O. MERRILL.

CAISSON CONSTRUCTION.

APPLICATION FILED MAR. 17, 1909.

956,126.

Patented Apr. 26, 1910.

2 SHEETS—SHEET 1.

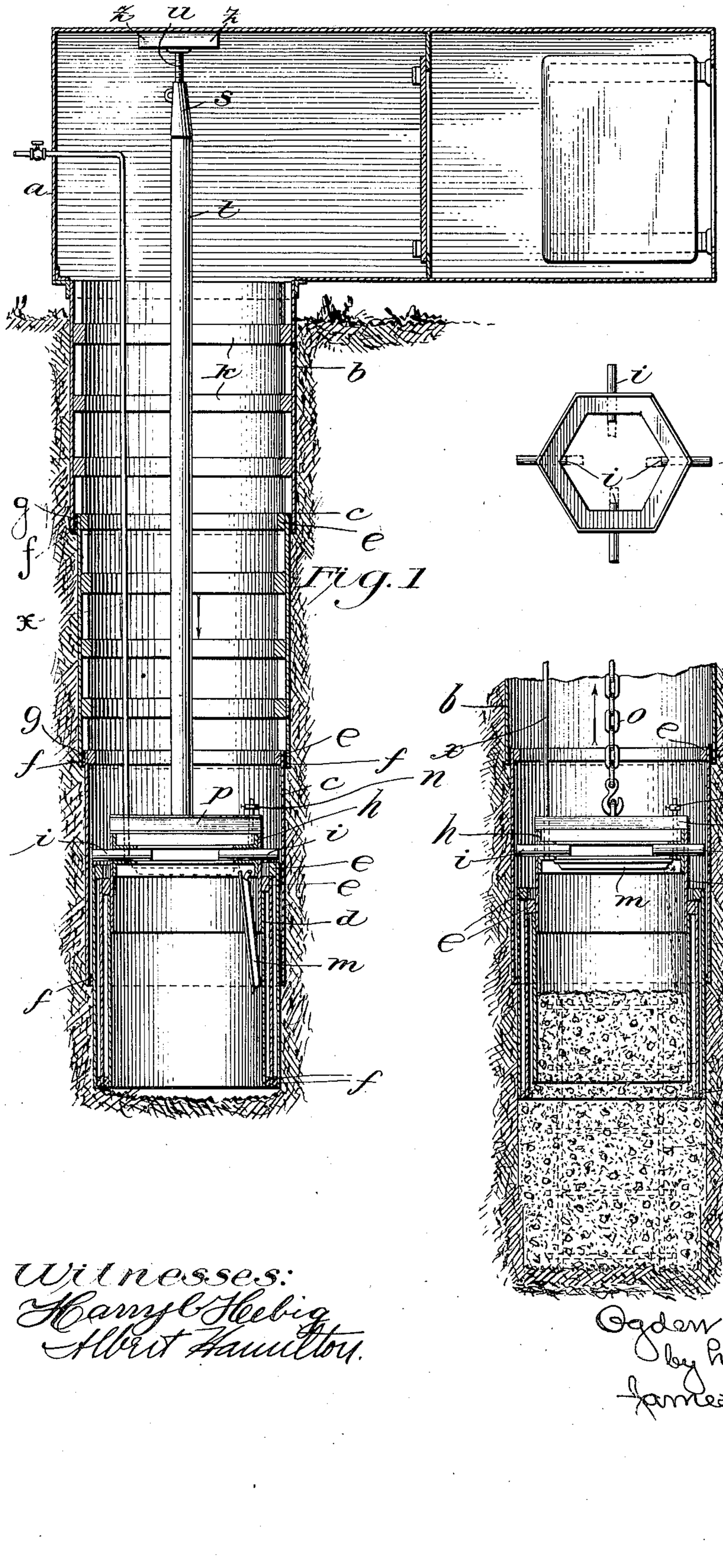

Fig. 1

Fig. 6.

Fig. 2.

