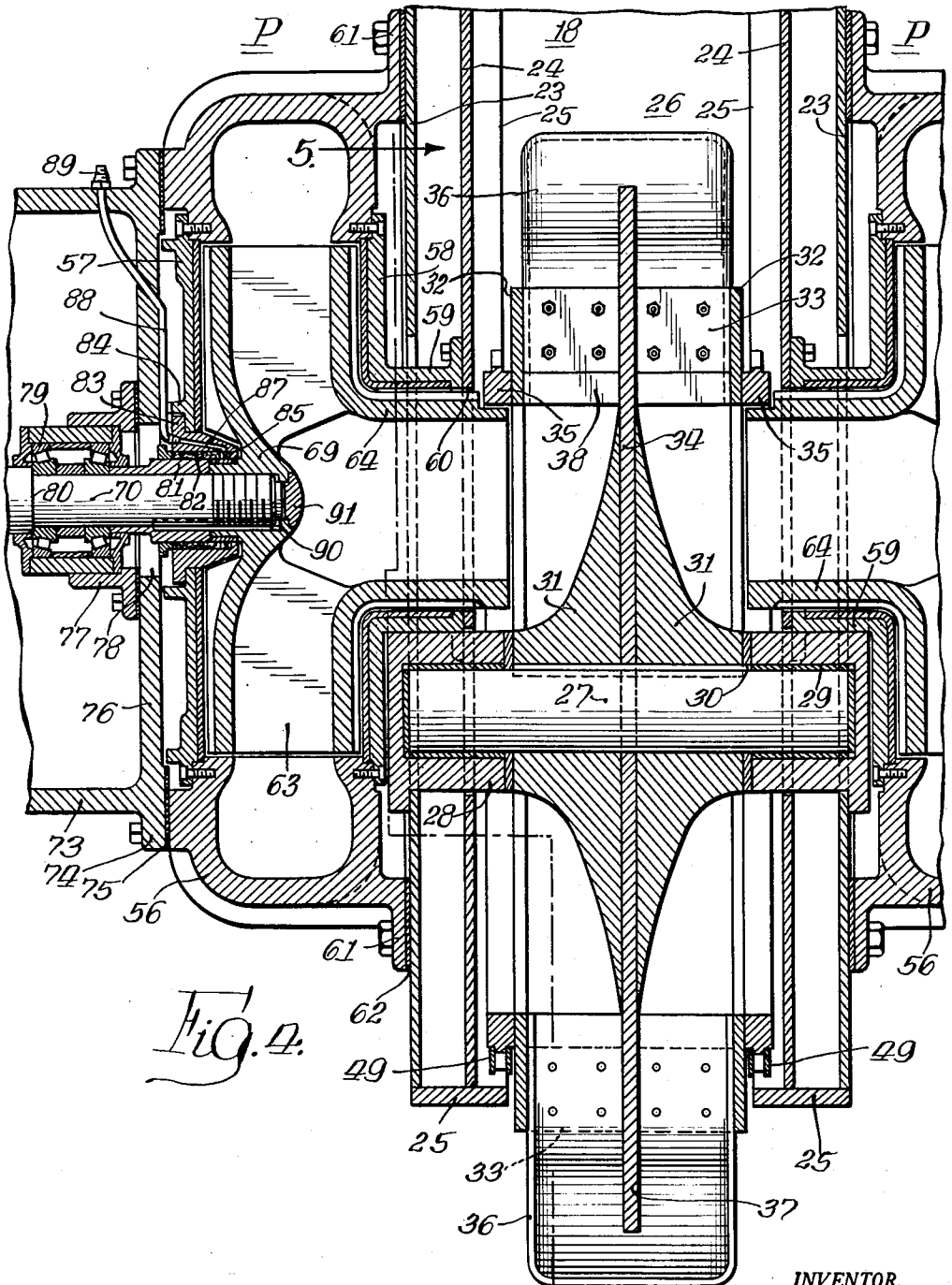


Fig. 4.

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DIGGER WHEEL, PUMP AND MOTOR UNIT FOR DREDGES

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10 Claims. (Cl. 37—66)

This invention relates to dredging apparatus, and has to do with a digger wheel, pump and motor unit particularly suitable for use in dredging and analogous operations.

