May 30, 1961 L. W. RYSER ET AL 2,986,008

APPARATUS FOR FORMING CONCRETE PILES

Original Filed Nov. 16, 1955 2 Sheets-Sheet 1

Fig. 1.

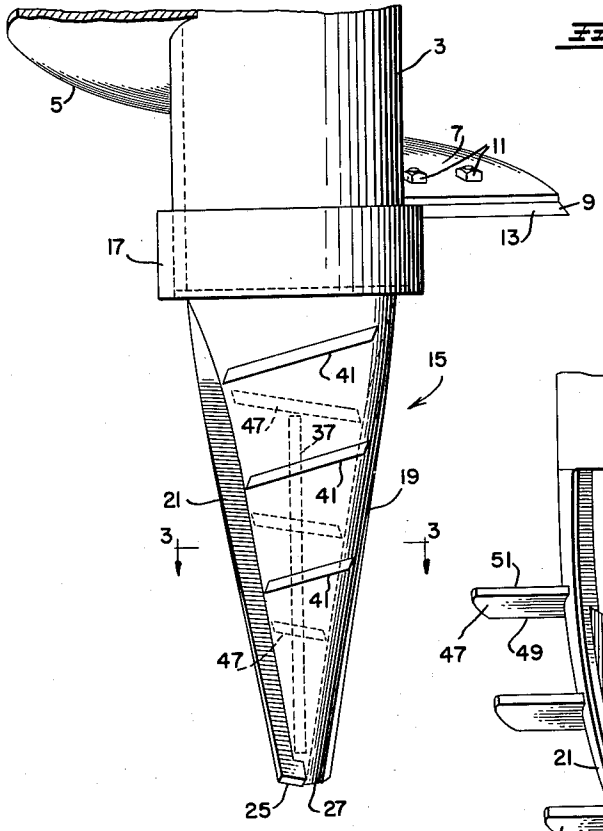
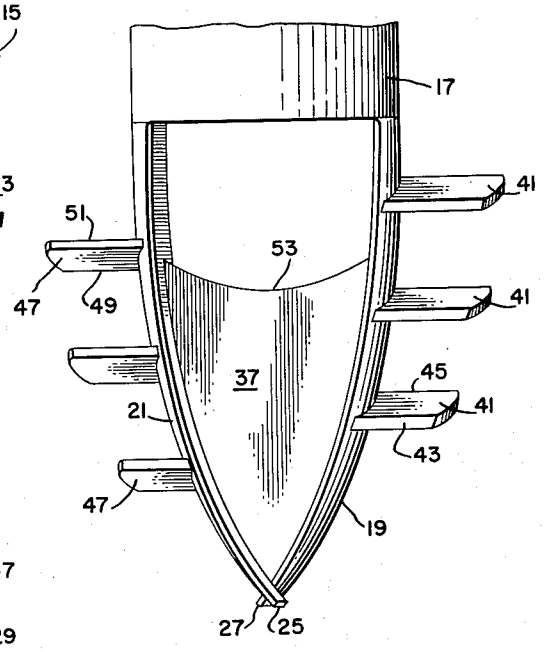


Fig. 2.



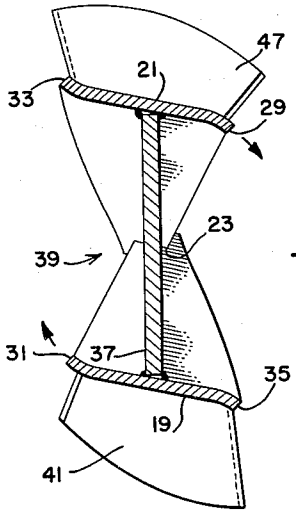


Fig. 3.

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Fig. 4.

