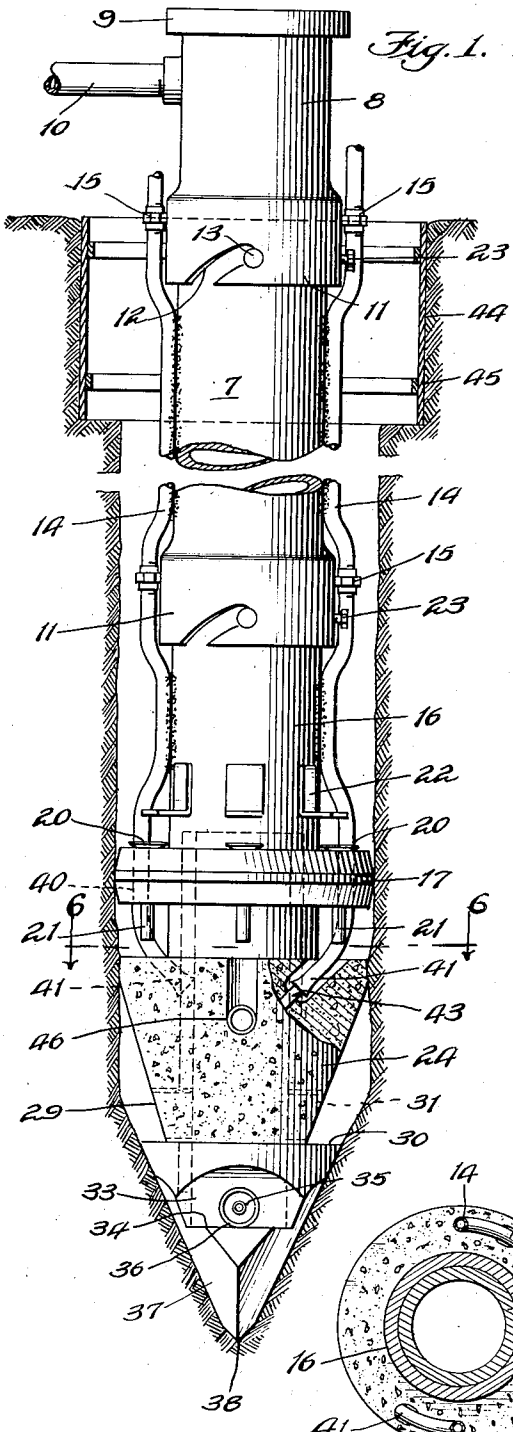
June 13, 1939. W. J. NEWMAN 2,162,108

METHOD FOR FORMING CONCRETE FOUNDATION COLUMNS

Filed June 9, 1937 2 Sheets-Sheet 1



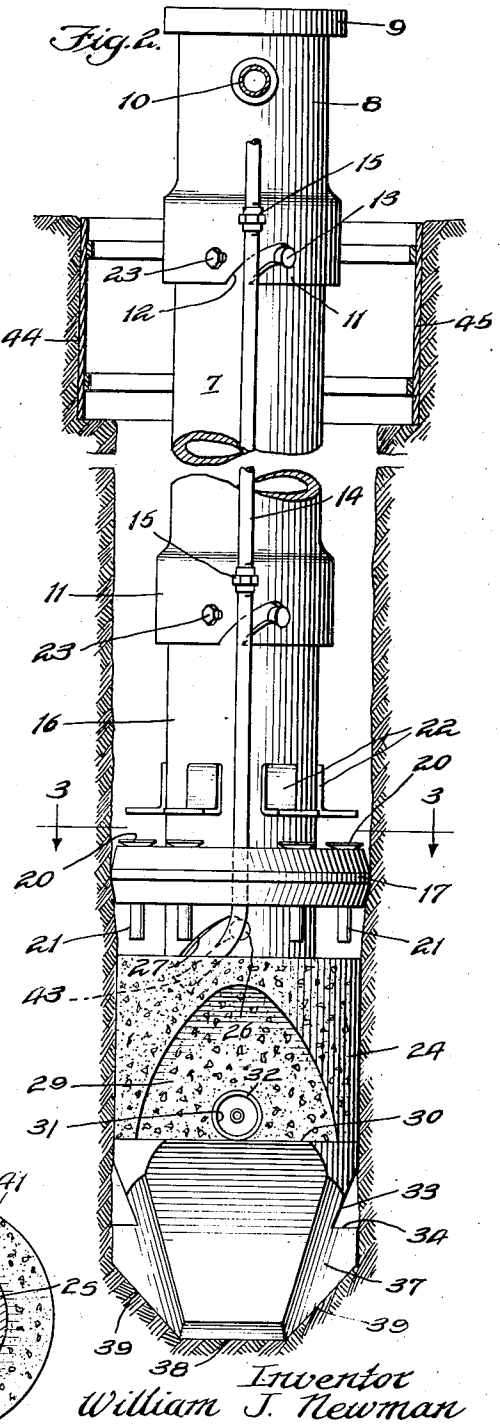


Fig. 6.

