United States Patent [19]

Kniff et al.

[11] **3,821,993**

[45] **July 2, 1974**

[54] **AUGER ARRANGEMENT**

[75] Inventors: **Thomas J. Kniff**, Bedford; **Robert J. McKenry**, Windber, both of Pa.

[73] Assignee: **Kennametal Inc.**, Latrobe, Pa.

[22] Filed: **Sept. 7, 1971**

[21] Appl. No.: **178,161**

[52] **U.S. Cl.** **175/292**, 175/335, 175/354, 175/391, 299/80

[51] **Int. Cl.** **E21b 9/26**

[58] **Field of Search** ... 175/292, 384, 382, 392, 391; 299/61, 80, 92

[56] **References Cited**

UNITED STATES PATENTS

2,734,733	2/1956	Wilms	299/80
2,822,159	2/1958	Joy	175/392 X
3,512,838	5/1970	Kniff	299/92 X
2,783,974	3/1957	Veasman	175/391 X
2,912,228	11/1959	Kandle	175/292
3,385,383	5/1968	Sturgeon	175/292
3,508,622	4/1970	Benetti	175/384

Primary Examiner—Marvin A. Champion
Assistant Examiner—Richard E. Favreau
Attorney, Agent, or Firm—Melvin A. Crosby

[57] **ABSTRACT**

The specification discloses an auger arrangement for boring holes in earth formations in which the auger comprises a body with a central cutter arrangement including a pilot cutter on the axis and with laterally extending wing portions on the auger, on each of which is pivotally mounted a wing cutter arranged to swing outwardly when the auger rotates in cutting direction and to swing inwardly when the auger is not rotating or when it is rotating in the reverse direction so that the auger can readily be withdrawn from a hole bored thereby.

