May 1, 1962 J. P. WALTON 3,032,128

BELLING TOOLS

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Fig. 1

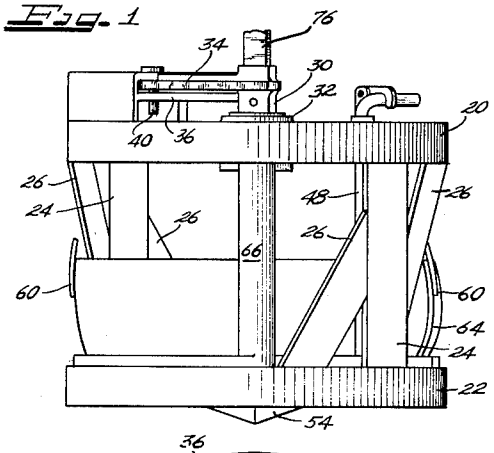


Fig. 3

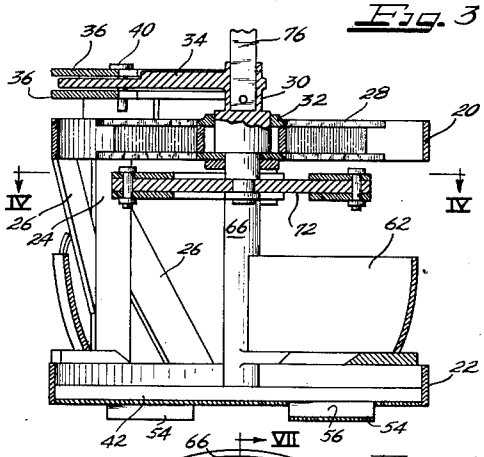


Fig. 2

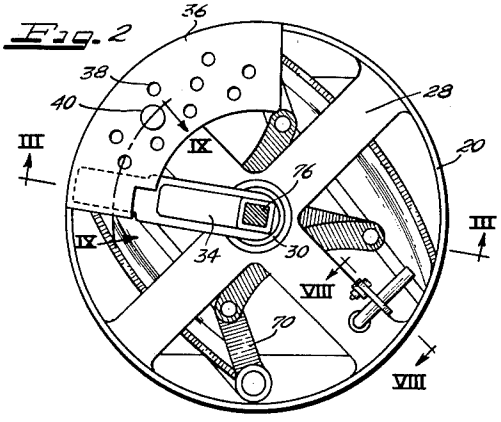


Fig. 4

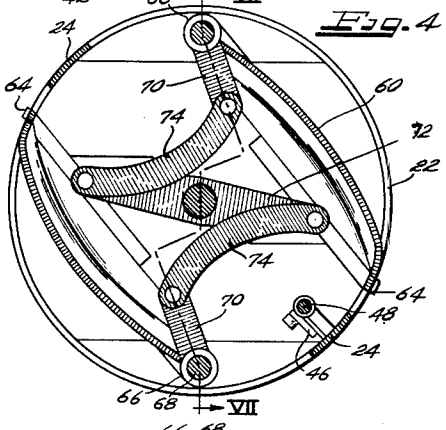


Fig. 6

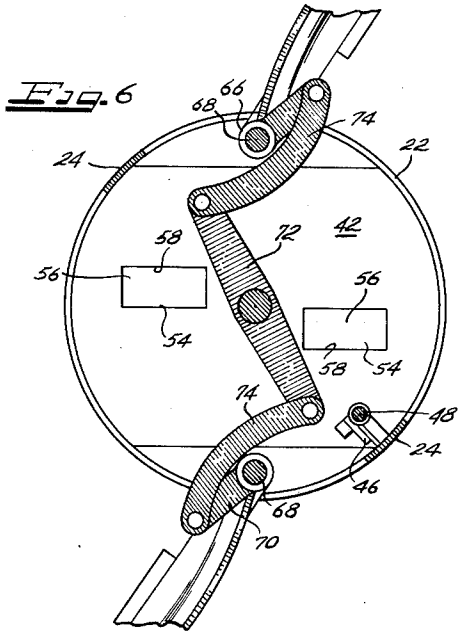
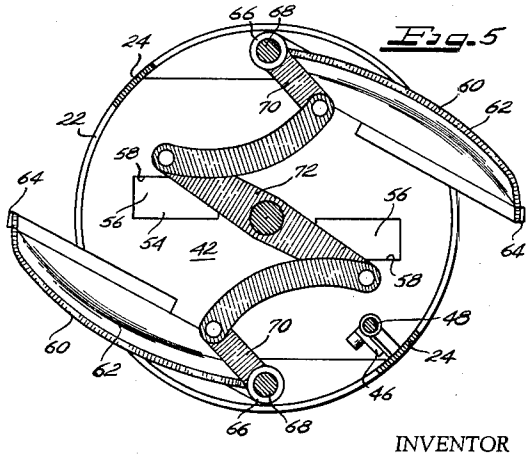


