ABSTRACT OF THE DISCLOSURE

An apparatus is disclosed for drilling spaced holes in the surface and along the length of a pole, the holes being drilled at an angle to the axis of the pole. The apparatus is comprised of a longitudinally disposed machine bed having cradle means for supporting poles aligned parallel to each other. A drill assembly is provided together with means for moving the drill assembly relative to the poles along the machine bed to predetermined positions. Means responsive to a signal rotate the poles to predetermined radial positions, while means are provided for actuating the drill assembly after the poles have been indexed in the predetermined radial position. The complete drilling of a pole from end-to-end is determined by a coded array of actuating means located in the path of travel of the drilling assembly.

This invention relates to a pole-drilling apparatus and, in particular, to an apparatus for drilling spaced holes in poles for use in mounting branches in the production of artificial trees.

Artificial Christmas trees have come into increasing use in recent years. Some of the advantages of artificial trees are that they are clean, can be easily erected and can be dismantled and stored away for future use. The branches are designed so that one end can be inserted into holes drilled at an angle in a supporting pole or simulated tree trunk.

An object of this invention is to provide an apparatus which is programmed to drill spaced holes automatically along the length of a set of poles.

Another object is to provide a pole-drilling apparatus comprising a drill assembly which is movable in one of several predetermined drilling positions along a machine bed supporting the assembly.

A still further object is to provide a pole-drilling machine having means for discharging a set of poles which have been drilled while another set of poles is moved into loading position.

These and other objects will more clearly appear from the following disclosure and the accompanying drawings, wherein:

FIG. 1 shows in three dimensions one embodiment of the pole-drilling apparatus provided by the invention;

FIG. 2 is a view in elevation taken along line 2—2 of FIG. 1, showing the pole-loading mechanism of the apparatus;

FIG. 3 is also a view in elevation showing schematically the right side of the drill assembly;

FIG. 4 is a section taken along line 4—4 showing the arrangement of the chucks employed in gripping and rotating the poles, including means for driving said chucks;

FIG. 5 is a cross section of a chuck taken along line 5—5 of FIG. 4;

FIG. 6 is a view of the chuck-driving means as observed in elevation along line 6—6 of FIG. 5;

FIG. 7 depicts in plan view the drill assembly of the apparatus.

FIG. 8 is a head-on elevation view of the drill assembly carriage as observed along line 8—8 of FIG. 1;

FIG. 9 is a section of the worm drive for moving the drill assembly carriage along the machine bed as seen along arrows 9—9 of FIG. 8;

FIG. 10 is a more detailed rendition in side elevation of a pneumatically operable drill employed in the drill assembly;

FIGS. 11 and 12 are top and elevation views, respectively, of a pneumatically operable pole stop means;

FIG. 13 is a side view of the pole stop means of FIG. 12 as viewed along line 13—13.

FIG. 14 is a view in elevation as seen along arrows 14—14 of FIG. 1 showing the worm-driving mechanism;

and

FIG. 15 is a block diagram illustrating the cycle of operation of the apparatus.

Starting broadly, the invention comprises an apparatus for drilling spaced holes in the surface of one or a plurality of poles at an angle to the axis thereof. In its preferred embodiment, the apparatus comprises a longitudinally disposed machine bed which also includes a drill assembly having at least one drilling means with its drilling axis disposed at an angle to the longitudinal axis of the machine bed. A carriage is provided for supporting the drill assembly which has a path of travel along the machine bed, the apparatus being provided with means for moving and indexing the carriage in predetermined positions along the machine bed, means being also provided for supporting at least one pole along the longitudinal axis of the machine bed. The apparatus has means for rotating the pole in one of a plurality of predetermined radial positions, means being also provided for moving the drill means along its drilling axis relative to a pole to be drilled. In order to effect a sequential operation of steps, switch responsive means are provided associated with the apparatus for actuating the drill assembly and for actuating the means for rotating the pole via a coded array of actuating means located in the path of travel of said carriage means for actuating the switch responsive means.

Referring now to FIG. 1 which depicts the pertinent parts of the apparatus in perspective, a longitudinally disposed machine bed is shown designated generally by the numeral 10, the machine bed being supported by legs, not shown. The machine bed is made up of framework of side members, such as 11a, 11b, 12 and end members, such as 13. The machine bed supports a carriage designated generally by the numeral 14 which in turn supports a drill assembly designated generally by the numeral 15, the drill assembly being made up of four stands of drills 18 to 18, inclusive, having pneumatic means indicated in general outline by numerals 19 to 22, respectively, said means being shown in more detail in FIG. 7. The drills are supported by brackets 23 so that the drill axes are inclined to the longitudinal axis of the machine bed and the poles to be drilled.

