

March 4, 1924.

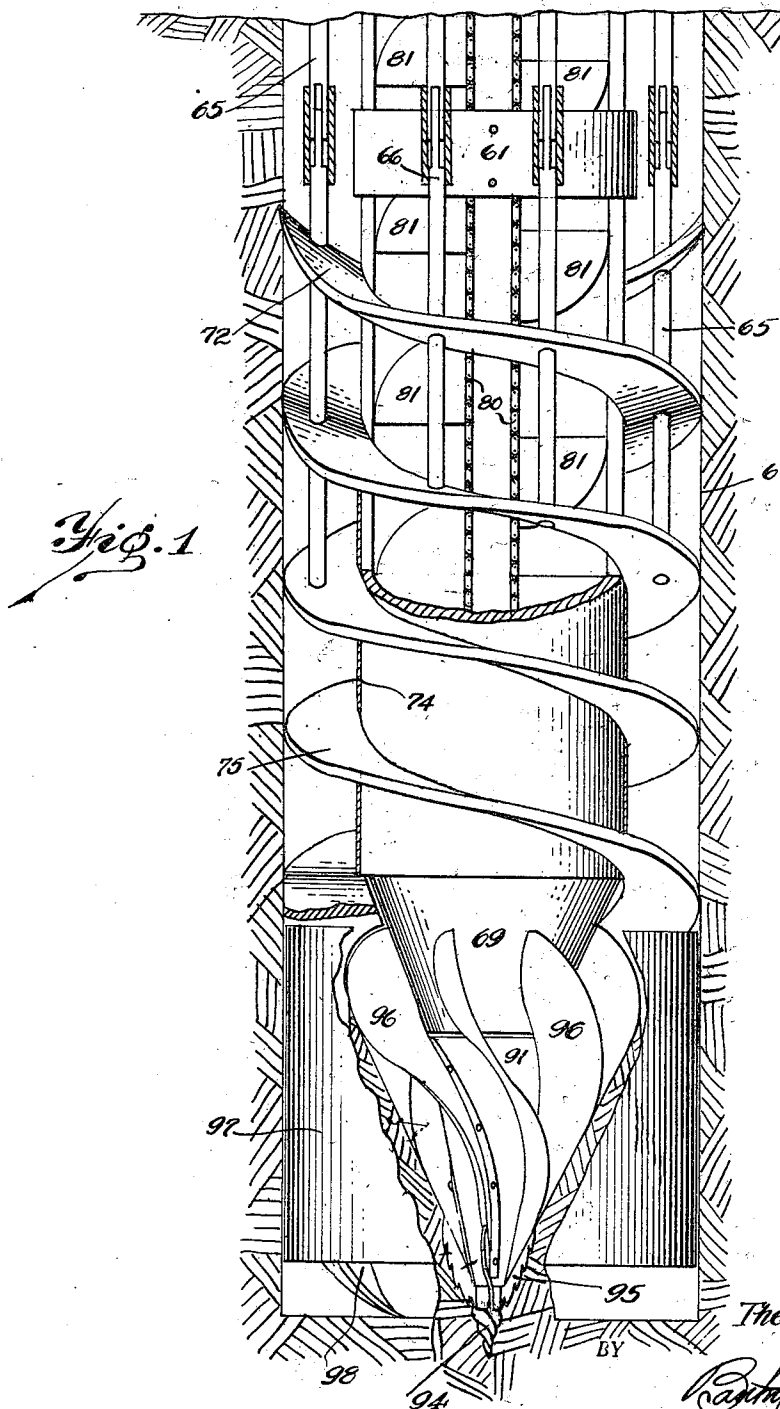
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T. J. FREDA

EARTH BORING APPARATUS

Filed Nov. 14, 1921

7 Sheets-Sheet 1



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March 4, 1924.

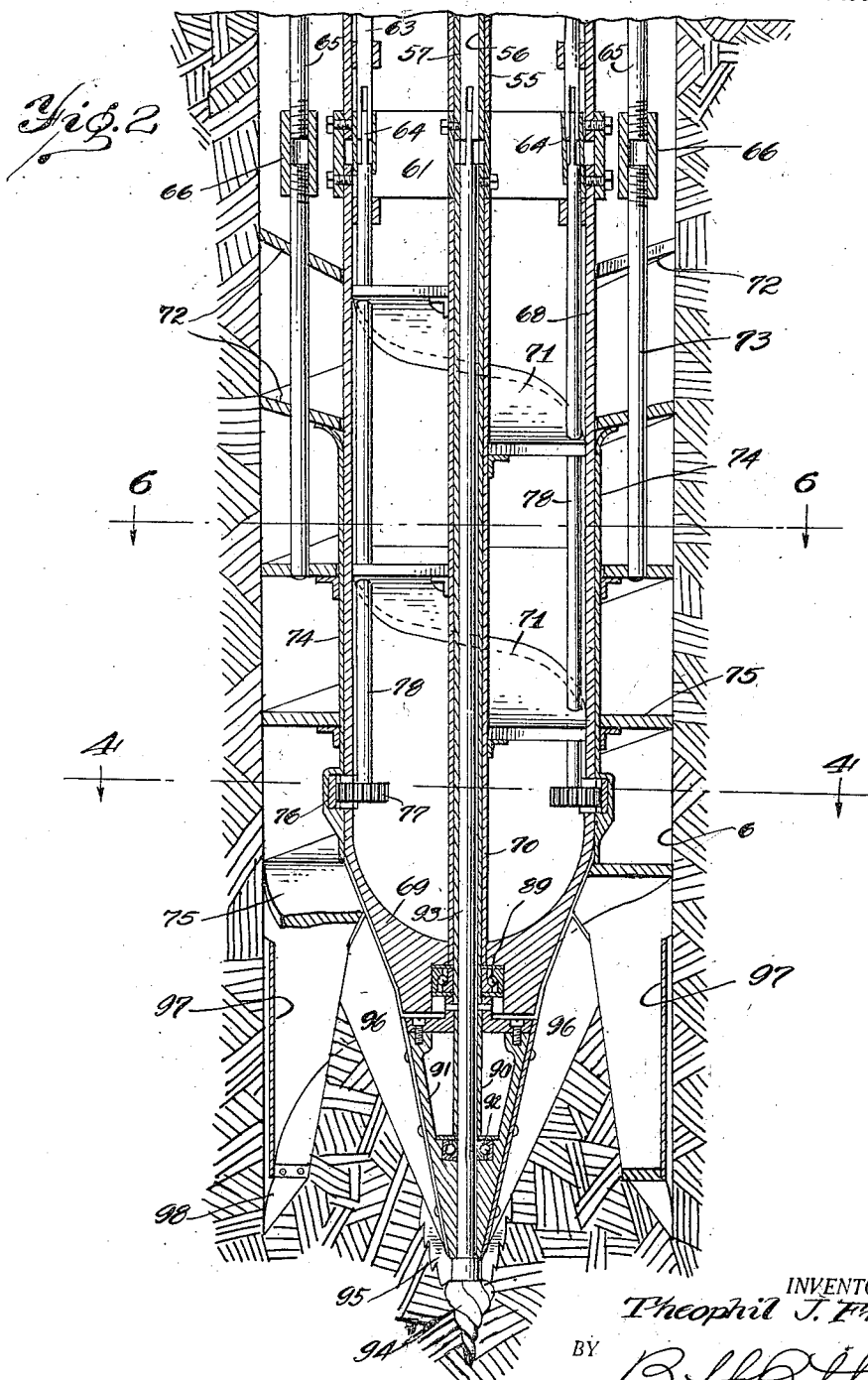
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EARTH BORING APPARATUS