It is known to provide a stick or column mounted on a float or hull for appropriate manipulation and provided at its lower or free end with a digger wheel having an associated suction line for discharge of the material or spoil removed by the wheel. In such known apparatus the wheel is driven by a motor mounted in the hull and suction pump, connected to the suction line, and its associated motor are also mounted in the hull. That necessitates priming of the pump and the use of comparatively expensive material for the suction line, and incurs heating of the motors with resultant reduced efficiency thereof. Further, the driving connections between the digger wheel and its driving motor in the hull are rather complex and expensive to maintain and may render adjustment and operation of the supporting column difficult and slow under adverse conditions. There is also the problem of clogging of the suction line, with resultant objectionable interruption in operation, due to the lack of positive mechanical pressure effective for forcing the spoil through the suction line pipe or conduit.

The unit of my invention is intended to avoid the objections above noted to the known dredging apparatus mentioned. To that end I provide a supporting stick or column mounted for vertical or lengthwise adjustment and movable about a transverse axis, such column having at its free end a unit comprising a digger wheel and associated pumps and motors. The pumps are positive discharge centrifugal hydraulic pumps discharging into flexible hose lines of adequate strength, through which the spoil is forced by the pumps. The pumps are driven by electric motors enclosed in water tight housings and are cooled by the water in which the unit is submerged. That avoids objectionable heating of the motors thereby rendering possible the use of smaller and less expensive motors for a given horse power than is permissible when the motors are mounted in the hull as in the known apparatus referred to above. The pumps and the motors are disposed at opposite sides of the digger wheel, effective for neutralizing side thrust and thereby reducing objectionable stresses and wear of parts. A further object of my invention is the provision of a digger wheel of improved construction and so disposed relative to the pumps as to assure maximum delivery of spoil thereto. Further objects and advantages of my invention will appear from the detail description.

In the drawings:

FIGURE 1 is a side view of a supporting column and a unit mounted thereon embodying my invention, shown as mounted on a dredge hull, the latter being shown fragmentarily and in side elevation;

FIGURE 2 is a sectional view, on an enlarged scale relative to FIGURE 1, taken substantially on line 2—2 of FIGURE 3;

FIGURE 3 is a sectional view taken substantially on line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view, on an enlarged scale, taken substantially on line 4—4 of FIGURE 2, certain parts being shown in elevation; and

FIGURE 5 is a sectional view taken substantially on line 5—5 of FIGURE 4, certain parts being broken away.

In FIGURE 1, I have shown the unit of my invention as mounted at the lower or free end of a supporting stick or column 10 of rectangular cross section slidably mounted through a collar 11 pivoted at 12 on an upright 13 mounted on a dredge hull 14. The column 10 is provided at its rearward side with a lengthwise rack bar 15 with which meshes a pinion 16 secured on a shaft 17 mounted on a bracket 18 carried by collar 11. The lower portion of column 10 flares downward to provide a head 18 of downwardly increasing width to which is attached, at the front thereof, a cable 19 for swinging the column 10 in counterclockwise direction about the transverse axis 12 during the dredging or digging operation. A second cable 20 is attached to the rearward side of head 18 for swinging the latter rearward, during which time the cable 19 is slacked off, as will be understood. The hull 14 is provided at the front or bower portion thereof with a lengthwise opening or slot for accommodating swinging movement of the column 10 about the transverse axis 12 and suitable means is provided for maneuvering the hull 14 for making desired cuts by the digger wheel, as is known and need not be shown nor described in detail here.

