April 29, 1941. E. T. BEPLAT 2,239,872

APPARATUS FOR SINKING FORMS FOR CONCRETE PILES

Filed March 25, 1939

Fig. 1

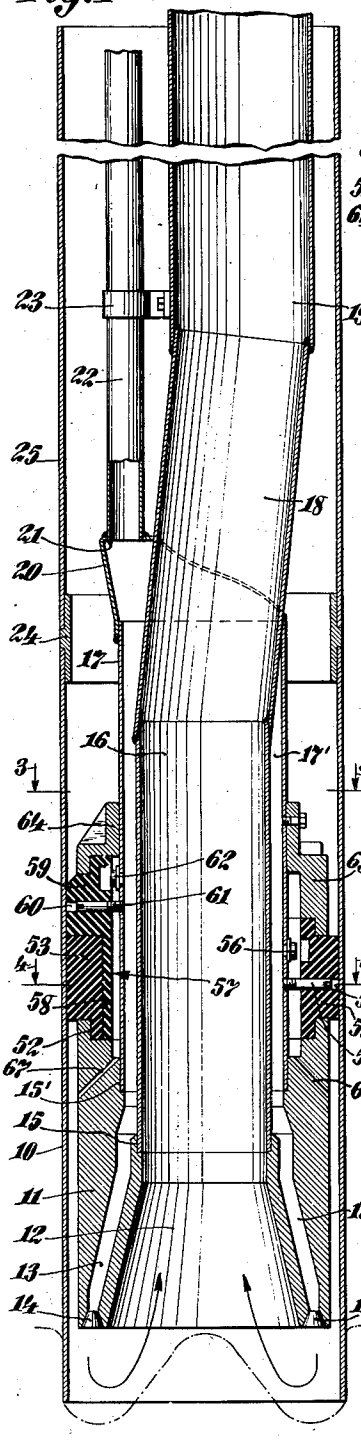


Fig. 3

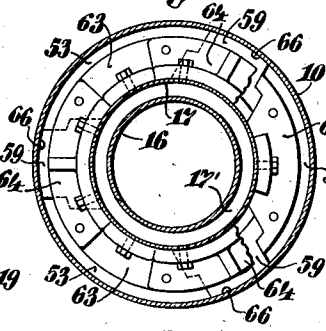


Fig. 4

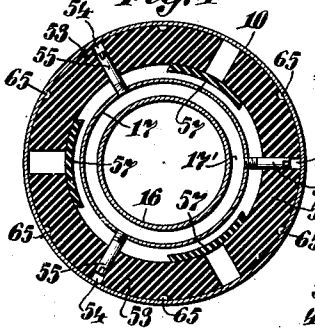


Fig. 5

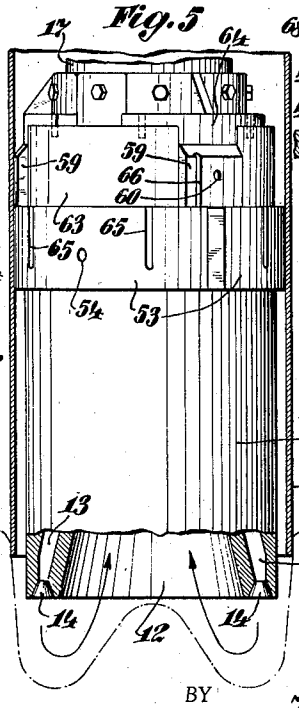
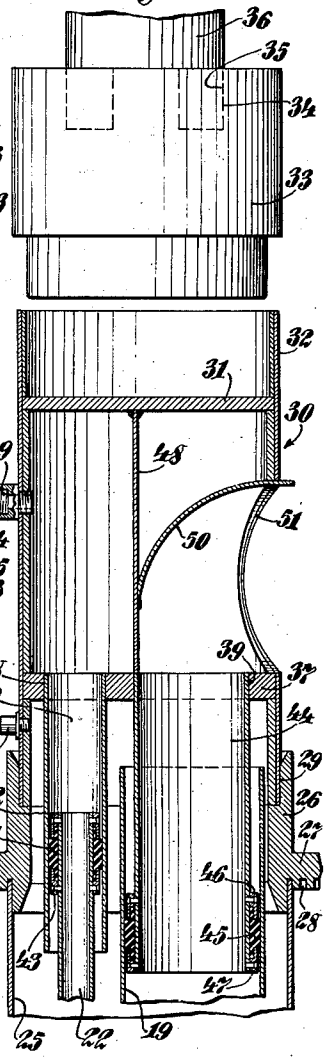


Fig. 2



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Patented Apr. 29, 1941

2,239,872

UNITED STATES PATENT OFFICE

2,239,872

APPARATUS FOR SINKING FORMS FOR CONCRETE PILES

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Application March 25, 1939, Serial No. 264,109

6 Claims. (Cl. 61—78)

The present invention relates to pile driving, and more particularly to an improved apparatus for rapidly and effectively sinking tubular forms such as are used in the construction of concrete piles, although it is not limited to such use.