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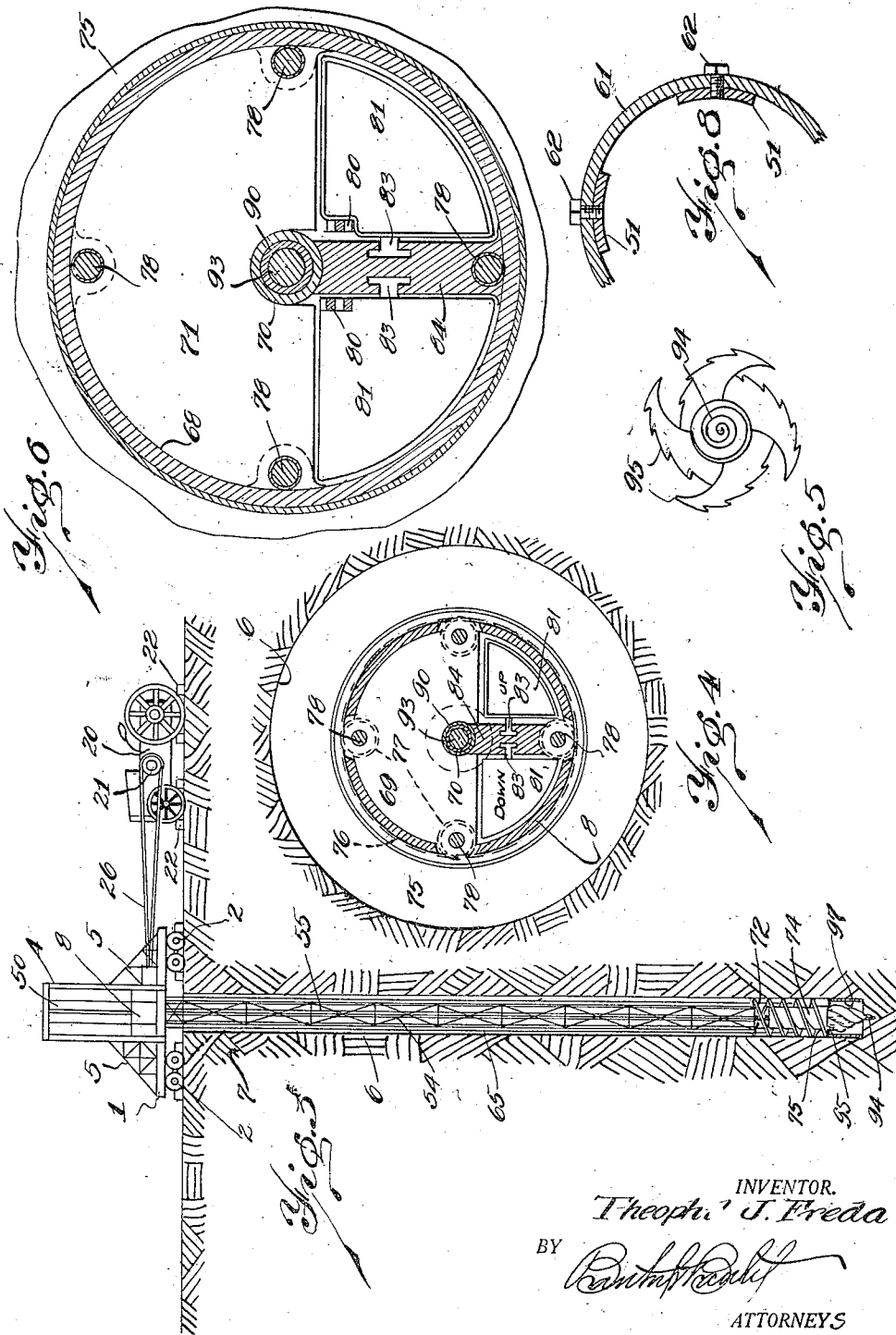
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EARTH BORING APPARATUS