Referring to FIGURES 2 to 4, inclusive, the column 10 is of elongated box-like construction and the lower or head portion 18 thereof comprises outer side plates 23 and inner side plates 24 spaced inward a short distance from the outer plates 23, the space between the plates 23 and 24 being closed by a relatively thick strip 25 welded thereto and extending inward a short distance beyond the inner plate 24. A digger wheel 26 is rotatably mounted between the inner side plates 24 and is keyed on a shaft 27 rotatably mounted in flanged journal boxes 28 passing through plates 23 and 24 and suitably secured, conveniently by bolting, to plates 23, the journal boxes 28 being provided with suitable anti-friction liners 29 and there being suitable rings or washers 30 disposed between the inner ends of the journal boxes 28 and the hub 31 of wheel 26. The latter comprises two thick steel rings 32 between which extend cross bars 33 uniformly spaced about rings 32 circumferentially thereof and welded thereto. The hub 31 is formed in two parts between which is disposed a steel disk or divider plate 34 which extends radially outward to at least the outer peripheries of the side rings 32, preferably a substantial distance therebeyond. Sprocket rings 35 are welded to the outer faces of the side rings 32 with their radially inner faces aligned with the radial inner faces of the side rings 32. Appropriately formed digger buckets 36, provided with lengthwise slots 37 receiving the divider plate 34, seat on and are bolted to the cross bars 33, the respective buckets 36 being provided with a stiffened radially inner portion 38 forming a shoulder 39 which abuts the radially inner edge of the cross bar 33, as shown more clearly in FIGURE 5. The buckets 36 may, of course, be of any suitable form and construction to suit the work to be done, as may the cross bars 33, as will be understood. The column 10 is provided a short distance above the head 18 thereof, with interior transversely extending upper and lower partitions 40 and 41, respectively, forming, with the corresponding portion of column 10, a water tight housing 42 in which is mounted a variable speed electric motor 43 of suitable known type. The shaft of motor 43 has driving connection, through a coupling 44, to the input shaft 45 of a speed reducing unit 46 of suitable known type mounted in column 10 adjacent partition 41. Two sprocket wheels 47 are secured on the output shaft 48 of the speed reducer unit 46, at opposite sides thereof, and receive sprocket chains

49 (FIGURES 2 and 3) passing over idler sprocket wheels 50 secured on a counter shaft 51 extending between the sides of column 10 and rotatably mounted in flanged bearing cups 52 extending through and secured to the outer side plates 23 of head 18, the end portions of shaft 48 being likewise rotatably mounted in similar bearing cups 53. The sprocket chains 49 pass from the idler sprockets 50 about the sprocket rings 35 of the digger wheel 26 and thence to and about the sprocket wheels 47. The electric motor 43 is connected, by means of a suitable cable (not shown) to a generator in the dredge hull 14, or to any other suitable source of electrical energy. The motor 43, when energized, drives the digger wheel, through the speed reducer 46 and associated chain and sprocket means, at appropriate speed in counterclockwise direction as viewed in FIGURES 1, 2 and 5, as will be understood. While the digger wheel is being rotated counterclockwise as above described, the column 10 is swung in counterclockwise direction, as viewed in FIGURE 1, about the transverse pivot axis 12, so as to advance the cutter wheel into the bank or shoulder B for making the cut, indicated by the broken line c, the material or spoil removed by the cutter wheel being delivered to pumps, as will be described more fully presently.

