Sept. 24, 1968 A. H. VAUGHAN ET AL 3,402,487

HYDROPNEUMATIC RIVER RAKE

Filed Sept. 11, 1964 3 Sheets-Sheet 1

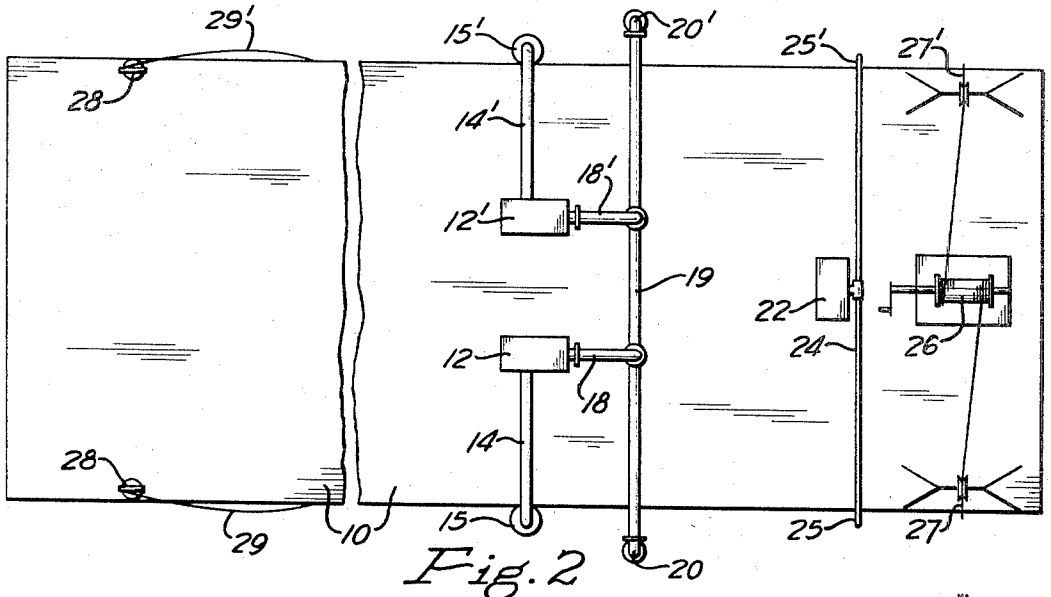


Fig. 2

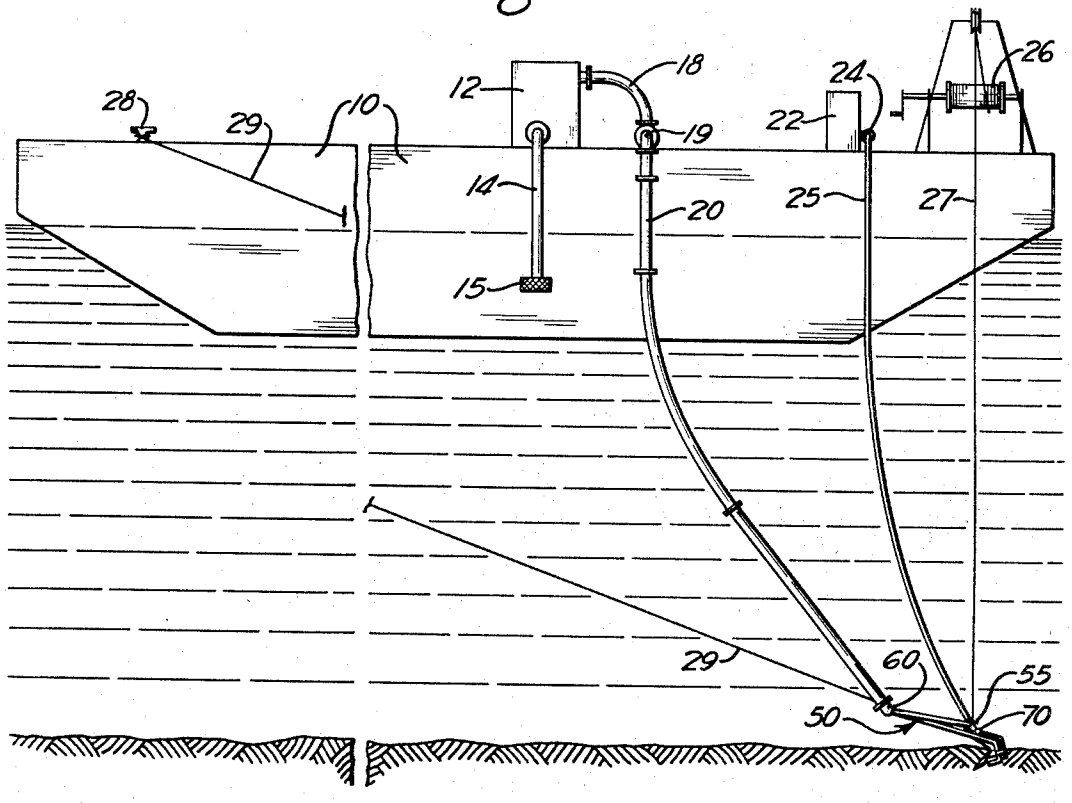