Fig. 5



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BELLING TOOLS

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Fig. 7

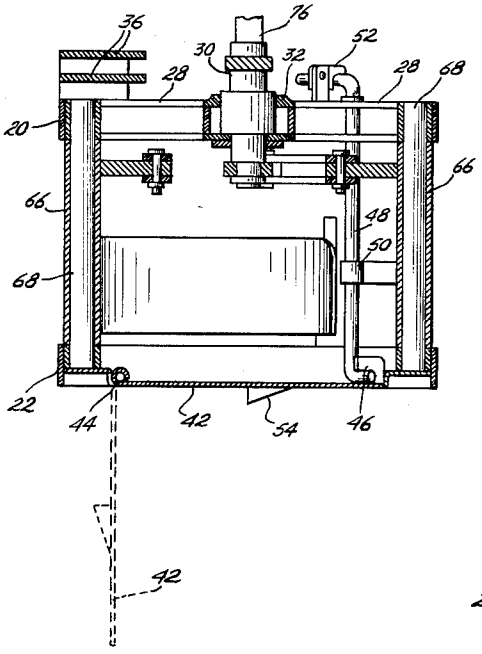


Fig. 9

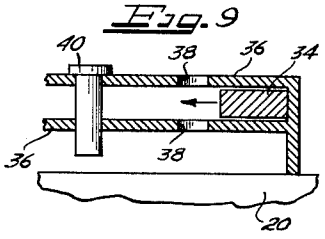


Fig. 8

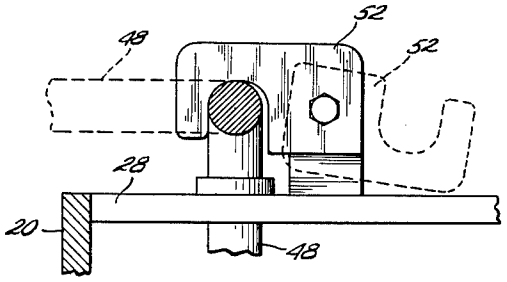
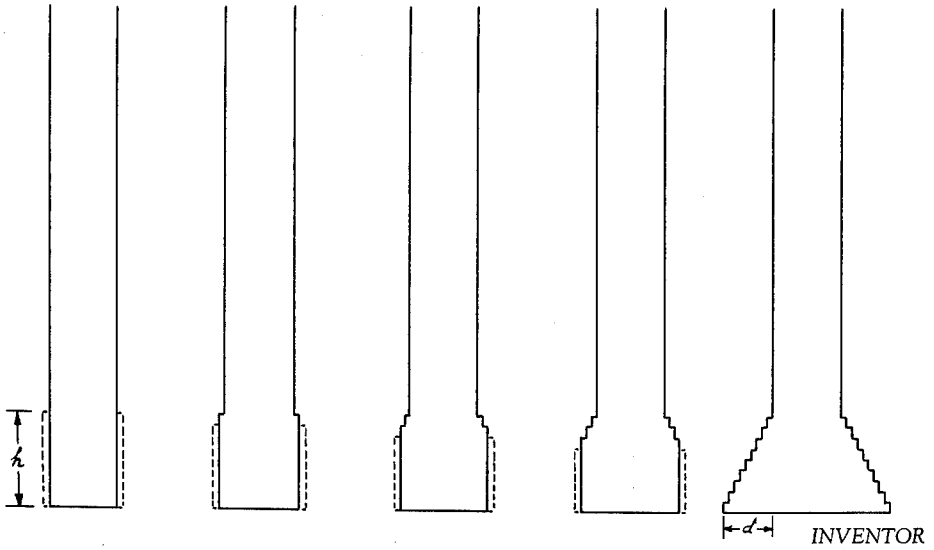