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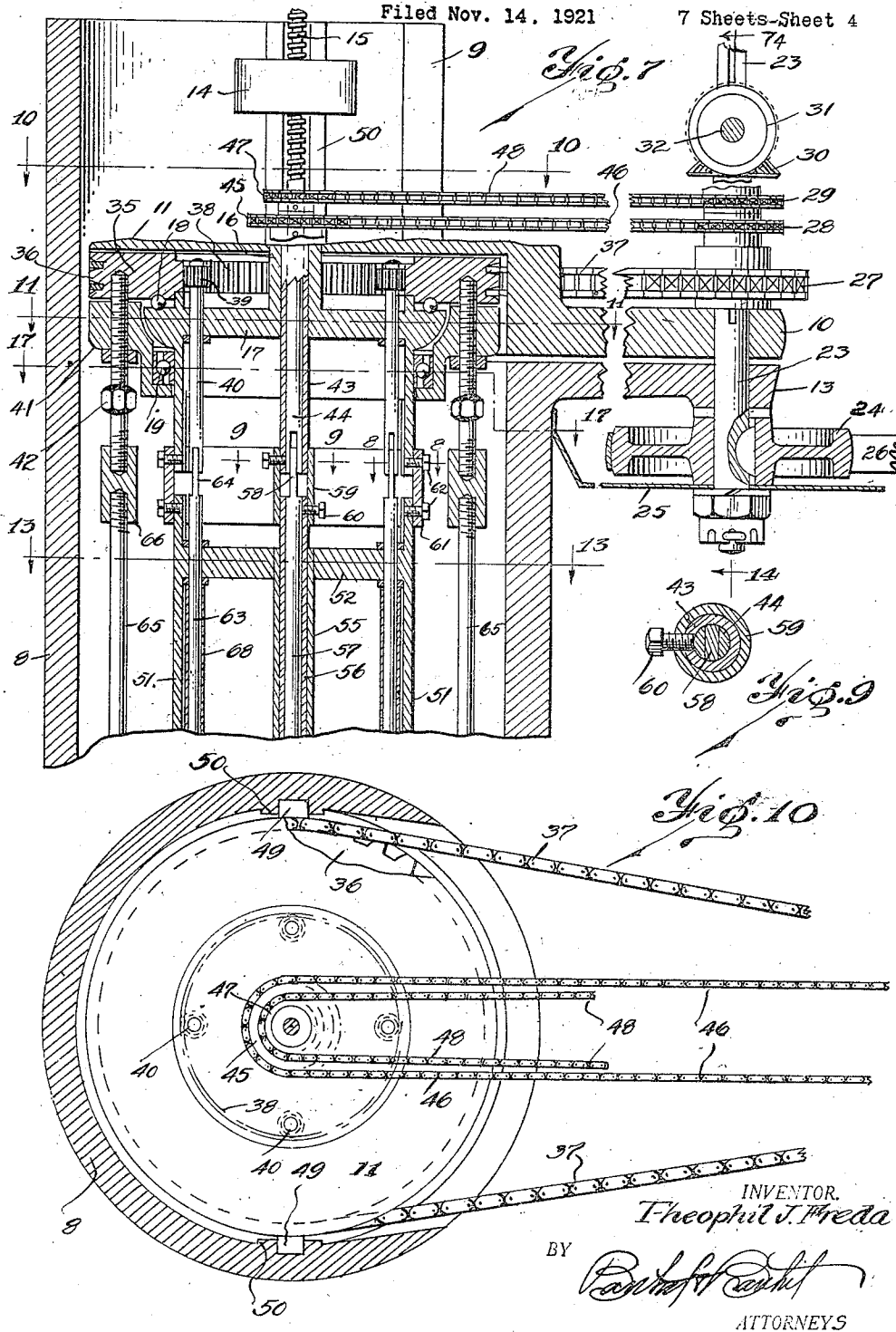
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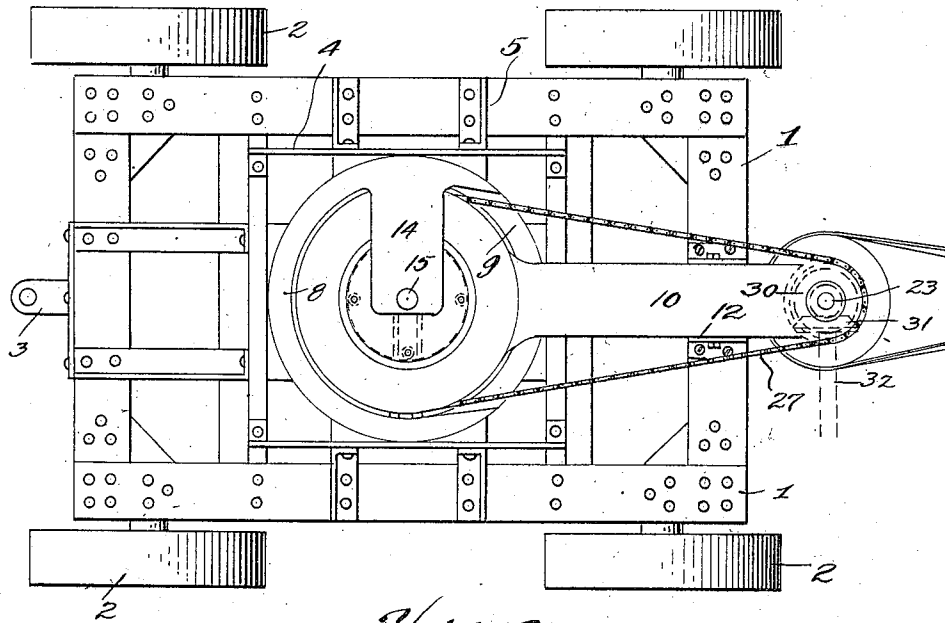