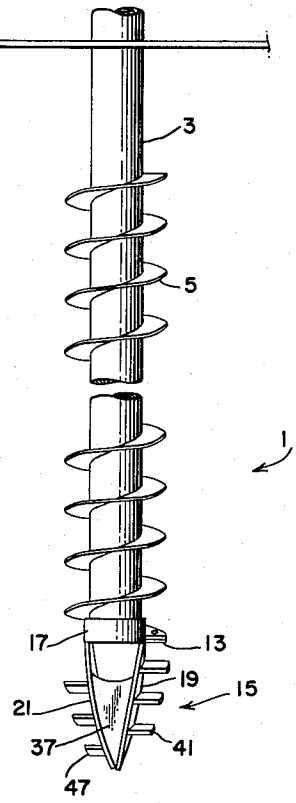
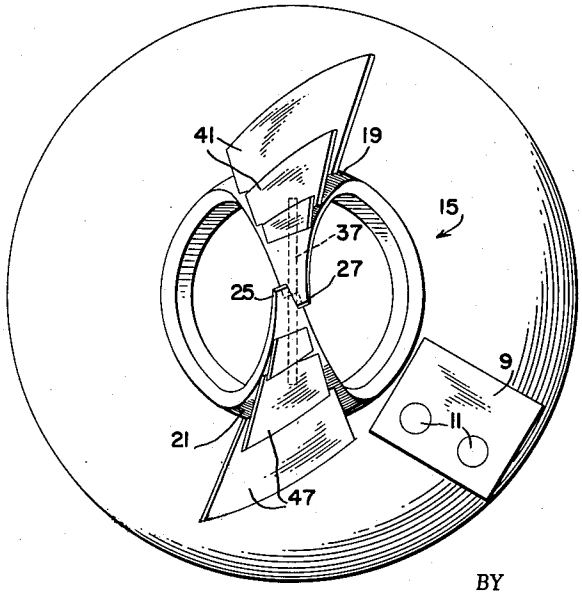


Fig. 5.



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APPARATUS FOR FORMING CONCRETE PILES

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Original application Nov. 16, 1955, Ser. No. 547,241, now Patent No. 2,920,455, dated Jan. 12, 1960. Divided and this application Oct. 29, 1957, Ser. No. 693,094

3 Claims. (Cl. 61—53.64)

This application is a division of our copending application Serial No. 547,241, filed November 16, 1955, now Patent No. 2,920,455.

This invention relates broadly to the production of concrete piles and in its more specific aspects it relates to apparatus whereby poured-in-place concrete piles are rapidly and efficiently produced; and the nature and objects of the invention will be readily recognized and understood by those skilled in the arts to which it relates in the light of the following explanation and detailed description of the accompanying drawings illustrating what we at present believe to be the preferred embodiments or mechanical expressions of our invention from among various other forms, arrangements, combinations and constructions, of which the invention is capable within the spirit and scope thereof.

In construction work where concrete piling is required, it is conventional practice to drill a hole in the ground to the proper depth with an earth auger and to then withdraw the auger whereupon the pile is formed by pouring concrete into the hole. Concrete piles are, of course, used in many different ground formations and classes of earth and we have encountered many difficulties and inherent problems in forming piles in the conventional manner, and our present invention is directed toward and does solve the many undesirable aspects and operational problems which have heretofore caused the forming of piles to be a slow, expensive and relatively difficult construction process.

In conventional methods of forming piles the nature of the soil in which the hole has been drilled may be such that after the auger is withdrawn, the wall of the hole will collapse or cave in so that the next step in the process of pouring the concrete may not be accomplished. When such a cave-in occurs, it is necessary to redrill the hole or remove the dirt in some way and to shore up, reinforce or stabilize the walls so that the hole may be kept clear and the concrete poured to form the pile.

Various means have been devised for stabilizing the soil to prevent cave-ins following withdrawal of the auger. For instance, treatment of the soil with stabilizing chemicals has been suggested and tried, and structural apparatus for preventing cave-ins and collapse of the walls have been used. However, except in ideal soil conditions such methods and operations are very difficult and are obviously expensive and time-consuming.

Our studies and experiments in this field resulted in the development of the concept which involves the use of the drill or earth auger itself as the stabilizing medium for the wall of the hole into which the concrete is to be poured. It will be recognized that this conception and the method and apparatus whereby it may be practically carried out, eliminates the time-consuming steps of removing the auger after the hole has been drilled, then stabilizing the walls of the hole if the soil will permit and then pouring the concrete. Not only does our concept

involve the saving of time, but it also eliminates the need for certain apparatus and materials which were required in the practice of prior methods, and it ensures against cave-ins while prior methods were, at best, uncertain.