7 Claims, 5 Drawing Figures

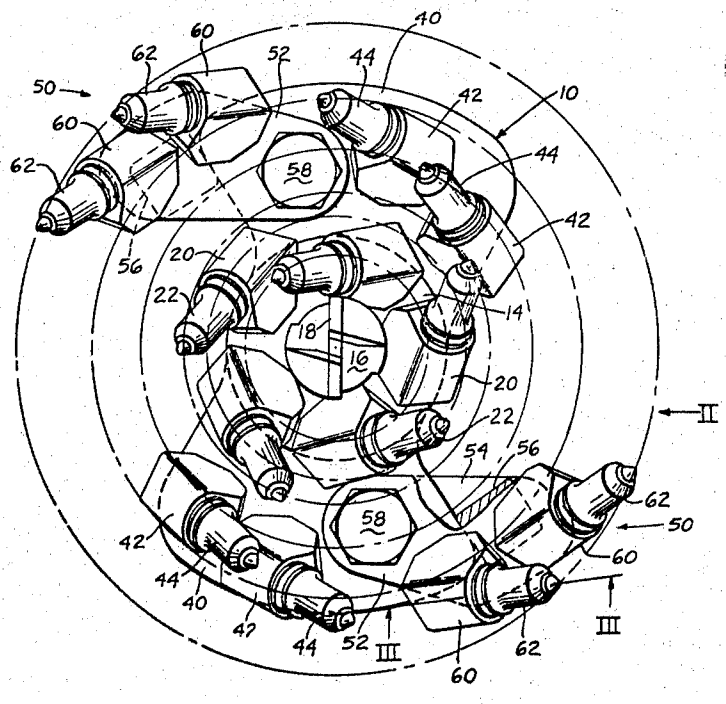


FIG-1

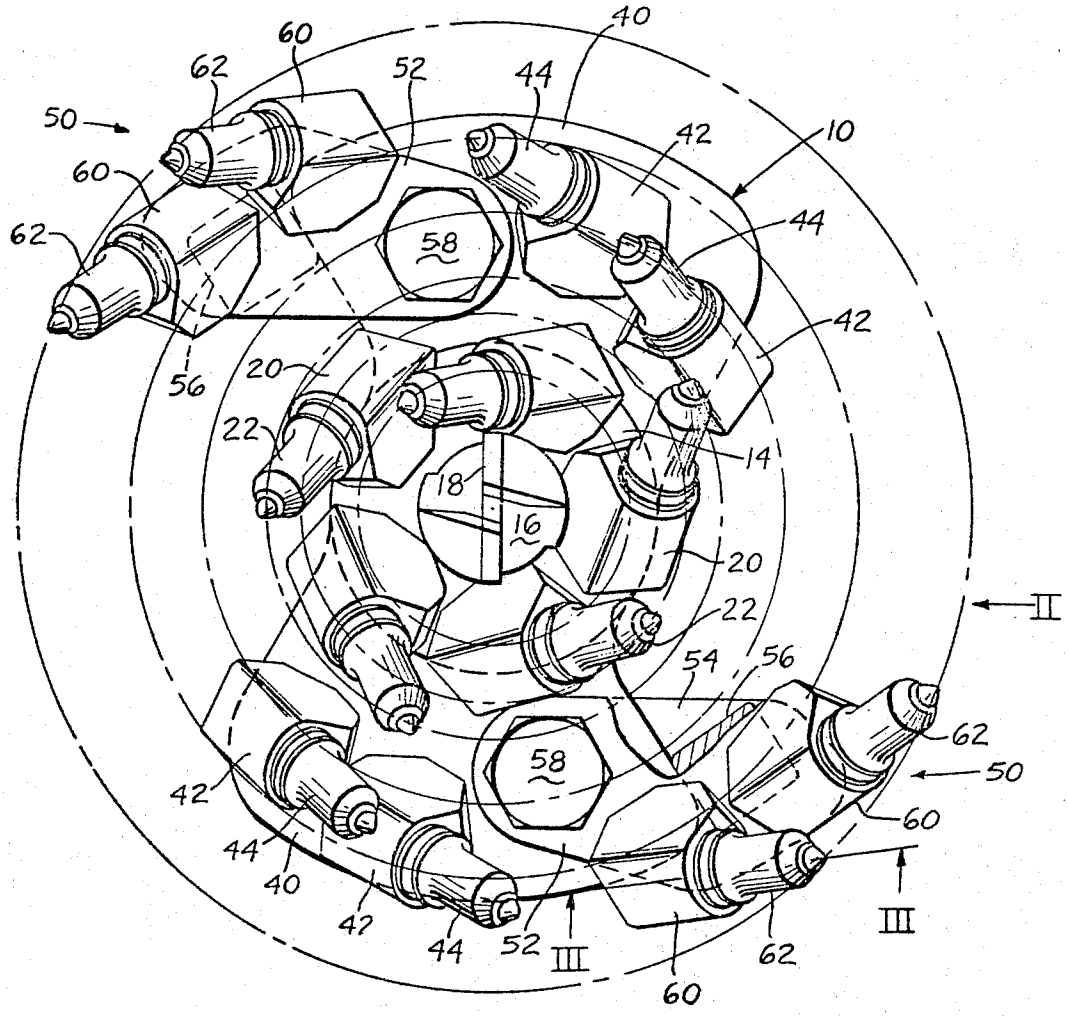

40
60
62
52
44
50
42