In the present method of sinking forms of this character, the form is driven into the earth by means of a suitable hammer until the forces of friction acting inside and outside the form substantially retard its movement. The driving is then stopped and the material within the form is blown out by means of air under pressure from a hose lowered into the form. By alternate driving and blowing in this manner, the form is finally sunk to the desired depth.

The method described above has been found to be generally unsatisfactory in several respects. For one thing, it cannot be used economically in driving forms of large diameter, because the cost of providing sufficient air to maintain the necessary pressure in such forms, for the effective removal of the excavated earth is excessive. Accordingly, it has been the customary practice to sink a plurality of forms of relatively small diameter rather than one or several forms of large diameter, although the latter is by far the better practice.

The principal object of the present invention, accordingly, is to provide an improved apparatus for sinking forms for concrete piles, which is free from the defects of the prior art mentioned above, and by means of which forms of relatively large diameter may be sunk economically and in a rapid and highly effective manner.

Another object of the invention is to provide an improved apparatus of the above character in which the earth within the boundary of the form may be excavated simultaneously with the driving of the form.

A further object of the invention is to provide an improved apparatus of the above character which is adaptable for use in sinking piles of different diameter.

In a preferred embodiment of the invention, a blowing head is provided which is adapted to be lowered within a form, and which comprises a plurality of nozzles concentrically disposed about a discharge opening. Air under pressure is adapted to be directed from the nozzles against earth adjacent the periphery of the form, which is broken up and discharged together with the air, through the discharge opening in the head. The excavated material and air are then carried up the form through a conduit of relatively small diameter, in which the required pressure may be readily maintained with ordinary and economical quantities of air. Suitable means is provided in accordance with the invention for preventing the escape of air between the blowing head and the inner wall of the form.

Additional objects will become apparent from the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a view in vertical section of the lower portion of an excavating device constructed in accordance with the invention, and in an operative position within a form;

Fig. 2 is a view in vertical section illustrating the upper portion of the apparatus including the driving member;

Fig. 3 is a view in section taken along line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a view in section taken along line 4—4 of Fig. 1 looking in the direction of the arrows; and

Fig. 5 is a view, partially in section, illustrating an alternative operative position of the device.

Referring to Fig. 1, a tubular form section is shown at 10, within the lower portion of which a blowing head 11 has been lowered. The blowing head 11 may be shaped to conform with the cross section of the form 10, and is provided with a centrally disposed discharge opening 12 through which excavated earth is adapted to be discharged. Formed within the head 11 is an annular passage 13 terminating at the lower extremity of the head 11 in a plurality of nozzles 14 of relatively small diameter, through which air under pressure is adapted to be directed against the ground adjacent the periphery of the form 10.

At the upper portion of discharge opening 12 a circular recess 15 is provided, within which a discharge pipe 16 is adapted to be secured. A similar recess 15' is provided in the upper portion of the air passage 13 in which a second pipe 17 of larger diameter than the discharge pipe 16 is adapted to be received. The space between the discharge pipe 16 and the outer pipe 17 provides an annular conduit 17' through which air under pressure may be directed to the passage 13 in the blowing head 11 for breaking up earth at the lower extremity of form section 10.

The discharge pipe 16 may be welded or otherwise secured to a second section of pipe 18, which in turn is welded to the pipe 19 which directs the excavated earth to the discharge opening

at the upper end of the form. The outer pipe 17 is closed off by a suitable closure member 20 welded to withstand high air pressure, which is provided with an aperture 21 into which an air supply pipe 22 is adapted to be fitted. The air supply pipe 22 may be held in position by means of a suitable clamp 23 bolted or otherwise secured to the pipe 19. The length of the form may be increased by providing a suitable coupling member 24 of a well known type, on which a second section 25 may be seated, and the length of the air supply pipe 22 and the discharge pipe 19 may be increased by adding sections in the conventional manner, using similar coupling members (not shown).