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Filed June 9, 1937 2 Sheets-Sheet 2

Fig. 3.

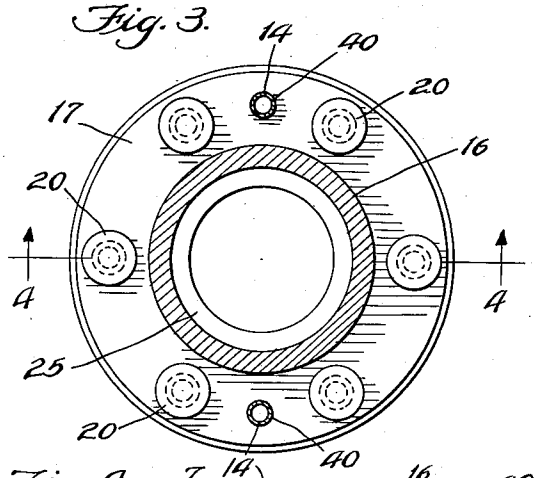


Fig. 4.

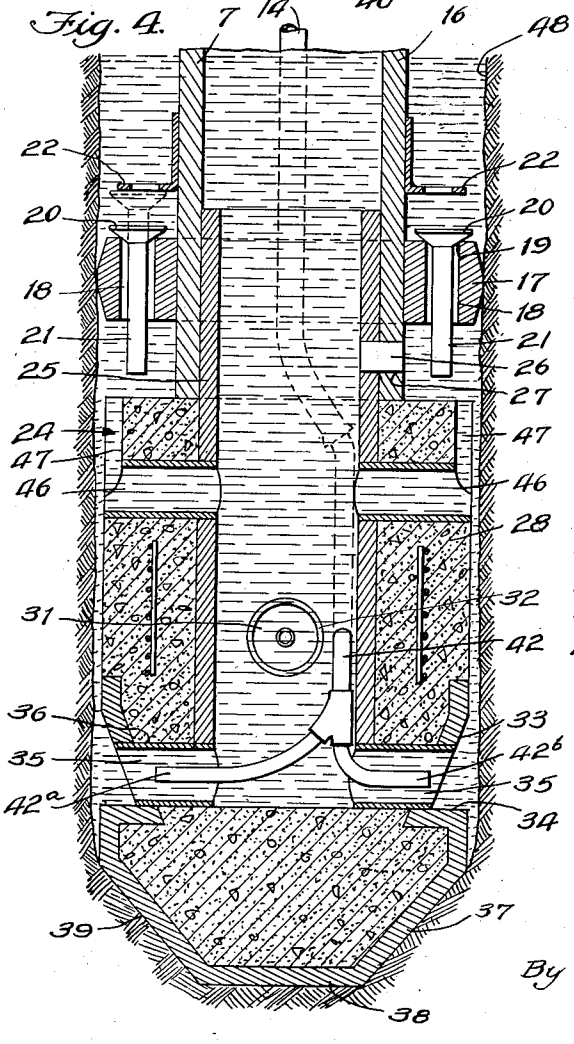
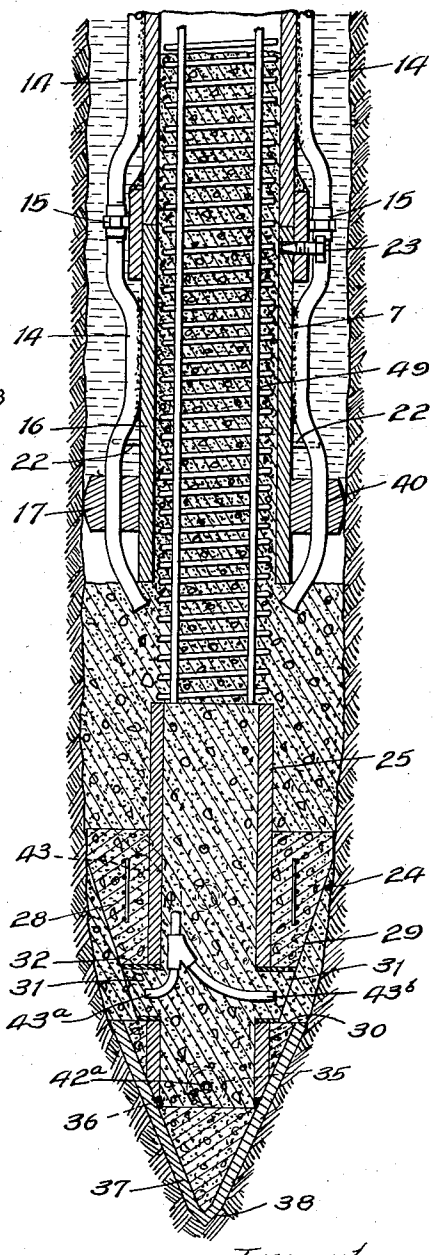