10
60
44
62
58
42
56
20
22
14
18
16
20
II
22
54
56
62
58
50
42
60
44
40
47
44
52
III
III
62
60

FIG-2

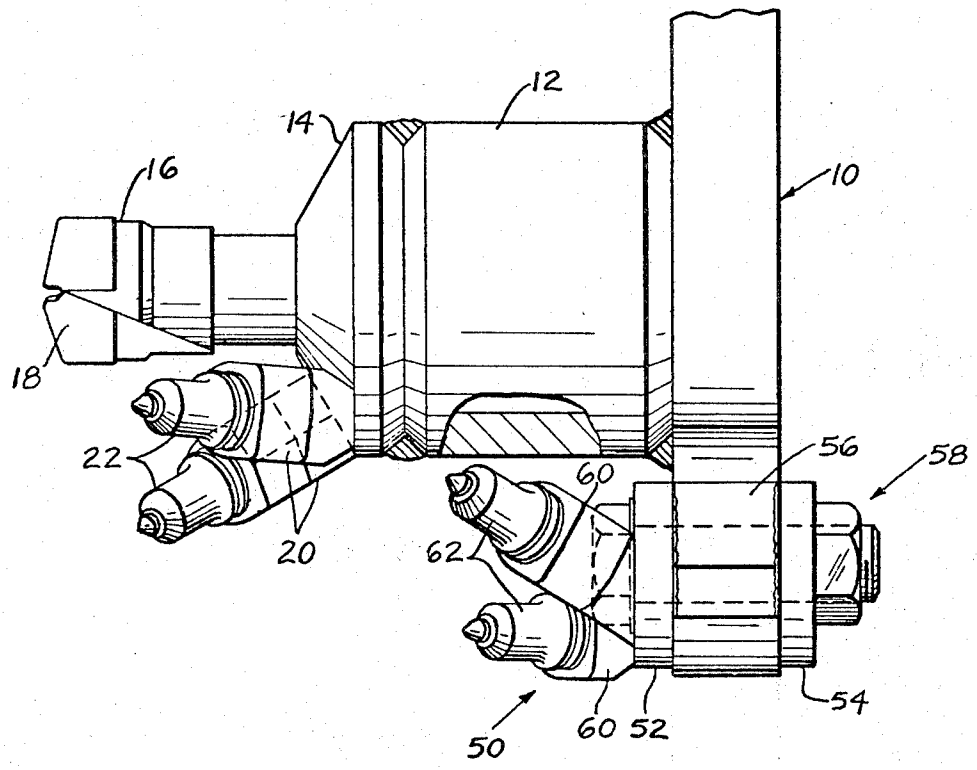