Fig. 12

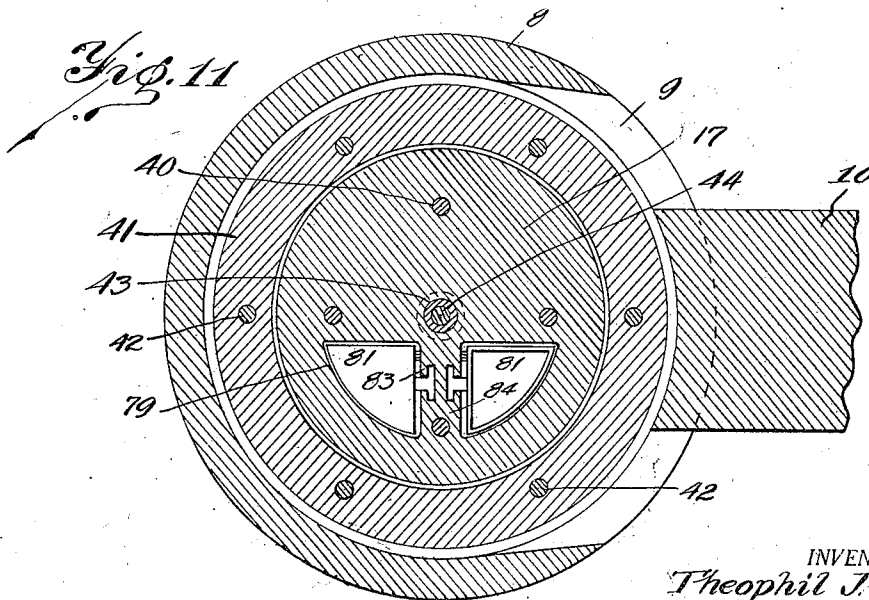


Fig. 11

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7 Sheets-Sheet 6

Fig. 15

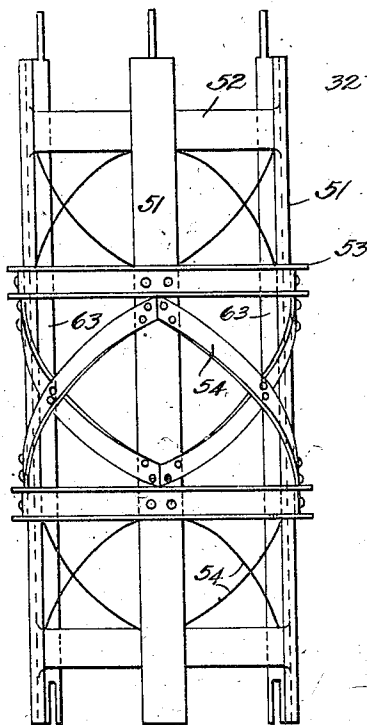
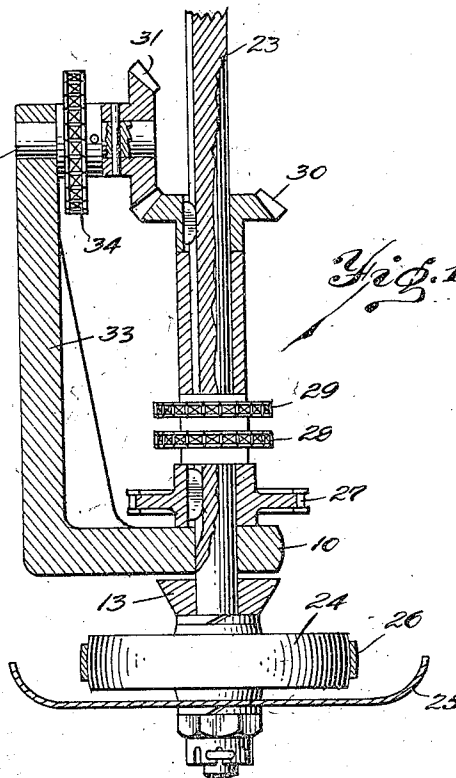


