United States Patent

Kauffman et al.

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[45] **Jan. 18, 1972**

[54] MODULAR PLOW SYSTEM FOR MIXERS AND THE LIKE

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[73] Assignee: **National Engineering Company**, Chicago, Ill.

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[52] **U.S. Cl.** **259/107**, 416/224, 15/246.5

[51] **Int. Cl.** **B01f 7/16**

[58] **Field of Search** 416/223, 224; 15/246.5, 104.13; 241/300; 259/107, 7, 11, 15, 17, 18, 22, 48–71

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[57] **ABSTRACT**

A modular plow system for mixers and the like of the type employing a mixing chamber for holding a quantity of material wherein the chamber includes a bottom wall and a peripheral sidewall and a rotary mixing head mounted therein. The mixing head includes plow support means movable over the bottom wall, and a plow backing member is provided with an advancing face angularly disposed with respect to the bottom wall of the chamber and a lower edge spaced above the bottom wall. A planar, modular, replaceable plow member is removably mounted on the advancing face of the backing member and means are provided for securing the plow member to the backing member in a plurality of different positions whereby a selected edge of the plow may be placed in the region of most intense wear.

8 Claims, 16 Drawing Figures

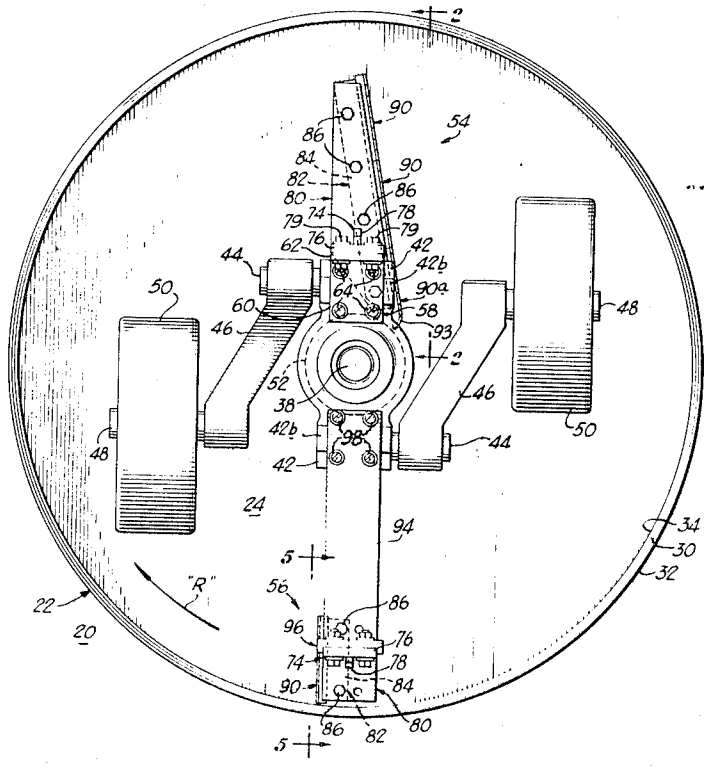

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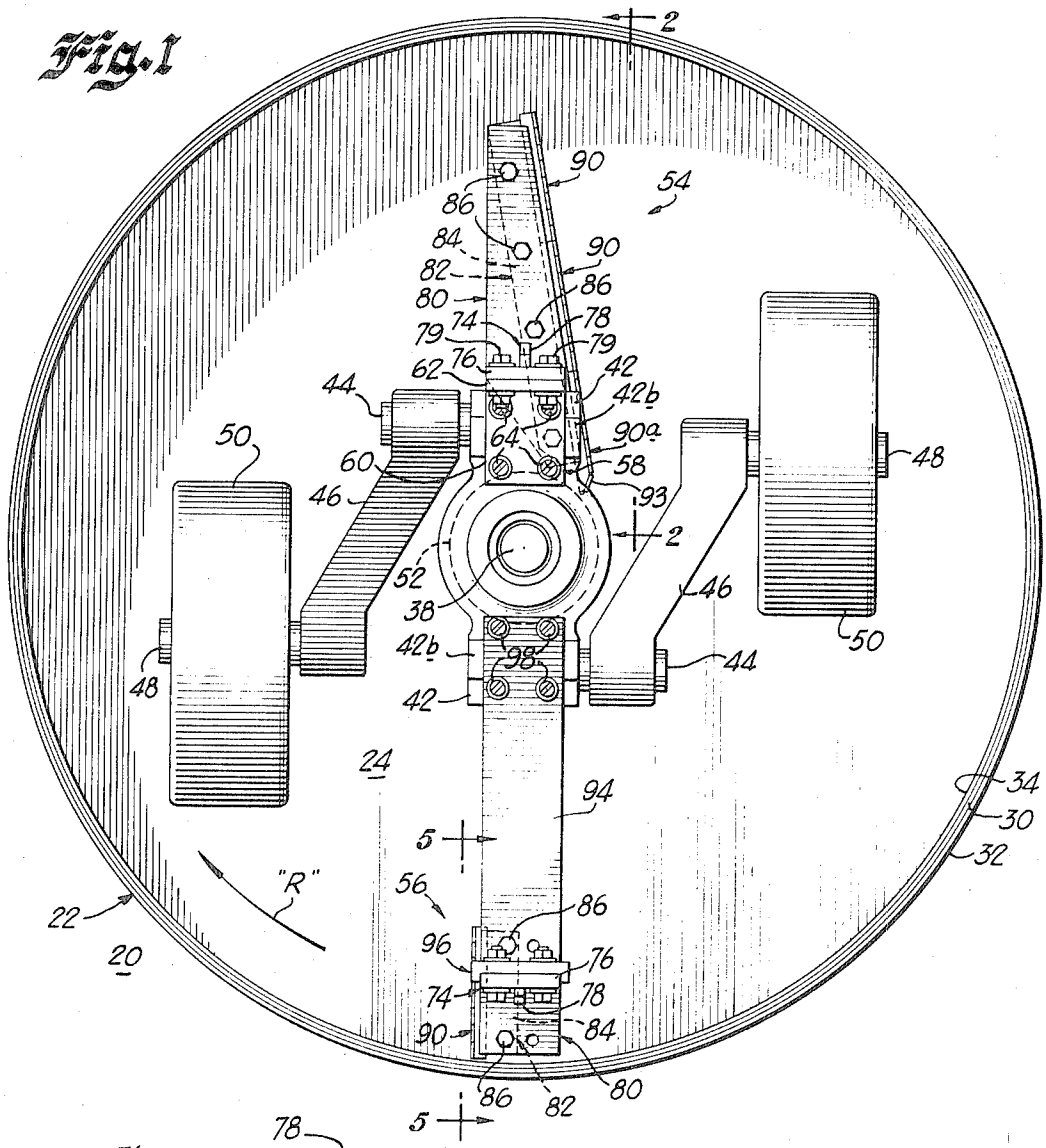
Fig. 1