FIG-3

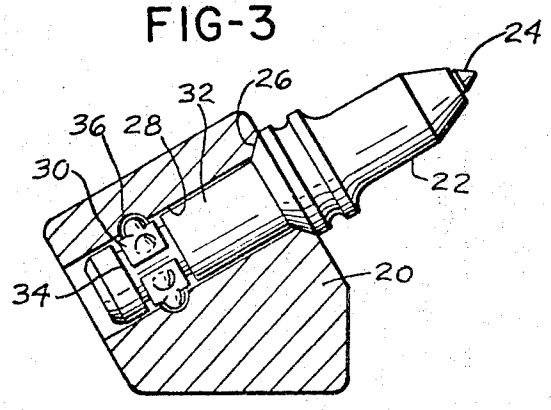


FIG-4

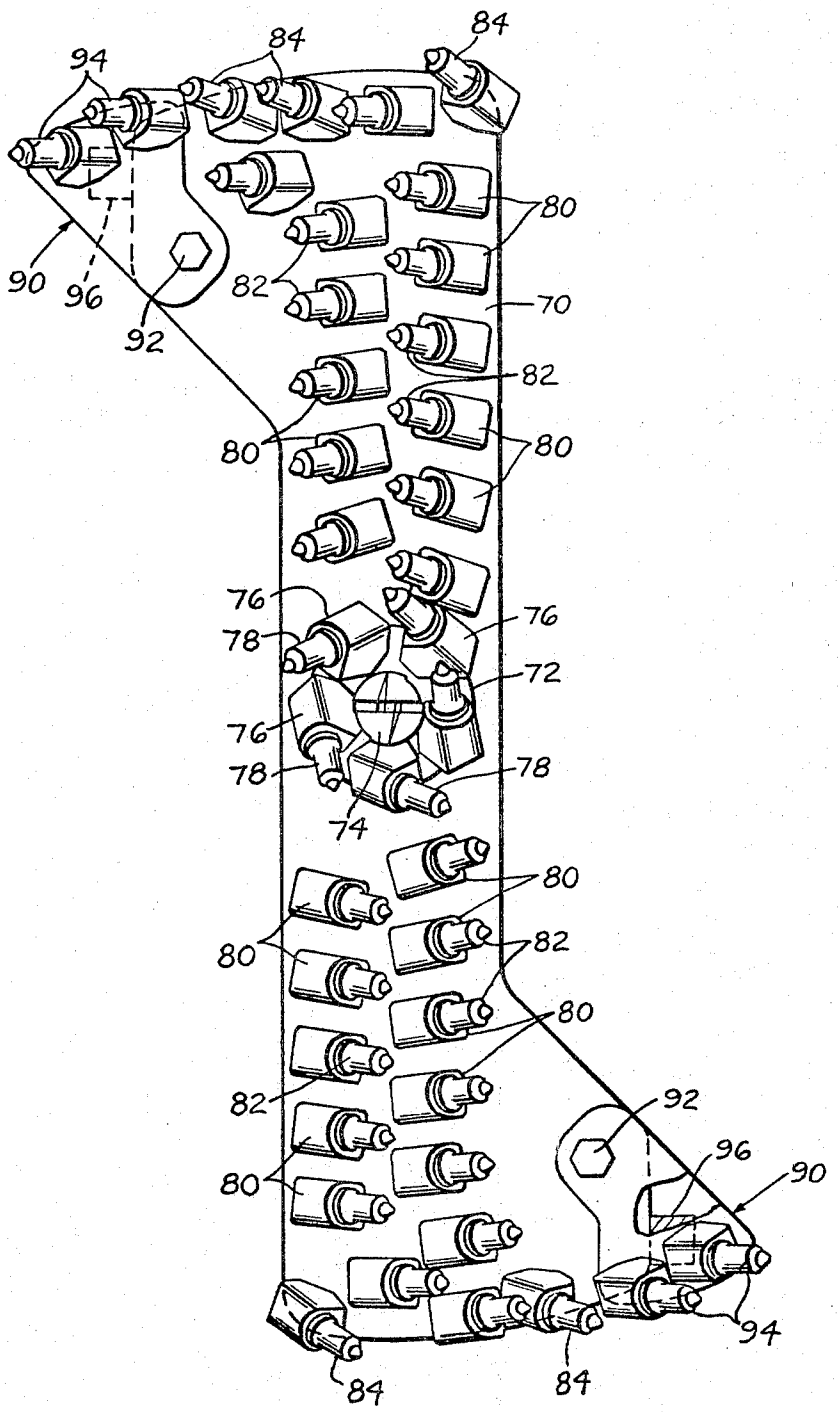
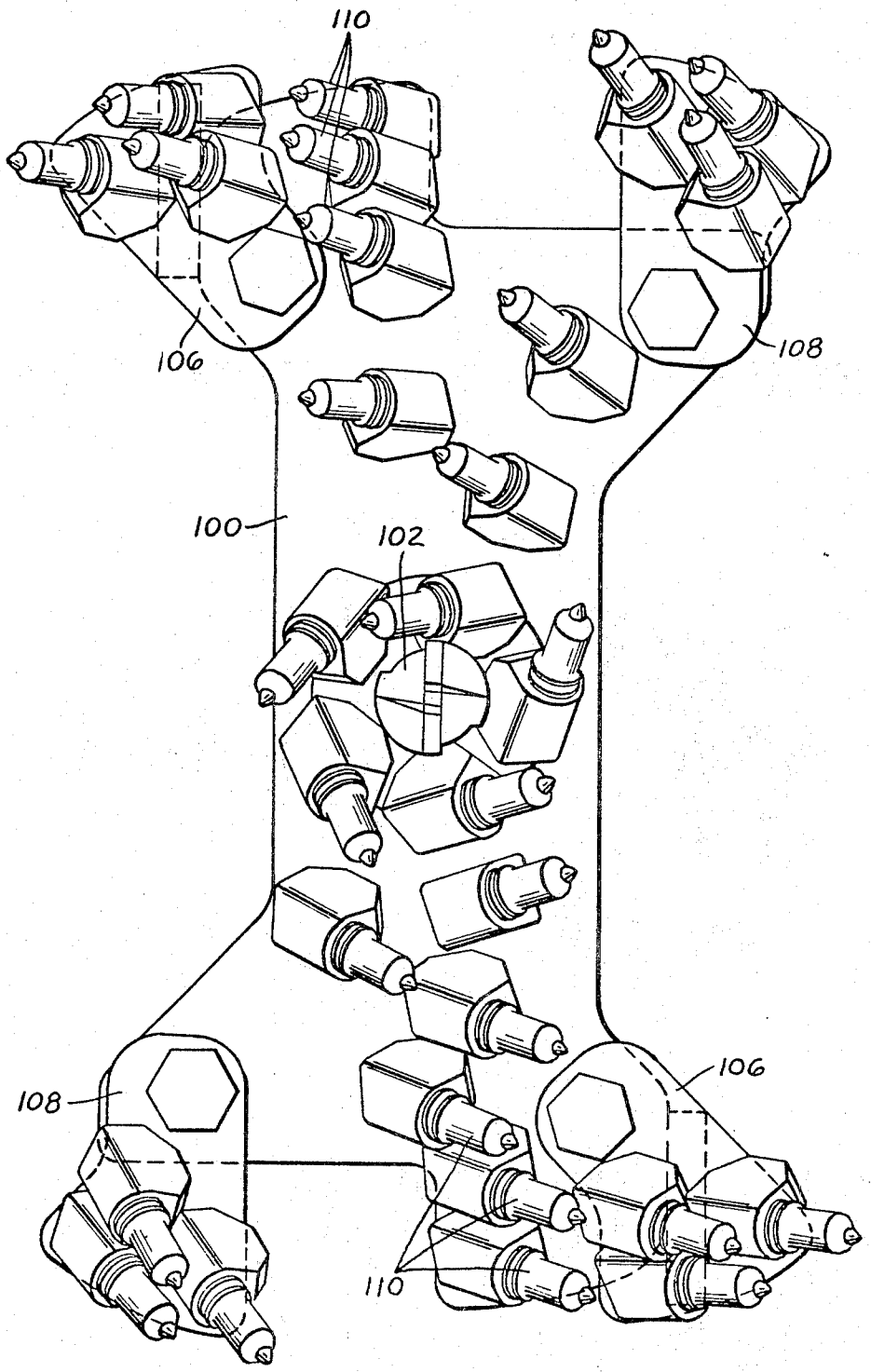