Fig. 1

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HYDROPNEUMATIC RIVER RAKE

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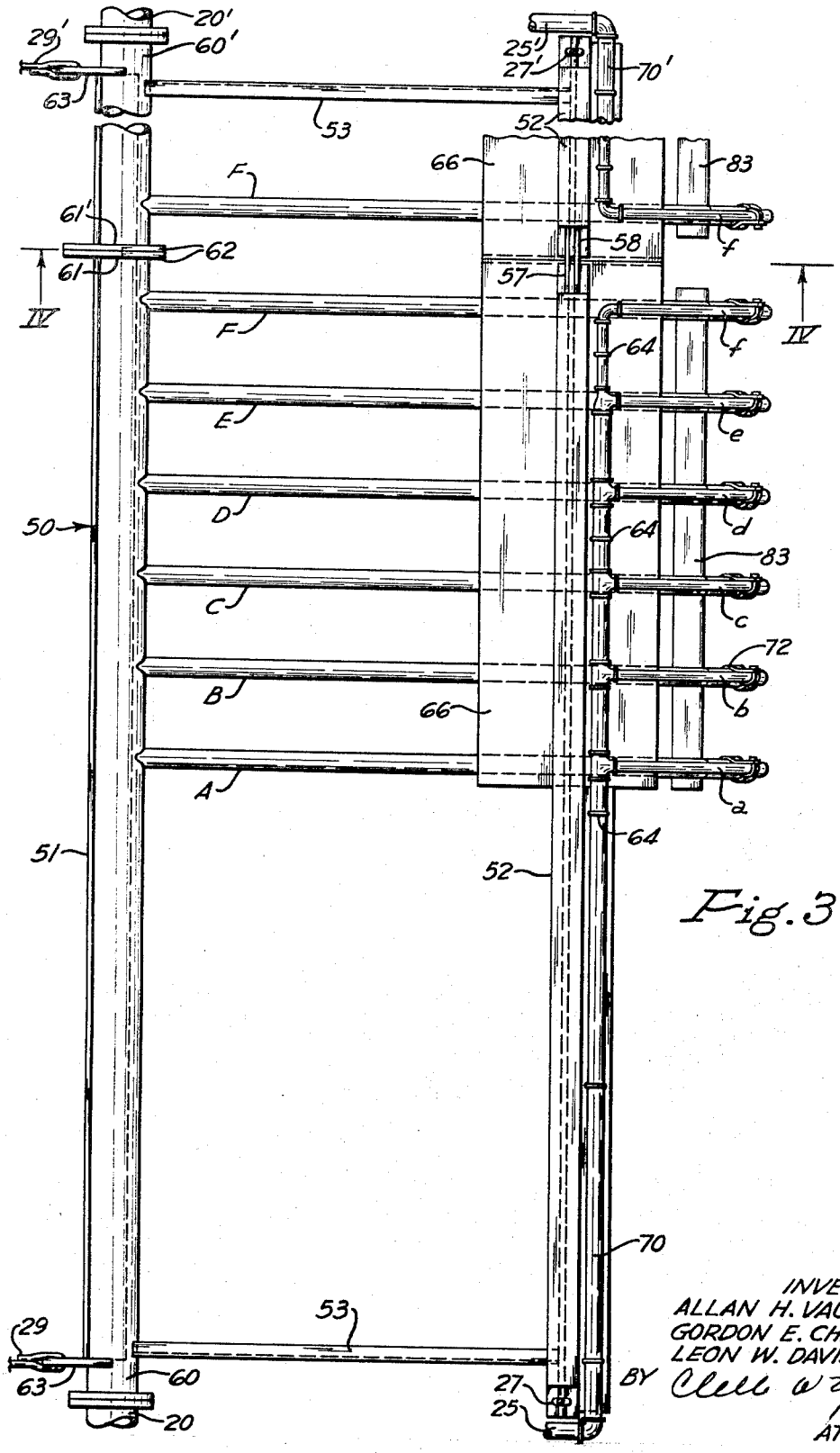