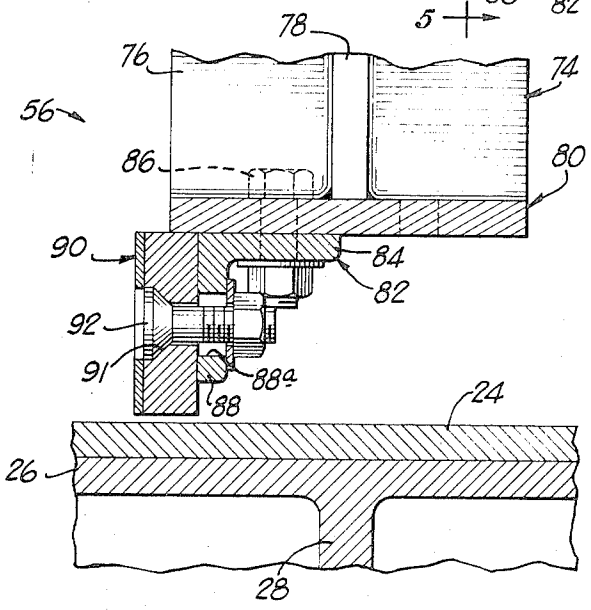


Fig. 2

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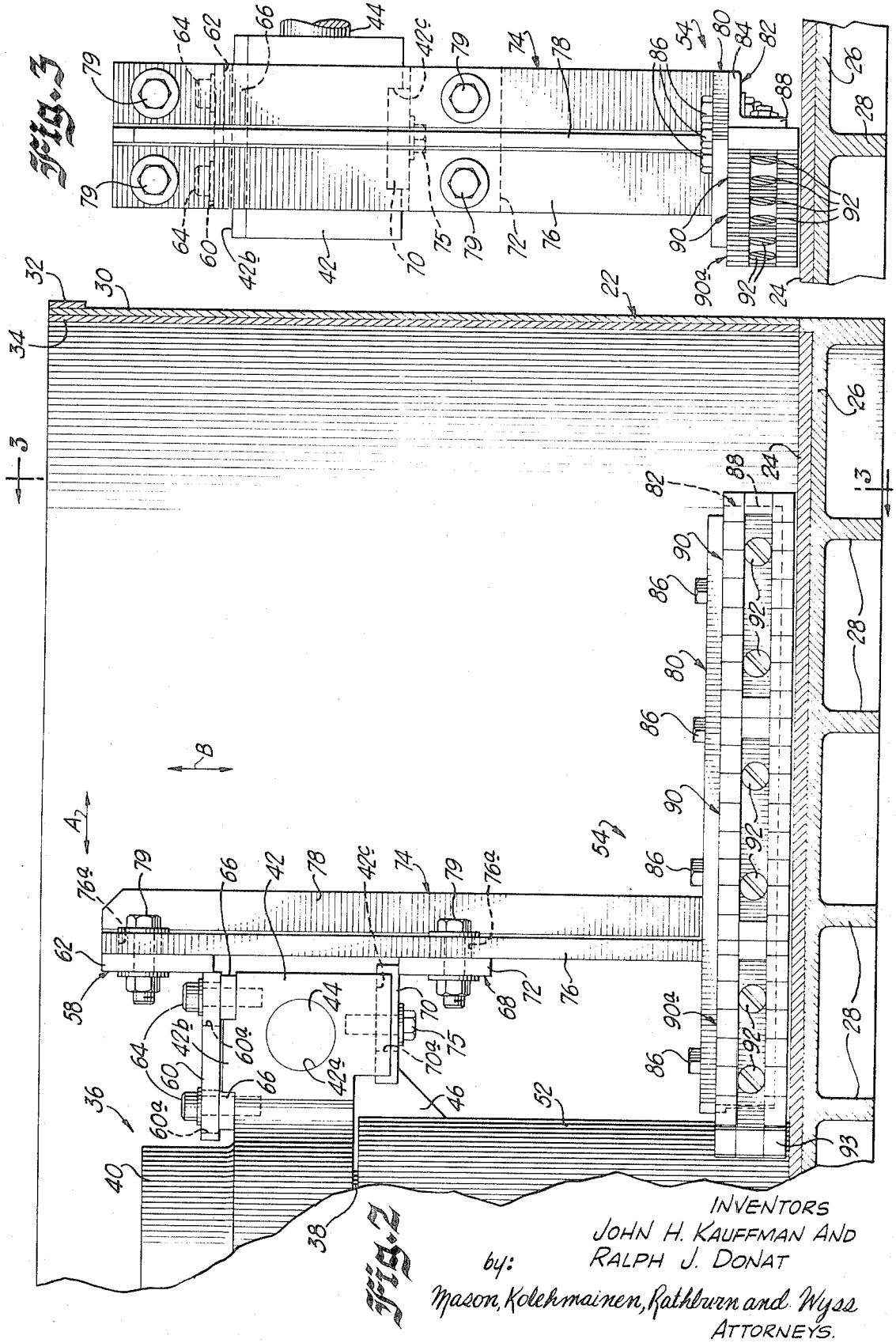
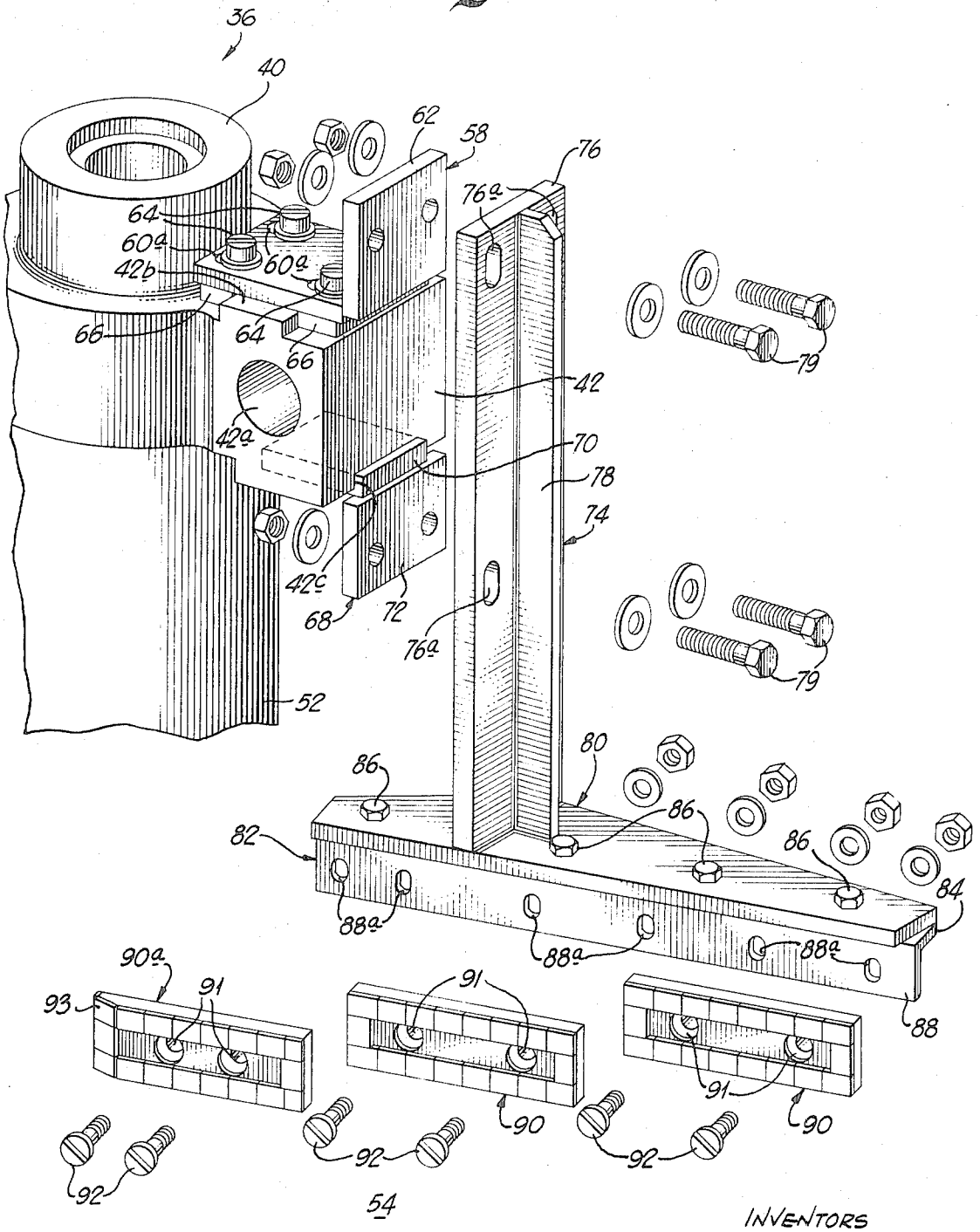