The carriage has a pair of cross members 24, 25 separated by plates 26 and 27, the carriage also having a top support 28 to which brackets 23 are fixed. The carriage is slidably mounted on a stationary shaft 29 and a corresponding stationary shaft 29a not shown in FIG. 1 but clearly depicted in FIG. 8. The carriage is driven in either direction of the longitudinal axis of the machine bed via worms 30 and 31 by means clearly apparent in FIG. 14 to be described later.

Extending from the side of the carriage in FIG. 1 is a limit switch assembly designated generally by the numeral 32 for indexing the carriage in predetermined positions along said machine bed comprising a plurality of limit switches 32a (not FIG. 8), each of which is adapted
to be actuated by one or more cam buttons 320 provided in coded array on cam plate 33 programmed in accordance with a particular sequence of drilling desired. The limit switch actuates a conventional time (not shown) timer which has a cam which controls the timer for a complete cycle (e.g., a complete revolution) and one or more additional cams on the same shaft of the timer programmed in accordance with the number of holes to be drilled in a pole as shown diagrammatically in FIG. 15. Thus, where three equally spaced holes are to be drilled about the periphery of the pole, the cam controlling the drilling may have three equally spaced peripheral notches, each notch corresponding to one of the three holes. A finger contact riding the cam is actuated by the first notch as a pole is rotating to a particular radial indexing position whereby to control pole rotation. As the finger contact is actuated by the first notch, the motor rotating the poles stops to the desired indexing position, and the drill begins its downward drilling cycle. At the end of the drilling cycle, a switch on the drill assembly is actuated which causes the drill bit to be withdrawn pneumatically from the hole and the timer again actuated until the second notch on the timer cam is reached to radially index the pole for the next hole-drilling cycle, and so on.

The poles to be drilled are first supported in a cradle assembly designated generally as 34 of, for example, the type shown in the exploded view of FIG. 4. Components 35 are held in spaced parallel relationship by cross members 36, 37 supported on each side of the apparatus by rods, such as 38, which are supported by end brackets 39 and 40 which are fixed to the side members 11 and 12 of the machine bed. Each of the cradle support elements 35 is cradled in it a pole 41 for loading into the drilling section of the apparatus. Pole pushers 42 and 43 are provided mounted on brackets 44 and 45 which are slidably mounted on tracks 46, 47 which extend the whole length of and beneath the cradle. The pole positions are actuated by pulley and wire system to be described later. Where the poles in the forward part of the machine have been completely drilled and the carriage has returned to home position, a pole-stop means 48 located at the end of the machine is cleared and the poles in the cradle pushed forward against the ends of the pole-stop means 48 which are pushed out of the machine bed with the new poles replacing them. The poles for drilling are held by rotatable chucks 49 in chuck mount 50 to be described later.