Fig. 10 Fig. 11 Fig. 12 Fig. 13 Fig. 14



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BELLING TOOLS

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Fig. 15

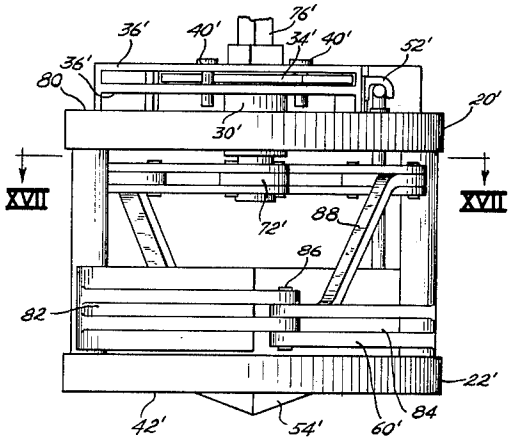


Fig. 16

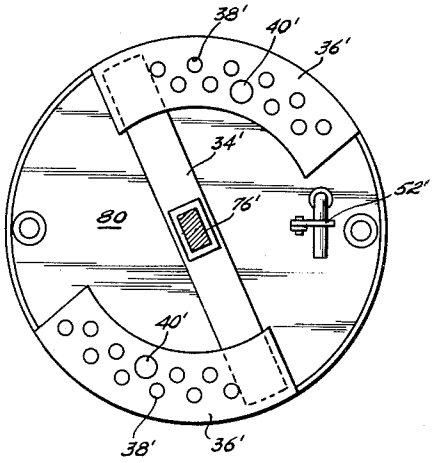
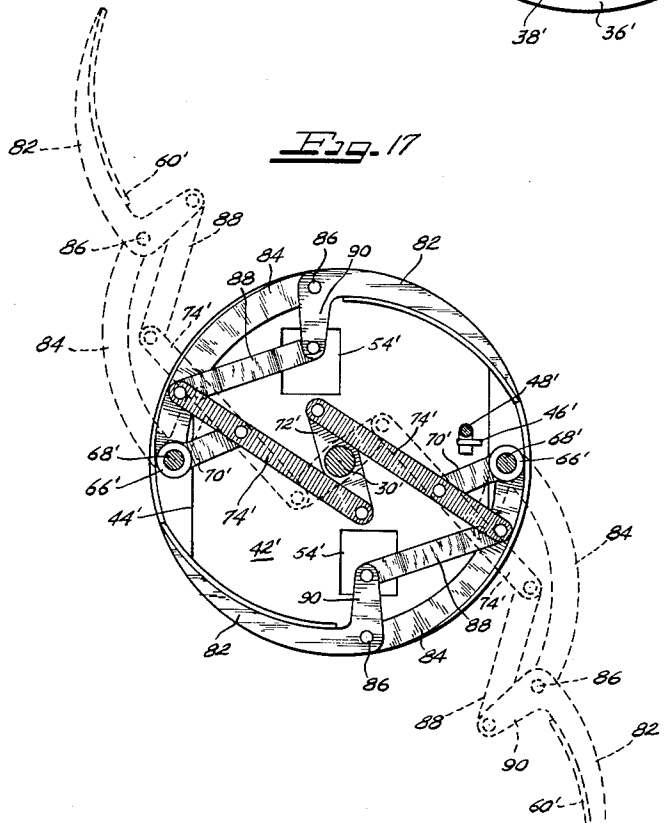


Fig. 17



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United States Patent Office 3,032,128 Patented May 1, 1962

3,032,128

BELLING TOOLS

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Filed Nov. 10, 1959, Ser. No. 852,136
6 Claims. (Cl. 175—292)

My invention relates to a belling tool for enlarging or "belling" the bottom of caissons.

It is customary to drill holes into the earth which are filled with steel reinforced concrete to serve as footings or foundations for buildings and other structures. These are called caissons and the hole is usually drilled by an earth auger to a depth sufficient to reach bed rock or other solid material, such as "hard pan." Depending upon the terrain, the depth of these holes will vary and sometimes may reach a depth of 100 or more feet. In order to increase the load carrying capacity of a caisson, the bottom of the hole is "belled out" or enlarged. The "belled out" area of a caisson is generally conical in shape having an enlarged lower end. Thus a greater bearing area is provided at the bottom of the caisson so that the caisson supports a load greater than could be supported had the bottom not been "belled out."

The earth auger for drilling a caisson and the tool for belling the bottom of the hole are generally operated by a portable drilling rig. These drilling rigs are driven to the site and have a rotatable and telescoping kelly to which the auger and belling tools are attached. The kelly is rotated to operate the auger and at the same time extend to force it downwardly into the ground to drill the hole in a conventional manner.

Various belling tools have been provided in the past but they have all had certain shortcomings. With many prior art belling tools, or belling buckets, it is necessary to put downward pressure on the kelly to open the belling bucket after it reaches the bottom for digging operation. Such downward pressure frequently causes the belling tool to dig the hole deeper and provide an uneven bottom; also such belling tools are not subject to the versatile use of belling tools not requiring downward pressure on the kelly for opening of the tool. Other prior art belling tools have cutting blades which are shaped to provide the final contour of the bottom bell or otherwise have long cutting blades. Due to the fact that these tools are characterized by having large areas of digging surface, they are very difficult to operate, require excessive power, and cannot be used in certain soils. Furthermore with prior art tools, the operator could not adequately clean out the bottom of the hole without sending a man down into the hole, which is at best very expensive.

The belling tools of this application represent an improvement over the underreamer or belling tool shown in United States Patent 2,621,898, issued December 16, 1952, to J. G. Brodheat et al. and owned by the assignee of the present application. The belling tools of this application incorporate similar basic principles and basic structural arrangements shown and described in United States Patent 2,621,898 but, in addition, include certain important features and improvements over the underreamer of this patent. United States Patent 2,621,898 is hereby incorporated herein by reference.

Generally speaking, the belling tool of this invention comprises a circular cage-like housing having cutting blades pivotally mounted on vertical shafts at the perimeter of the housing. A hub rotatably mounted at the top of the housing is adapted to receive the drilling spindle or kelly, and linkage elements are connected in the top portion of the housing between the hub and pivotally mounted blades. Rotation of the kelly in one direction will cause the blades to open by means of the linkage members, for digging operation, and rotation of the kelly in the other direction will cause the blades to close for removal of the belling tool from the hole. The center area of the housing is free of obstruction so that dirt will be delivered by the blades into the center portion of the housing for removal from the hole. The blades extend outwardly from the lower area of the side of the housing in cutting position to clean the bottom of the caisson. A hinged bottom plate is provided which may be opened to dump or drop the dirt from the housing and the bottom of the bucket is provided with scoop openings so that loose dirt in the central bottom of a hole will continually be cleaned up by rotation of the belling tool. Provision is made for controlling the diameter to which the belling tool will be opened by rotation of the kelly. The control mechanism is positioned on the top of the cage and comprises an arm secured to the hub which engages an adjustable pin to limit the amount which the blades are opened by rotation of the kelly and hub.

An object of my invention is to provide a belling tool that is simple, economical and efficient to operate and is constructed to withstand the abuse received in normal operation.