Fig. 5.



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2,162,108

METHOD FOR FORMING CONCRETE FOUNDATION COLUMNS

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Application June 9, 1937, Serial No. 147,176

5 Claims. (Cl. 61—57)

I have discovered that by utilizing air under relatively high pressure and water, foundation columns may be formed in earth by driving methods as distinguished from boring or other excavating methods. The diameter of the columns made in accordance with the present method may be limited but the forming of columns up to thirty-six inches in diameter is contemplated under favorable conditions. In accordance with the present invention, a hole or well is formed by driving methods similar to pile driving and after the hole has been made to the desired depth, as for instance to rock or other solid foundation, it is filled with concrete which may be reinforced.

The objects of the present invention are to provide a improved method of forming columns for foundations or the like whereby they may be constructed at a relatively low cost and will be particularly strong and serviceable in use; to provide an improved method of forming a hole for a foundation by utilizing water and air in the formation thereof and to also utilize the air in the placement of the concrete; to provide an improved method of making foundation columns of considerable depth by driving methods whereby the adjacent earth will not be objectionably affected; to provide improved means for use in forming foundation columns; to provide an improved driving head; and to provide such other advantages in operation and improvements in construction as will appear from the following description.

In the accompanying drawings illustrating this invention,

Figure 1 is a side view showing my hole forming apparatus in operative position;

Figure 2 is a similar view taken at right angles to Figure 1;

Figure 3 is a sectional view taken on the line 3—3 of Figure 2;

Figure 4 is an enlarged sectional detail of the driving head and adjacent parts;

Figure 5 is a sectional view illustrating the placing of the concrete in the completed hole or well; and

Figure 6 is a sectional view taken on the line 6—6 of Figure 1.