Fig. 3

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HYDROPNEUMATIC RIVER RAKE

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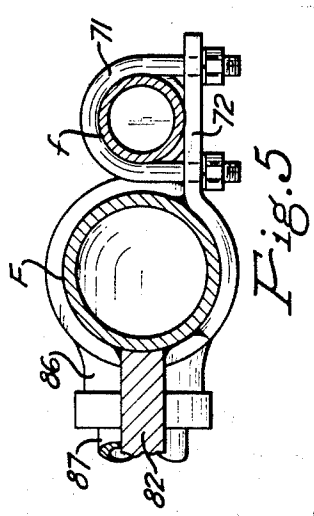
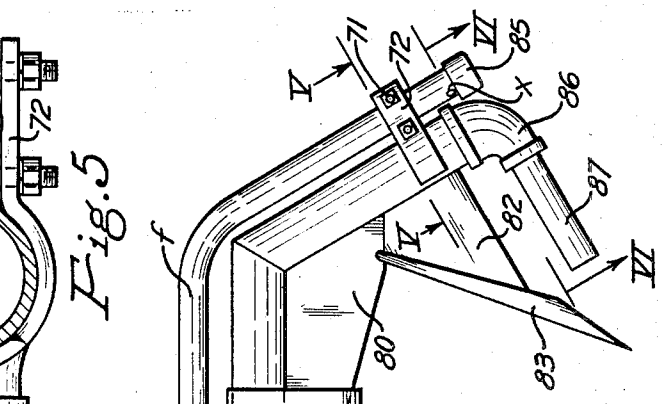