Another object of my invention is to provide a belling tool having blades pivotally mounted at the perimeter of a housing;

(1) Wherein a single kelly is connected to the housing and is connected through mechanical links to the blades so that initial rotation of the kelly will open the blades and further rotation will cause digging action by the belling tool.

(2) Wherein a rotatable hub is mounted at the end of the housing and connected to the kelly, and a link is carried by the hub and connected at its ends to the pivotably mounted blades so that rotation of the kelly relative to the housing causes opening and closing of the blades.

(3) Wherein a hinged bottom is provided for the housing for dumping a load therefrom.

(4) Wherein a hubs is rotatably mounted in the housing and is connected to open the blades on rotation and an adjustment arm is secure for rotation with the hub to engage an adjustable stop to predetermine the amount of opening of the blades upon rotation of the hub; and

(5) Wherein a kelly drives the tool and each blade comprises two members pivotally secured together and connected through linkage mechanism to the kelly for opening the blades on rotation of the kelly whereby the effective cutting diameter of the tool is substantial in comparison with the diameter of the cage.

A further object of my invention is to provide a belling tool wherein the entire control for opening and operating the tool is achieved through rotation of a single shaft or kelly. In addition, novel apparatus is provided to adjust the amount the tool is opened.

A still further object of my invention is to provide a belling tool which is constructed and arranged to complete the belling of a hole without the necessity of a man entering the hole and cleaning and shaping the bell.

These and other objects and advantages will become more readily apparent as the description proceeds and is read in connection with the drawings, in which:

FIG. 1 is an elevational view of one form of the belling tool of my invention and shows the cutting blades and dump bottom in closed position.

FIG. 2 is a plan view of the belling tool shown in FIG. 1.

FIG. 3 is a vertical sectional view taken on line III—III of FIG. 2.

FIG. 4 is a horizontal sectional view taken on line IV—IV of FIG. 3.

FIG. 5 is a view similar to FIG. 4 but showing the cutting blades in a partially open position.

FIG. 6 is a view similar to FIGS. 4 and 5 but showing the cutting blades open to a wider position than shown in FIG. 5.

FIG. 7 is a vertical sectional view taken on line VII—VII of FIG. 4 showing in greater detail the parts of my belling tool contained within the housing.

FIG. 8 is an enlarged partial detail view of the mechanism for locking the dump bottom in place and is taken on line VIII—VIII of FIG. 2.

FIG. 9 is an enlarged detail view showing the mechanism for limiting the opening of the blades, and is a sectional view taken on line IX—IX of FIG. 2.

FIGS. 10, 11, 12, 13 and 14 are vertical sectional views of caissons drilled into the earth and show in sequence the steps by which earth is removed from the bottom of the hole by my novel belling tool to produce a completed caisson.

FIG. 15 is an elevational view of a modified form of the belling tool of my invention which has a cylindrical housing approximately the same size as that of the belling tool shown in FIGS. 1 through 7 but which is provided with multiple part cutting blades and is capable of belling a hole to a greater diameter than that of the device shown in FIGS. 1 through 7.

FIG. 16 is a plan view of the modified belling tool of FIG. 15 and shows a modified adjustment mechanism for controlling opening of the blades.

FIG. 17 is a sectional plan view of the modified belling tool of FIG. 15 showing the mechanism within the housing and is taken on line XVII—XVII of FIG. 15.

In the drawings, the cylindrical cage or housing of my belling tool comprises upper and lower rings **20** and **22** which are interconnected and spaced apart by vertical side slats **24**, spaced on diametrically opposite sides of rings **20** and **22**. As best seen in FIG. 1, angular braces **26** are connected between the vertical slats **24** and rings **20** and **22** for purposes of strengthening the entire housing.

As seen in FIGS. 2 and 3, a top cross frame **28** is secured within ring **20**. This frame has hollow rectangular legs, as seen in FIG. 3, and has a vertical height approximately equal to the height of ring **20**.

Rotatably secured within top frame **28** is a hub **30**. A bearing member **32** is secured within top frame **28** and rotatably supports the hub, with hub **30** held against lateral movement within bearing member **32**. Extending axially away from the upper part of hub **30** is a horizontally disposed adjusting arm **34**. Adjusting arm **34** is integral with hub **30** and, therefore, rotates with the hub. The outer end of adjustment arm **34** extends between horizontal plates **36**, as best seen in FIGS. 1, 2, 3 and 9. Plates **36** are supported by top ring **20** and top frame **28**. As seen in FIGS. 2 and 9, a series of holes **38** are provided in plates **36**, the holes in the two plates being aligned. A pin **40** may be inserted in any pair of aligned holes **38** and the pin will span plates **36**. Thus, when hub **30** is rotated in a clockwise direction as viewed in FIG. 2, adjustment arm **34** will rotate until it engages pin **40**.

As best seen in FIG. 7, a drop bottom or dump bottom **42** is pivotally connected across the bottom of bottom ring **22** by means of hinge **44**. Secured at the opposite end of dry bottom **42** is a latch ear **46**. A lock rod **48** releasably engages latch ear **46** and is rotatably mounted within bearing **50** and within top frame **28**. The upper end of rod **48** is bent at right angles to provide a horizontal portion which cooperates with latch **52** (see FIGS. 7 and 8) which is mounted for pivotal movement on top frame **28**.