Fig. 4



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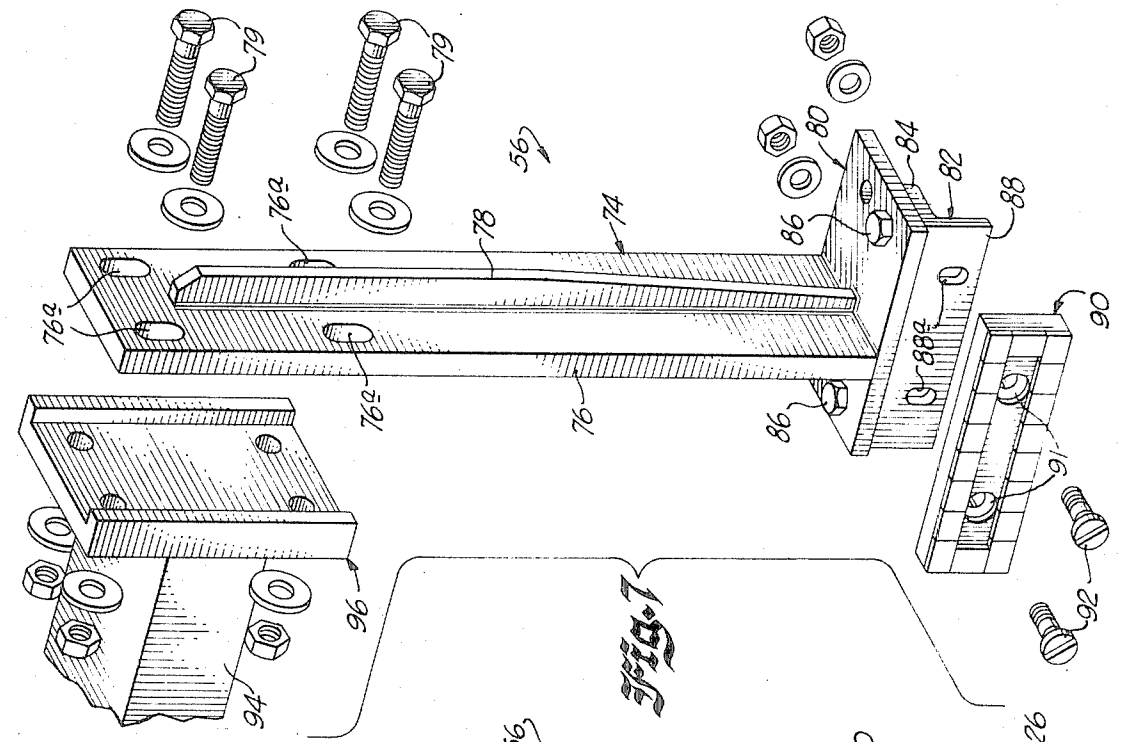