Fig. 14

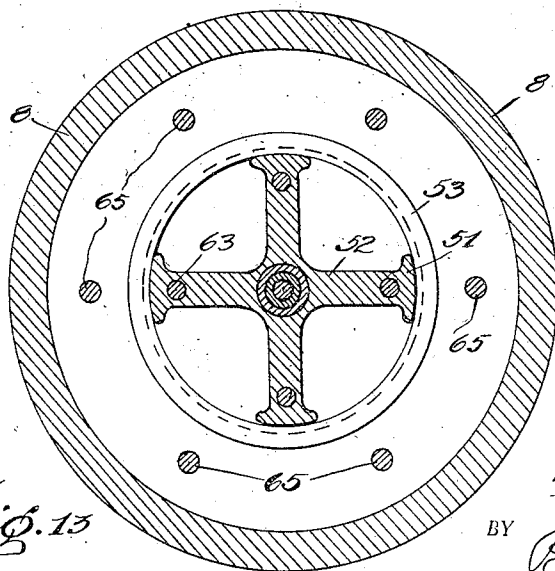


Fig. 13

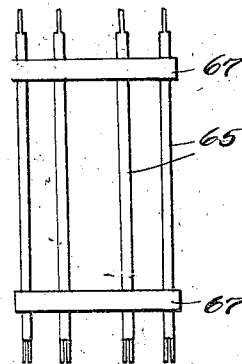


Fig. 16

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EARTH BORING APPARATUS

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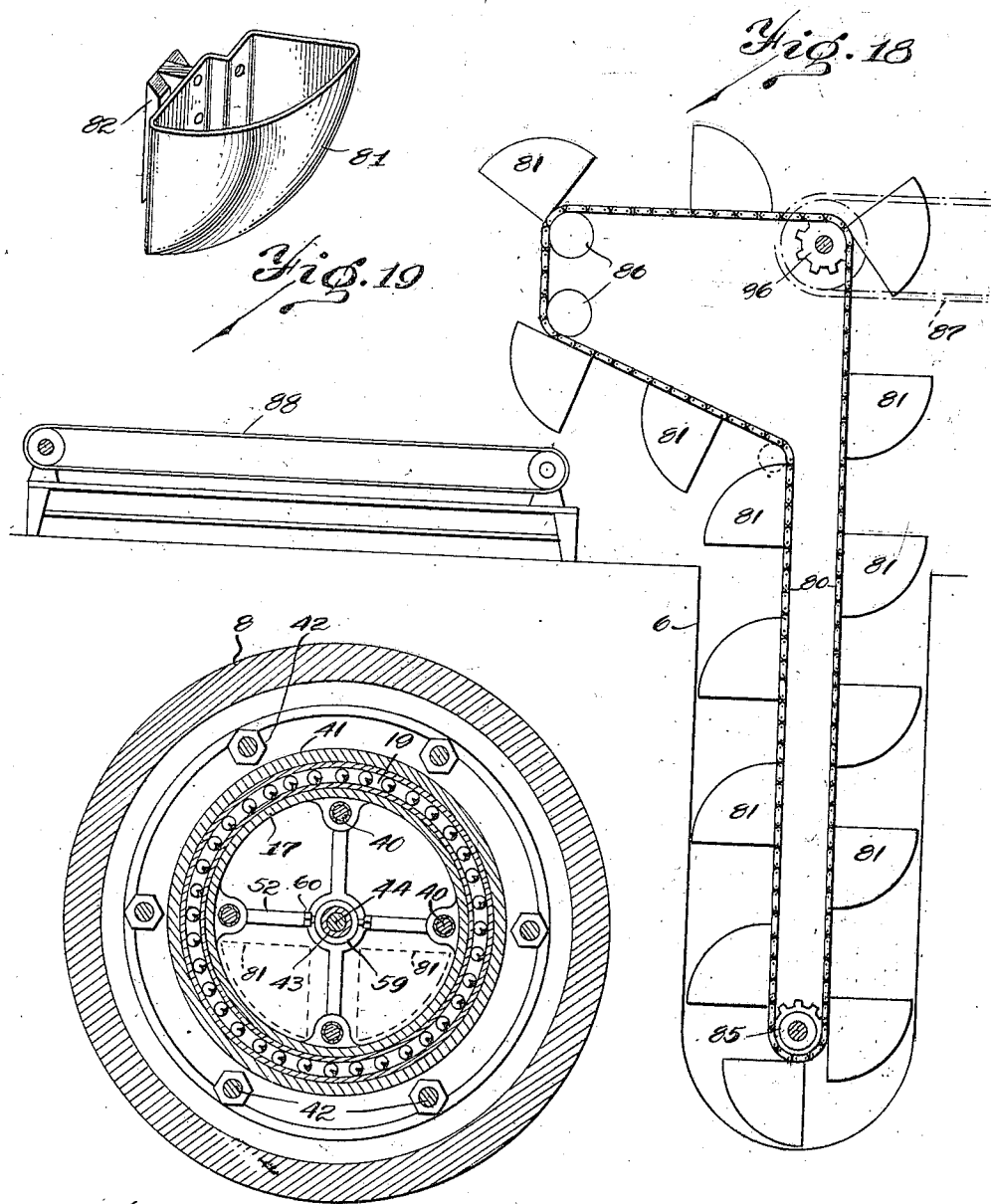


Fig. 17

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UNITED STATES PATENT OFFICE.

THEOPHIL J. FRED A, OF DETROIT, MICHIGAN.

EARTH-BORING APPARATUS.

Application filed November 14, 1921. Serial No. 514,859.

To all whom it may concern:

Be it known that I, THEOPHIL J. FRED A, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Earth-Boring Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings.

10 This invention relates to an earth boring machine and has special reference to a portable machine that may be moved from place to place for excavating purposes. On a small scale of construction the machine or apparatus may be used for digging openings for silos, wells, foundations, shafts, etc., and on a large scale of construction it may be employed to provide entries to tunnels, mines, sewers, quarries, etc. In either instance the machine or apparatus possesses the following characteristics:

First, the machine may be easily transported from one place to another and readily set up to permit of a hole being progressively dug and the loosened earth delivered to the surface of the ground and into suitable transporting vehicles, thereby eliminating all manual handling of excavated earth and permitting of a hole being expeditiously and economically dug.

Second, the boring machine includes a plurality of separable units which can be joined or built upon one another to provide a skeleton shaft or casing that may extend into the earth a desired depth, the shaft units being progressively assembled as a hole is dug to permit of boring or digging instrumentalities being rigidly supported at the bottom of the hole and operated from the top thereof.

Third, there is an auger, spiral cutter, loading platforms and bucket conveyor, together with novel operating mechanism therefor, and all of these elements are assembled in a compact manner so that one may be somewhat braced by others. These devices are assembled as a unit and are employed for starting a hole, after which other units are added as the boring progresses.

My invention includes a transportable surface machine; a power plant and operating mechanism; skeleton casings or depth units; a spiral screw conveyor and its operating mechanism; discharge platforms, chutes and bucket conveyor with its operat-

ing mechanism, and, a spiral cutter, auger and its operating mechanism. All of these devices will be hereinafter separately considered, under such captions, and then the general operation of the machine or apparatus described.

Reference will now be had to the drawings, wherein—

Figure 1 is a side elevation of the boring unit of the apparatus, partly broken away and partly in section, showing its location in the ground;

Fig. 2 is a vertical sectional view of the same;

Fig. 3 is a side elevation of the complete apparatus showing diagrammatically its relation to a bored hole;

Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is a detail view showing the end of a centering screw or auger;

Fig. 6 is a horizontal sectional view taken on the line 6—6 of Fig. 2;

Fig. 7 is an enlarged vertical sectional view of a portion of the surface machine, illustrating the operating mechanism;

Fig. 8 is a horizontal sectional view taken on the line 8—8 of Fig. 7;

Fig. 9 is a similar view taken on the line 9—9 of Fig. 7, illustrating the center spindle of the apparatus;

Fig. 10 is a horizontal sectional view taken on the line 10—10 of Fig. 7, showing power transmission mechanism;

Fig. 11 is a horizontal sectional view taken on the line 11—11 of Fig. 7;

Fig. 12 is a plan of the surface machine;

Fig. 13, is a horizontal sectional view taken on the line 13—13 of Fig. 7;

Fig. 14 is an enlarged vertical sectional view taken on the line 14—14 of Fig. 7;

Fig. 15 is a side elevation of an intermediate unit of the apparatus;

Fig. 16 is a similar view of a spindle unit of the apparatus;

Fig. 17 is a horizontal sectional view taken on the line 17—17 of Fig. 7;

Fig. 18 is a diagrammatic elevation of the bucket conveyor and apron conveyor of the apparatus, and

Fig. 19 is a perspective of one of the buckets of the bucket conveyor.