Latch **52** serves to lock dump bottom **42** in its closed position when dump bottom **42**, lock rod **48**, and latch

ear **46** are in the positions shown in FIG. 7. To prepare to open dump bottom **42**, latch **52** is moved to the dotted line position shown in FIG. 8 and the handle portion of lock rod **48** may then be rotated to the position shown in dotted lines in FIG. 8. Such rotation of lock rod **48** disengages the lower end of the lock rod from latch ear **46** and dump bottom **42** is allowed to swing to its open position as shown in dotted lines in FIG. 7.

Dump bottom **42** is provided on its lower surface with scoops **54**. Scoops **54** have bottoms **56** (see FIG. 6) which taper upwardly from leading edge **58** until they are flush with the upper surface of dump bottom **42**. Thus when the belling tool of FIG. 6 is rotated in a clockwise direction, dirt below dump bottom **42** will move upwardly into the belling tool through scoops **54**.

Two blades **60** are provided, one on each side of the belling tool, as best seen in FIGS. 1 through 7. Blades **60** have a curved deflector portion **62** and an outer or cutting edge **64**. The inner ends of blades **60** are secured to sleeves **66** as seen in FIGS. 4 through 7. Sleeves **66** are rotatably mounted on shafts **68** and sleeves **66** with blades **60** are rotatable about shafts **68** which form a bearing for the sleeves. A crank arm **70**, as best seen in FIGS. 2 through 7, in fixedly connected to each of the sleeves **66**.

Referring to FIGS. 3 through 7, it will be seen that a cross arm **72** is fixedly connected to the lower end of hub **30** so that the cross arm rotates with hub **30**. Each end of cross arm **72** has pivotally connected thereto a link member **74** whereby cross arm **72** and links **74** may rotate relative to each other. The outer ends of links **74** are connected by a pivotal connection to cranks **70** which, as hereinbefore described, are fixed to sleeves **66**. Thus rotation of hub **30** will transmit motion through cross arm **72**, links **74**, cranks **70**, and sleeves **66** to blades **60**.

The kelly for operating the belling tool is indicated in the drawing in FIGS. 1, 2, 3 and 7 by the number **76**. The kelly is square in cross section and the upper end of boss **30** is provided with a corresponding square recess to receive kelly **76**. The kelly is pinned within boss **30**.

In operation of the tool of my invention, the hole in the earth is first drilled by conventional augers to the shape shown in solid lines in FIG. 10 of the drawings. The auger is then removed from the kelly of the drilling rig and my novel belling tool is secured to the kelly. In particular, kelly **76** is placed within and pinned to boss **30** as shown and dump bottom **42** is closed. The kelly is rotated in a counter clockwise direction when viewed as in FIG. 2 of the drawings to move blades **60** into their closed positions, i.e. that position shown in FIGS. 1 through 4 of the drawings. When the blades are thus closed, adjusting arm **34** will be moved to the position shown in FIGS. 1, 2 and 3 of the drawing. Pin **40** is then placed in an appropriate set of aligned holes **38** in parallel plates **36**. The distance which blades **60** will open upon rotation of kelly **76** will be controlled and limited by the positionment of pin **40**.

To start belling operation, pin **40** is usually first inserted in the lowermost set of holes **38**, as shown in FIG. 2 of the drawings. Kelly **76** can then only rotate boss **30** a limited amount due to the fact that adjustment arm **34** will strike pin **40**. Since boss **30** is rotated only a limited amount, blade **60** will be opened only a small amount through the linkage interconnecting the blades and boss. If pin **40** is moved into the next set of aligned holes **38**, in plates **36**, rotation of the kelly will allow the blades to open to a greater extent, etc. In determining where the pin **40** will be adjusted to make the first cut and subsequent cuts with the belling tool, the make up of the earth, the power of the drilling rig and several other factors will be controlling.

After pin **40** is properly located and the blades closed,

the belling tool is lowered into the hole by means of kelly 76. When the belling tool rests upon the bottom of the hole, kelly 76 is then rotated in a clockwise direction as viewed in FIG. 2 of the drawings. Rotation of the kelly causes boss 30 to rotate within its bearing in the frame of the belling tool and cross arm 72 will be rotated in a clockwise direction, as viewed in FIGS. 2, 4, 5 and 6. As cross arm 72 is rotated, links 74 will move, as shown in FIGS. 5 and 6 of the drawings, to rotate cranks 70 and therefore sleeves 66 about shafts 68. Blades 60 will be rotated toward an open position due to the rotation of sleeves 66, since the blades are attached thereto. Blades 60 will continue opening until adjustment arm 34 on boss 30 engages pin 40 which has been placed in the first set of aligned openings 38 of FIG. 2. As soon as adjustment arm 34 strikes pin 40, blades 60 will not open further and the entire belling tool will begin to rotate with kelly 76 since the force of rotation from the kelly is being applied to the housing of the belling tool through adjustment arm 34 and pin 40. As the belling tool rotates, leading edges 64 of the blades will loosen earth and upon continued rotation this earth will pass back along curved portions 62 of the blades into the central portion of the belling tool and onto dump bottom 42. Thus it will be seen that initial rotation of the kelly causes the blades to open and further rotation of the kelly causes the blades to cut away the earth.

