Oct. 8, 1940. S. G. RUDDELL ET AL 2,217,258

APPARATUS FOR FORMING TAPERED CONCRETE PILES

Filed June 6, 1939 2 Sheets-Sheet 1

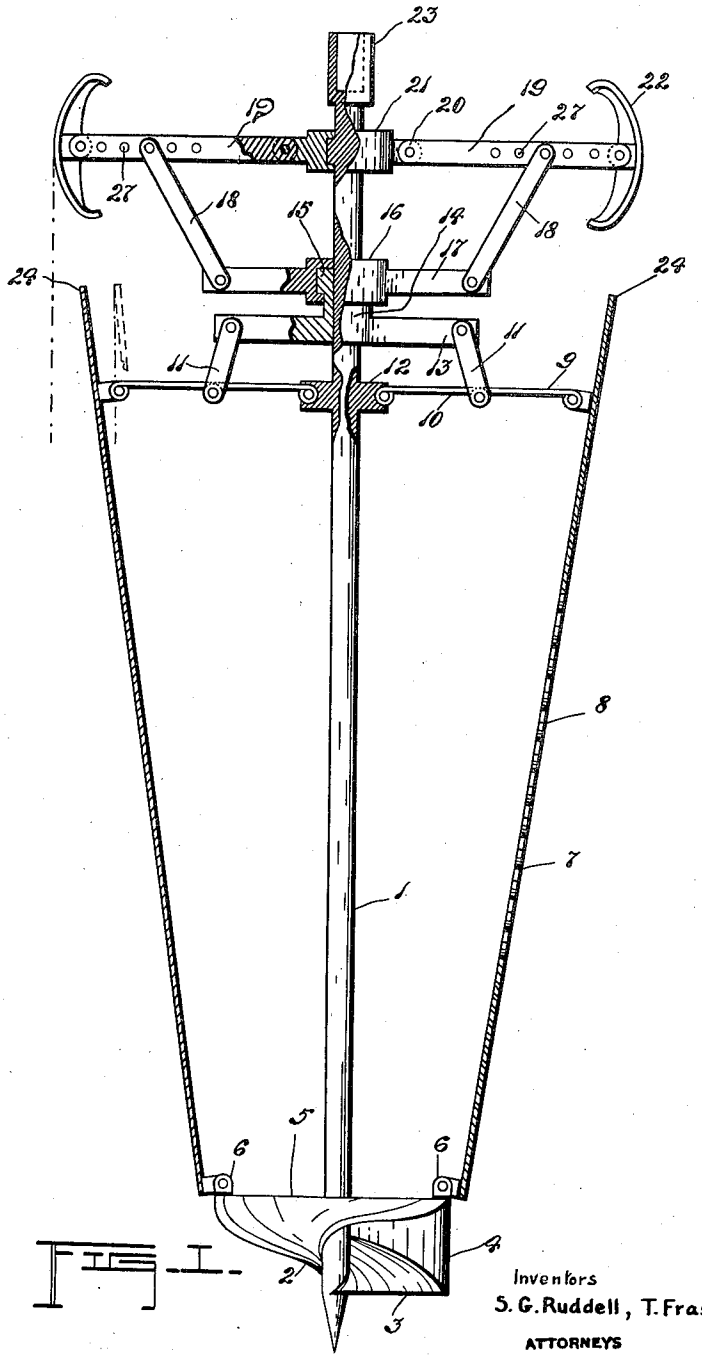


FIG. I.