In accordance with this invention I use a sectional driving pipe whereby sections may be coupled on as the driving progresses. One of these sections is shown at 7 coupled to a driving cap 8 having a heavy top 9 which is to be engaged by the hammer of a pile driver or the like. The cap 8 has an inlet pipe 10 for supplying water. The lower end of the cap has a coupling portion 11 with angularly arranged slots 12 for engagement with pins 13 on the upper end of the pipe 7 to form a bayonet joint or connection whereby these parts may be quickly coupled and uncoupled as for adding additional sections. The coupling is locked by means of a screw 23 having a tapered point for engagement with a hole in the end of the pipe as shown particularly in Figure 5. All of the pipe sections are also provided with similar couplings as will be readily seen from the drawings. By means of these couplings the ends of the pipe are brought into abutting relation and the coupling bands or rings 11 which are preferably welded to the upper sections coact to make substantially water-tight joints. One or more air pipes 14 are carried down along the outer side of the driving pipe 7 for supplying air for the various operations as will be described. These air pipes are also preferably made in sections corresponding with the sections of the driving pipe and are secured to the driving pipe as by welding or the like so that the air pipes may be coupled up by couplings 15 as the driving pipe sections are added. The lowermost pipe member 16, which is to be connected with the driving head, is provided with a guide ring or annular shoe 17 which is rigidly secured thereto adjacent to the lower end, which guide or shoe also serves as a closure or packing ring between the pipe and the adjacent walls of the hole. This ring is provided with valve controlled passages for permitting fluid to pass upwardly therethrough and to prevent the same from passing downwardly. In the particular arrangement shown the ring has a plurality of holes 18 with valve seats 19 at their upper ends which coact with valves 20 having stems 21 that extend down through the holes and serve to hold the valves in operative position. Stops 22 are fastened to the sides of the pipe and serve to limit the upward movement of the valves.

The lower pipe member 16 is coupled directly to the driving head designated generally by the numeral 24. This driving head may be made of any suitable material but as it will ordinarily be left at the bottom of the hole I prefer to make it as shown, principally of reinforced concrete in order to reduce the cost of the same which is particularly desirable when the heads are of large diameter. The driving head has a center pipe 25 which fits closely within the end of the pipe 16 as shown in Figures 3 and 4, and has pins or

projections 26 for engagement with angular slots 27 in the lower end of the pipe 16 to provide a bayonet joint connection between these parts and one which will permit uncoupling when desired. The driving head has a body portion 28 formed mainly of concrete, this portion being generally of round or cylindrical shape at the top and wedge-shaped at the bottom. The flat sides of the wedge are undercut as shown at 29 to provide protecting ledges 30 for outlet holes or openings 31 which lead from the central opening of the pipe 25 to the outer surface of the head. These openings may conveniently be made by means of short pipe sections 32 which extend outwardly from the pipe 25 as shown in Figure 5. The straight or edge surfaces of the head are also undercut or recessed as shown at 33 to provide protecting ledges 34 for holes or passages 35 which lead out from the pipe 25 at substantially right angles to the holes 21. These holes may also be conveniently formed by short pipe sections 36 as shown in Figure 4. The lower wedge-shaped end of the driving head is provided with a cutting shoe 37 preferably made of cast steel and having suitable projections or the like for interlocking the same with the concrete body portion which is preferably cast or molded into the shoe. The shoe also is provided with lugs or projections 36a which are engaged by the lower end of the pipe 25 so that force applied to the pipe will be carried directly to such cutting shoe. This shoe has a straight cutting edge 38 forming the main portion of the wedge or chisel and such cutting edge is also preferably tapered up to the sides as shown at 39.

The air tubes 14 pass down through holes 40 in the guide ring 17 and fit closely therein. The lower ends of these tubes are bent axially and circumferentially to provide somewhat spiral terminals 41 that extend a short distance below the end of the pipe 16. These projecting lower ends are adapted to fit over or engage with the upper ends of coacting pipes or tubes 42 and 43 positioned in the driving head 24. The upper ends of the tubes 42 and 43 are also bent axially and circumferentially so that their upper ends are in position to enter the enlarged or bell-shaped ends of the tubes 14 when the head is in engaging and driving position on the end of the pipe 16. In other words, the rotary movement necessary to make the coupling with the bayonet joint between the pipe 16 and 25 causes the inter-engagement or coupling of the air tubes. Likewise when the parts are turned to uncouple the main pipes the air tubes will be uncoupled by the same movement. The tube 42 has two branches 42a and 42b that extend down and out into the holes 35 as shown in Figure 4, to direct the air radially out through said holes. The tube 43 also has lower branches 43a and 43b that extend into the holes or openings 31 in order to direct air outwardly through these openings in the sides of the wedge.