As previously mentioned, in the first cutting operation of the belling tool, the belling tool is lowered to the bottom of the hole. After the kelly has been rotated to open the blades and start the cutting action, the entire belling tool is slowly raised upwardly from the bottom of the hole by means of the kelly, while rotation of the kelly is being continued. Thus the area indicated by dotted lines in FIG. 10 will be cut away as the belling tool is rotated and raised. The distance *"h,"* as indicated in FIG. 10, to which the earth is to be cut away will be determined by the required height of the belled out portion of the caisson and, in its initial cutting operation, the kelly will be raised while it is being rotated to enable the belling tool to cut away earth surrounding the hole to a sufficient height. Some of the earth cut away will be moved into the belling tool while some will fall to the bottom of the hole.

When the cut indicated in FIG. 10 has been completed, or whenever the bucket is full of earth, rotation and vertical movement of the kelly is stopped. The kelly is then rotated in a reverse direction, or a counter clockwise direction, as viewed in FIG. 2 of the drawings. This reverse rotation causes boss 30 to rotate relative to the housing and, therefore, cross arm 72 is rotated in a counter clockwise direction, when viewed as in FIGS. 2 through 5 of the drawings. This rotation of cross arm 72 through links 74, cranks 70 and sleeves 66 causes blades 60 to move toward their closed position. When the blades are closed, adjustment arm 34 will have returned to its initial position against a stop, such as shown in FIG. 2. The belling tool is then removed from the hole by raising the kelly vertically. Dirt that has been loosened by the blades and moved inwardly into the housing of the belling tool is forced into and held within the cylindrical housing by blades 60 when they are being closed and when they are closed. As the belling tool is being removed from the hole, the earth is thus trapped and retained therein.

After the belling tool reaches the surface, the tool is then swung away from a position over the hole in order to dump or discharge the earth contained therein. To empty the belling tool, latch 52 (FIGS. 7 and 8) is released as previously described and locking rod 48 rotated to disengage the lower end of the locking rod from latch ear 46. Thus dump bottom 42 swings to the position shown in dotted lines of FIG. 7 and dumps the contents of the belling tool.

After the belling tool is emptied, dump bottom 42 is moved to its closed position and again locked in place. The belling tool is then swung over the hole. Pin 40 may be moved to another set of aligned holes to enable the belling tool to cut to a greater diameter. In the example I am using, pin 40 would now be moved to the second set of aligned holes 38 in plates 36 and the belling tool would be lowered into the hole until it reached the bottom. With the belling tool positioned in the bottom of the hole, the kelly is again rotated in the appropriate direction to first cause blades 60 to open to the extent predetermined by the positionment of pin 40. After the blades have opened to this extent, kelly 76 continues to rotate the entire belling tool and the blades cause earth to be dug away and moved by the blades into the housing of the belling tool. As this rotation is continued, the kelly is slowly raised to thereby raise the belling tool away from the bottom of the hole. With this action, the area indicated by dotted lines in FIG. 11 will be dug away.

In this second step, the belling tool will not be raised the same distance from the bottom of the hole as it was with the initial cut. As previously explained, the belled out portion of the hole is to assume a shape somewhat like a cone and, therefore, the height of each successive wider cut will be less than the height of the previous cut. Most caissons are provided with bells having sides forming a 60° angle with the horizontal bottom. In such 60° bells, it is quite easy to determine the height of each cut since the distance *"d"* shown in FIG. 14 is one-half of the height *"h"* shown in FIG. 10.

After the second cut is completed or whenever the belling tool is full, rotation and vertical lift of the kelly will be stopped. The kelly is then rotated in a reverse direction to close the cutting blades as previously described and trap and hold the loosened earth within the belling tool. The kelly may then be raised and the belling tool emptied in the manner previously described.

It should be understood that some of the earth loosened by the first cut fell to the bottom of the hole. When the tool is lowered into the hole for the second cut, the blades will first sweep all of this loosened earth into the housing. In some cases, the loosened earth may prevent my belling tool from initially reaching the bottom and, in this case, the rotation is started to remove this loosened earth and lower the tool to the bottom.

To make the third cut, pin 40 will be moved to the next series of holes 38 in plates 36 and the same series of operations followed, which will cause the area indicated by dotted lines in FIG. 12 to be cut away at the bottom of the hole. In the next sequence of operation, the area indicated by dotted lines in FIG. 13 will be cut away and this sequence of operation is continued until the bottom of the hole is belled out completely as indicated in FIG. 14. After the last cut, the bottom of the hole is completely cleaned by rotation of the tool in the bottom of the hole with the blades fully opened. During this clean-up operation, as well as during all digging operations, the scoops 54 continually clean all earth from the bottom of the hole beneath the housing of the belling tool.

One of the greatest difficulties with prior art belling tools is the fact that these tools would not properly shape and clean out the hole. For obvious reasons, loose earth cannot be left in the bottom and, therefore, with these prior art tools it was necessary to send men down into the hole for a final cleaning and shaping operation. This is extremely expensive, not only because of the hand labor but because of the time and expense expended in inserting a steel tubing into the hole so it is safe for the men to be lowered into and work in the hole.

With the belling tool of my invention, I have found in actual practice that my belling tool will completely clean and shape the hole without any need for lowering men into the hole. This is due to the unique construction and

arrangement of my belling tool and makes it far less expensive to use than prior art belling tools.