In describing my invention by aid of the views above referred to, I desire to point out that the same are intended as merely illus-

trative of an earth boring apparatus by which my invention may be put into practice, and I do not care to confine my invention to the precise construction and arrangement of parts shown, other than defined by the appended claims.

As pointed out in the beginning the invention will be described under the various captions previously mentioned, and reference will now be had to that portion of the apparatus which is above ground.

Transportable surface machine and its framework.

(Figs. 3, 7, 11, and 12.)

The surface machine comprises a strong and durable rectangular frame 1 suitably mounted on trucks 2, one of which trucks may be steerable, and the machine is adapted to be moved from place to place by a tractor or other source of power attached to the frame 1 at an end piece 3. After the machine is located at a site of operation the trucks 2 are adapted to be blocked or chucked, as shown in Fig. 3.

Centrally of the frame 1 is a vertical shaft framework 4 rigidly held by braces 5 and this framework is of sufficient height to permit of units of the apparatus being easily assembled as a hole 6 is bored in the ground 7 beneath the shaft 4.

In the shaft 4 and supported from the walls thereof is a cylindrical casing 8 and the upper end of said casing has a side opening 9 providing clearance for a tongue 10 of a platform 11 located within said casing, the tongue 10 serving as an extension of the platform and, extending over the rear end of the frame 1, to which it is secured by angle brackets 12 or other fastening means.

The casing 8, at the base of the opening 9, has a horizontal platform or extension 13 below the platform tongue or extension 10, and in the upper portion of the casing 8 is an inwardly projecting bracket 14 for a feed screw 15 which is axially of the casing 8 and adapted for raising and lowering the boring units, particularly lowering the same as the boring operations are carried on.

Mounted centrally of the platform 11 is the hub or bearing portion 16 of a stationary head 17, and said head is provided with anti-frictional bearings 19 and 20.

Power plant and operating mechanism.

(Figs. 3, 7, 9, 10, 11, and 17.)

A well known type of tractor 20 having a side pulley drive 21 can be conveniently used for moving my apparatus from one place to another, also as a power plant when the wheels of the tractor are held on the ground by blocks or chucks 22.

Journalled in the platform 13 and the platform extension 10 is a vertically disposed

shaft 23 and keyed or otherwise mounted on the lower end of the shaft is a horizontal pulley or belt wheel 24 with a belt guard 25 beneath it and supported by the casing 8 and the lower end of the shaft 23. Trained over the pulleys 21 and 24 is an endless belt 26 by which power may be transmitted from the tractor 20 to the shaft 23.

Mounted on the upper end of the shaft 23 are superposed sprocket wheels 27, 28, and 29 and slidably keyed on the shaft is a beveled gear wheel 30 meshing with a beveled gear wheel 31 mounted on a shaft 32, journaled in an upright 33, carried by the platform extension 10. On the shaft 32 is a sprocket wheel 34 and from the sprocket wheel may be derived power for operating the feed screw 15 by any suitable mechanism (not shown).

Rotatable on the anti-frictional bearings 18 of the head 17 is a large horizontal turn table 35 having its periphery in the form of a sprocket wheel 36 so that a sprocket chain 37 may be trained over the sprocket wheels 27 and 36 to permit of the turn table being revolved, it being understood that the platform 11 is sufficiently cut away to provide clearance for the sprocket chain 37. The turn table 35 has an internal rack 38 and meshing with this rack are a plurality of pinions 39 carried by the upper ends of an equal number of drive spindles 40, said spindles being vertically disposed and journaled in the stationary head 17 with the lower ends of said spindles extending to the lower end of the head.

Engaging the anti-frictional bearings 19 of the stationary head 17 is a collar 41 which is attached to the turn table 35 by a plurality of turn buckles 42, these turn buckles depending from the collar 41, between the casing 8 and the stationary head 17.

Journalled in the hub or bearing 16 of the stationary head 17 is an outer tubular spindle or shaft 43 and in this tubular shaft is an inner center shaft or spindle 44 which may be suitably connected to the feed screw 15 so that it may be raised and lowered. On the upper end of the outer shaft 43 is a sprocket wheel 45 for a sprocket chain 46 extending from the sprocket wheel 28. On the upper end of the inner shaft 44 is a sprocket wheel 47 for a sprocket chain 48 extending from the sprocket wheel 29, so that the inner and outer shafts of the stationary head 17 may be driven from the tractor driven shaft 23. In referring to sprocket wheels and sprocket chains in connection with my apparatus, it is to be understood that other power transmission elements may be readily substituted for this power transmission mechanism.

In order that the operating mechanism, including the platform 11, may be raised and lowered by the screw 15, relative to the cas-

ing 8, the platform 11 has side members 49 slidable in guides 50 carried by the inner walls of the casing 8, and the guides 50, as brought out in Fig. 3, will extend to the top of the shaft 4 so that the operating mechanism may be bodily shifted to the top of the framework to permit of units being mounted below the operating mechanism, and reference will now be had to one of the units.

Skeleton casings or depth units.

(Figs. 3, 7, 8, 9, 13, 15, and 16.)

Each unit comprises a plurality of equally spaced uprights 51 connected by interior spiders 52 and exterior bands 53, the spiders and bands being equally spaced throughout the length of the upright and between the bands and spiders are diagonally disposed curved braces 54 which tie the structural elements together and into a rigid skeleton framework possessing rigidity and light enough in weight to be readily handled at the surface machine.

Centrally of the spiders 52 and extending throughout the length of the unit is a tubular bearing 55 and in said bearing is a section of an outer shaft 56 and a section of an inner shaft 57. Considering the unit which is in proximity to the operating mechanism in the casing 8, and shown in Fig. 7, the inner shafts 44 and 57 are coupled by a tongue and groove connection 58 so that said shafts will revolve together in the outer shaft, and said outer shafts are coupled together, for rotative continuity, by sleeves 59 fixed to the outer shafts by set screws 60 or other fastening means. The lower ends of the inner and outer shafts are adapted to be connected to the shafts of an adjoining unit in a similar manner, and the ends of the uprights 51 are connected to the stationary head 17, and to the ends of adjacent uprights, by coupling sleeves 61 and set screws 62 or other fastening means, so that the units will be held in perfect alinement and suspended beneath the stationary head 17.