FIG. 7

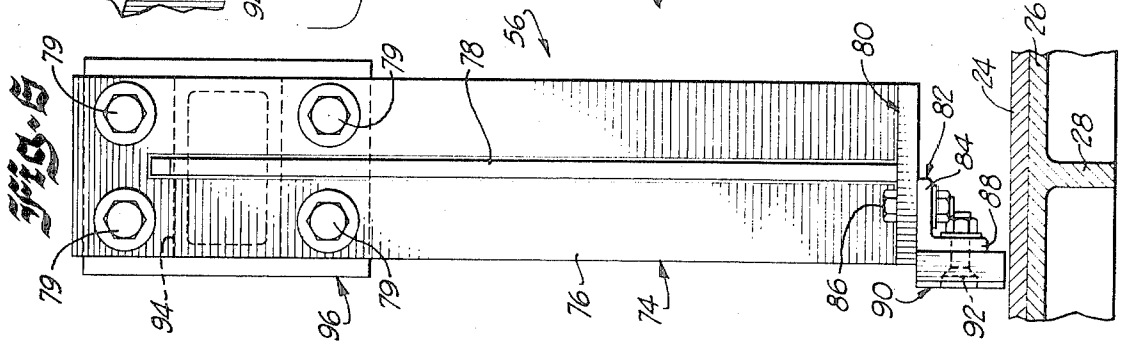

FIG. 6

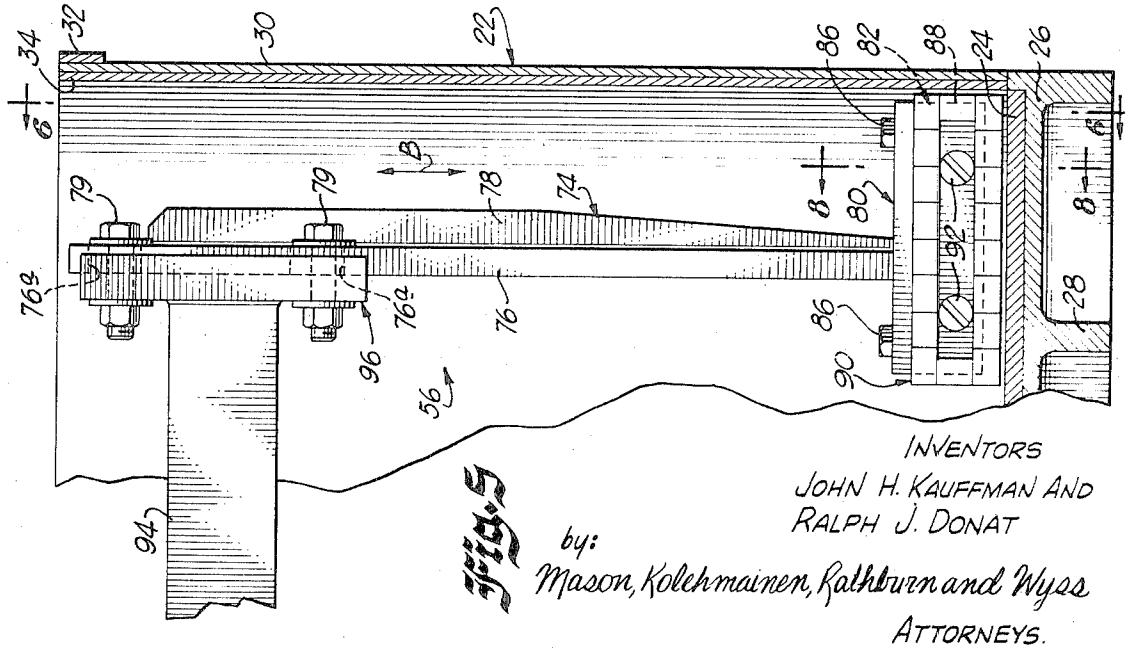

FIG. 5

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Fig. 9

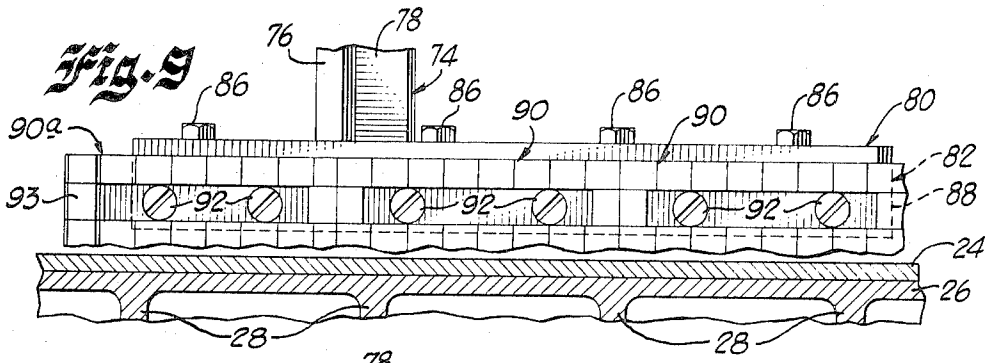


Fig. 10

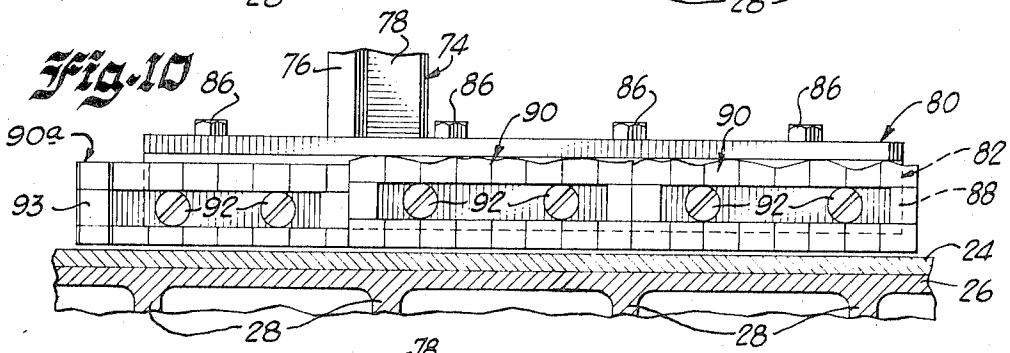
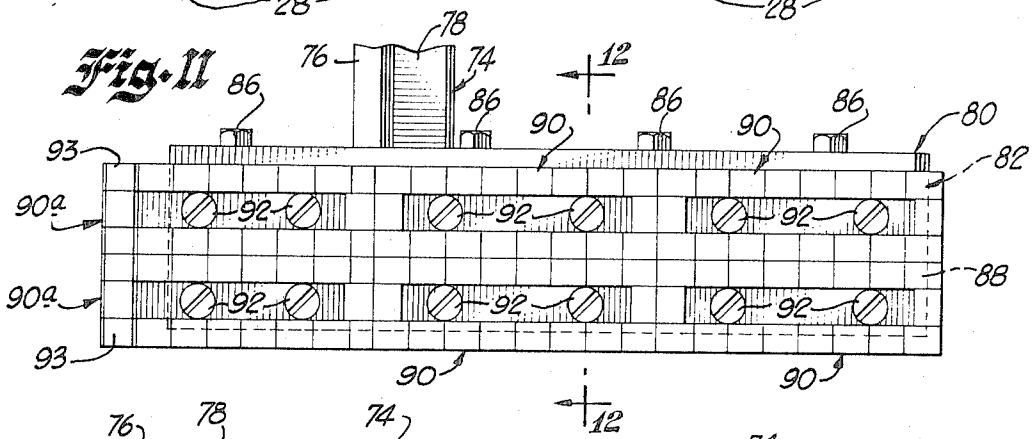