Fig. 5



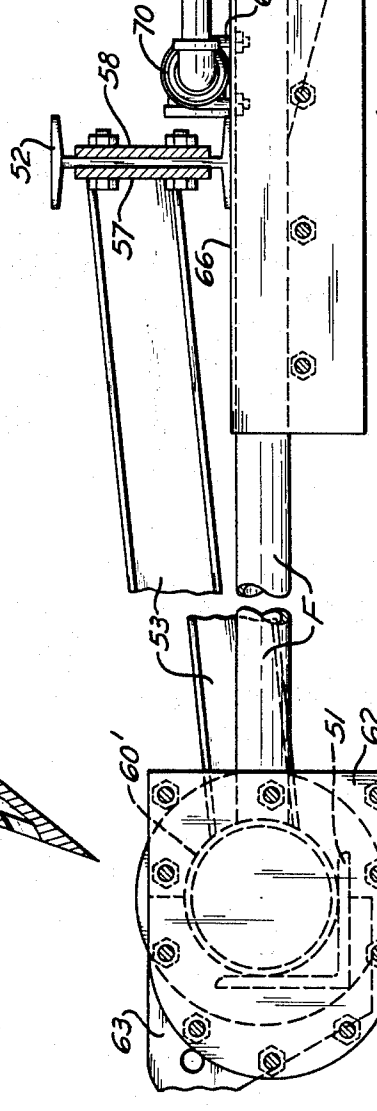


Fig. 4

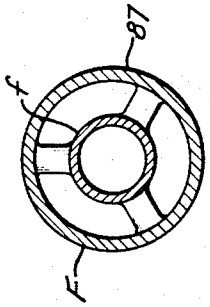


Fig. 7

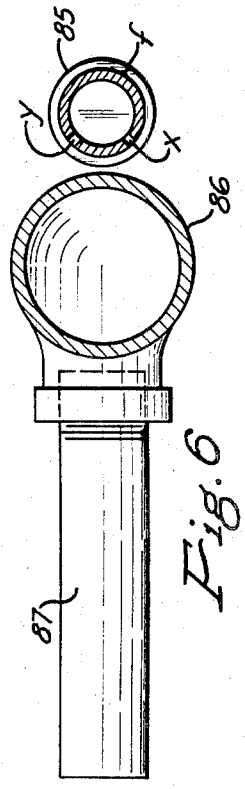


Fig. 6

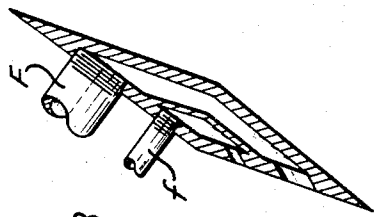


Fig. 8

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HYDROPNEUMATIC RIVER RAKE

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Filed Sept. 11, 1964, Ser. No. 395,734
3 Claims. (Cl. 37—78)

ABSTRACT OF THE DISCLOSURE

A rake having in combination a dispersion means adapted to direct a stream of air in the vicinity of a mechanical plowing means and an hydraulic plowing means adapted to deliver a stream of water in the vicinity of the mechanical plowing means.

This invention relates to a method and an apparatus for treating the bed of a waterway, and more specifically, to a method and apparatus for restoring the efficiency of Ranney wells.

A Ranney well has a bore extending into the earth which serves as a storage chamber for water, and a plurality of finger-like projections emanating from the chamber, usually near the bottom of it. The bore is generally lined with concrete and sunk into the ground on the bank of a waterway to the level of the rock layer of the earth's strata. It is in this chamber of the well that the water accumulates, and from which it is thereafter pumped to consumers. The water in the cylindrical portion of a Ranney well accumulates through the finger-like projections or laterals at its base, which projections are generally made of perforated steel pipe and extend under the waterway. The water which filters down through the earth and/or the bed of a waterway past the rocky gravel layer of the earth's strata enters the perforated steel pipe of the laterals, and is channeled into the cylinder of the well where it accumulates. As a consequence, when the bed of a waterway becomes encrusted, the water is unable to filter down to these finger-like projections or laterals of the Ranney well, and the well operates less and less efficiently. Further, in the eventuality that the season is dry and the level of water in the waterway is low, the extra pressure due to the height of the water in the waterway is no longer available to aid in pushing the water through the earth's layers to the laterals and thence into the body of the well. Where the combination of the above mentioned factors cooperate at the same time, a disastrous situation arises with the consequence that an ample supply of water may not be available.

Therefore, since Ranney wells depend on the porosity of the bed of a body of water in order to maintain their level of efficiency, it is vitally important to those communities that depend solely on Ranney wells for their source of water, to maintain some degree of porosity of the river bed in order to maintain the level of water in the well. Where the bottom of a body of water has become encrusted or impacted, and where it is given to becoming thus encrusted and impacted at frequent intervals of time, an economical and relatively simple apparatus is an absolute necessity in order to insure an adequate water supply to communities depending on a Ranney well, or any other type of well that derives water from a body of water such as a river, for example.