A centrifugal hydraulic pump P is mounted on head 18 of column 10 at each side thereof, the pumps being disposed adjacent and at opposite sides of the digger wheel 26. The pumps P are, in general, of known construction and a brief description thereof will suffice. Each pump P comprises a suitable casing 56 to which are bolted outer and inner heads 57 and 58, respectively, with associated wear resistant liners. The inner head 58 has a central inwardly extending neck 59 open to the upper portion of the circular opening defined by the adjacent side ring 32 of digger wheel 26, it being noted that shaft 27 of wheel 26 is disposed below or to one side of neck 59, as shown more clearly in FIGURES 2, 4 and 5. It will be noted that the neck 59 is flanged at its inner end and seats on and is suitably secured, conveniently by bolting, to the corresponding inside plate 24 of head 18 about a circular opening 60 of plate 24. The pump casing 56 is provided with appropriately disposed flanges 61 seating on and bolted to the outer side plate 23 of head 18, a sealing gasket 62 being interposed between plate 23 and casing 56 to assure a fluid tight closure therebetween. A pump runner 63 of suitable known type is rotatably mounted in casing 56 and is provided with a tubular throat member or neck 64 extending through neck 59 of the inner head 58 and into the adjacent sprocket ring 35 of the digger wheel 26. In that connection it will be noted (FIGURE 4) that the upper portion of the inner end of throat member 64 is of reduced wall thickness and is disposed in close proximity to the radially inner face of the sprocket ring 35. A discharge nipple or tube 65 extends from the upper portion of the pump casing 56 substantially tangent thereto (FIGURES 1 to 3) and preferably is flanged at its upper end for attachment thereto of a flexible discharge conduit or hose 66 formed of rubberized fabric or other suitable material and of adequate strength to withstand the internal pressures to which it may be subjected, the hose 66 leading to a suitable point of discharge for the spoil and being supported, if desired or necessary, by suitably spaced floats attached thereto, as is known. The pump runner 63 is provided with a central hub 69 which is threaded onto the inner end portion of a motor shaft 70, to which hub 69 is also keyed. The shaft 70 extends from an electric motor 71 of suitable type mounted in a housing or casing comprising two flanged sections 72 and 73 bolted together with an intervening sealing gasket, flange 74 at the inner end of section 73 seating on and being bolted to pump housing 56 with an intervening sealing gasket 75. The inner end of housing or casing section 73 is closed by an end wall 76 to the outer face of which is secured, conveniently by bolting, a flanged bearing support ring 77. The ring 77 is disposed concentric with an opening 78 in end wall 76, through which shaft 70 passes, and supports a roller bearing assembly 79 for shaft 70 confined between shoulder 80 of the shaft and an interior shoulder of ring 77. A spacer sleeve 81 extends about shaft 70 and is confined between the inner end of the bearing assembly 79 and the outer end of hub 69. The inner end of sleeve 81 extends into a packing gland 82 of suitable known type mounted in a flanged stuffing box 83 bolted to the outer head 57 of pump casing 56, within an outwardly extending annular flange 84 thereof. The packing gland 82 preferably includes a water ring 85 of known type which receives water from a duct 87 in the stuffing box 83. The outer end of duct 87 is flared to receive the flared end of a tube 88 fitting therein and passing therethrough upward through flange 84 and through wall 76 to a fitting 89 at the top of section 73 of the motor housing. The tube 88 passes through the circumferential wall of housing or casing section 73 and the fitting 89 provides means for attaching to tube 88 a flexible tube or conduit through which clean water under pressure may be supplied to the water ring 85 and thence to the inner portion of the packing gland 82, effective for preventing entry of abrasive materials about the shaft 70. Shaft 70 is provided, at its inner end, with a stud 90 of reduced diameter which fits snugly in a corresponding bore in hub 69 of runner 63, the inner end of such bore being closed by the flanged plug or cap 91 suitably secured, conveniently by welding, in the inner end of hub 69.

The motor shaft 70 extends through sections 73 and 72 of the motor housing or casing and is mounted at its outer end in roller bearings (not shown) carried by closure cap 94 suitably secured conveniently by bolting, to the outer end wall of motor housing or casing section 72 with an intervening gasket, to provide a fluid tight closure therebetween. Section 72 of the motor housing or casing contains an electric motor of suitable known type which is connected by a cable (not shown) to a generator or other suitable source of electrical energy carried by the hull 14. The motors are disposed coaxial with the pumps and preferably are driven in parallel and are variable speed motors. In the operation of the unit of my invention the spoil is discharged from the digger wheel 26 at opposite sides of the divider plate 34 into the throat member 64 of the motor pump runners 63 and is discharged by the latter under positive pressure through the discharge hose or conduits 66. By disposing the digger wheel shaft 27 to one side of the necks 59 of the inner heads 58 of the motor casings 56, and securing the side rings 32 of the digger wheel 26 together by the cross bars 33, the inner ends of the throat member 64 of the pump impellers 63 are unobstructed, conducive to ready delivery thereto from the digger wheel 26 of the spoil. The inner side plates 24 of head 18 of column 10 are disposed in proximity to the sides of the digger wheel 26 and the closure plates or strips 25 of the head 18 of column 10 extend about the head 18 at the front and the back thereof and upward to a partition and brace structure 92 extending from front to back of head 18 between the sprocket chains 49, a short distance above the digger wheel 26. A previously noted, the strips 25 extend inward beyond the inner side plates 24, into close proximity with the side rings 32 of digger wheel 26 and, in cooperation with plates 24, confine the spoil laterally in the digger wheel thereby avoiding objectionable loss or spillage thereof. The inwardly projecting portions of strips 25 also provide, in cooperation with the plates 24, boxings about the sprocket rings 35 and chains 49 protecting them against damage and clogging by the material or spoil in which the digger wheel is operating. As the buckets 36 approach the upper portion of digger wheel 26 in the ro-