Fig. 11



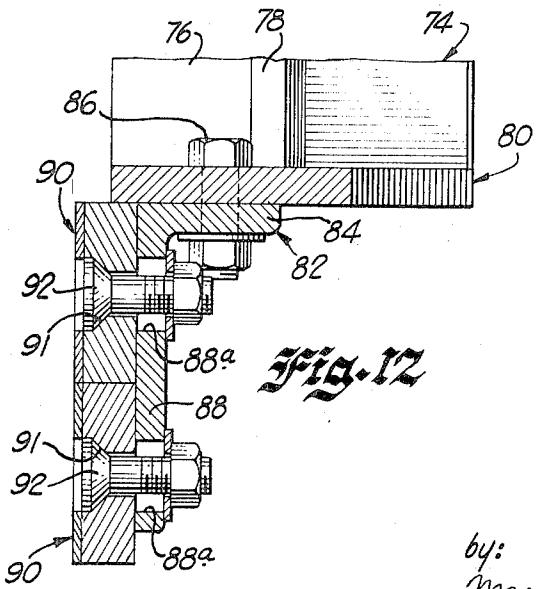


Fig. 12

Fig. 13

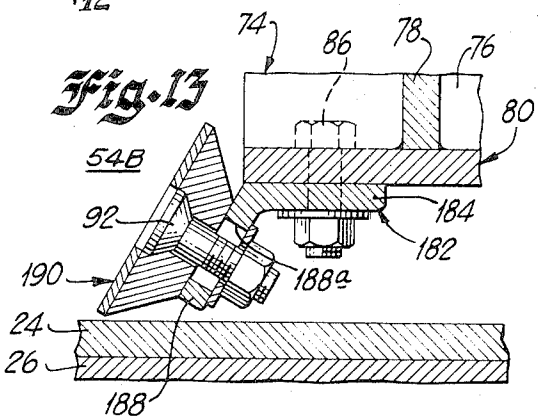


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Fig. 14

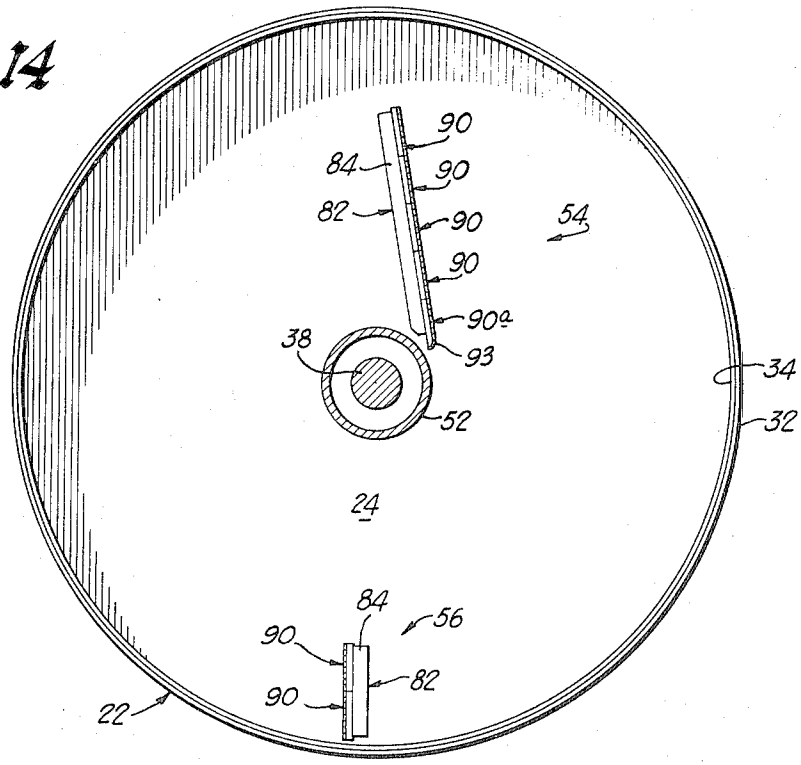
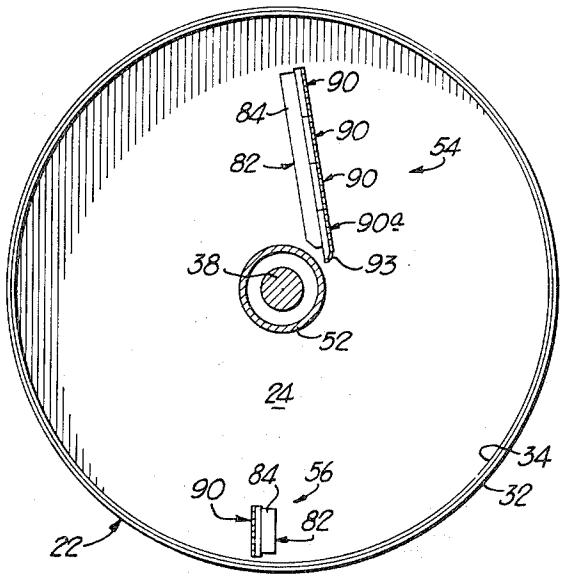


Fig. 15



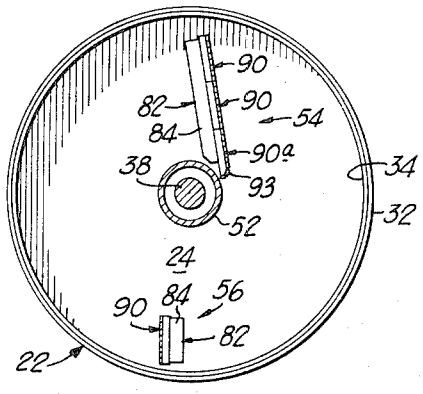


Fig. 16

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MODULAR PLOW SYSTEM FOR MIXERS AND THE LIKE

The present invention is directed to a new and improved modular plow system for mixers and the like and more particularly is directed towards a modular plow system for use in mixers and mulling machines wherein the material being treated may be extremely abrasive and cause accelerated wear on the surface and edges of the plow members.

Mixing and mulling machines used for conditioning relatively abrasive materials such as foundry sand and the like usually employ large, heavy mulling wheels to break up and pulverize the materials and several plows or scrapers of different types and configurations for moving the material into the path of the wheels and for turning the material over and mixing it. Because of the abrasiveness of certain materials excessive plow wear occurs, especially along the lower edges of a plow where the abrasive material tends to be rolled up between the bottom edge of the plow and the bottom wall of the mixing chamber. In many cases, after a relatively short period of operating time, the lower edge portion of the plow is so badly worn that the entire plow is replaced in order for the mixer to continue an effective job of mixing the material. Many of the prior art mixing and mulling machines employ rather complex plow structures, some of them including especially curved advancing faces and relatively complex support structures. Plows for machines of this type are relatively high in cost, especially where curved plow blades are involved, and when excessive wear occurs, resulting in frequent replacement of the plow blades, high operating costs are the result.

One means for combating high rates of wear encountered with highly abrasive material is to provide hard surface facing on the plows in the form of tungsten carbide material, or other wear-resistant materials, such as "stellite" applied onto the face of the plow in the regions where the most severe wear occurs. Because of different applications and different operating conditions encountered in the field, the exact point or region of intense wear for a particular design of plow or mixer may not always be readily forecast, and accordingly, it has been extremely difficult, if not impossible, to provide for hardened wear-resistant surfaces in the desired regions on the plow to fit all the possible applications and conditions for which a particular size of mixer may be useful.

In addition to the difference in materials, mixers of different capacities are common, and a manufacturer having a complete line of mixers must keep on hand a relatively large stock or inventory of plows of different sizes for each of the mixers being produced and used. In many instances, plows for a particular machine in a particular application are custom made and extremely costly as a result, but because failure of a plow during production often causes excessive economic loss to a user, unless the plow can be replaced within a short period of time, the high cost is deemed unavoidable.