Various dredging apparatuses have been suggested for destroying the crust on the surface of a river bed, but none of these have been every effective. Even those apparatuses which have afforded a little relief, do so for only very short periods of time, necessitating frequent

and expensive dragging operations in all seasons of the year.

It is therefore an object of this invention to provide an expedient method for restoring the effectiveness of Ranney wells, and any other type of well that depends on a body of water for its supply of water.

It is a further object of this invention to provide an apparatus which will restore the porosity of the bed of a body of water.

It is a further object to provide an apparatus which will afford relief to the users of Ranney wells for relatively long periods of time without the necessity of frequent dredging operations.

Yet another object of this invention is to provide an apparatus which will effectively restore the porosity of the bed of a body of water and reclassify it by allowing the more buoyant debris to escape to the surface of the water, allowing the sandy materials to resettle, and allowing the undesirable silt-like material to be removed downstream.

Yet another object of this invention is to provide an apparatus which operates efficiently to dislodge fallen trees and embedded rocks, for example, so that they may be easily removed.

A further object of this invention is to provide an apparatus capable of substantially leveling off the surface of the bed of a waterway and removing entangling plants and debris so that the waterway may be made safe for navigation.

These and other objects will become apparent from the following description and the accompanying drawings in which

FIGURE 1 is a diagrammatic side view of the whole assembly of one embodiment of the invention;

FIGURE 2 is a partial diagrammatic plan view of the embodiment of FIGURE 1;

FIGURE 3 is a top plan view of the rake assembly;

FIGURE 4 is a section taken through the assembly at IV—IV of FIGURE 3;

FIGURE 5 is a view taken along V—V of FIGURE 4;

FIGURE 6 is a view taken along VI—VI of FIGURE 4; and

FIGURES 7 and 8 illustrate other embodiments of an apparatus provided by this invention.

The foregoing objects and others are accomplished in accordance with this invention, generally speaking, by providing an apparatus for treating the bed of a body of water and adapted to be pulled by a barge or the like, said apparatus including a rake assembly combining a mechanical plowing means, an hydraulic plowing means and a dispersion means, all of which are mounted on a supporting structure which includes a plurality of heavy steel beams to which the plowing means and dispersion means are fastened. The mechanical plowing means includes a plurality of spaced plow shares which dig into the bed of the waterway and which are arranged in a manner similar to a garden rake. The hydraulic plowing means includes a water manifold to which is connected a plurality of water conduits, there being preferably one conduit for each plow share. The water conduits terminate in a nozzle which directs a stream of water under a substantial pressure to the vicinity of the plow share. The dispersion means includes an air manifold to which is connected a plurality of air conduits, there being one air conduit for each water conduit. The air conduits are disposed behind the plow share and the nozzle of each water conduit and have an outlet which permits air delivered under a substantially high pressure to cause high turbulence of the materials stirred up by the plow share and the jet of water. The dispersion means rapidly agitates the material in its vicinity allowing the more buoyant

materials such as uprooted plants and the like to rise to the surface of the water, and permitting the silt to enter the main stream of the body of water to be conducted away from the portion of the river bed being treated. The heavier sandy material settles to the bottom of the waterway, and the porosity of the bed of the waterway is thus restored and the bed of the waterway is effectively reclassified.

In the eventuality that a body of water is being treated which is stagnant or which has substantially no current, one modification of this invention which has been found to be extremely practical is the use of propellers, either alone or in conjunction with a stream of air or water directed away from the dredging area to carry away the undesirable silt-like portions of the river bottom which have been plowed up. Further, the plow share which is rigidly fixed to the assembly within the point of aim of the water jet may be adapted to dig into the bed of a waterway to any desired depth and the depth to which it is capable of plowing is restricted only by the size of the plow share available, the practical limits of the strength of the supporting structure, and the power of the dragging means for the rake assembly.