tation thereof, the material or spoil is diverted at opposite sides of the divider plate **34** into the pump throat members **64**. In that connection, referring to FIGURE 4, it will be noted that the hub **31** of the digger wheel increases in thickness radially inward providing, at opposite sides of the divider plate **34**, surfaces which are inclined radially inward and axially outward of the digger wheel **26**, such surfaces being highly effective for directing the spoil into the throat members **64** of the pump runners **63**. The pumps P being at opposite sides of the digger wheel **26**, are oppositely related, that is, are right and left hand pumps, as will be understood. The pumps are coaxial with each other and with the associated motors **71**, the axis of digger wheel **26** being eccentric to the common axis of the pumps and the drive motors therefor, as previously noted. The pump motors **71** are submerged in water during the dredging operations, as is the digger wheel motor **43**, thereby guarding against objectionable heating of the motors. That renders it possible to use motors which are of smaller size and less expensive, for a given horse power, than the motors which would be required if carried by the dredge hull in accordance with the present practice referred to above.

During dredging operations, the pumps and associated parts of the unit may be subjected to substantial side thrusts capable of causing objectional stresses and wear of parts if not guarded against. By disposing the pumps and their drive motors at opposite sides of the digger wheel, the side thrusts are substantially neutralized, and the disposition of the motors and the pumps coaxially has the further advantage of avoiding twisting stresses to which the unit might otherwise be subjected. The unit of my invention thus neutralizes side thrust and twisting stresses, which is conducive to long life and accurate operation while rendering possible the use of smaller and less expensive motors than would otherwise be permissible. A further advantage of the unit of my invention is that the motors are disposed in proximity to the pumps and the digger wheel, thereby eliminating complex driving connections between the digger wheel and its motor, which is conducive to ease and accuracy in manipulating the supporting column while avoiding the expense and delay frequently encountered in respect to the driving connections between the digger wheel and its drive motor when the latter is mounted in the dredge hull in accordance with the present practice above mentioned.

It will be understood, as indicated above, that changes in detail may be resorted to without departing from the field and scope of my invention, and I intend to include all such variations, as fall within the scope of the appended claims, in this application in which the preferred form only of my invention has been disclosed.

I claim:

1. In dredging apparatus, a supporting column free at one end and mounted for lengthwise movement and for movement about a transverse axis, a unit carried by said column at the free end thereof comprising a digger wheel, two pumps at opposite sides of said wheel receiving spoil therefrom, motors at the outer sides of said pumps having driving connection thereto, said pumps and motors being coaxial and said wheel being rotatable about an axis eccentric to the common axis of said pumps and motors, and a motor carried by said column having driving connection to said wheel.

2. In dredging apparatus, a unit comprising a central digger wheel, pumps at opposite sides of said digger wheel, the latter being rotatably mounted on said pumps and having independent drive means, and motors at the outer sides of said pumps having driving connection therewith, said pumps and digger wheel having cooperating means for discharging spoil from said digger wheel into said pumps.

3. In dredging apparatus, a unit comprising a central digger wheel, pumps at opposite sides of said digger wheel, the latter being rotatably mounted on said pumps and having independent drive means, and motors at the outer sides of said pumps having driving connection therewith, said motors being coaxial with said pumps and the latter and said digger wheel having cooperating means for discharging spoil from said digger wheel into said pumps.

4. In dredging apparatus, a unit comprising a digger wheel, pumps at opposite sides of said digger wheel respectively comprising a casing and a runner therein, tubular throat members extending from said runners to said digger wheel at opposite sides thereof, said digger wheel having side openings for discharging spoil into said throat members and being mounted for rotation relative to said pump runners and having independent drive means, and motors at the outer sides of said pumps having drive shafts extending into said pump casings with driving connection to said runners.