It is an object of the invention and an advantage over the prior art to provide a standardized modular plow system whereby a single standardized size of plow may be utilized alone or in multiples on a number of different sized mixers.

Another object of the invention is to provide a modular plow system wherein only a single standard-size replacement replaceable modular plow need be stocked in inventory to service a whole line of mixers for different operating applications.

Another object of the invention is to diminish mixer downtime by reducing the time delay involved in replacement of a worn plow or eliminating delays because of failure to have the right size replacement plow on hand in stock.

Generally, it is an object of the present invention to provide a new and improved modular plow system for mixers and the like.

More particularly, it is an object of the present invention to provide a new and improved modular plow system especially adapted for use with mixers and mullers employed for treating abrasive materials where wear on the plows is an important factor.

Still another object of the present invention is the provision of a new and improved modular plow system wherein a single standardized-size modular plow member is used either singly or in multiples for a plurality of mixers of different sizes.

Yet another object of the present invention is to provide a modular plow system of the character described wherein a worn modular plow may be utilized in several different positions thereby lengthening the useful life thereof before replacement or reconditioning is required.

The foregoing and other objects and advantages of the present invention are accomplished in a new and improved modular plow system for mixers and the like which employ a mixing chamber for holding a quantity of material to be treated having a bottom wall and a peripheral sidewall with a rotary mixing head mounted for rotation in the chamber. The mixing head includes plow support means movable over and above said bottom wall, comprising a plow backing member having an advancing face angularly disposed with respect to the bottom wall of the chamber and having a lower edge spaced above the bottom wall. A planar, readily replaceable, modular plow of standardized size is removably mounted on the advancing face of the backing member, and the plow includes at least one pair of abrasion-resistant edge portions on an outer wear face thereof for direct engagement with the material. Means is provided for securing the plow to the backing member in a selected one of a plurality of operative positions wherein one of the wear-reinforced edges is positioned in a region of most intense wear. Rapid wear normally occurs along the lower edge of the plow and at the lower corners, so the plow is readily dismounted from the backing member and turned upside down so that a fresh wear-reinforced edge is positioned along the lower edge where the most intense region of wear takes place. Accordingly, in a relatively short period of time, the effectiveness of a worn plow edge can be restored to normal without requiring any extensive downtime for the mixer by changing the position of the plow on the backing member. Moreover, in mixers wherein multiple modular plows are utilized and the wear occurs unevenly (that is, more severe on some of the plows than on others), the position of the respective worn plows can be interchanged, one for the other, to provide additional operating life to a set of plows without requiring new plow members.

For a better understanding of the present invention, reference should be had to the following detailed description taken in conjunction with the drawings, in which:

FIG. 1 is a top plan view of a mixer having a modular plow system in accordance with the present invention;

FIG. 2 is a fragmentary vertical elevational view taken substantially along lines 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken substantially along lines 3—3 of FIG. 2;

FIG. 4 is an exploded perspective view of the modular plow system for the inside plow of the mixer;

FIG. 5 is a vertical elevational view taken substantially along lines 5—5 of FIG. 1 illustrating the modular plow system for the outside plow of the mixer;

FIG. 6 is an end elevational view taken substantially along lines 6—6 of FIG. 5;

FIG. 7 is an exploded perspective view illustrating components of the outside plow of the mixer;

FIG. 8 is a fragmentary sectional view taken substantially along lines 8—8 of FIG. 5;

FIG. 9 is a front elevational view of a modular plow system in accordance with the present invention shown after considerable wear has occurred along the lower edge;

FIG. 10 is a front elevational view of the plow system of FIG. 9 illustrating the plow after replacement of one of the individual plows and repositioning of other individual plows;

FIG. 11 is a front elevational view of a modular plow system in accordance with the present invention employing a plurality of modular plow members in a plurality of rows;

FIG. 12 is a transverse sectional view taken substantially along lines 12—12 of FIG. 11;

FIG. 13 is a transverse sectional view similar to FIG. 12 of an embodiment of a modular plow system in accordance with the present invention wherein the angle of the advancing faces of the plow module is supported at an acute angle relative to the bottom wall of the mixing chamber;

FIG. 14 is a top plan view in a generally schematic form of a relatively large-size mixer employing a selected number of modular plow members on the outside and inside plows thereof;

FIG. 15 is a top plan view similar to FIG. 14 of an intermediate-size mixer employing a different number of modular plow members of the same standardized module size as in the mixer of FIG. 14; and

FIG. 16 is a top plan view similar to FIGS. 14 and 15 of a relatively small-size mixer employing a different number of modular plow members of the common standardized size used in the intermediate and large-size mixers.

Referring now more particularly to the drawings, in FIGS. 1 through 10 is illustrated a mixing and mulling machine used for conditioning bulk material, such as foundry sand or other abrasive material, and generally referred to by the reference numeral 20. The mixer employs a modular plow system in accordance with the features of the present invention and includes a generally cylindrical crib or mixing chamber 22 having a replaceable, circular-shaped bottom wall or wear plate 24 which is mounted on a ribbed support structure 26 having a plurality of integrally formed, vertical stiffening ribs 28 on the underside thereof, as best shown in FIG. 2. When the bottom wall 24 is worn down after a period of time, the wear plate may be readily replaced on the support structure 26. The mixing chamber 22 includes an upstanding cylindrical outer sidewall 30 with stiffening rim 32 around the upper edge and a replaceable inner wall or liner 34 preferably formed in segments of a cylinder and readily replaceable after excessive wear has occurred.

The mixing chamber 22 is adapted to contain a quantity of bulk material such as foundry sand and the like which is to be conditioned or treated by pulverizing and mixing action, and for this purpose the mixer 20 includes a rotary mixing head assembly 36 (FIG. 1) which is supported on an upright vertical shaft 38 positioned adjacent the center of the mixing chamber. The mixing head assembly 36 includes a generally cylindrical head portion 40 mounted on the upper end of shaft 38 and including a pair of diametrically opposed, outwardly extending, relatively short arms or projections 42, each having a cylindrical crossbore 42*a* therein (FIGS. 3 and 4).

The cylindrical crossbores 42*a* of the opposed arm portions 42 are provided to support axle members 44 connected to the upper ends of a pair of mounting wheel support arms 46. At the lower end of each support arm 46 is provided an outwardly extending wheel support axle 48 (FIG. 1) for supporting a relatively large, heavy mulling wheel 50 freely rotatable on the axle. As the mixing head assembly 36 is rotated around the mixing chamber 22 in a clockwise direction, as shown by the arrow "R" in FIG. 1, the large, heavy mulling wheels 50 directly engage and pulverize the material contained in the chamber by mashing and kneading the material against the wear plate or chamber bottom wall 24. The mulling wheels 50 traverse an annular path around the mixing chamber 22 spaced radially inwardly of the cylindrical wall liner 34 and radially outwardly of a cylindrical shaft cover 52 in coaxial alignment on the shaft 38 and extending between the wear plate or the bottom wall 24 of the chamber and the turret head 40.