When a foundation column is to be made a hole 44, which is somewhat larger than the hole to be formed, is dug in the surface of the ground and provided with lagging 45. This hole may be approximately five feet in depth and is filled with water before the driving operation begins. The driving head with the necessary lengths of pipe and connections are then centered in the hole preparatory for the driving operation. These parts may be supported in any usual manner and the pipe is driven by means of a pile driver or the like (not shown). As the driving progresses water is forced in through the pipe 10 under substantial pressure and passes down through the pipe or string of pipes 7 and terminal pipe 16 into the driving head 24. It passes out from the driving head through the holes 31 and 35 under the tapered or cut away portions of the head. The ledges immediately below such holes serve to prevent the dirt from entering or backing into the hole as the driving proceeds. The water thus passing out around the head tends to loosen the soil and also to lubricate the periphery of the cutting head and expedite the driving operation. It will of course be apparent that as the head is driven in the ground the upper cylindrical portion will ordinarily fit tightly in the hole so that all the water may not pass up around the side of the head. Any excess water pumped into the head will pass out through holes 46 which extend out through the sides of the head as shown in Figures 1 and 4 and connect with upwardly extending grooves or channels 47 that provide passageways up to the space between the head and the guide ring 17. The outer periphery of the guide ring is preferably tapered longitudinally in both directions or curved as shown in Figure 4 so that the largest diameter is at the center and this portion is of slightly greater diameter than the driving head so that the ring makes a substantially tight closure between the pipe 16 and the side walls 48 of the hole formed by the head. The excess water will then pass up through the check valves 20 into the space between the pipe 16 and the walls 48, which space is kept full of water during the entire operation and the pressure of the water supports the walls and tends to prevent caving in. It will also be noted that the pressure of the ring against the sides will tend to smooth and compact the sides of the well or hole as the driving proceeds. In the meantime air is preferably supplied during the entire driving operation, the air being furnished from any suitable source to provide the necessary pressures which will ordinarily be approximately one hundred pounds per square inch or more if the work is at considerable depth. The air forced out through the holes 31 and 35 tends to churn the water and to agitate the same to accentuate the cutting and loosening operation and to facilitate the movement of the driving head. Any excess air may also pass up and out through the valves 20 and escape to the atmosphere. If desired, water or other fluid may be supplied through the pipes 14 in the place of air.

If a rock or boulder is encountered the wedge-shaped bit or shoe will tend to split the same and will act more effectively than would a conical point. If such rock is not readily split by the first actions, the drill pipe and head may be raised a short distance and then turned approximately ninety degrees so that the cutting edge 38 will then tend to cut the rock at right angles to the original cut and ordinarily this will be effective in producing the desired operation. It will be noted that during the turning movement the pipe should be turned in the same way that it is turned to couple the bayonet joint in order to prevent disconnecting the head. In view of the peculiar wedge shape of the head except at its uppermost portion there would be relatively little friction on the sides thereof during the operation and this friction is minimized by the action of the air and water.

When the cutter head reaches solid rock or other bottom or is driven to the desired depth,

the water is pumped out of the pipe 16 and the head, this pumping preferably being done rapidly. The valves 20 will hold the water in the space above the ring 17 so that the sides of the hole will be supported even after the water is pumped out from the center.

As soon as the water is pumped out reinforcement such as shown at 49 is placed in position in the pipe and may rest on the head as shown in Figure 5. Grout is then poured down through the pipe 16 into the openings in the head sufficient in quantity to fill the head and such openings and during this operation the air of approximately seventy-five to one hundred pounds is driven down through the tubes and tends to agitate the grout and force it into the various holes and nicks or cranies around the head. As soon as the head is filled with grout the pipe 16 is turned to uncouple the bayonet joint or detachable connection between the same and the driving head. The pipe is then filled with concrete such as intended to complete the column and gradually raised so that it acts as a tremie for filling the hole. During this filling operation the air is continued to be supplied and will be discharged below the end of the pipe as shown in Figure 5 so that it tends to rotate and agitate the concrete as it is being deposited in place and will force the same against the side walls of the hole. The tangential arrangement of the outlets of the air tubes is such that it facilitates such rotating action of the concrete and blowing of the same against the side walls. As the string of pipes 7 is raised the uppermost sections will be removed and the ring 17 will gradually force the water surrounding the pipe up and out of the top of the hole where it may flow off or be otherwise removed. Such filling action is continued until the hole is filled to the proper heighth and the reinforcement will of course be properly embedded in the same.