Because of the novel combination and relative location thereof, the plow share, the air delivered under substantially high pressure, and the water pumped at a substantially high pressure cooperate at substantially the same area of concentration with the result that the rock-like formations which occur on the surface of a bed of a body of water are easily broken up and pulverized in one action restoring the bed of the waterway to a porosity which allows wells in the surrounding area to fill. In addition, it is readily apparent that such an apparatus has many applications in instances where it is desirable to level off the bottom of a waterway and reclassify it, or to prepare it for safe navigation by boats and the like vessels. The present invention is extremely useful for ridding the bottom of a waterway of natural and artificial deposits and barriers which build up or are deposited in the course of time, and the apparatus is invaluable for destroying entangling plants and the like which also tend to make navigation hazardous. A further advantage of the invention resides in the fact that although the apparatus is so efficient for treating the bed of a waterway and restoring Ranney wells and other wells depending on the waterway for their source of water, the apparatus and the means of employing it poses no threat to the wildlife which enjoy the waterway being treated as their natural habitat. The apparatus of this invention is not injurious to fish and other wildlife that inhabits the waterway, and for this reason, an added humane advantage is demonstrated over any other type of apparatus heretofore available for treating the bed of a body of water.

The preferred embodiment of this invention is more specifically described with reference to the accompanying drawings in which all of the numerical designations in the various figures uniformly refer to the same portion of the assembly. FIGURES 1 and 2 are a diagrammatic side view of the whole assembly and a partial diagrammatic plan view, respectively, and show a shallow draft barge or boat **10** of conventional construction which may be provided with a means for self-propulsion or which may be towed or pushed by another vessel. Mounted on the barge are two conventional power driven pumps shown schematically at **12** and **12'**. Each pump receives water by means of a trailing intake line **14** and **14'** on either side of the barge, which intake line is provided with a filter or strainer **15** and **15'**. From each pump **12** and **12'**, water is impelled rearwardly via an outlet line **18** and **18'** to an athwartship deck water header **19** which feeds the water under pressure to conduits **20** and **20'** at either side of the barge **10**. Although any suitable pump and pressure may be used to force the water to the conduits **20** and **20'**, in the preferred embodiment of the invention about 300 to 1500 g.p.m. are pumped at about 50 to 200 p.s.i.g. The conduits **20** and **20'** then direct the water under a substantially high pressure into the water manifolds **60** and **60'** of the rake assembly **50**.

Mounted medially behind the deck water header **19** on the barge **10** is an air compressor shown schematically at **22**. The air compressor **22** connects via a T to an athwartship air hose **24** which delivers air at a high pressure to conduits **25** and **25'** at either side of the vessel. Although any suitable air compressor and pressure may be used to force the air to the conduits **25** and **25'**, in the preferred embodiment of this invention about 500 to 1500 c.f.m. are pumped at about 100 to 200 p.s.i.g. The conduits **25** and **25'** direct the pressurized air into the air manifolds **70** and **70'** of the rake assembly **50**.

Mounted medially behind the air compressor **22** on the barge **10** is a lift winch **26** which needs no further description since it is standard barge equipment. The winch is attached at either side of the barge **10** to the lift beam **52** of the rake assembly **50** by means of lift cables **27** and **27'**.

At the forward portion of the barge **10** is a deck cleat **28** to which is attached two drag cables **29** and **29'**, one on either side of the barge **10**. The drag cables **29** and **29'** are connected to either end of the rake assembly **50** and serve the function for which they are named.

With reference to the rake assembly **50**, for the sake of expediency in illustrating the apparatus, FIGURE 3 shows a top view of only the left half of the rake assembly. It is readily apparent that a whole rake assembly is easily fabricated by merely making the part shown and connecting it to the same part made opposite hand. The half rake assemblies are joined at the portion of the rake furthest from the dragging means by the use of splice plates **57** and **58**. The portion of the rake closest to the dragging means is joined to the same part made opposite hand by bolting together the two water manifolds **60** and **60'**. The water manifolds **60** and **60'** are made of pipe flanged at both ends, each of which pipes is closed off at one end **61** and **61'**. It is at these closed off ends of the flanged pipe that the water manifolds are bolted together.