As the mixing head assembly 36 is rotated around the mixing chamber 22, the mulling wheels 50 are free to float up and down on the material and lumps are broken up by the kneading and squeezing action on the material between the surfaces of the wheels and the bottom wall of the mixing chamber.

In accordance with the present invention in order to insure that none of the material being treated in the mixing chamber 22 is left over without adequate mulling and mixing action, the mixer 20 includes an inner plow assembly generally referred to by the reference numeral 54 and shown best in FIGS. 2 through 4. The inner plow assembly is effective for moving the material radially outwardly away from the shaft cover 52 toward the path traversed by the mulling wheels and insures against a region of stagnating material in the central portion of the mixing chamber 22. The mixer also includes an outer plow assembly generally referred to by the reference numeral 56, best shown in FIGS. 5 through 8, for moving the material radially inwardly from around the outer edge of the mixing chamber and away from the crib-lining wall 34 into the path traversed by the mulling wheels 50. The outer plow assembly prevents material buildup around the periphery of the mixing chamber and, in addition, both plow assemblies are continuously dislodging or removing material from the bottom wall or wear plate 24 and turning this material over and over to provide a continuous mixing action.

Referring now more particularly to FIGS. 2, 3, and 4, the inner plow assembly 54 includes a modular plow system constructed in accordance with the features of the present invention. The support arms 42 of the turret head 40 are provided with a ridge 42*b* on the upper surface thereof and a groove 42*c* at right angles thereto is provided on the lower surface of the support arms. An angle bracket 58 having a horizontal flange 60 and a vertical flange 62 is secured on top of the ridge 42*b* by a plurality of capscrews 64 which project downwardly through elongated adjustment slots provided in the flange 60 and through spacing blocks 66 into threaded apertures formed in the support arm 42. Because of the slotted openings 60*a* in the flange 60, the angle bracket 58 is movable inwardly and outwardly relative to the center of the mixing chamber, as indicated by the arrow "A" in FIG. 2, to provide the desired radial position for the plow assembly relative to the vertical center axis of the drive axle 38.

A lower angle bracket 68 is provided with a horizontal flange 70 slidably mounted in the groove 42*c* on the underside of the support arm 42 and the bracket includes a downwardly extending vertical flange 72 aligned with the flange 62 on the upper bracket. The flange 70 of the lower angle bracket 68 is secured to the underside of the support arm 42 by a pair of capscrews 75 which project upwardly through elongated adjustment slots 70*a* formed in the flange 70. Suitable threaded bores are provided on the underside of the support arm 42 in the base of the groove 42*c* to receive the capscrews. The angle brackets 58 and 68 provide support for a vertically extending support leg 74 of T-shaped cross section having a web portion 76 and a stiffening rib 78 running longitudinally down the center thereof. The web portion 76 of the leg 74 is provided with a plurality of elongated slots 76*a* in order to accommodate removable fasteners 79 in the form of bolt, nut and washer assemblies, as shown, which are adapted to fixedly attach the support leg 74 to the bracket flanges 62 and 72. Because of the elongated slots 76*a* in the support leg, the leg can be adjusted vertically as indicated by the arrow "B" in FIG. 2.

A horizontal plow blade support plate 80 is secured to the lower end of the vertical leg 74 as by welding, or the like, and the plate projects in opposite directions from the leg in a generally radial orientation with respect to the center of the mixing chamber. The support plate 80 is wider in horizontal dimension adjacent the central portion joined with the lower end of the support leg 74 and is tapered to a minimum width at opposite ends, as best shown in FIGS. 1 and 4. The advancing or forwardly facing edge of the plate is positioned on an acute angle in relation to a true radial extending outwardly from the central axis of the shaft 38 (best shown in FIG. 1) so that the inner end of the plow engages material in advance of the outer end or outside tip. Accordingly, as the mixing head is rotated in a clockwise direction, as shown by the arrow "R" in FIG. 1, the material in the center of the chamber around the shaft cover 52 is displaced radially outwardly along the advancing face of the inner plow assembly 54. This material is moved into the path of the mulling wheels 50 and is thoroughly pulverized thereby.

In accordance with the present invention, the plow support plate 80 is provided with an elongated backing member 82 of angular cross section mounted on the underside thereof. The backing member includes an upper horizontal flange 84 removably secured to the plate by a plurality of fasteners, such as the bolt, nut and washer assemblies 86. The backing angle 82 includes a vertical flange 88 extending downwardly from the lower surface of the horizontal support plate 80, and the flange is provided with a plurality of vertically elongated slots 88*a*, as best shown in FIG. 4. The vertical position of the support leg 74 is adjusted as indicated by the arrow "B" (FIG. 2) so that the lower edge of the vertical flange 88 of the backing angle 82 may be spaced above the upper surface of the bottom wall 24 of the mixing chamber by a desired amount of clearance. The forward or advancing face of the backing flange 88 is perpendicular to the bottom wall of the mixing chamber and as the mixing head assembly 36 is rotated, the plow assembly sweeps a relatively large percentage of the entire surface area of the bottom wall.

In accordance with the present invention, the vertical backing flange 88 is adapted to support one or more standard-size modular plows 90 which are generally rectangular in shape and formed of steel or other metal. Each plow is provided with a pair of countersunk holes 91 adapted to receive fastening bolt assemblies 92 for securing the plows in place on the backing flange 88. In order to increase the useful life of the plows, the forward or advancing faces are provided with a wear-resistant material, such as tungsten carbide chips or "-stellite." The wear-resistant facing material is normally provided only around the outside edges of the plow face in the region where the most intense wear is likely to occur.

Referring to FIGS. 9 and 10, the most intense area of wear generally occurs along the lower edges of the plows 90 and when material being treated is extremely abrasive the lower edges of the plows are gouged and ground unevenly, as shown by the action of the material passing between the lower edges of the plows and the bottom wall of the chamber. As shown in FIG. 9, when the lower edges of the plows become so jagged and worn that good mixing and scraping action is no longer achieved, the plows are removed and repositioned on the backing flange 88 with the worn edges on top and fresh edges along the bottom, as shown in FIG. 10. The plows 90 can be repositioned on an individual basis or in groups, and thus a single plow module has at least twice the useful life of an ordinary prior art plow. The elongated vertical slots 88*a* in the backing flange 88 permit the clearance distance between the lower edges of the plows to be adjusted relative to the mixing chamber bottom wall 24, and the vertical leg 74 can be moved vertically to provide a further range of adjustment.

The jagged and worn uneven edges of a plow may be ground off to a smoother line when the plow is removed, and the same plow can then be used again by adjusting its position downwardly on the backing flange 88 to obtain the desired clearance, as shown in FIG. 10.