In practicing our method of producing poured-in-place concrete piles we do not remove the earth auger immediately following the operation of drilling the hole to the proper depth, instead the auger is gradually withdrawn from the hole as the concrete is pumped in through the auger itself. Thus, the auger forms at all times the wall reinforcing means for that portion of the hole which has not been filled with concrete. It will be fully appreciated as the description of our apparatus proceeds that the concept of slowly withdrawing the auger as the concrete is poured eliminates the need for certain heretofore required extra equipment and materials and reduces the number of steps to be performed in forming concrete piles, and our invention therefore constitutes a substantial saving in labor, time and materials without sacrificing the strength or efficiency of the finished pile.

In order to provide practical equipment to carry out our method of using the earth auger as the stabilizing or supporting means for the walls of the hole while pumping or otherwise causing concrete to flow through the auger and into the hole while withdrawing the auger as the hole is filled with concrete, we evolved an earth auger of novel construction and also supporting and operating equipment of an ingenious nature whereby the efficiency of our operation is substantially advanced.

The drill or earth auger which we have evolved is of generally tubular construction so that a duct or core is provided therethrough through which the concrete flows into the hole. Since the auger which is used as the stabilizer for the walls of the hole is the one which has drilled the hole in the ground, it is provided with a cutting bit on one end which must be so designed that it will not obstruct the flow of concrete from the drill into the hole. Because of the consistency of the concrete the complete flow course provided in the drill must be designed for free and unobstructed flow of the concrete if efficient and satisfactory results are to be obtained. We have designed the bit of our earth auger so that it affords free flow of the concrete into the hole which the auger has drilled and we have also designed the bit to act as a spreader for the concrete as it flows from the auger and into the hole.

It will be recognized that during the drilling operation it will be necessary that the duct or tubular core of the auger be kept free of the excavated material so that the concrete may flow therethrough at the proper time. We have designed a bit or drill tip which functions in this desirable manner for it deflects the excavated material radially outwardly away from the lower outlet from the concrete flow duct through the auger to ensure against such excavated material entering and clogging or obstructing the duct.

We have devised an earth auger which drills the hole, then functions as a stabilizing or supporting means for the walls of the hole and provides a duct for free flow of concrete therethrough without requiring the removal or alteration of any parts thereof after the drilling operation but before the concrete pouring operation may be started. Thus, without change or alteration of any character whatsoever, our earth auger serves the various functions required of it.

In order to carry out our purpose of using the earth auger as a wall stabilizing medium and of forcing concrete through the auger as it is withdrawn from the hole which has been drilled thereby, we have devised a novel rig for supplying the concrete to the auger and for controlling the auger in all of its various operations in carrying out the steps of our method.

With the foregoing general objects, features and re-

sults in view, as well as certain others which will be apparent from the following explanation, the invention consists in certain novel features in design, construction, mounting and combination of elements, as will be more fully and particularly referred to and specified hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a view in elevation of the bit or tip of the earth auger with parts of the auger being broken away.

Fig. 2 is a view in elevation of the bit or tip of the earth auger rotated approximately 45° from the position illustrated in Fig. 1.

Fig. 3 is a view taken on line 3—3 of Fig. 1.

Fig. 4 is a view in elevation of the earth auger of this invention.

Fig. 5 is a plan view of the lower end of the earth auger illustrating the bit or tip of the auger.

In the accompanying drawings we have used the numeral **1** to designate in its entirety the earth auger of this invention. The auger is formed with a tubular shaft or stem **3**, the upper end portion of which extends above the ground and is operatively associated with any suitable mechanisms for causing rotation thereof during a drilling operation and for vertically moving and controlling the auger. Such mechanisms may be of the type disclosed in our aforementioned pending patent application Serial No. 547,241. The open upper end of the tubular shaft is adapted to receive concrete under pressure therein for flow of the concrete through the auger and into the drilled hole. Any suitable arrangement for supplying concrete to the auger may be employed, such as that disclosed in the aforesaid pending patent application.

The earth auger **1** which is particularly useful in forming poured-in-place concrete piles comprises the hollow stem or shaft **3** which is open at both ends and is designed for free and unobstructed flow of concrete therethrough. Fixed on and extending upwardly from the lower end of shaft **3** to a point spaced below the upper end of the shaft are flights **5** which function to remove the excavated material as the auger is rotated in a drilling operation. We have had satisfactory results when using a shaft of approximately 5" I.D. and approximately ¼" thick plate flights at approximately 7" pitch. The edge of the lower flight **7**, which is a continuation of flights **5**, mounts a cutting plate **9** by means of bolts **11** and the cutting plate may be provided with a tapered leading edge **13** for cutting into the ground as the auger is rotated in a drilling operation.