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Fetherstonhaugh & Co

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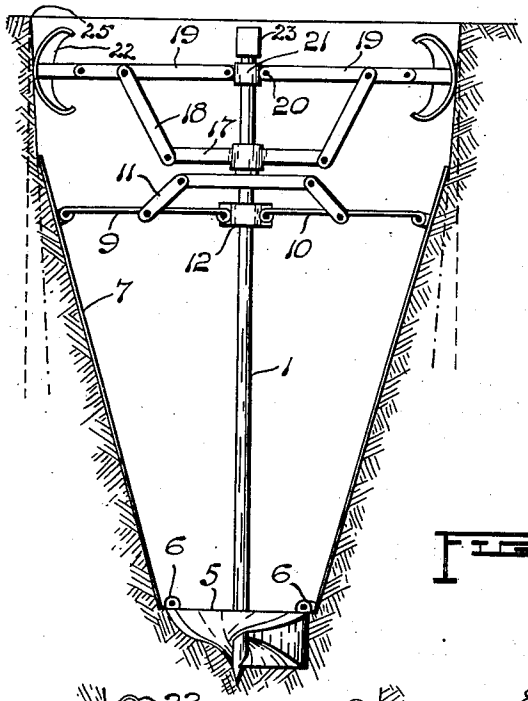


Fig. 2.

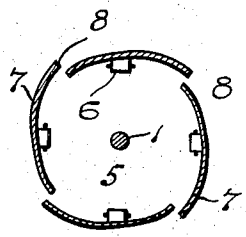


Fig. 5.

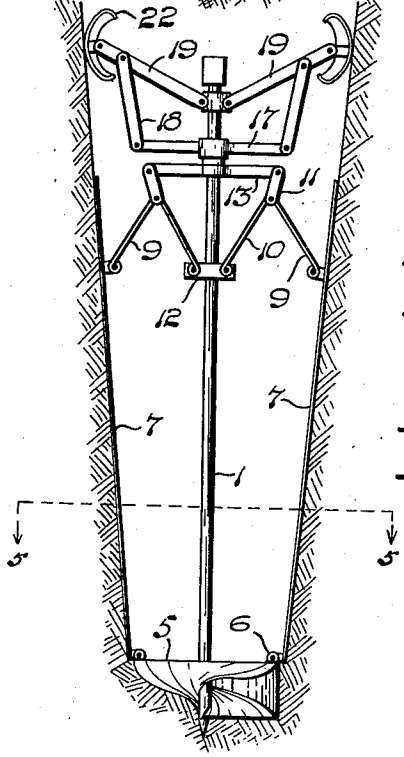


Fig. 3.

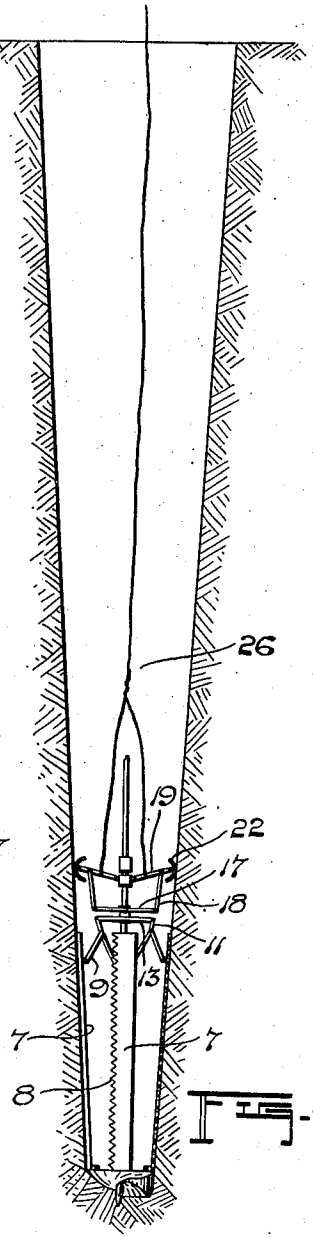


Fig. 4.

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Patented Oct. 8, 1940

2,217,258

UNITED STATES PATENT OFFICE

2,217,258

APPARATUS FOR FORMING TAPERED CONCRETE PILES

Stuart G. Ruddell and Thomas Fraser, Winnipeg, Manitoba, Canada

Application June 6, 1939, Serial No. 277,716

4 Claims. (Cl. 255—76)

Our invention relates to an apparatus for forming tapered concrete piles, an object of this invention being to provide a subteranean pile as a foundation or underpinning for structures and particularly dwellings and apartment houses which will exert greater frictional resistance against the surrounding earth and have greater resistance to the compressive force exerted by the weight at its apex than is the case with the present cylindrical types of concrete pile.