84
84
94
80
90
96
82
70
92
82
80
80
76
76
78
72
76
78
78
74
80
80
82
80
82
92
96
90
80
94
84
84

FIG-5



AUGER ARRANGEMENT

The present invention relates to augers, particularly to earth augers, and more particularly still to augers capable of being made in a plurality of different sizes and which are arranged for readily being withdrawn from the hole being bored.

Earth augers are known and usually comprise spiral flights which may have hardened or sharpened leading edges. Such augers are useful in many locations but, where hard formations are encountered, the usual type auger is defective because it is subject to being damaged by the rocks struck thereby and cannot easily break up rocks or shale.

The particular object of the present invention is the provision of an auger arrangement in which the foregoing defects of augers according to the prior art are eliminated.

A particular object of the present invention is the provision of an auger arrangement having an improved cutting and penetrating powers and one which will easily break up rocks encountered thereby and easily reduce shale and other hard formations and without damage to the auger.

A further object of the present invention is the provision of an auger arrangement having wing cutters thereon which move outwardly when the cutter is turning in working direction, but which will move inwardly when the auger is reversed or when the cutter is not rotating so that the auger can readily be withdrawn from a hole taken thereby.

Another object of the present invention is the provision of an auger in which the leading end is provided with a plurality of self-sharpening cutter elements which are readily detachable from the auger so that they can be replaced by others when they become worn or damaged, whereby it is a simple matter to maintain the auger in good operating condition at all times.

These and other objects and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. **1** shows an end view of a small auger constructed according to the present invention;

FIG. **2** is a side view of the auger of FIG. **1** looking in the direction of the arrow II on FIG. **1**;

FIG. **3** is a sectional view through a typical cutting tool of the auger and is indicated by line III—III on FIG. **1**;

FIG. **4** is an end view of a typical larger size auger according to the present invention; and

FIG. **5** is an end view of an auger having four wing cutters thereon.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, the auger arrangement according to the present invention comprises a body provided with a plurality of bores or having blocks with bores therein fixed to the body with the bores being inclined generally in the direction of rotation of the auger and each being adapted for detachably but rotatably receiving a pick type bit having a hard pointed leading end.

The auger body is provided with wing cutters, each rotatably carrying pick type bits and adapted to swing outwardly when the auger is rotating in working direction and to swing inwardly when the auger is rotating in the opposite direction.

The auger body is adapted for mounting on the end of a driving means such as a pipe, or a string of pipe, in case the hole being bored is of extreme length, or the auger according to the present invention can be backed up by spiral flights for carrying away the material taken by the auger.

DETAILED DESCRIPTION OF THE INVENTION

The auger according to the present invention, and with pariicular reference to FIGS. **1** to **3**, comprises a base plate **10** adapted for being mounted on a suitable driving instrumentality, such as the end of a tubular pipe or string of pipe.

The particular manner of connecting base plate **10** to the pipe is not illustrated, but it could be welded on an adaptor for being threaded to the pipe, or base plate **10**, or could otherwise be affixed to the pipe, so as to be coaxial therewith whereby it can be driven in rotation and advanced into a formation to be reduced.

The base plate **10** in the center thereof, on the front, has fixed thereto, as by welding, a spacer **12**, and secured to the outer end of a spacer **12** is body part **14** of a central cutter structure. Projecting axially outwardly from the center of body part **14** is a pilot cutter **16**, which may be threaded to body part **14** or otherwise affixed thereto. Pilot cutter **16** may take any of several forms and, in FIGS. **1** and **2**, it will be seen to comprise hard metal carbide blade portions **18** fixed to a steel support **19**.