Witnesses:
Harry C. Hebig
Albert Hamilton.

Inventor:
Ogden Merrill
by his attorney
James Hamilton

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2 SHEETS—SHEET 2.

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Fig. 3.

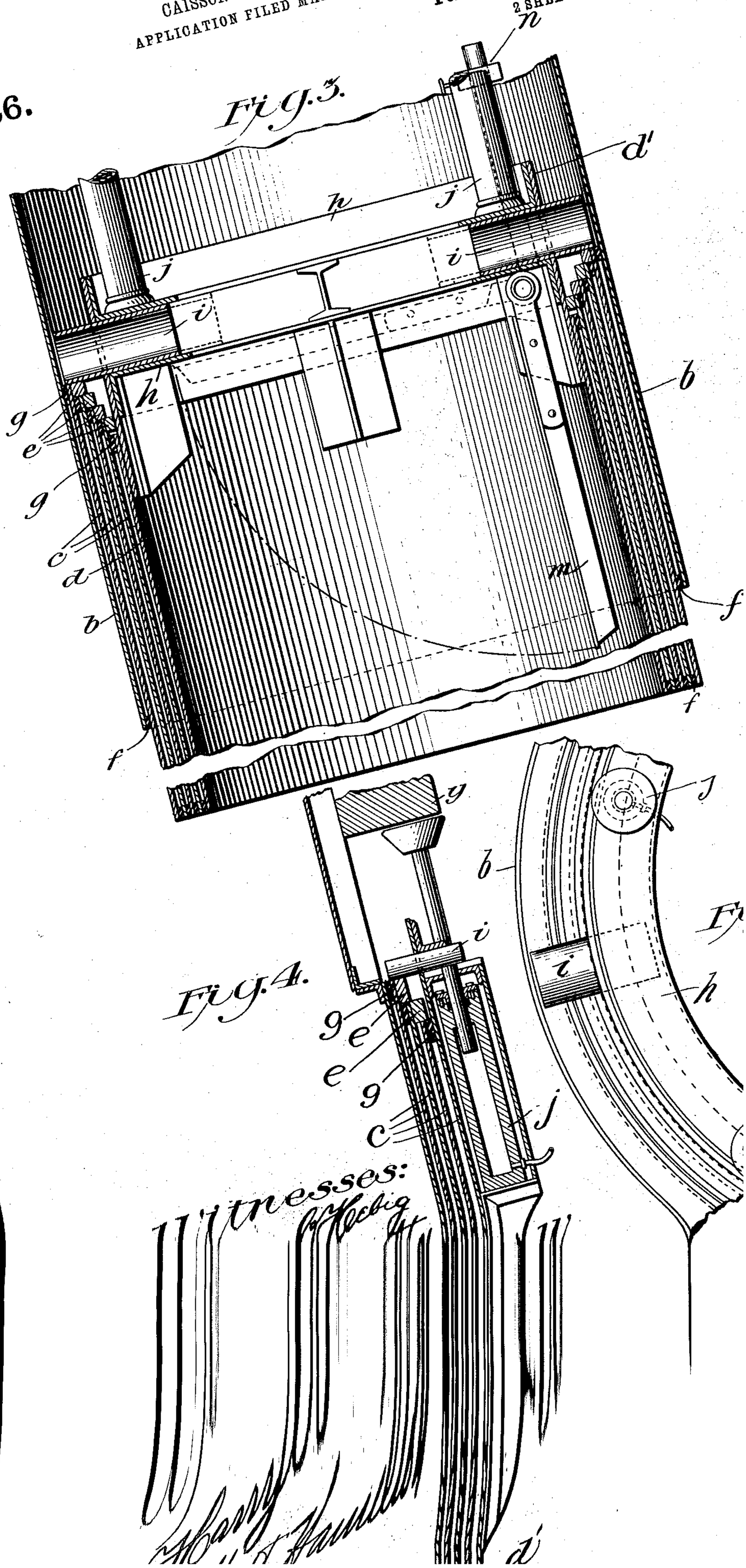

Fig. 4.