A further object of our invention is to provide an implement for forming a mould for a tapered cast-in-place concrete pile of any desired length.

A further object of our invention is to provide a device of the character herewithin described which is economical to manufacture, can be easily operated and which cannot easily become out of order.

With the above more important objects in view and such other minor objects as may appear as the specification proceeds, our invention consists essentially in the arrangement and construction of parts all as hereinafter more particularly described, reference being had to the accompanying drawings, in which:

Figure 1 is a side elevation of our implement.

Figure 2 is a further illustration of our device in situ near the commencement of a tapered mould.

Figure 3 is an illustration of our device at a position which may either be considered intermediate of a length of a mould for a cast-in-place concrete pile or at the base thereof.

Figure 4 is a sectional illustration of the mould as formed by our implement with the implement itself at the base thereof.

Figure 5 is a section on the line 5—5 of Figure 3.

In the drawings like characters of reference indicate corresponding parts in the different figures.

In our Canadian Patent No. 386,164, we have described a frusto-conical subterranean mould for the broadened base of a cylindrical cast-in-place concrete pile and in our Canadian Patent No. 372,692, we have described a process and mechanism for rifling the cylindrical wall of the mould for a cylindrical cast-in-place concrete pile, and in the first of the above enumerated patents, the virtue of the base described, resides in the fact that the area over which the compressive downward force acting upon the pile is distributed, being greater than as if no such base were provided, counteracts more effectively the tendency of the pile to sink under its load. The rifling disclosed in the second above enumerated patent, on the other hand, is designed to increase the frictional resistance of the cylindrical pile to a downward force as the opposed rifling in the mould for the pile permits the formation of two opposing and continuous spiral ribs which assist greatly in preventing a downward end thrust on the pile and when the said rifling and the frusto-conical base are employed together in one pile, the resistance to a downward thrust on the pile per square inch is increased several times.

In the present invention we disclose a further method together with apparatus for effectuating the method, by means of which the frictional resistance of a cast-in-place pile against the downward end thrust may be greatly increased and the form of pile herewithin described, may also be rifled or provided with a frusto-conical base in addition if desired.

In the formation of the tapered mould illustrated in the accompanying Figure 5, we employ the implement most clearly illustrated in the accompanying Figure 1, which will be seen to comprise a center shaft 1 pointed at its lower end and provided with a spiral auger flight 2 of substantial diameter, which of course, may be varied considerably but which for normal use in connection with structures where the weight will probably be in the neighborhood of ten to fifteen tons per pile, will be from seven to fourteen inches. This auger flight is provided with a sharp entering edge 3 and a partial wall 4 for the guidance of cut earth into the implement as later to be described.

Around the perimeter 5 of the auger, are positioned in approximately diametrical relationship, four bearings 6 which form part of hinge assemblies, about which the reaming blades 7 may pivot or swing within limits towards or away from the center shaft 1.

These reaming blades are of curved, cross-sectional configuration as most clearly illustrated in Figure 5 and provided with saw-toothed cutting edges 8. The reason for the curvature of these members will be obvious from a consideration of the accompanying Figure 5, which shows the implement in plan and with the reaming blades closed in together, from which it will be seen that in this position, they partially nest or engage so that they constitute with the comparatively shallow auger 2, a closed receptacle in which a large amount of earth may be contained to be drawn to the surface and discharged therefrom at intervals.

The upper ends of my reaming blades 7 are hingedly secured to links 9, which in turn, are

each freely connected to radiating links 10 and to connecting links 11. The radiating links 10 are hinged at the inner ends thereof to a suitable concentric fixed hub 12 positioned upon the center shaft while the upper ends of the connecting links 11 engage with projecting spokes 13 which radiate from the sleeve 14, which is free to slide upon the center shaft 1.