We have used the numeral **15** to designate in its entirety the tip or bit of the earth auger. The tip **15** is mounted on the lower end of hollow shaft **3** by means of a collar **17** which encompasses the end of the shaft and is fixed thereto by welding or the like. The collar may be of split ring construction and if so, the split should be welded after the collar **17** is mounted on the lower end of shaft **3**.

Fixed in any suitable manner, as by welding, to the collar **17**, we provide a pair of oppositely disposed and circumferentially spaced elongated vanes **19** and **21** which depend downwardly from the collar. Each vane is inwardly curved or of arcuate formation downwardly to a point where the ends thereof are notched and abut as at **23**, the extending ends **25** and **27** forming a fishtail point for the drill bit which breaks up any hard strata of material that may be encountered in the drilling operation. The abutting ends of the vanes may be fixed together by welding. The vanes are of downwardly tapering construction and the diameter of the lower end of the tip **15** is reduced relative to the diameter of the upper end. The forward or leading edge of vane **21** is curved inwardly as at **29**, while the forward or leading edge of vane **19** is curved inwardly as at **31**. The rear or pressure edge of vane **21** is curved outwardly as at **33** while the rear or pressure edge of vane **19** is curved outwardly as at **35**.

A spreader plate **37** is welded to each of the vanes, the spreader plate extending between and in welded engagement with the vanes from a point adjacent the abutting tips thereof upwardly a distance. This spreader plate, as will become apparent, functions as a structural member for the vanes and also as a spreader element for the concrete as it flows out of the auger. Each vane is twisted or warped about a generally longitudinal axis and in the same direction from their fixed points on the collar to thereby offset each longitudinal edge of one vane relative to the plane of rotation of one of the longitudinal edges of the other vane. This twisting distortion or warping of the vanes also causes the abutting ends of the vanes to be offset as at **39**. Due to the warping of the vanes **19** and **21**, as described, the leading edges **31** and **29** on the vanes, along substantially their entire lengths, are disposed radially inwardly relative to the trailing edges **35** and **33** of the vanes. Consideration, particularly of Fig. 3 of the drawings, will clearly illustrate that, as the auger is rotated in a drilling operation in the direction of the arrow, the excavated material will be thrown radially outwardly due to the unique distortion configuration of the vanes, which relatively positions the leading and trailing edges, as described. Thus, no excavated material will be forced or will otherwise accumulate in and clog the shaft **3** through which concrete is adapted to flow.

In order to facilitate the drilling operation we provide a number of fins on each vane which extend radially outwardly therefrom. In the particular embodiment illustrated in the drawing we provide three fins **41** which may be welded to the vane **19** in vertically spaced relation. Each side fin is fixed to the vane at an angle or inclined downwardly in a forward direction so that its leading edge **43** is lower than its trailing edge **45**. Three generally similar fins **47** are fixed on vane **21**, the lowermost of said fins being fixed in a plane below the lowermost fin **41** on vane **19** and the other fins **47** being alternately positioned horizontally with respect to fins **41**. The fins **47** are mounted at an angle so that each leading edge **49** is lower than each trailing edge **51**. It will be recognized that due to this particular construction the fins **41** and **47** will push the material up to the cutting edge **13** and onto the flights.

When it is desired to form poured-in-place concrete piles, the auger is positioned over the spot where the hole is to be drilled, whereupon the auger is lowered into ground contact and is caused to rotate to drill the hole to the proper desired depth, whereupon rotation of the auger is stopped and the auger is maintained in its position within the hole which it has just drilled. With the auger in position within the drilled hole, it will be evident that it acts as a reinforcing or stabilizing member preventing collapse or cave-in of the walls of the hole. With the auger in this position concrete may be caused to flow therethrough and into the hole.