At the upper end of section 25 (Fig. 2) a coupling member 26 is provided on which a driving head is adapted to be seated. The coupling member 26 has a wide flange 27, in the under side of which a plurality of concentric grooves 28 are formed to accommodate forms of different diameter, section 25 being in one of the grooves 28. In the upper portion of the coupling member 26, a circular recess 29 is formed in which the driving head 30 is adapted to be seated. In the upper portion of the driving head 30 a circular plate 31 is secured to form a cylindrical chamber 32, within which an anvil 33 is adapted to be received. The anvil 33 may be provided with a plurality of recesses 34 in which the legs 35 of the usual driving hammer 36 are adapted to be positioned.

In the lower portion of the driving head 30 a circular plate 37 is secured within which the apertures 38 and 39 are formed. Fitted within the aperture 38 is a short section of pipe 40 into which the upper extremity of the air supply pipe 22 is adapted to be slidably received. In order to provide an air-tight joint suitable packing 41 is provided, which is held in place by means of glands 42 and 43, secured at the upper extremity of the pipe 22.

Fitted within the aperture 39 in plate 37 is a short section of pipe 44 of relatively large diameter, which is adapted to be slidably received within the discharge pipe 19. An air-tight joint is provided by means of the packing 45, which is held securely in place by the glands 46 and 47, secured at the lower extremity of the pipe section 44. It will be noted from the above that the distance between the driving head and the blowing head 11 may be varied over a slight range without breaking the connections to the air supply and the discharge pipe located at the upper portion of the form 25.

A vertical member 48 is secured between the plate 31 and the plate 37 which forms an airtight enclosure into which air may be introduced from an air inlet 49 fitted in the wall of the driving head 30, by means of which air may be directed to the air supply pipe 22. A curved member 50 is secured to the vertical member 48 for directing the excavated earth from the discharge pipe 44 to an aperture 51 formed within the driving head 30. It will be evident that the curved member 50 together with the aperture 51 enables the excavated material to be discharged from the form in any desired direction.

In order that the blowing head 11 may be readily lowered into and withdrawn from the form, it is necessary that its outer diameter be less than the inner diameter of the coupling member 24. When the blowing head 11 is so constructed, however, a space exists between it and the form section 10 through which air escapes. Accordingly means is provided for blocking off this air space during the blowing operations, as described below, in order that the air pressure within the form may be maintained as high as possible.

As shown in Fig. 1, a circular groove 52 is formed at the upper portion of the blowing head 11, within which are provided a plurality of sectors 53 made of resilient material such as, for example, rubber. Three such sectors 53 are shown in Fig. 4, although any number might be used. Each of the sectors 53 is provided with a centrally disposed guide hole 54 within which a guide pin 55 is adapted to be received. The guide pins 55 may be secured to the outer pipe 17, as shown in Fig. 4, and where three sectors 53 are used their centers are preferably placed approximately 120° apart.

Above each of the pins 55 in the pipe 17 is a check valve 56 (Fig. 1) which is normally closed, but which is adapted to be opened whenever air under pressure is present in the passage between the discharge pipe 16 and the outer pipe 17. It will be evident that as soon as air under pressure is supplied to the device through the inlet 49, the check valves 56 will be opened and a blast of air under pressure will be directed against each of the sectors 53, causing them to move out radially until they are in engagement with the inner wall of the form 10. It will be noted, however, that as the sectors 53 move outwardly, they tend to separate from each other so that a space exists between each of them, the centers of the spaces being approximately 120° apart, as shown in Fig. 4.

In order to prevent the escape of air through these spaces, auxiliary sectors 57 (Fig. 4), also of resilient material, are provided. Each of these sectors 57 (Fig. 1) comprises a lower portion 58 of relatively small thickness, and an upper portion 59, whose width is such that it will lie flush with the two adjacent sectors 53 when its lower portion 58 is in contact with the rear sides of the adjacent sectors 53.

Each of the sectors 57 is also provided with an aperture 60 (Fig. 1) within which a guide pin 61 is adapted to be received, the guide pins again being secured to the outer pipe 17 and disposed approximately 120° apart. In order that the auxiliary sectors 57 may move out radially on their guide pins simultaneously with the sectors 53, additional check valves 62 are provided in the pipe 17, which are normally closed, but which are adapted to be opened whenever air under pressure is introduced into the apparatus. It will be evident that as soon as air is supplied to the apparatus, the sectors 53 and auxiliary sectors 57 will simultaneously move outwardly and radially on their guide pins 55 and 61, respectively, thus preventing the escape of air between the blowing head 11 and the form 10.