Witnesses:

C. Kecbig

H. A. Hamilton

Inventor:

UNITED STATES PATENT OFFICE.

OGDEN MERRILL, OF NEW YORK, N. Y.

CAISSON CONSTRUCTION.

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To all whom it may concern:

Be it known that I, OGDEN MERRILL, a citizen of the United States, residing in the borough of Brooklyn, city of New York, county of Kings, and State of New York, have invented certain new and useful Improvements in Caisson Construction, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to improvements in the construction of concrete structures, such as piers, caissons, foundations and the like; and an object of my invention is to provide means for and a method of such construction which will result in great saving in the expenditure of time and money.

Heretofore the lining of the shaft in constructions of the character referred to has been left in the shaft; and, consequently, such linings may be said to have been lost or to have perished in their first use. Further, the forcing of such linings into position has required the expenditure of a great deal of energy and the work has generally been slow and wasteful of time.

In carrying out my invention, I provide a nest of tubular shaft liners of different diameters; and then force these shaft liners successively from within one another and into position to line the shaft, as the work of excavation proceeds. The force required to move the nest of shaft liners is practically only that required to overcome the skin friction between the outermost shaft liner or shell in the surrounding soil. After the shaft liners have been positioned, foundation material, such as concrete, sand or the like, is introduced into the shaft and the shaft-liners are forced upwardly, telescoping within each other. Thus, the entire nest of shaft liners is recovered for use upon another piece of work, and the same shaft-liners may be used over and over again, whereby the great cost of the shaft-lining is saved, and, as above pointed out, the energy required to position the shaft-lining is only that necessary to force a single shaft-lining member downwardly against the friction of the surrounding earth, whereby a great saving in time and energy is accomplished.

In the carrying out of my new process and in the use of my new apparatus in the placing of underpinning, it is unnecessary to use as an abutment the building under which the structure is placed. Thus, the outermost shell may be sunk (by digging, placing the shell and then tamping the earth filled in around the latter, for example) a distance sufficient to insure that the friction of the earth will hold the shell in place against the upward thrust of the jacks in placing the inner liners or shells. And if found desirable or necessary, the resistance offered to this upward thrust of the jacks may be increased by loading the outermost shell (or the air-lock) with heavy weights.

It will be readily understood by all skilled in this art that my new process and apparatus are well adapted to the building of open foundations and to the placing of underpinning below buildings already erected.

In the drawings illustrating the principle of my invention and the best mode now known to me of applying that principle, Figure 1 is a vertical section of a caisson shaft in process of being sunk in accordance with my invention; Fig. 2 is a detail in vertical section illustrating the removal of the shaft liners and the filling of the shaft with foundation material, such as concrete; Fig. 3 is a central vertical section through a nest of telescoped lining shells or shaft liners and the inclosed working-chamber; Fig. 4 is a detail in section showing the arrangement of a hydraulic jack and the shell of the working-chamber; Fig. 5 is a detail showing in plan the distribution of the jacks on the jack-frame; and Fig. 6 is a detail in plan of the jack-frame and the push-arms carried by it.

The air-lock *a* is provided with a downwardly-extending shaft-lining extension-shell *b* within which are slidably mounted a nest of telescoped tubular lining-shells or shaft-liners *c*. Surrounded by the latter is the shell *d* of the working-chamber. Each of the lining-shells *c* is provided at its top edge or rim with an inwardly-extending ring flange *e*; and each of the flanges *e* overhangs or overlaps the flange of the lining-shell or shaft-liners *c*. Surrounded by the latter is the that is, the top edge or rim of the outermost shaft-liner of the nest lies above the others and its flange *e* overhangs the rim of the shaft-liner next within the nest, and the same relation exists between the flange *e* of each shaft-liner and the rim of the shell which lies within and adjacent to it. Hence, these flanges *e* are somewhat step-like in their arrangement, rising from within outwardly. The shaft-lining shell *b* of the air-lock *a* and the shaft-liners *c* are preferably