In designing the tip or bit of the auger, it was necessary to form all components of the tip so that they would not obstruct the concrete as it flows out of the hollow shaft and past and through the tip. It was essential, of course, not to sacrifice the cutting and operating characteristics of the tip in order to afford free unobstructed flow. With these prerequisites in mind, we also had to design the tip so that it would throw the excavated material radially outwardly, rather than inwardly, to thereby avoid clogging the shaft or the tip with excavated material which would hinder concrete flow. We have evolved a tip which accomplishes all of these purposes. It presents no obstructions against flow of concrete. It cuts efficiently and it throws the excavated material radially outwardly and upwardly where it is caught by the spiral flights **5** and carried upwardly out of the hole. As the drilling operation proceeds, the blade **13** cuts into

the ground radially outwardly of the hole cut by vanes **19** and **21**. Since the interior flow duct for concrete provided by shaft **3** is smooth and presents no obstructions whatsoever against concrete flow and, since the bit or tip permits the concrete to flow therepast, without substantial obstruction, it will be recognized that we have provided an unobstructed concrete flow passage through the auger.

As the concrete flows out of the shaft, it will not be obstructed or hindered by the tip for the reason that all components thereof, which are more or less in alignment with the interior of the shaft, are spaced a distance from the outlet therefrom and the closest is the upper edge **53** of plate **37**, which is relatively thin and a non-obstructive surface. Thus, the concrete will not clog up as it exhausts from the shaft outlet and may freely flow radially outwardly between the vanes **19** and **21** and into the hole.

As the concrete is forced through the shaft and out the tip or bit into the hole, the auger is slowly and non-rotatively withdrawn and the spreader plate **37** serves to divide and spread the concrete flowing through the bit.

Merely as one example from among many of the dimensional characteristics which the auger may have, we have successfully drilled the holes and poured the concrete, as described, while using a 15½" diameter auger to produce a 16" hole, the I.D. of the shaft **3** being 5", the overall length of the tip or bit being 13½", while the diameter of the lower end is approximately 5½" (shaft O.D.), and the O.D. diameter of the collar **17** is 6¾". The upper edge **53** of spreader plate **35** is approximately 4" below outlet of shaft **3**.

We claim:

1. In an auger for drilling holes in the ground for forming poured-in-place concrete piles, including an open-ended tubular shaft providing an unobstructed opening for flow of concrete therethrough, a pair of oppositely disposed and circumferentially spaced elongated earth displacing members fixed in circumferentially spaced relation to and depending downwardly from the end of said tubular shaft, each of said members having a longitudinally extending leading edge and trailing edge, and each of said members being twisted on a generally longitudinal axis in the same direction from their fixed locations on the tubular shaft, and the entire lengths of the leading edges of the members being positioned radially inwardly with respect to the trailing edges, and said members being curved inwardly along their longitudinal axes with their ends in offset relation, whereby the excavated material will be directed radially outwardly in a drilling operation and upon completion thereof the concrete may freely flow from the tubular shaft past the members into the hole.

2. In an auger for drilling holes in the ground for forming poured-in-place concrete piles, including an open-ended tubular shaft adapted for flow of concrete therethrough, a pair of elongated earth displacing members connected in diametrically opposed relation on the lower end of said shaft and depending therefrom, and each of said members being curved inwardly along its longitudinal axis with their lower ends in abutting relation and fixed together at a point spaced a substantial distance from the lower end of the tubular shaft, and a spreader plate extending between said members from points adjacent the lower ends thereof upwardly a distance and said plate being fixed to said members, the upper edge of the plate being spaced from the lower end of said shaft for free flow of concrete from the lower end of the shaft and between the members and into the hole.

3. In an auger for drilling holes in the ground for forming poured-in-place concrete piles, including an open ended tubular shaft providing an unobstructed opening for flow of concrete therethrough, a pair of oppositely disposed elongated earth displacing members fixed at one end in circumferentially spaced relation to and depending downwardly from the end of said tubular shaft, each of said members having a longitudinally extending leading edge and a longitudinally extending trailing edge and being formed with the leading edge transversely curved inwardly along its length toward the opposite member and the trailing edge transversely curved outwardly along its length away from the opposite member, and said members being curved inwardly along their longitudinal axes with their other ends in offset relation, whereby the excavated material will be directed radially outwardly in a drilling operation and upon completion thereof the concrete may flow freely from the tubular shaft past the members into the hole.

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