As shown in Fig. 3, the upper portions of the sectors 53 are held in place by means of suitable flange sectors 63 which may be bolted or otherwise secured to the outer pipe 17. The auxiliary sectors 57 are likewise held in place by similar flange sectors 64 also secured to the outer pipe 17, so that the assembly is substantially airtight.

In operation the form 10 may be driven into the earth for a short distance so that the blowing head 11 rests upon the earth's surface substantially as shown in Fig. 1. Air under pressure is then supplied to the inlet 49 and is directed from the nozzles 14 against the earth adjacent the lower periphery of the form 10. The

air acts to break up the earth, which is then carried along with the air up through the discharge opening 12, pipe 16, pipe 18, pipe 19, pipe 44 and out through aperture 51. It will be noted that the blowing head removes the earth within the boundary of the periphery of the form 10 so that the only frictional force retarding the movement of the form 10 is that due to the earth adjacent its outside surface. Accordingly, the power required to drive the form in accordance with the present invention is substantially less than that required previously.

Moreover, the driving head 30 may be driven during the blowing operation, thus enabling both the blowing and driving operations to be performed simultaneously. In certain cases as, for example, where the soil is relatively soft, the weight of the head casting 30 and the anvil 33 will be sufficient to sink the form 10 without the application of any external force.

The sinking operation may be further expedited by permitting the blowing head 11 to lead the form 10 by a slight distance, as shown in Fig. 5. When this is done the ground is excavated to a substantial distance beneath the form 10, and only a relatively slight force is required to sink the form 10 to the required depth.

Before removing the blowing head 11 from the form 10 after the driving operation has been completed, it is necessary that the sectors 53 and 57 be moved back into their normal positions in order to enable the device to be moved past the coupling member 24. For this purpose a plurality of vertical grooves 65 are formed in the surface of the sectors 53. These grooves 65 communicate with the space between the blowing device and the form at one end, but since they do not extend for the entire width of the sectors 53, air cannot escape from the blowing nozzles 14 between the blowing head 11 and the form section 10. Similar grooves 66 are formed in the surface of the sectors 57 which, likewise, are blocked off at their lower end but which communicate at their upper ends with the space between the blowing device and the form.

When it is desired to move the sectors 53 and 57 to the normal disengaged position, air under pressure is introduced by means of the inlet 68 into the space between the form and the blowing device above the sectors 53 and 57. This air passes down through the grooves 65 and 66 and exerts sufficient pressure to push the sectors 53 and 57 radially on their guide pins away from the inner wall of the form. Inasmuch as the check valves 56 and 62 close when the blowing operations are discontinued, a plurality of small vents 67 are provided in the blowing head 11 through which air trapped behind the sectors 53 and 57 may escape as the sectors 53 and 57 are moved away from the inner wall of the form.

A plurality of blowing heads of different sizes may be provided for sinking pipes of various diameters up to the largest size desired. In all of the blowing heads, however, the diameter of the discharge pipe 16 will be maintained substantially the same, and this diameter will be such that the pressure required for discharging excavated earth may be readily maintained without using excessive quantities of air.

It will be evident from the foregoing that forms relatively large in diameter may be sunk rapidly, effectively and economically in accordance with the present invention, and, since the blowing and driving operations may be performed simultaneously, considerable saving in time is effected. Moreover, the curved member 50 and the aperture 51 enable the direction of discharge of the excavated earth to be controlled, thus preventing possible damage to the clothing of passersby from contact with the material being discharged. This combination also eliminates the delays sometimes caused by the necessity for stopping the blowing operation in order to let pedestrians pass without fear of having their clothing soiled.

While a preferred embodiment of the invention has been described in detail above, the invention is not intended to be in any way limited thereby, but is susceptible of numerous changes of form and detail within the scope of the appended claims.

I claim:

1. In apparatus for sinking forms, the combination of a tubular member adapted to be lowered into a form, said tubular member having a passage therein for directing air against earth at the bottom of the form, and having a centrally disposed discharge opening therein, a cover member on the form having an air inlet and a discharge outlet therein, a substantially airtight, telescoping conduit connected between said air passage and the air inlet, a second substantially airtight, telescoping conduit between said discharge opening and the discharge outlet, said conduits permitting relative movement of said tubular member with respect to the cover member during the sinking of the form, an anvil on the cover member, and means for striking the anvil, whereby earth within the form may be removed simultaneously with the driving thereof.