The mechanism for driving the pole pushers is shown in FIG. 2 which is an elevation view looking in the direction of the drill spindle in section. Pole pusher 43 (FIG. 1) is driven by a set of grooved pulleys 53, 54, 55, 56 and 57 via metal cables 58 and 58a, the ends of the cables being anchored at 59 and 60 at the home position of the pole pusher and at 61, 62 of piston rod 63 of pneumatic cylinder 64, the use of two cables assuring a balanced driving system. When the poles in the drilling area shown in FIG. 1 have been completely drilled, the carriage returned to home position and the pole stop 48 removed, pneumatic cylinder 64 is actuated to drive the new set of poles into rotatable chucks 49 in drilling position and to move the drilled set out of the machine by pushing the set freely out of said chucks 49. From the description of the apparatus is depicted in FIG. 3 which is an elevation view taken in the direction of arrows 3–3 of FIG. 1. The carriage and drill assembly are shown schematically at 14 and 15, respectively, the drill assembly having a fluid feed means 65 coupled thereto for feeding compressed air to the pneumatic cylinders of the drill assembly (note also FIG. 7). Air pressure feeding lines and pressure control gauges are shown at 66, the air being fed via line 67a to various pneumatic valves associated with the apparatus. The chuck mount for gripping the poles is shown in FIG. 3 at 50 and in more detail in FIG. 4. A motor 69 and clutch 70 rotate the chuck, the motor having a sprocket wheel 68 for transmitting power to the chuck via a chain drive 69 and a train of transmission sprocket wheels (note FIG. 4). The pole stop means 48 is shown in FIGS. 3, 11 and 12 as being supported on pneumatically operable pole stop assembly 70. At the far end of the apparatus (FIG. 3), drive means 71 is provided having a reversibly driven motor 72 mounted within bracket 73, the worm drive means being shown in more detail in FIG. 14. FIG. 4 shows in more detail the chuck mount 50 employed for gripping the poles. In the embodiment shown in FIGS. 4 and 5, four rotatable pole-gripping chucks 74 to 77 are provided in which poles 41 are gripped. The poles are held in place by pole-gripping means, e.g., pins, 78 shown more clearly in FIG. 5 which is a cross section of a typical chuck taken along line 5–5 of FIG. 4. In FIG. 5, pole 41 is shown passing axially through the chuck which comprises a hollow shaft 79 held within a collet 80 mounted on an antifriction bearing 81, the bearing in turn being coaxially supported within an annular member 82 via a washer 83. At the exit end 84 of the chuck, three bell cranks 85 are pivotally mounted, each crank having threaded in one leg thereof pole-gripping member 86 and pins 78, the collet 80 being supported by a spring 86 for each of the bell cranks. An annular member 87 surrounds the bell cranks to provide an annular chamber in which each of the pivotally mounted bell cranks is confined. A pole release means is provided comprising a ring member 88 having pins 89 projecting therefrom passing through an annular locating means 90 confined within the chuck. The pole release member or ring 88 is mounted with some play so that when a force "F" is uniformly applied against the ring, the bell cranks are caused to move radially away from pole 41 and disengage pole-gripping means 78 from the pole so that the pole can be removed from the chuck. During the return trip of the drill carriage, the carriage being allowed to return to home position and strike release members 88, thereby releasing the poles from the gripping action of the chuck so that the pole pushers can dislodge the drilled poles by pushing new poles against them.

As stated hereinbefore in describing FIG. 3, the chucks are rotated via motor 67 and sprocket wheel 68 (note also FIG. 4) which is keyed to motor shaft 91. As shown in FIG. 4, sprocket 68 is coupled via chain 69 to sprocket 92 coaxial with toothed gear 93, the chain being held taut by idle sprocket 94 of FIG. 4. All of the transmission gear 95 which meshes with the outer periphery of annular gear 96 of pole-gripping chuck 74 and thence to gears 97, 98 and 99 of chucks 75 through 77. Gear 95 is mounted on a stub shaft 100. The chuck mount 50 also supports the ends of worms 30 and 31 via an antifriction bearing such as that designated by 101 in FIG. 6. Referring to FIG. 6, the transmission gears are shown supported within enclosure 102, gear 94 being supported by stub shaft 103 and gear 93 by stub shaft 104.

The details of the drill assembly shown in FIG. 7 of the drill assembly are shown in the plan view of FIG. 7. Drills are numbered to correspond to the designations shown in FIG. 1, drills 15 and 16 with pneumatic cylinders 19 and 20, respectively, being typical of the four drills employed. The foregoing cylinders are coupled to fluid feed lines 105, 106 and 107, respectively, the fluid feed lines extending to a central coupling station designated generally by numeral 109, the central station being in turn connected by hose 108 and 109 to the central air control gauges 66 as shown in FIG. 3.

The carriage portion 14 of the drill assembly has four hollow pole guides 110 to 113 supported between front and back plates 24 and 25, respectively, of the carriage. Each of the pole guides has a collar, that is 110c to 113c, on the front face of plate 24, the pole guides also having
integral therewith drill guides 111b to 113b, each of which communicates with the inside of each of the hollow pole guides, the drill guides being aligned with the index axis of each of the drills 15a and 15b, and in mesh. When drilling is called for, all four drills simultaneously move down through the drill guides and penetrate the poles to a depth determined by a limit switch (not shown), whereby the flow of air in pneumatic cylinders 19 and 20, etc., is reversed by conventional valve means to raise the drills to home position while the poles are rotated and indexed in the next radial position for drilling.