When a column is made in this manner it will be seen that the cutting head, which necessarily has been forced tightly into its final position, will provide a substantial base for supporting the column which will also be further supported by the frictional engagement of the concrete with the side walls and the filling of any enlargements or weakened places in the walls by the forcing of the concrete therein by the action of the air as above described.

From this description it will be seen that I provide means for forming concrete columns in a novel manner as well as an improved method of constructing the same but I do not wish to be limited to the exact steps or details of construction herein shown and described except as specified in the following claims, in which I claim:

1. The method of forming a concrete foundation column which comprises driving a pipe having a detachable driving head and having a closure ring of larger diameter than the head for closing the space between the lower end of the pipe and the adjacent walls of the hole formed in the ground, into the ground and simultaneously forcing air and water through said head to the outer surface thereof for loosening the earth, then pumping out the contents of the pipe and head after the head has reached the desired depth, then forcing grout into the head to fill the same, then disconnecting the pipe from the head and filling it with concrete to be deposited in the hole and gradually raising the pipe and using it as a tremie for depositing the concrete, said concrete being acted upon by air under pressure as it is being deposited, and water being maintained in the space between the pipe and the sides of the hole as the filling progresses.

2. The herein described method which includes driving a pipe having a detachable driving head into the ground to form a hole, said head having longitudinal and lateral passageways communicating with the pipe and said pipe having a closure ring positioned adjacent to the lower end thereof for closing the space between the pipe and the sides of the hole, forcing water through said pipe and passageways to the outer surface of the head and to keep the hole filled therewith, also supplying fluid under pressure to the outlets from the head and continuing such operation until the head has reached a desired depth, then pumping the contents out of the pipe and head while maintaining water in the hole outside of the pipe, then filling the head with grout or the like, then uncoupling the pipe from the head and using the pipe as a tremie for depositing concrete in the hole, and simultaneously supplying air to the concrete at the point of discharge for the purposes described.

3. The method of foundation building which includes providing an extensible cylindrical driving member having a driving cap and having means for supplying the same with water, and also providing an auxiliary extensible air conduit along the cylindrical member, and providing a detachable head with passageways adapted to be connected with the cylindrical member and said air conduit, driving said head into the ground to form a hole while supplying air and water thereto, then pumping the water out from the cylindrical member and head while maintaining water in the hole outside of the cylindrical member, placing reinforcements in the cylindrical member, and finally filling the hole with concrete by using the cylindrical member as a tremie and forcing the concrete against the sides of the wall by compressed air, substantially as described.

4. The method of constructing underground foundation columns which consists in driving a pipe, having a detachable perforated driving head at its lower end and a closure at its upper end, into the ground, and simultaneously forcing water under pressure into the pipe and through said perforations and also forcing air under pressure through conduits outside of the pipe leading to said perforations, then detaching the air and water supply, then pumping the water out of the pipe and driving head, then supplying concrete to said pipe and gradually withdrawing the pipe while simultaneously forcing jets of air against the concrete as it is discharged from the pipe whereby the concrete will be forced into intimate contact with the walls of the hole and into any irregularities along the periphery of the hole as described.

5. The herein described method of column forming which comprises excavating a shallow well in the ground and lagging the same, then filling the well with water, then driving a pipe having a perforated driving head downwardly through the well to form a hole, forcing water through the pipe and head during the driving operation, then pumping out the water from the pipe and disconnecting it from the head and using the pipe as a tremie for filling the hole with concrete, water being maintained between the pipe and walls of the hole during such filling operation.

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