2. In apparatus for sinking forms, the combination of a tubular member adapted to be lowered into a form, said member having a plurality of nozzles therein concentrically disposed about a centrally located discharge opening, means forming a passage in the tubular member for directing air to said nozzles, a conduit within the form for directing air under pressure to said passage in the tubular member, a second conduit within the form for directing excavated earth from the discharge opening, a plurality of resilient cylindrical sectors disposed about said air directing conduit and a plurality of check valves in said last-named conduit adapted to direct air under pressure therefrom against said sectors to move them into engagement with the form, whereby the escape of air between said tubular member and the form may be prevented.

3. In apparatus for sinking forms, the combination of a tubular member adapted to be lowered into a form, said member having a plurality of nozzles therein concentrically disposed about a centrally located discharge opening, means forming a passage in the tubular member for directing air to said nozzles, a conduit within the form for directing air under pressure to said passage in the tubular member, a second conduit within the form for directing excavated earth from the discharge opening, a plurality of movable resilient cylindrical sectors disposed about said air directing conduit, each of said sectors having an aperture therein, a plurality of spaced guide pins on said last-named conduit, adapted to be received within said apertures, means on said air directing conduit for limiting the extent of movement of said sectors and forming therewith a substantially airtight assembly and a plurality of air check valves in said last-named conduit for directing air against said sectors to move them outwardly on the guide pins into engage-

ment with the form whereby the escape of air between the tubular member and the form may be prevented.

4. In apparatus for sinking forms, the combination of a tubular member adapted to be lowered into a form, said member having a plurality of nozzles therein concentrically disposed about a centrally located discharge opening, means forming a passage in the tubular member for directing air to said nozzles, a conduit within the form for directing air under pressure to said passage in the tubular member, a second conduit within the form for directing excavated earth from the discharge opening, a plurality of movable resilient cylindrical sectors disposed about said air directing conduit, means on said air directing conduit for limiting the extent of movement of said sectors and forming therewith a substantially airtight assembly, a plurality of check valves in said last named conduit for directing air therefrom against said sectors to move them into engagement with the form, said sectors having a plurality of longitudinal recesses formed in the surfaces thereof, communicating at their upper extremities with the space between the form and the tubular member, and being less in length than the length of said sectors, an air inlet for introducing air under pressure into the form above the tubular member to move the sectors away from the form, and a plurality of air vents for venting air trapped behind said sectors, whereby the sectors may be moved out of engagement with the form to facilitate the removal of the tubular member therefrom.

5. In apparatus for sinking forms, the combination of a tubular member adapted to be lowered into a form, said tubular member being of lesser diameter than the diameter of the form, and having a plurality of nozzles therein concentrically disposed about a centrally located discharge opening, means forming a passage in the tubular member for directing air to said nozzles, a cover member on the form, having an air inlet and a discharge outlet therein, means on the cover member for driving the form into earth, an extensible conduit connected between said discharge opening in the tubular member and the discharge outlet, a second extensible conduit connected between the passage in the tubular member and the air inlet, the lower portion of said second conduit being concentric with and of greater diameter than said first conduit, a plurality of resilient sectors disposed about the lower portion of said second conduit, each having an aperture therein, a plurality of guide pins on the lower portion of said second conduit, adapted to be received within said apertures, means on the lower portion of said conduit for limiting the extent of movement of said sectors and forming therewith a substantially airtight assembly and a plurality of air check valves in the lower portion of said second conduit for directing air therefrom against said sectors for moving them outwardly into engagement with the form, whereby the escape of air between the tubular member and the form may be prevented.

6. In apparatus for sinking forms which includes a hollow member adapted to be lowered into a form, said hollow member having passages therein for directing air againt earth at the bottom of the form, and having a centrally disposed discharge opening therein, the combination of a bearing member on the form, a driving head mounted on the bearing member, said driving head having an air inlet and a discharge outlet associated therewith, a substantially airtight, telescoping conduit connected to said air inlet and communicating with the passages in the hollow member, and a second substantially airtight, telescoping conduit connected between said discharge outlet and discharge opening, whereby the hollow member may move relatively to the driving head during the sinking of the form.

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