A head-on view of the apparatus of FIG. 7 is shown in FIG. 8, the carriage 14 being slidably supported on stationary shafts 29 and 29c which are fixed via spaced vertical supports 29b and 29c on side members 11b and 12 of the machine bed, limit switch assembly 32 for indexing the linear travel of the carriage being shown relative to cam plate 33 as also shown in FIG. 1. The collars 110a to 113a are shown fastened to face plate 24 via screws, the face plate also showing the location of worms 30, 31 passing therethrough and by means of which carriages 14 and 15 are moved along the machine bed.

FIG. 9 which is a section taken alone line 9-9 of FIG. 8, shows worm 30 passing through the chassis of the carriage, the worm passing through an annular bearing ring 114 having bearing elements 114a nesting in the grooves of the worm. Stationary shaft 29 supports the carriage chassis together with stationary shaft 29c as shown, the chassis having a pair of built-in bearings 115 and 116 with bearing elements 115a and 116a riding on the stationary shaft.

The drill assembly is shown in side elevation in FIG. 10 with pole 41 passing through hollow pole guide 111a of carriage 14.

FIGS. 11 to 13 show the detail for the pole stop means, FIG. 11 being a top view and FIG. 12 a head on view in elevation. Pole stop means 48 is adapted to move from left to right and vice versa as shown by the arrows in FIGS. 11 and 12. The pole stop means is provided with tongues 117 to 120 (FIG. 12) having pole abutment means 121 to 124 extending substantially perpendicularly therefrom. Pole stop means 48 is slidably mounted via slots 125, 126 along which stub bolts 127, 128 ride in back plate 48a. Behind the back plate is located a pneumatic cylinder 129, that is which is connected to a pump 131 which extends through slot 132 and connects to pole rod means 48. The pneumatic cylinder and piston are actuated via means not shown (e.g. solenoid valve), upon completion of the drilling cycle and after the carriage has returned to home position to actuate a switch which operates a valve to control the flow of air to and from the pneumatic cylinder. As soon as the pole stop means is released, the pole pusher means pushes a new set of poles forward to dislodge those already drilled. FIG. 13 is a side elevation of the view of FIG. 12 as seen along line 13-13.

FIG. 14 which is a front elevation of the extreme end of the apparatus behind the pole stop means depicts the detail of the motor-driven worm drive mechanism. A motor 133 is provided having a sprocket 134 which drives via chain 135 sprocket wheels or gears 136 and 137, a tension producing idler sprocket 138 being provided carried by lever arm 139 pivotally mounted at pivot 140. Worms 30 and 31 are meshed with gear 143 and 144 respectively, the gears being coaxially fixed on worms 30 and 31. The motor is reversible so that the carriage driven by worms 30 and 31 is capable of being driven up and down the longitudinal axis of the machine bed.

The operation of the apparatus will be understood by referring to the block diagram of FIG. 15. The carriage and drill poles 30 and 31 are in home position 50 similar to that of FIG. 10. Start button 145 is pressed to actuate drive relay 146. Carriage feed 147 is accordingly actuated (via the worm transmission from motor 133 of FIG. 14) and the carriage begins its forward drive 148 until it reaches a position on cam plate 33 wherein one of the carriage index means, i.e., limit switches 32a (note FIG. 8), contacts cam button 32b. For convenience, the limit switch 31b is shown in FIG. 15 as S-1. The moment the cam button is contacted, the carriage stops and is appropriately indexed at the position along the pole where drilling is to commence. At the same time, a timer is actuated, the timer having a series of cams for radially indexing the positions of the poles, one of which cam S-2, 3, 4, 5, 6 is preset by switch 149 and program a 3-hole drilling operation, each hole to be 120° apart, while the timer at the same time controls a complete 360° cycle turning of the poles. The timer is synchronized to run with motor 67 that drives the rotatable chucks. The moment the selection is made and the poles radially indexed made, a switch is actuated to cause the pneumatically operable drills to simultaneously come down through drill guide 110b to 113b into the poles until a depth is reached which is detected by a conventional limit switch (note S15 in FIG. 15) on the drill assembly (not shown) which operates an air valve for reversing the drill travel. The drills back out of the holes, the cam in the timer for radially indexing the poles causes motor 67 to be actuated whereby to cause the pole-mounting chucks to rotate 120° and then stop, followed by the drills being actuated to descend and drill another hole as before.

In the block diagram of FIG. 15, the actuation of the 3-hole cam results in the drill being put through an in-out cycle step 152 which via a limit switch 151 leads into the next pole-indexing cycle step 152, that is the pole is rotated to the next drilling position, after which a limit switch 153 is actuated to repeat the in-out drill cycle indicated by numeral 150.