Journaled in the outer end of the spiders 52 are spindles 63 and these spindles have tongue and groove connections 64 with the spindles 40 and also the spindles of any adjoining unit.

Each unit also includes a set of connecting rods 65 which are coupled to the turn buckles 42 by coupling sleeves or members 66, and similar sleeves or members are employed for connecting the rods of adjoining units. As shown in Fig. 16 the rods 65 may be tied together by bands 67 to prevent swaying of said rods when a large number of units are assembled and this view also illustrates how spindles may be connected in the lowermost unit of the apparatus. In some instances the spindles 63

may be in bearings 68 between the spiders 52 of each unit, as shown in Fig. 7, and with said units of a less depth than the shaft 4, the operating mechanism, including a platform 11 may be raised and units placed in the casing 8 and coupled together so that the hole 6 may be bored to any desired depth.

Spiral or screw conveyor and its operating mechanism.

(Figs. 1, 2, and 3.)

The lowermost unit of the apparatus includes uprights 68 similar to the uprights 51 of other units, with the exception that the lower ends of the uprights 68 are connected by a head 69 into which extends the stationary tubular bearing 70 corresponding to the bearings 55 of other units. This bearing cooperates with the uprights 68 in supporting spiral discharge platforms 71, one arranged above the other at one side of the bearing 70, that is, considering the space between the uprights 68 of the lower unit, as well as the uprights 51 of other units, to be substantially circular, the platforms 71 are in one of the semi-circular spaces, leaving the other clear for a bucket conveyor.

Rotatable about the uprights 68 is a spiral or screw conveyor 72 supported by connecting rods 73 connected to the rods 65 so that the spiral conveyor will be rotated in synchronism with the collar 41 and the turn table 35. The spiral conveyor has its spiral or screw conformation gradually increasing in pitch or tilted so that earth will work towards the center of the conveyor and be discharged on either of the platforms 71, the lowermost platform taking care of the majority of the earth and any excess earth may be carried to the uppermost platform.

Surrounding the lower ends of the uprights 68 is a sleeve 74 provided with a spiral or screw conveyor 75 adapted to form part of a spiral cutter to be hereinafter described. The sleeve 74 has an internal rack 76 and meshing with said rack are pinions 77 on spindles 78 which extend through the discharge platforms 71 and are coupled to the spindles 63 of superposed units, so that the conveyor 75 may be also revolved in synchronism with the turn table 35.

Bucket conveyor.

(Figs. 4, 6, 11, and 18.)

The platform 11 and the stationary head 17 have sector shaped openings 79 providing clearance for an endless bucket conveyor comprising an endless chain 80 provided with spaced buckets 81. On the buckets 81 are shoes 82, T-shaped in cross section and adapted to slide in guide grooves 83 provided therefor in rails 84 forming part of each unit and also part of the platform 11, so

that the ascending and descending buckets will at all times be retained at one side of the hole and may enter the lowermost unit and receive earth from the discharge platform 71. Suitably supported in the lowermost unit is a sprocket wheel 85 about which the lower end of the chain 80 is trained and other sprocket wheels 86 will be supported by the casing 8 so that the sprocket chain 80 may be driven by a sprocket chain 87 from the sprocket wheel 31 or any other source of power. By reference to Fig. 18, it will be noted that after the buckets leave the hole 6 said buckets are carried to one side to discharge the earth on an endless apron 88 or into vehicles, the endless apron being a convenient means of casting the earth to one side and said apron may be driven from any suitable source of power. The apron is only used when it is not convenient to empty the bucket direct into vehicles and said buckets are of a conventional form adapted to hold the contents thereof until tilted. With one string of buckets entering the hole 6 while the loaded buckets are being raised it is obvious that earth can be quickly removed from the hole 6.

The rails 84 may be solid partitions in the various units or may be of skeleton construction so long as the moving buckets do not interfere with one another.

Spiral cutter, auger, and operating mechanism.

(Figs. 1, 2, 3, and 5.)

The head 69 has an anti-frictional bearing 89 and extending therethrough is the outer shaft 90 of the lowermost unit, best shown in Fig. 2. Mounted on the lower end of the outer shaft 90 is a conical head 91 provided with an anti-frictional bearing 92 and extending through this bearing and the outer shaft 90 is an inner shaft 93. The shafts 90 and 93 are coupled to the inner and outer shafts of the superposed units and are consequently driven by the operating mechanism at the surface machine.

On the lower end of the shaft 93 is an auger 94 which bores into the ground and assists in establishing the direction in which the hole 6 is to be bored. The upper end of the auger 94 has spiral serrated cutting blades 95 adjoining spiral cutter blades 96 carried by the conical head 91 and the cutter blades 96 extend upwardly along the sides of the stationary head 69, so that besides being a continuation of the serrated blades 95, said blades will cause the loosened earth to be carried upwardly and eventually discharged on to the spiral conveyor 75. The lower end of this spiral conveyor 75 supports a sleeve 97 and said conveyor terminates in cutting teeth and scoops 98 within the sleeve with the spiral conveyor serving as a spiral cutter in the sleeve cooperating with the blades 96

in scraping and loosening earth to be removed from the hole 6. As shown in Fig. 2 the earth is removed from the sides and bottom of the hole 6 and a small crater is constantly formed in the bottom of the hole, the walls of the crater being cut away as fast as the boring instrumentalities descend, and since the earth is removed as soon as loosened there is no danger of the apparatus within the hole being clogged. It is therefore possible for shale and indurate earth to be attacked by the cutters forming part of the lowermost unit of the apparatus and in order that there may be clearance for the revolving conveyors, this conveyor portion of the lower unit may gradually taper from its upper end inwardly towards its lower end, with the exception of the sleeve 97 which maintains the diameter of the hole 6 irrespective of its depth.