From the foregoing, it can be seen that the interchangeable, adjustably positioned, standardized sized, modular plows 90 permit a much greater useful life at lower cost and provide increased flexibility than heretofore possible with other types of plow mechanisms.

If desired, the inside or innermost modular plow 90*a* in the inner plow assembly 54 as shown, may be modified slightly from the other plows 90 to provide a sharpened inner edge or corner 93 which is best shown in FIGS. 1 and 4. The inner plows 90*a* are identical to the standard modular plows 90 except for the sharpened inner corner edge which is designed to better scrape and remove material accumulations away from the region immediately around the shaft cover 52 at the center of the chamber. In many applications, sharpened inner corner edges are not required because material buildup and accumulation problems in the central portion of the chamber are not excessive, and in these cases plows 90*a* are not used.

Referring momentarily to FIGS. 11 and 12, therein is shown a modified form of inner plow assembly 54A wherein the plurality of modular plows 90 and 90*a* are arranged in vertically stacked horizontal rows, as shown. The backing angle 82 is provided with a deeper vertical backing flange 88 in order to accommodate the pair of vertically stacked modular plows. While the modified plow assembly 54A of FIGS. 11 and 12 is shown as having a total of six modular plows, it should be understood that plow assemblies having different numbers and arrays of standard size, modular plows may be used to provide the desired area of advancing plow face. As wear occurs along the lower edges of the plows on the lowest row in the plow assembly 54A, the lower plows may be removed and may be turned upside down for repositioning or exchanged with fresh plows from the upper row.

Referring to FIG. 13, if it is desired to provide an acute angle between the face of an advancing plow and the bottom wall of the mixing chamber, a modular plow assembly 54B, having a modified form of backing angle 182, is provided. The angle 182 has a downwardly and forwardly extending backing flange 188 which has a forward face on an acute angle with the plane of the mixing chamber bottom wall 24. Slightly modified modular plows 190 are mounted onto the backing flange 188 with conventional mounting bolts 92, as shown. The body portion or base of the modular plow members 190 are chamfered inwardly and rearwardly along their longitudinal edges, as shown, in order to permit the acute angular relation and lower edge clearance without interference between the plow and the bottom wall, as shown.

Referring now to FIGS. 5 through 8, the outer plow assembly 56 is generally similar to the inner plow assembly 54 and includes a radially outwardly extending, elongated support arm 94 which is bolted to the support arm 42 of the mixing head 40 by means of a plurality of capscrews 96 (FIG. 1). At the outer end of the arm 94 a channel-shaped leg support member 96 is secured in vertical position in order to receive and support the upper end of the vertically extending plow support leg 74. The plow support leg 74 is provided with a plurality of vertically elongated slots 76*a* for receiving mounting bolt assemblies 79 which project through a web portion of the channellike bracket 96. The support assembly permits the plow 90 to be moved up and down in the direction of arrow "B" (FIG. 5) in a manner similar to that described in connection with the inner plow assembly 54. While the outer plow assembly 56 illustrated includes only a single modular plow 90, it is to be understood that if additional plow face area is required a plurality of modular plows 90 could be used in the inner plow assembly and that the individual plow modules 90 are interchangeable between the inner and outer plow assemblies 54 and 56.

In this connection, referring now to FIGS. 14, 15, and 16, therein is shown in somewhat schematical form, three different sizes of mixing chambers 22. In the large size mixer of FIG. 14, the inner plow assembly 54 includes a total of four standard-size, modular plows 90 mounted in a single or double row in end-to-end relation on the backing angle 82 in addition to a sharpened inner plow member 90*a* at the inner end. The outer plow assembly 56 includes a pair of standard-size modular plows 90 in a single or double row mounted end to end. In the intermediate size mixer of FIG. 15, the inner plow assembly 54 includes a total of four standard-size modular plows per row, and the outer plow assembly 56 employs only a single, standard-size modular plow 90. The small-sized mixer, as shown in FIG. 16, employs inner and outer plow assemblies 54 and 56 having the same number of standard-size modular plows as the mixer 20 described in detail herein. It will thus be seen that the use of standard-size, modular plows in different numbers and arrays can provide the desired plow face areas needed for mixing chambers of various different sizes, from small to large. Thus for all the different size mixing chambers in a manufacturer's line of mixers, only a single, standard-size, modular plow 90 is required with resultant improvements in servicing inventory and shipping problems.

While there have been illustrated and described several embodiments of the present invention, it will be appreciated that

numerous changes and modifications will occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A modular plow system for mixers of different sizes which include mixing chambers of different dimensions for holding a quantity of material to be conditioned, said chambers including a bottom wall, a peripheral sidewall and a rotary mixing head mounted in said chamber including plow support means having a support plate parallel to and movable over said bottom wall; said plow system comprising a plow backing member detachably mounted on said plow support plate and including a downwardly depending advancing face angularly disposed with respect to said bottom wall and a lower edge spaced above said bottom wall; at least one rectangular shaped, planar, modular plow of standard size removably mounted on said advancing face of said backing member, said plow having at least one pair of abrasion-resistant edge portions on an outer face along substantially parallel opposite edges thereof; and means for securing said plow to said backing member in first and second positions, respectively, wherein a selected one of said opposite edges is adjacent said lower edge of said backing member.

2. The modular plow system of claim 1 including a plurality of said modular plows of equal size mounted in a horizontal row on said advancing face of backing member and interchangeable from one position in the row to another.

3. The modular plow system of claim 1 including a plurality of said modular plows of equal size mounted in vertically stacked rows on said advancing face of backing member and interchangeable from one row to another.

4. The modular plow system of claim 1 wherein said system comprises a pair of said plow backing members supported from said mixing head and spaced at different distances outwardly of the center of said bottom wall of said chamber comprising inner and outer members; a plurality of said modular plows of equal size mounted on said inner and outer plow backing members and interchangeable from one to the other.

5. The modular plow system of claim 1 wherein said advancing face of said backing member is sloped at an acute angle to the bottom wall of said mixing chamber, said modular plow having chamfered corners along said opposite edges to provide a desired clearance distance between the lower edge of said outer face and said mixing chamber bottom wall.

6. The modular plow system of claim 1 wherein said last-mentioned means comprises a plurality of removable fasteners and slot means defined in said backing members, said fasteners adjustable vertically in said slot means permitting a lower edge of said modular plow to be adjusted a selected clearance distance above said bottom wall of said chamber.

7. A mixer for abrasive materials and the like comprising a modular plow system as defined in claim 1, said mixing head including plow support means carrying an inner one of said backing members adjacent the axis of rotation of said mixing head and an outer backing member spaced outwardly of said axis, a plurality of said modular plows interchangeably mounted on said advancing faces of said backing members.

8. The mixer of claim 7 including a plurality of said modular plows mounted in end-to-end relation on the advancing face of one of said backing members.

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