The rake assembly comprises for each half rake, a supporting structure, a water manifold **60** and an air manifold **70**. The water manifold **60** and the air manifold **70** are each connected to a plurality of conduits indicated by capital letters and lower case letters for the water system and air system respectively. Each water conduit terminates in a nozzle and each air conduit terminates by being closed off so that the air stream is forced through holes critically positioned in the conduit. For the purposes of illustration, the half rake assembly is shown with six pairs of conduits; however, it is obvious that as many or as few pairs of conduits as desired may be used in each half rake assembly.

More specifically, the supporting structure of each half rake assembly is comprised of a first transverse member **51** and a second transverse member **52**, the water manifold being secured by a brace **53** to the second transverse member **52**. The first transverse member **51** is an L-shaped beam and is secured to flange **62** and drag line plate **63**. The second transverse member is an I-beam and is also designated herein as a lift beam since it is to either end **27** of this member of the assembly that the lift cables are attached by which the rake may be raised and lowered. The water manifold **60** is welded and buttressed into the angle of the first transverse member **51**. The end brace **53** is coped to fit the curvature of the water manifold and secured to the water manifold **60**, while the other end of the brace **53** is welded to the lift beam **52**. The lift beam **52** is rigidly attached to the conduits of the water manifold A, B, C, D, E, and F by means of a tie plate **66** secured to the underside of the lift beam **52**. The air manifold **70** from which a plurality of conduits *a, b, c, d, e,* and *f* emanate is rigidly attached by means of U-bolts **64** to the tie plate **66**. Similarly, each of the air conduits *a, b, c, d, e,* and *f* is clamped to a parallel water

conduit by means of a U-bolt **71** and a bracket **72** as shown in FIGURE 5.

In FIGURE 4 in which one of the outlet assemblies is detailed in a section taken through the rake assembly at IV—IV of FIGURE 3, a portion of the supporting structure is illustrated in more precise detail than shown in FIGURE 3. The first transverse member **51** is an L-beam support for the water manifold **60'**. The brace **53** is coped to fit the water manifold **60'** and is welded thereto. The other end of the brace **53** is welded to the second transverse member **52**. Splice plates **57** and **58** bolted to the web of the second transverse member **52** serve as a means for joining the half rake assemblies together. The two halves are also joined at the portion of the rake closest to the dragging means by bolting together the flanges **62** and the adjacent ends **61** and **61'** of the water manifolds **60** and **60'** respectively. A drag line plate **63** is located at either end of the rake assembly. The air conduits are rigidly attached by means of U-bolts **64** to a tie plate **66** which also secures the water conduits and supports them. Each air conduit *f* is also attached to a parallel water conduit F by means of a U-bolt **71** and a bracket **72**. (This assembly is more specifically shown in FIGURE 5 which is a section taken along V—V of FIGURE 4.) A stiffener plate **80** is welded to the water conduit and secures the bend in the water conduit, and rigidly supports it. A gusset plate **82** fastened to the water conduit F and the stiffener plate **80** rigidly supports a blade or plow share **83** in spaced relationship to the outlet of the water conduit **87** and the outlets of the air conduit *x* and *y*.

The relationship between the plow share, the nozzle of the water conduit, and the outlets of the air conduit shown in FIGURES 3–6 is preferred for the utmost efficiency of operation. The relationship between the air outlet and the water conduit is more precisely shown in FIGURE 6 which is a view taken along VI—VI of FIGURE 4, and which shows a cross-section of the water conduit F terminating in a nozzle **87**, and a cross-section of the air conduit *f* terminated by a cap **85**. The air conduit *f* has two holes *x* and *y* through which the air jets out around the water conduit F at a point just above the bend in the elbow **86** of the water conduit. The location of the air holes is important since they must be in a position to direct streams of air around the water conduit, but they must be spaced close together enough so that they are capable of sufficiently concentrating the streams of air to stir up the materials plowed up by the cooperative effort of the plow share and the water jet. Further, if the holes are shifted a substantial distance upward or downward, the streams of air would be incapable of "sifting" and stirring the materials plowed up from the bottom of the waterway. Therefore, in the preferred embodiment of the invention pictured in FIGURE 6, the air holes are positioned at substantially 45° angles on either side of a straight line drawn through the center of the air and water conduits, and at a point just above the bend of the elbow **86** of the water conduit.