Considering the general operation of the apparatus, it will be noted that the operating mechanism in the casing 8 is built so that the auger, cutting instrumentalities and conveyors may be all driven irrespective of the number of units interposed between the conveyors and the surface machine, the units being installed as fast as the hole is bored, and this is accomplished without the necessity of lining or providing the hole with casings, although the same may be used if found necessary in certain kinds of soil where the walls are liable to cave in.

With the surface machine a vehicle and the units carried by other vehicles the tractor may be employed for pulling the train of vehicles from one site to another, and since the operating mechanism is all assembled on the surface machine, the apparatus can be quickly and easily placed in operation.

What I claim is:—

1. A boring apparatus comprising a machine having a casing, a tubular boring unit including spiral cutters adapted to enter the ground below said machine, means on said machine for revolving said boring unit, other tubular units adapted to be interposed between said boring unit and the operating means thereof so that the hole may be progressively bored, the operating means for said boring unit extending through said tubular units adjacent the walls of said units, an auger axially of said tubular boring unit, and axial operating means for said auger independent of the operating means of the remainder of the boring unit.

2. A boring apparatus comprising a machine having a casing, a boring unit adapted to enter the ground below said machine, a driven turn-table in the casing of said machine adapted to rotate said boring unit, a feed screw in said casing supporting said turn table for raising and lowering said turn table, additional units adapted to be interposed between said boring unit and said

machine so that a hole may be progressively bored, and circumferentially arranged shafts and spindles adapted for transmitting power from said driven turn table to said boring unit, there being a set of spindles for each additional unit.

3. A boring apparatus comprising a machine having a casing, a boring unit adapted to enter the ground below said machine, a driven turn-table in the casing of said machine adapted to rotate said boring unit, a feed screw in said casing supporting said turn table for raising and lowering said turn table, additional units adapted to be interposed between said boring unit and said machine so that a hole may be progressively bored and an endless bucket conveyor extending from said machine to said boring unit and adapted to convey loosened earth from said boring unit to said machine, said conveyor being disposed at one side of an axial plane of the additional units.

4. In a boring apparatus wherein a boring unit is supported between trucks and adapted to be driven into the earth to bore a hole, means for rotating said unit, said means comprising a horizontally disposed turn table having its peripheral portion detachably connected to said boring unit, a tractor for moving said apparatus and adapted to operate said turn table when said apparatus is in position for boring a hole, means driven by said tractor adapted for raising and lowering said turn table and the boring unit connected thereto, and skeleton units adapted to be interposed between said turn table and said boring unit to permit of a hole being progressively bored.

5. In a boring apparatus wherein a boring unit is supported between trucks and adapted to be driven into the earth to bore a hole, means for rotating said unit, said means comprising a horizontally disposed turn table, a tractor for moving said apparatus and adapted for operating said turn table when said apparatus is in position for boring a hole, means driven by said tractor adapted for raising and lowering said turn table and the boring unit connected thereto, and an endless conveyor adapted to be operated by said tractor and passed through said turn table to said boring unit, said conveyor being composed of buckets guided by a rail between up and down going buckets.

6. A boring unit for a boring apparatus, comprising a head, a rotary spiral cutter at said head, a rotary auger at the end of said spiral cutter, means axially of said head for independently driving said cutter and said auger, and a spiral driven conveyor about said head and terminating in cutting teeth.

7. A boring unit as characterized in claim 6, wherein said spiral driven conveyor has its cutting teeth in a plane with the spiral cutter so as to progressively form craters in

the bottom of the hole from which earth may be removed.

8. A boring unit for a boring apparatus comprising uprights, spiral discharge platforms between said uprights, an endless conveyor movable between said uprights and adapted to receive earth from said discharge platforms, a spiral conveyor about said uprights adapted to convey earth to said discharge platforms, and cutters at the lower ends of said uprights adapted to loosen earth for said spiral conveyor.

9. A boring unit as in claim 8, wherein means at a remote point is adapted for independently operating said cutters and said spiral conveyor.

10. A boring unit for a boring apparatus, comprising a head, independently driven cutters at said head, a spiral conveyor above said head adapted to receive earth loosened by said cutters, and an endless conveyor adapted to receive earth from said spiral conveyor, a portion of said endless conveyor extending into said spiral conveyor.

11. In a boring apparatus, a boring unit, skeleton units adapted to be progressively connected to one another with one of said skeleton units connected to said boring unit, said boring unit including cutters, discharge platforms and means for transferring loosened earth from said cutters to said discharge platforms;—and means operable through said skeleton units for removing earth discharged from the platforms of said boring unit.

12. A boring apparatus as in claim 11, wherein the last mentioned means includes an endless bucket conveyor.

13. In a boring apparatus, a boring unit, skeleton units adapted to be progressively connected to one another with one of said skeleton units connected to said boring unit, said boring unit, comprising a head, cutters at said head, means axially of said head and said skeleton units for operating one of said cutters, and means about said boring unit for operating the other of said cutters.

14. A boring apparatus as in claim 13, and means extending through said skeleton units to said head adapted to remove earth loosened by said cutters.

15. A boring unit comprising uprights, a spiral cutter about said uprights, means between said uprights for operating said spiral cutter, a discharge platform between said uprights adapted to receive earth from said spiral cutter, and a vertical endless conveyor between said uprights adapted to receive earth from said discharge platform.

16. In an earth boring apparatus, a transportable casing, a boring unit insertable through said casing and adapted to bore a hole below said casing, means in said casing for operating said boring unit, said boring unit including cutters independently oper-

ated from said operating means, said operating means being detachably connected to said unit, and other units adapted to be interposed progressively between said boring unit and its operating means so that said boring unit may be operated at a point remote from said casing.

In testimony whereof I affix my signature in presence of two witnesses.

THEOPHIL J. FREDERICK

Witnesses:

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ANNA M. DORR.