Body part **14** may be formed with tool receiving holes therein or may have welded thereto a plurality of blocks **20**, each having a hole for receiving a pick type bit **22**. As will be seen in FIG. **1**, the blocks **20**, secured to body **14**, are fixed to the body in such a manner that the pick type bits **22** therein are inclined circumferentially in the direction of rotation of the auger and are also inclined at different angles to the axis of the auger and are distributed radially and circumferentially of the auger.

The pilot cutter or bit **16**, together with the pick type bits **22** mounted in the blocks **20** on body **14**, thus efficiently reduce a formation equal to or slightly larger than the distance outwardly from the axis of the auger to the radially outermost one of the pick type bits **22**.

Turning for the moment to FIG. **3**, which shows a block **20** in section and a pick type bit **22** therein, it will be noted that the pick type bit is generally cylindrical and is concentric about a central longitudinal axis. At the leading end, the bit has mounted therein a hard wear resistant pointed tip **24** consisting, for example, of a cemented hard metal carbide such as tungsten carbide. The block and bit have interengaging thrust transmitting shoulders at **26** which may take the form of a tapering shoulder intermediate the length of the bit and a tapering mouth at the end of bore **28** in block **20**.

The bit **22** is releasably retained in the block as by a spring band **30** mounted on the shank **32** of the pick in a groove **34** provided for the spring band and, in relaxed position, having a portion projecting outwardly from the periphery of shank **32** so as to be engageable in an annular recess or notch **36** provided in bore **28**.

The spring band keeper retains the pick in the block but does not inhibit free rotation of the pick in the bore in the block. The free rotation of the pick is important because it permits the pick to wear down uniformly

around the entire periphery at the point thereof and thus to remain sharp throughout the life thereof.

Returning to FIGS. 1 and 2, the base plate 10 is formed with diametrically opposite wing portions 40 and, on these wing portions, are mounted further blocks 42 having pick type bits 44 therein with each bit and block being constructed as illustrated in FIG. 3. The blocks 42 and the picks therein on the wing portions are so arranged that the pointed ends of the picks are distributed radially and circumferentially of the auger thereby increasing the size of a formation which is taken by the picks mounted on body 14.

In the boring of holes with an auger of the nature illustrated herein, it is a convenience to be able easily to withdraw the auger, for the purpose of replacing worn pick type bits thereon, or to withdraw the auger at the completion of a drilling operation.

The withdrawing of the auger from the hole bored thereby according to the present invention is simplified by mounting on the outer end of each of the wing portions 40 of the base plate 10, a wing cutter arrangement generally indicated at 50. Each wing cutter arrangement comprises an upper plate 52 and a lower plate 54 with a stop block 56 fixed to both thereof.

Plates 52 and 54 are spaced a distance at least equal to the thickness of plate 10 so that plate 10 can be received therebetween while the wing cutters are freely pivotal on the plate. The plates 52 and 54 of the wing cutter and base plate 10 are bored to receive a nut and bolt 58 for pivotally retaining the respective wing cutter on base plate 10.

As will be seen in FIG. 1, the stop block 56 is arranged to abut base plate 10 when the respective wing cutter is swung outwardly while permitting the wing cutter readily to swing inwardly. Each wing cutter, on its upper plate 52, has further blocks 60 mounted thereon with pick type bits 62 rotatably mounted therein in the manner shown in FIG. 3.

The picks on the wing cutters are distributed circumferentially and radially when the wing cutters are swung to their outermost positions and determine the maximum diameter of the bore cut by the auger. Furthermore, it is preferable for the leading bit on each wing cutter to extend axially forwardly from the remaining bits on the respective wing cutter to promote efficient cutting action.

In operation, the auger of FIGS. 1 and 2 is rotated in the counterclockwise direction, as viewed in FIG. 1, and this will cause the wing cutters 50 to swing outwardly to the position illustrated in FIG. 1, whereby the hole bored by the auger will be that diameter for which the auger is designed. In the case of the auger shown in FIGS. 1 and 2, the diameter of the hole bored might, for example, be 13 inches.

When the cutter is to be withdrawn from the hole taken, it can be merely pulled backwardly, or it can be rotated in reverse direction, and in either case, the wing cutters 50 will tend to swing inwardly thus displacing the bits thereon radially inwardly a distance of up to one inch or more, thereby providing adequate clearance between the wall of the hole bored and the outermost periphery of the auger.

It has been found that the pick type bits distributed on the auger as illustrated do an extremely efficient job of reducing formations while remaining sharp at all times because of the freedom of the bits to rotate in the bores provided therefor.