Upon completion of the third and last hole, the timer has gone through a 360° cycle whereupon the carriage feed mechanism is actuated via line 154 and resumes its travel along the machine bed until another indexing cam button is actuated, e.g. S-2, which controls the drilling of three holes 120° apart but peripherally staggered or alternate relative to the three holes determined by S-1. The carriage stops upon striking of indexing the cam button and a new cycle is effected through line 155, wherein the drill-in and drill-out cycle is repeated three times as before, the poles being rotated 120° each time a hole is finished as described hereinbefore. At the completion of the three alternate holes, the timer actuates the drive relay 146 and the carriage means along with it strikes the next indexing cam button corresponding to S-3 and so on. Upon completion of the last set of holes corresponding to S-5 (5-hole cam), the worm drive resumes and the carriage now moves to the end of the machine where it contacts return switch RS-6 (FIG. 15) causing the worm drive to reverse, the return drive of the carriage being traced along line 156 in FIG. 15. When the carriage reaches home position near chuck mount 50, it strikes chuck release member 88 (FIG. 5) to disengage pole gripping means 78 from the poles and thus open chucks 157 (FIG. 15).

At the same time, the stock discharge and stock feed limit switch 158 is actuated whereby pole stop means 48 (FIGS. 11 to 13) is cleared and pole pushers 42, 43 actuated to push poles 41 from the loading end of the machine through the chucks whereby the drilled poles are pushed through fresh poles placed in drilling position. The pole pushers then return to home position and the pole stop means returns to the normal position relative to the end of the poles as shown in FIG. 11. The start button 145 is actuated and the automatic drilling cycle repeated for the new set of poles. In the meantime, another set of poles is loaded on the cradle. Although the above described embodiment is described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand.
Such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

What is claimed is:

1. An apparatus for drilling spaced holes in the surface of at least one pole which comprises,
   a longitudinally disposed machine bed,
   carriage means mounted on said machine bed and moveable to travel along said machine bed,
   a drill assembly supported by said carriage having at least one drill means with its drilling axis disposed at an angle to the longitudinal axis of the machine bed,
   drive means including carriage indexing means associated with said machine bed for moving said carriage along said machine bed,
   said carriage indexing means including electric switch and trip means spaced to correspond to predetermined longitudinal displacement of said carriage for linearly indexing said carriage from one to another correspondingly predetermined position along said machine bed,
   whereby said carriage is indexable in predetermined positions along said bed according to the switch means actuated,
   means for supporting at least one pole along said machine bed in cooperation with said drill assembly, said means including rotatable chuck means forward of said carriage for gripping said at least one pole,
   means coordinated with said switch and trip means for rotating said chuck means, including means for indexing said rotation to one of several angular positions for drilling,
   and automatic means responsive to achievement of each of said predetermined angular positions for actuating said drill.

2. The apparatus of claim 1, wherein the means for supporting at least one pole comprises a plurality of rotatable chucks, each having means associated therewith for gripping the end of a pole.

3. The apparatus of claim 2, wherein the means for rotating the poles are means for rotating the chucks gripping the poles.

4. The apparatus of claim 2, wherein the means for loading the poles into drilling position comprise a cradle for supporting the poles and pusher means for moving the poles from the cradle into support relationship with the chucks.

5. The apparatus of claim 2, wherein pole stop means are provided for positioning the poles relative to the chucks.

6. The apparatus of claim 1, wherein the drill assembly has pneumatically operable means for moving the drills into and out of the poles; wherein said switch means comprises an array of limit switches thereon for operating with cam buttons on the apparatus lying in the path of travel of the carriage for controlling a timer programmed to control the movement of the carriage, the rotation of the poles and the drilling cycle; wherein said rotatable chucks are provided for gripping and rotating said poles to predetermined radial position; and wherein said chucks each have a pole-release means which is actuated when contacted by the carriage upon completion of a pole-drilling cycle.

7. The apparatus of claim 6, wherein a cradle support is provided for loading poles in drilling position, and wherein pusher means are provided for pushing the poles from the cradle support into drilling position relative to the chucks.

8. The apparatus of claim 7, wherein pole stop means are provided for positioning the poles in drilling position, and wherein pneumatically operable means are provided for clearing the stop means to enable discharge of drilled poles by said pusher means during the loading of a new set of poles.

References Cited

UNITED STATES PATENTS

2,898,783 8/1959 Kiesling ------- 77--64X

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