Freely mounted and surrounding the shoulder 15 at the upper end of the sleeve 14, is a circumscribing collar 16 provided with a pair of diametrically disposed arms 17, to the outer ends of which are positioned a pair of pivotally connected connecting links. These links are freely mounted at their upper ends each to one of the pair of radiating arms 19, which it will be seen are hingedly connected at their inner ends 20 to the collar 21, which is free to rotate about the center shaft 1.

At the outer end of each of the radiating arms 19 is the domed element 22 shown in section in the accompanying Figure 1, these elements being also freely mounted upon the ends of the radiating arms as clearly illustrated although under certain soil conditions, it may be found desirable to secure the same rigidly against any tendency to rotate.

The upper end of my center shaft 1 is provided with a socket 23 of internally squared cross-section for the reception of the usual auger sections, which are used for rotating the implement and having now described the constituent parts of our implement, its operation will be explained.

As the implement is rotatably inserted into the earth, it drills downwardly and forms the excavation illustrated in the accompanying Figure 2 and until the upper extremities 24 of the reaming blades have sunk to ground level, it may be found desirable to lock the blades in extended position. Generally speaking, however, this is not necessary in view of the fact that as clearly illustrated in the accompanying Figure 5, the cutting edges 8 of the blades are somewhat flattened with respect to curvature so that they glance off at a slight tangent, thereby holding the cutting edge of the several blades in cutting position with respect to the surrounding earth. This has the effect of preventing any tendency of the blades to collapse into the position illustrated in the accompanying Figure 3.

It must be particularly noted in connection with this implement that the radiating arms 19 project at all times slightly beyond the upper ends 24 of the reaming blades 7 and this is essential for the operation of this implement and if they did not so project but were on the other hand, in vertical alignment, it would be impossible to form a tapered mould. With the arrangement described, however, and with particular reference to the accompanying Figure 2, it will be apparent that as soon as the implement has travelled downwardly through the ground sufficiently far for the element 22 to engage the rim 25 of the excavation, the whole linkage assembly will gradually collapse toward the center shaft 1. This will have the effect of drawing the reaming blades 7 together, at a constant rate of speed as the implement travels downwardly, and theoretically, the excavation or tapered hole will comprise an infinite number of cylindrical steps although in actual practice, these will be virtually imperceptible.

In stating that the linkage assembly gradually collapses as the implement bores downwardly through the ground, we mean of course, that the same gradually assumes the position best illustrated in the accompanying Figure 3, from which it will be seen that the radiating arms 19 gradually rotate upwardly about the pivot point 20, which in turn, lifts the sleeve 14 via the spokes 17 and the connecting link 18. This in turn, raises the spokes 13, the connecting links 11 and the links 9 and 10, consequently drawing the reaming blades together and it will be particularly noted, that the arrangement in construction of parts is such that while the center shaft, the reaming blades, the links 9 and 10 and the sleeve 14 with the spokes 13 and the links 11, all rotate, the collar 16 and associated spokes together with the connecting links 18 and the radiating arms 19, all remain stationary and simply travel vertically as the implement penetrates the ground.

In the accompanying Figures 1, 2 and 3, it will be noted that we have only illustrated two diametrically opposed reaming blades, while in the accompanying Figure 4, although four such blades are illustrated, they are shown as being considerably narrower than is actually the case and as illustrated in the accompanying Figure 5. This has been resorted to for convenience, however, in illustrating the actual mechanism of our implement but it is to be understood that it is practically essential that the blades should be of substantial width in order that soil will not trickle in large quantities between the blades when they are drawn together for the purpose of raising the implement via the cable 26, the lower spliced end of which is made fast around the radiating arms 19.