Furthermore, since the bits are presented to a formation in such a manner that the load imposed on each pick is generally in the axial direction thereof, the bits constructed as illustrated are extremely strong and the bits do not tend to bend or break. An auger constructed as illustrated will, thus, drill efficiently with a minimum of power and the bits will remain effective and sharp throughout the life thereof.

When a bit becomes defective, or worn out, it is a simple matter to pry the bit out of the bore in which the shank is disposed and to replace it with a new bit which is merely pressed into the hole until the spring band keeper thereon snaps into the receiving recess provided in the bore of the respective support block.

FIG. 4 shows the manner in which the principles of the present invention could be extended to the manufacture of augers of larger diameter. In FIG. 4, the base plate 70 is in the form of a bar-like member and upstanding axially from the center thereof is a spacer member and body combination 72 the same as spacer 12 and body 14 of FIGS. 1 and 2.

Projecting axially from the center of the last mentioned body part is a pilot cutter 74, while the body part is formed with bit receiving bores or has support blocks 76 welded thereto and receiving picks 78 inclined in the direction of rotation of the auger while working and inclined to the axis of the auger so as to be presented to the formation being reduced in radially and circumferentially distributed relation.

The auger shown in FIG. 4 is adapted for boring a hole which might be, for example, 37 inches in diameter, and in order to reduce the entire area during the boring operation, there is distributed along the arms of base plate 10 a plurality of bores for receiving bits, or a plurality of blocks 80 in which bits 82 are rotatably mounted. Two rows of the bits 82 are provided along each arm of plate 10.

As will be seen in FIG. 4, the bits 82 which are in the lead when the auger is rotating in working direction, are radially spaced and are inclined in the direction of rotation of the auger and the axial planes of the axes thereof are substantially tangential to the path of motion of the respective bit.

The trailing row of bits along each arm of base plate 70 are similarly arranged except they are disposed radially in the region between adjacent ones of the leading bits on the respective arm of the base plate. Still further, the bits on each arm of base plate 70 are preferably staggered somewhat with respect to the bits on the other arm thereof and in this manner substantially complete coverage of the area being worked by the auger is obtained.

The outer ends of the arms of base plate 70 advantageously include two or more bits 84 inclined outwardly somewhat so as to engage the region being treated outwardly from the ends of the base plate 70 thereby protecting the edge of the base plate from extreme wear under all conditions of operation.

Similarly to the modification of FIGS. 1 and 2, the leading sides of the outer ends of the two arms of base plate 70 are provided with swingable wing cutters 90 pivoted to base plate 70 by bolts 92 and carrying rotatable bits 94. As in connection with the wing cutters 50 of the first described modification, the leading one of the bits on each of the wing cutters 90 is preferably axially advanced over the others of the bits thereon. The bits on the wing cutters are distributed circumferen-

tially in respect to the axis of the auger and may also be distributed radially thereof.

Also, as in connection with the FIGS. 1 and 2 modification, the wing cutters **90** are formed of upper and lower plates which receive therebetween the base plate **70** and between which upper and lower plates there are provided the stop blocks **96** that determine the outwardly pivoted portions of the wing cutters while permitting the wing cutters to swing inwardly when the auger is withdrawn from a formation, or when it is rotated therein in the reverse direction.

As an example, the diameter of a hole taken by the auger of FIG. 4 without the wing cutters thereon might be about **35** inches and which diameter is determined by the gauge cutters **84.** With the wing cutters on the base plate of the auger, the diameter taken would be 37 inches.

FIG. **5** shows a modification in which the auger consists of a plate **100** with a central pilot cutter **102.** Cutters are distributed along the length of plate **100** in the usual manner, and at the forward corners of the plate there are pivoted the wing cutters **106** and at the rear corners thereof there are pivotally supported the wing cutters **108.** Each of the aforementioned wing cutters has an inward position and an outward working position the same as the previously described modifications.