In addition to those modifications already mentioned wherein extra streams of air and or water either alone or in conjunction with a propeller or the like may be added to the assembly to facilitate the operation of the rake in a stagnant or relatively stagnant body of water, or wherein it was mentioned that the plowing depth of the blade may be regulated and is limited only by the strength of the equipment and the available plow shares or blades, there are various other modifications of the apparatus which have been found to be expedient in the practice of this invention. For example, in the modification illustrated in FIGURE 7, a cross-sectional view of the nozzle **87** is shown. In this modification of the apparatus, only one conduit is externally apparent since one conduit is positioned inside of the other; in this manner, the jet of water and the jet of air are delivered simultaneously through the same outlet under a substantially high pressure. In another modification shown in FIGURE 8, the water and the air jets are delivered through the blade or plow share which is an elongated tetrahedron-shaped, hollow blade or plow share. It is to be remembered that the primary purpose of the jet of water is to aid in the plowing operation, while the air is a dispersing means by which the material plowed up is "sifted" and the bottom of the waterway is reclassified as hereinbefore explained. For that reason, it is preferable in this arrangement, that the air is emitted at a point somewhat above that at which the water is delivered.

Although the invention has been described in considerable detail in the foregoing, it is to be understood that variations may be made by those skilled in the art without departing from the spirit and scope of the invention except as set forth in the claims.

What is claimed is:

1. A means for treating the bed of a waterway which comprises a mechanical plowing means, a hydraulic plowing means and a dispersion means which are mounted on a supporting structure; said mechanical plowing means being comprised of a plurality of spaced plow shares; said hydraulic plowing means being comprised of a plurality of water conduits which emanate from a water manifold, each of which water conduits terminates in a nozzle which directs a stream of water under a pressure of from about 300 to about 1500 gallons per minute (g.p.m.) at about 50 to about 200 p.s.i.g. to the vicinity of a corresponding plow share; said dispersion means being comprised of a plurality of air conduits, there being one air conduit for each water conduit, each of which air conduits being mounted on the corresponding water conduit in such a manner that the outlet of the air conduit which is comprised of two holes spaced at 45° angles on either side of a straight line drawn through the center of the air and water conduits, directs streams of air around the water conduit to the vicinity of the plowing means at a pressure of from about 500 to about 1500 cubic feet per meter (c.f.m.) at about 100 to about 200 p.s.i.g.; said supporting structure being comprised of a plurality of beams to which the plowing means and the dispersion means are fastened.

2. A means for treating the bed of a waterway which comprises a mechanical plowing means, a hydraulic plowing means and a dispersion means, said mechanical plowing means being comprised of a plurality of spaced plow shares; said hydraulic plowing means being comprised of a plurality of water conduits which emanate from a water manifold, each of which water conduits terminates in a nozzle which directs a stream of water under a substantial pressure to the vicinity of a corresponding plow share; said dispersion means being comprised of a plurality of air conduits which emanate from an air manifold, each of which air conduits being positioned inside of a corresponding water conduit of the hydraulic plowing means.

3. A means for treating the bed of a waterway which comprises a mechanical plowing means, a hydraulic plowing means and a dispersion means; said mechanical plowing means being comprised of a plurality of spaced hollow plow shares; said hydraulic plowing means being comprised of streams of water delivered through outlets provided in the hollow plow share to the vicinity of the plow point; said dispersion means being comprised of streams of air delivered through outlets provided in the hollow plow share at a point above that at which the stream of water is delivered.

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