We would also point out in connection with this implement that by adjusting the connecting link 18 in the various line-up of apertures 27, it is obviously possible to vary the rate of taper and although the accompanying drawings do not illustrate our device in correct dimensions in this respect, it will be obvious to those skilled in the art to which it appertains that when the tips 24 of the reaming blades are set only slightly inwards with respect to the phantom line 28, the rate of taper will be very much slower than would be the case if the tips occupied the relative position as shown in phantom line in the accompanying Figure 1, which of course, would make for a shorter and more steeply tapered hole.

We also wish to point out that if desired, our reaming blades may be tapered from top to bottom in cases where it is desired that in the closed position of the blades there shall be a slight diminution of the diameter of the bucket formed by the closing of the reaming blades towards the base thereof but this is not essential although it should be noted that when the cutting edge and the rear edge of each of the reaming blades are parallel, then in this case, the bucket formed by the closing together of the same will be of cylindrical formation, otherwise there would be a gradually increasing aperture between the blades towards the top through which dirt and soil could trickle.

It is also necessary in connection with this invention to explain that it is most desirable if not essential that the cutting edges of the reaming blades project off at a slight tangent to the circle of rotation so that they bite into the wall of the drilling being excavated and thus hold the blades outwardly against the tendency of the radial arms 19 to pull them inwardly.

We would finally state in connection with the invention illustrated upon the accompanying drawings and described herein, that we do not

wish to be confined in respect to the shape of the mould or drilling which we have devised to a tapered configuration nor do we wish to be confined to a machine for forming an elongated drilling because under certain circumstances, it is only necessary to form a tapered mould of approximately the length of the implement itself, in addition to which we may at certain times, form a comparatively deep drilling or mould which will taper alternately inwardly and outwardly throughout its length and this can be done by using alternately the device described herein to form a tapered portion of its own length or longer and then proceeding to use the implement described in our Canadian Patent No. 386,164 which will obviously produce the configuration intended when used together with our herewithin described implement.

Since various modifications can be made in the above invention, and many apparently widely different embodiments of same, made within the scope of the claims without departing from the spirit and scope thereof, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense and we desire only such limitations placed thereon as are specifically expressed in the accompanying claims.

What we claim as our invention is:

1. An implement for drilling a tapered hole downwardly through the earth for a tapered cast-in-place concrete pile comprising in combination, an auger point, a rotatable reamer following said point and means forming part of said implement for automatically and progressively reducing the diameter of the cut of said reamer as said implement travels downwardly through the earth.

2. An implement for drilling a tapered hole downwardly through the earth of a length greater than the length of said implement for a tapered cast-in-place concrete pile comprising in combination, a center shaft, an auger at the base of said shaft, at least one elongated reaming blade following said auger and pivotally mounted at its lower end to the perimeter of said auger, an automatic reaming blade adjustment assembly upon said center shaft and above said reaming blade, said assembly comprising a pair of elements bearable against the wall of said tapered hole above the upper end of said reaming blade, a pair of pivoted arms radiating from said center shaft to which said elements are attached, a slidable sleeve upon said center shaft and a system of linkages extending between and connected to said radiating arms, said sleeve and the upper end of said reaming blade whereby, in the downward travel of said implement through the earth to drill said tapered hole, said elements will trail against the wall thereof progressively to angulate said radiating arms and in turn actuate said system of linkages and said sleeve, thereby swinging said reaming blade inwardly about its pivot point towards the longitudinal axis of said implement.

3. An implement for drilling a tapered hole downwardly through the earth of greater length than the length of said implement to form a mould for a tapered cast-in-place concrete pile and including in combination, at least one rotatable reaming blade pivoted at its lower end to said implement, said blade at the commencement of drilling diverging outwardly from the longitudinal axis of said implement from the point at which it is pivoted, a reaming blade adjustment assembly positioned above said reaming blade and comprising at least one element bearable against the wall of said tapered hole operative progressively to rotate said blade inwardly about its pivot point towards a position parallel with the longitudinal axis of said implement.

4. The implement as defined in claim 3 in which said reaming blade is of substantial width to form a partial bucket wall in which earth may accumulate during the downward travel of said implement and during the progressive inward swinging movement of said blade.

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