In the FIG. **5** modification, the body plate **100** also carries cutters **110** disposed in trailing relation to the leading wing cutters **106.**

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. In an auger for boring holes in earth formations; body means in the form of a base plate adapted for being driven in rotation on an axis perpendicular to the base plate by driving means connected to the back of the base plate, a plurality of first cutting elements distributed radially of said base plate on the front face thereof and adapted to engage and reduce a formation to which the auger is presented in rotation, said base plate having wing portions thereon at the ends and wing cutters pivotally mounted on said wing portions on axes substantially parallel to said axis of rotation of said base plate, said wing cutters having second cutting elements on the front face thereof, each said wing cutter having an outwardly swung position on the respective wing portion wherein at least one of said second cutting elements is disposed radially outwardly from the radially outermost of said first cutting elements on said base plate and an inwardly swung position wherein the said second cutting elements are disposed radially inwardly from the outermost positions thereof, at least one of each said wing cutter and the respective wing portion comprising a pair of plates in axially spaced relation and the other thereof comprising a plate portion adapted to fit between said pair of plates, and cooperating elements of abutment means on each wing cutter and the respective wing portion interengageable to halt and support the respective wing cutter when moved into the outwardly swung position thereof, each of said base plate and wing cutters being provided with bores, and each said cutting element being in the form of a generally cylindrical member having the leading end pointed and having a shank at the other end receivable in a respective one of said bores, each said bore and the cutting element therein being so inclined on said auger that the point ends of the cutting elements are in the lead during rotation of the auger whereby the load on each cutting element as the auger is rotated and pressed against a formation is substantially axial of the cutting element.

2. An auger according to claim **1** which includes a central pilot cutter means projecting forwardly from the plane of said base plate on the axis of rotation of the base plate and fixed to said base plate, said pilot cutter means projecting forwardly from said base plate a greater distance than any of said cutting elements.

3. An auger according to claim **1** in which each cutting element and the portion of the auger having the bore therein that receives the shank of the cutting element are provided with cooperating elements of abutment means to sustain axial thrusts imposed on the cutting element.

4. An auger according to claim **1** in which each said cutter includes a captive spring keeper on the said shank thereof for detachably but rotatably retaining the cutting element in the respective said bore.

5. An auger according to claim **1** in which said first cutting elements are distributed radially along said base plate in both directions from the axis of rotation of the base plate and are arranged in circumferentially spaced rows with the cutting elements in at least two rows being staggered in the radial direction of said base plate relative to each other.

6. In an auger for boring holes in earth formations; body means in the form of a base plate adapted for being driven in rotation on an axis perpendicular to the base plate by driving means connected to the back of the base plate, a plurality of first cutting elements distributed radially of said base plate on the front face thereof and adapted to engage and reduce a formation to which the auger is presented in rotation, said base plate having wing portions thereon at the ends and wing cutters pivotally mounted on said wing portions on axes substantially parallel to said axis of rotation of said base plate, said wing cutters having second cutting elements on the front face thereof, each said wing cutter having an outwardly swung position on the respective wing portion wherein at least one of said second cutting elements is disposed radially outwardly from the radially outermost of said first cutting elements on said base plate and an inwardly swung position wherein the said second cutting elements are disposed radially inwardly from the outermost positions thereof, at least one of each said wing cutter and the respective wing portion comprising a pair of plates in axially spaced relation and the other thereof comprising a plate portion adapted to fit between said pair of plates, and cooperating elements of abutment means on each wing cutter and the respective wing portion interengageable to halt and support the respective wing cutter when moved into the outwardly swung position thereof, the said second cutting elements being distributed on said wing cutters in the circumferential direction of the auger and the leading cutting element on each wing cutter projecting axially forwardly beyond the others of the cutting elements thereon.

7. In an auger for boring holes in earth formations; body means in the form of a base plate adapted for being driven in rotation on an axis perpendicular to the base plate by driving means connected to the back of the base plate, a plurality of first cutting elements distributed radially of said base plate on the front face

thereof and adapted to engage and reduce a formation to which the auger is presented in rotation, said base plate having wing portions thereon at the ends and wing cutters pivotally mounted on said wing portions on axes substantially parallel to said axis of rotation of said base plate, said wing cutters having second cutting elements on the front face thereof, each said wing cutter having an outwardly swung position on the respective wing portion wherein at least one of said second cutting elements is disposed radially outwardly from the radially outermost of said first cutting elements on said base plate and an inwardly swung position wherein the said second cutting elements are disposed radially inwardly from the outermost positions thereof, at least one of each said wing cutter and the respective wing portion comprising a pair of plates in axially spaced relation and the other thereof comprising a plate portion adapted to fit between said pair of plates, and cooperating elements of abutment means on each wing cutter and the respective wing portion interengageable to halt and support the respective wing cutter when moved into the outwardly swung position thereof, said base plate being in the form of an elongated bar-like member having the said wing portions formed on the leading sides thereof at opposite ends.

* * * * *