formed each at its lower edge with an inwardly-extending abutment-ring or ledge *f* which serves to limit the downward travel of the shaft-liner or shell next within and adjacent to it in the following manner: Each shaft-liner *c* and the shell *d* of the working-chamber are formed at the top with an outwardly-extending flange *g;* and as the lining-shell approaches the limit of its downward travel, the flange *g* approaches the ledge *f* of the lining-shell just outside, until finally the flange engages the ledge and gives warning to the operator that the lining-shell or shaft-liner is fully driven; but the use of the ledge *f* and flange *g* may be dispensed with, in which case the operator will rely upon his own judgment to determine when the shaft liner is fully driven and it is time to start to force the next inner shaft-liner downwardly into place.

Any suitable means may be employed for pushing the lining-members *c* and the working-chamber shell *d* into place as the work of excavation advances; but the following mechanism is shown in the drawings: The shell *d* of the working-chamber is provided at its top with a jack-frame *h* which carries the slidable push-arms *i*. The latter extend outwardly over the tops of the shaft-liners *c* and may be adjusted to engage the top or rim of each of the nest of telescoped shaft-liners *c* in succession. Upon the jack-frame *h* press the lower ends of a number of jacks *j* spaced around the jack-frame *h* at suitable intervals (Figs. 3 and 5). When the jacks *j* are operated, the jack-frame *h* is forced downwardly and carries with it the shell *d* of the working-chamber and the push-arms *i*. The latter engage the rim of the outermost shaft-liner *c* and pushes the same downwardly; and since the flanges *e* of the shaft-liners *c* overlap or overhang one another, the downward movement of the outermost shaft-liner of the nest is transmitted to the other shaft-liners. As soon as the outermost shaft-liner has been positioned, the push-arms *i* are drawn inwardly, until their outer ends overhang the rim or top of the second shaft-liner (numbering or counting from the outside of the nest inwardly). The jacks *j* are again operated and the remaining shaft-liners and the shell *d* of the working-chamber are moved downwardly, following the work of excavation. When the second shaft-liner of the nest has reached the limit of its downward travel (has been positioned), the push-arms *i* are again drawn inwardly and adjusted with their outer ends over the top of the next inner shaft-liner. The jacks are again operated; and this cycle of operations is repeated, until the required depth of the shaft or bed-rock or a suitable bottom stratum has been reached. As the work of excavation progresses, suitable bracing *k* may be positioned, if found necessary to support the pressure of the surrounding earth. After the work of excavation has been finished and the shaft has been sunk to the required depth, the working-chamber is partially filled with foundation material, such as concrete, and compressed air is introduced through the air-pipe *x* into the shell *d* the door *m* of which has been closed to make the shell air-tight. The pneumatic pressure will force the shell *d* upwardly. When the rim or top of the shell *d* strikes against the flange *e* of the innermost liner *c*, which lies next outside of it, the shell *d* will then carry that innermost liner *c* upwardly with it. Before the lower edge of the shell *d* leaves the concrete, the door *m* is opened and more concrete is introduced. The door *m* is then closed and pneumatic pressure is again applied, whereby the shell *d* is raised still further and carries with it the innermost liner *c* with which it is engaged. These steps are repeated, the flanges *e* of the liners *c* successively engaging one another and the excavation being gradually filled with concrete. Care is exercised to insure that the lower edge of the shell *d* is never raised out of the concrete, so that the latter acts as a seal for the compressed air. By means of the valve *n*, the pressure of the air inside the shell *d* may be regulated, which aids to accomplish this result. As the lining shells or members are raised, the bracing *k* is removed. A chain *o* may be attached at one end to the cross-bar *p* (Fig. 2) and at the other end to a hoisting engine (not shown) so as to aid in the raising of the nest of lining members and the working-chamber. Rods *q* are stuck in the "green" concrete as vertical reinforcement thereof and rings or hoops *r* are laid horizontally therein for circumferential reinforcement (see Fig. 2).