5. In dredging apparatus, a unit comprising a digger wheel, pumps at opposite sides of said digger wheel respectively comprising a casing and a runner therein, tubular throat members extending from said runners to said digger wheel at opposite sides thereof, said digger wheel having side openings for discharging spoil into said throat members and being mounted for rotation relative to said pump runners and having independent drive means, said digger wheel having a central divider plate and lateral openings for discharging spoil at opposite sides of said plate into said throat members, and motors at the outer sides of said pumps having drive shafts extending into said pump casings with driving connection to said runners.

6. In dredging apparatus, a unit comprising two coaxial pumps disposed in spaced parallel relation and respectively comprising a casing and a runner therein having a central tubular throat member opening through the inner side of said casing, motors mounted on the outer sides of said pump casings having drive shafts extending into said casings with driving connection to said runners, a rotatably mounted digger wheel shaft extending between said motor casings and disposed to one side of said throat members, and an independently driven digger wheel rotatably mounted on said shaft and having lateral openings disposed to discharge spoil into said throat members.

7. In dredging apparatus, a supporting member, two opposed pumps mounted on said member in spaced parallel relation respectively comprising a casing mounted on said supporting member and a runner therein having a central tubular throat member opening through the inner side of said casing, motors mounted on the outer sides of said pump casings having drive shafts extending into said casings with driving connection to said runners, a digger wheel shaft parallel with said motor drive shafts rotatably mounted on said supporting member between said pumps and disposed to one side of said throat members, a digger wheel rotatably mounted on said shaft and having lateral openings disposed to discharge spoil into said throat members, and a motor mounted on said supporting member and having driving connection to said wheel.

8. In dredging apparatus, a supporting member, two opposed pumps mounted on said member in spaced parallel relation respectively comprising a casing mounted on said supporting member and a runner therein having a central tubular throat member opening through the inner side of said casing, motors mounted on the outer sides of said pump casings having drive shafts extending into said casings with driving connection to said runners, a digger wheel shaft parallel with said motor drive shafts rotatably mounted on said supporting member between said pumps and disposed to one side of said throat members, a digger wheel rotatably mounted on said shaft, and a motor mounted on said supporting member and having driving connection to said wheel, said wheel comprising side rings defining unobstructed circular openings overlying and in close proximity to the inner ends of said throat members, a central divider plate extending radially outward of said wheel and a hub structure providing at

opposite sides of said plate surfaces extending radially inward and axially outward of said wheel for directing spoil into said throat members.

9. In dredging apparatus, a supporting member, two opposed pumps mounted on said member in spaced parallel relation respectively comprising a casing mounted on said supporting member and a runner therein having a central tubular throat member opening through the inner side of said casing, motors mounted on the outer sides of said pump casings having drive shafts extending into said casings with driving connection to said runners, a digger wheel shaft parallel with said motor drive shafts rotatably mounted on said supporting member between said pumps and disposed to one side of said throat members, a digger wheel rotatably mounted on said shaft, and a motor mounted on said supporting member and having driving connection to said wheel, said wheel comprising side rings held in spaced parallel relation by cross bars secured thereto and defining unobstructed circular openings overlying and in close proximity to the inner ends of said throat members, a central divider plate extending radially outward of said wheel to the outer peripheries of said rings, a hub structure providing at opposite sides of said plate surfaces extending radially inward and axially outward of said wheel for directing spoil into said throat members, and digger buckets secured to said cross bars fitting between and extending radially outward beyond said rings and provided with slots receiving said divider plate.

10. In dredging apparatus, a unit comprising a digger wheel mounted for rotation about a substantially horizontal axis, a pump at one side of said wheel comprising a runner rotatable about a substantially horizontal axis, a motor mounted at the outer side of said pump having driving connection thereto and enclosed in a water tight casing exposed for direct contact with water in which said unit is submerged, and means for driving said digger wheel independently of said pump and motor, said pump and digger wheel having cooperating means for discharging spoil from said digger wheel into said pump.

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