In FIGS. 15 through 17, I have shown a modified form of my invention, which is primarily different in that the belling tool may be expanded to cut to a greater diameter even though the housing of the belling tool is essentially the same size as that of the belling tool shown in the other drawings. In addition, the adjustment mechanism for controlling the expansion of the belling tool is somewhat different than that shown in the other embodiment.

Referring to FIGS. 15, 16, and 17 of the drawings, it will be seen that upper and lower ring frames 20' and 22' are provided and a top plate 80 extends across the top of ring frame 20'. A hub 30' is rotatably mounted within the top of the housing and at its upper end receives square kelly 76'. An adjusting arm 34' is secured to the upper end of hub 30' and extends diametrically across the belling tool, spaced above top plate 80. As best seen in FIGS. 15 and 16, parallel mounted but spaced apart plates 36' are provided on opposite sides of the belling tool. Plates 36' have aligned openings 38' extending throughout the length thereof which are adapted to receive pins 40'. The ends of adjusting arm 34' are disposed between parallel plates 36'. Thus when kelly 76' is rotated, hub 30' and adjusting bar 34' will be rotated until such time as the ends of adjusting bar 34' strike the pin or pins 40' to stop rotation of the hub relative to the belling tool.

A dump bottom 42' is provided on the belling tool and the same latch mechanism as shown in the other drawings is used for releasably locking dump bottom 42' in closed position. This mechanism comprises latch ear 46', lock rod 48' and latch 52'. Dump bottom 42' is also provided with scoops 54' and hinge 44'.

The blades 60' of the belling tool shown in FIGS. 15 through 17 are two part blades, the two parts being pivotally connected one to the other. The outer part is designated 82 and the inner part designated 84 and they are interconnected at pivot 86. The inner end of inner part 84 is secured to vertically arranged sleeve 66'. Sleeve 66' is mounted over shaft 68' and free to rotate thereon. A crank 70' is secured to sleeve 66' and extends outwardly therefrom.

A cross arm 72' is secured to the lower end of hub 30' and rotates with the hub. The outer ends of cross arm 72' are secured by pivotal connections to link 74'. Links 74' are in turn pivotally connected to cranks 70' at an intermediate point. The outer ends of link 74' are pivotally connected to second links 88 which are in turn connected to outer part 82 of blade 60'. Second links 88 are connected to outer part 82 of blade 60' at a point spaced from pivot 86 by means of crank 90 on part 82 of blade 60'.

The belling tool shown in FIGS. 15 through 17 is operated in essentially the same way as previously described. Pins 40' are placed in an appropriate series of holes 38' to control the distance which blades 60' will be opened. By providing an elongated adjusting arm 34' and pairs of plates 36' on each side of the belling tool, the rotating force transmitted from the kelly to the housing of the belling tool may be accomplished through two pins 40', when pins 40' are positioned in appropriate holes such as indicated in FIG. 15.

FIG. 17 clearly shows the structure by which blades 60' are open as the kelly is rotated. Rotation of the kelly causes boss 30' to rotate which rotates cross arm 72'. Through links 74' and 88, parts 82 and 84 of blades 60' will be swung outwardly into cutting position.

In the dotted lines in FIG. 17, blades 60' and other related parts are shown in an open position, and in solid lines, the blades and related parts are shown in their closed position. It is important to note that when blades 60' are in their closed position all parts of the blade and operating mechanism are contained within the circumference of the belling tool so that the tool may be removed from the hole in the same manner as the belling tool hereinbefore described. With the two part blade arrangement of this form of my invention, the belling tool can produce a bell of a greater diameter.

From the foregoing description, it should be readily apparent that I have developed a belling tool of unique design and construction which is positive and economical in operation, which is capable of doing a better job than tools heretofore available, and yet is simple in construction and relatively inexpensive to produce and operate.

The drawings and the foregoing specification constitute a description of my belling tool in full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims. It should, of course, be appreciated that various changes and modifications may be made without departing from the spirit and scope of the invention.

I claim:

1. In a belling tool, a cylindrical shaped housing having vertical side members and a bottom member, a top frame spanning said side members, a dump bottom hinged to said bottom member of said housing, lock means on said dump bottom for securing said dump bottom in closed position, operating means for said lock means extending upwardly from said lock means to the top of said top frame, a shaft vertically mounted at the side of said housing below said top frame and extending between said bottom member and top frame, a sleeve rotatably mounted over said shaft, a crank arm on said sleeve adjacent the lower side of said top frame, a blade secured to said sleeve adjacent said bottom member, said blade being rotatable about said shaft from a closed position within the confines of said housing at the lower end thereof to an open digging position wherein the blade extends beyond the confines of the housing, a hub rotatably mounted in said top frame, a kelly adapted to be rotated and being secured to said hub for rotation therewith, an arm secured to the lower end of said hub, said lower end of said hub and said arm being disposed below said top frame within the confines of said housing adjacent said top frame, a link having one end pivotally connected to said arm and the other end pivotally connected to said crank arm on said sleeve, said link being connected to said crank arm on said sleeve, in the upper portion of said housing, an adjusting member connected to said hub above said top frame, said adjusting member being an elongated member extending tangentially outward from said hub and terminating near the periphery of said cylindrical housing, and adjustable stop means supported by said top frame on the top thereof and comprising a plate member disposed adjacent the terminal end of said adjusting member and a movable stop carried by said plate member and engageable with the terminal end of said adjusting member, said hub and adjusting member being rotated together relative to said housing and said adjusting member stopping such relative rotation thereof when said adjusting member engages said movable stop, said hub, arm, link, crank arm and sleeve on rotation of said kelly in one direction causing said blade to move toward an open position and causing said blade to move toward a closed position when said kelly is rotated in an opposite direction, said kelly on rotation causing digging rotation of the belling tool with said blade extended to open position through engagement of said adjusting member with said movable stop.