In Fig. 1 the casing *s* of a screw-jack bears upon the top of a beam *t* the lower end of which rests upon the cross-bar *p;* and the screw *u* of the screw-jack bears upon the beam or block *z* carried by the roof of the air-lock *a*.

In Fig. 4 there is shown a casing or cylinder *v* of a hydraulic jack the lower end of which rests upon a bracket *w* of the jack-frame carried by the shell liner *d'*. The piston of the hydraulic jack bears against the abutment *y* which is supported in any suitable manner. As indicated in Fig. 5 there are a number of hydraulic jacks spaced or distributed around the bracket *w*, which is in the form of a ring.

I claim:

1. In a construction of the class described, the combination of a plurality of shaft-lining members having different diameters and adapted to be nested one within the other; a working-chamber shell adapted to be nested within said shaft-lining members;

and mechanism for moving said shell and shaft-lining members relatively to one another.

2. In a construction of the class described, the combination of a plurality of shaft-lining members having different diameters and adapted to be nested one within the other; and a working-chamber shell provided with means for forcing said shaft-lining members into and out of each other.

3. In a construction of the class described, a nest of shaft-lining members fitted slidably one within the other; the outer ones of said nest being each formed with inwardly-extending devices which overhang the upper edge of the member next within, whereby the driving of the outermost member carries the members within and the latter are free to be positioned successively from the nest.

4. In a construction of the class described, the combination with a nest of shaft-lining members fitted slidably one within the other and formed with inwardly-extending devices which overhang the upper edge of the shaft-lining member next within to engage the latter; of means for driving the outermost of said members and thereby the remainder of the nest through the medium of said inwardly-extending devices.

5. In a construction of the class described, the combination with a nest of shaft-lining members fitted slidably one within the other; of means for driving the nest as a whole and the inner members thereafter successively from within the nest.

6. In a construction of the class described, the combination with a nest of shaft-lining members fitted one within the other and interlocked at their upper edges; of means for driving the nest as a whole and the inner members thereafter successively from within the nest.

7. The process of forming a shaft, consisting of forming an excavation; forcing into the latter a nest of lining members; forming a second excavation; and forcing from within the nest and into place in the second excavation the next to the outermost of said nest of lining members.

8. A process of building a concrete structure consisting in forming a shaft; lining the same with a plurality of lining members; withdrawing the innermost lining member and filling the section of the shaft lined by it with foundation material; and then withdrawing in succession the remaining lining members and filling successively the sections of the shaft lined by them.

9. A process of building a concrete structure consisting in forming a shaft made up of a series of excavations each of less width than the one immediately preceding; forcing into said shaft successively lining members from within one another to line successively the excavations formed; withdrawing successively and within one another said lining members; and filling with foundation material said excavations one after another as said lining members are withdrawn therefrom.

10. A process of building a concrete structure consisting in forming a shaft made up of a series of excavations; lining successively each of said excavations; withdrawing the lining member of the innermost excavation and filling the latter with foundation material; and withdrawing the innermost and next to the innermost lining members and filling the next to the innermost excavation with foundation material.

11. The process of forming a shaft, consisting of forming an excavation; forcing into the latter a nest of lining members; forming a second excavation; and leaving the outermost member of the nest as a lining for the first-named excavation and forcing the remainder of the nest into the second excavation.

12. The process of forming a shaft, consisting of forming an excavation; forcing into the latter a nest of lining members; forming a second excavation of less width than that of the first-named excavation; and leaving the outermost member of the nest as a lining for the first-named excavation and forcing the remainder of the nest into the second excavation.

In testimony whereof I hereunto set my hand in the presence of two undersigned witnesses at New York, N. Y., this sixteenth day of March, 1909.

OGDEN MERRILL.

Witnesses:
E. I. McCarthy,
James Hamilton.