2. In a belling tool, a cylindrical shaped housing having vertical side members and a bottom member, a top frame spanning said side members, a shaft vertically mounted at the side of said housing below said top frame and extending between said bottom member and top frame, a sleeve rotatably mounted over said shaft, a crank arm on said sleeve adjacent the lower side of top frame, a blade secured to said sleeve adjacent said bottom member, said blade being rotatable about said shaft from

a closed position within the confines of said housing at the lower end thereof to an open digging position wherein the blade extends beyond the confines of the housing, a hub rotatably mounted in said top frame, a kelly adapted to be rotated and being secured to said hub for rotation therewith, an arm secured to the lower end of said hub, said lower end of said hub and said arm being disposed below said top frame within the confines of said housing adjacent said top frame, a link having one end pivotally connected to said arm and the other end pivotally connected to said crank arm on said sleeve, said link being connected to said crank arm on said sleeve in the upper portion of said housing, an adjusting member connected to said hub above said top frame, said adjusting member being an elongated member extending tangentially outward from said hub and terminating near the periphery of said cylindrical housing, and adjustable stop means supported by said top frame on the top thereof and comprising a plate member disposed adjacent the terminal end of said adjusting member and a movable stop carried by said plate member and engageable with the terminal end of said adjusting member, said hub and adjusting member being rotated together relative to said housing and said adjusting member stopping such relative rotation thereof when said adjusting member engages said movable stop, said hub, arm, link, crank arm, and sleeve on rotation of said kelly in one direction causing said blade to move toward an open position and causing said blade to move toward a closed position when said kelly is rotated in an opposite direction, said kelly on rotation causing digging rotation of the belling tool with said blade extended to open position through engagement of said adjusting member with said movable stop.

3. In a belling tool, a cylindrical shaped housing having vertical side members and a bottom member, a top frame spanning said side members, a shaft vertically mounted at the side of said housing below said top frame and extending between said bottom member and top frame, a blade carried by said shaft at the lower end thereof adjacent said bottom member, said blade being rotated from a closed position within the confines of said housing at the lower end thereof to an open digging position wherein the blade extends beyond the confines of the housing, a hub rotatably mounted in said top frame, a kelly adapted to be rotated and being secured to said hub for rotation therewith, an arm secured to said hub adjacent said top frame, connecting means between said blade and said arm, said connecting means being operated by rotation of said hub relative to said housing to rotate said blade between said open and closed positions, a stop member on said housing, a member secured to said hub and rotatable therewith, said last-mentioned member secured to said hub being engageable with said stop member when said hub has been rotated to a position opening said blade, said hub and housing being rotated together for digging operation when said member secured to said hub engages said stop member, whereby rotation of said kelly controls the opening and closing of said blade and digging operation of the belling tool.

4. The belling tool as described in claim 3 wherein said blade has two connected parts, with a first part of said blade directly carried by said vertical shaft, and a second part of said blade pivotally connected to said first part at a point spaced from said shaft, and said connecting means between said blade and said arm comprises a member connected with each of said blade parts.

5. In a belling tool, a cylindrical shaped housing having vertical side members and a bottom member, a top frame spanning said side members, a shaft vertically mounted at the side of said housing below said top frame and extending between said bottom member and top frame, a blade carried by said shaft at the lower end thereof adjacent said bottom member, said blade being rotated from a closed position within the confines of said housing at the lower end thereof to an open digging position wherein the blade extends beyond the confines of the housing, a hub rotatably mounted in said top frame, a kelly adapted to be rotated and being secured to said hub for rotation therewith, an arm secured to said hub adjacent said top frame, connecting means between said blade and said arm, said connecting means being operated by rotation of said hub relative to said housing to rotate said blade between said open and closed positions, said connecting means comprising a link disposed adjacent said top frame with one end connected to said arm and a member rotatable with said blade and having a portion disposed adjacent said top frame, said member rotatable with said blade having the portion adjacent said top frame connected to the other end of said link, said connecting means being operated by rotation of said hub relative to said housing to rotate said blade between said open and closed positions, whereby rotation of said kelly controls the opening and closing of said blade and digging operation of the belling tool.

6. The belling tool as described in claim 5 wherein said blade has two connected parts with a first part of said blade directly carried by said vertical shaft, and a second part of said blade pivotally connected to said first part at a point spaced from said shaft, and said connecting means between said blade and said arm comprises a member connected with each of said blade parts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,751,521	Miller	Mar. 25, 1930
1,854,823	Bertran et al.	Apr. 19, 1932
1,916,691	Schroeder	July 4, 1933
2,621,898	Brodhead et al.	Dec. 16, 1952