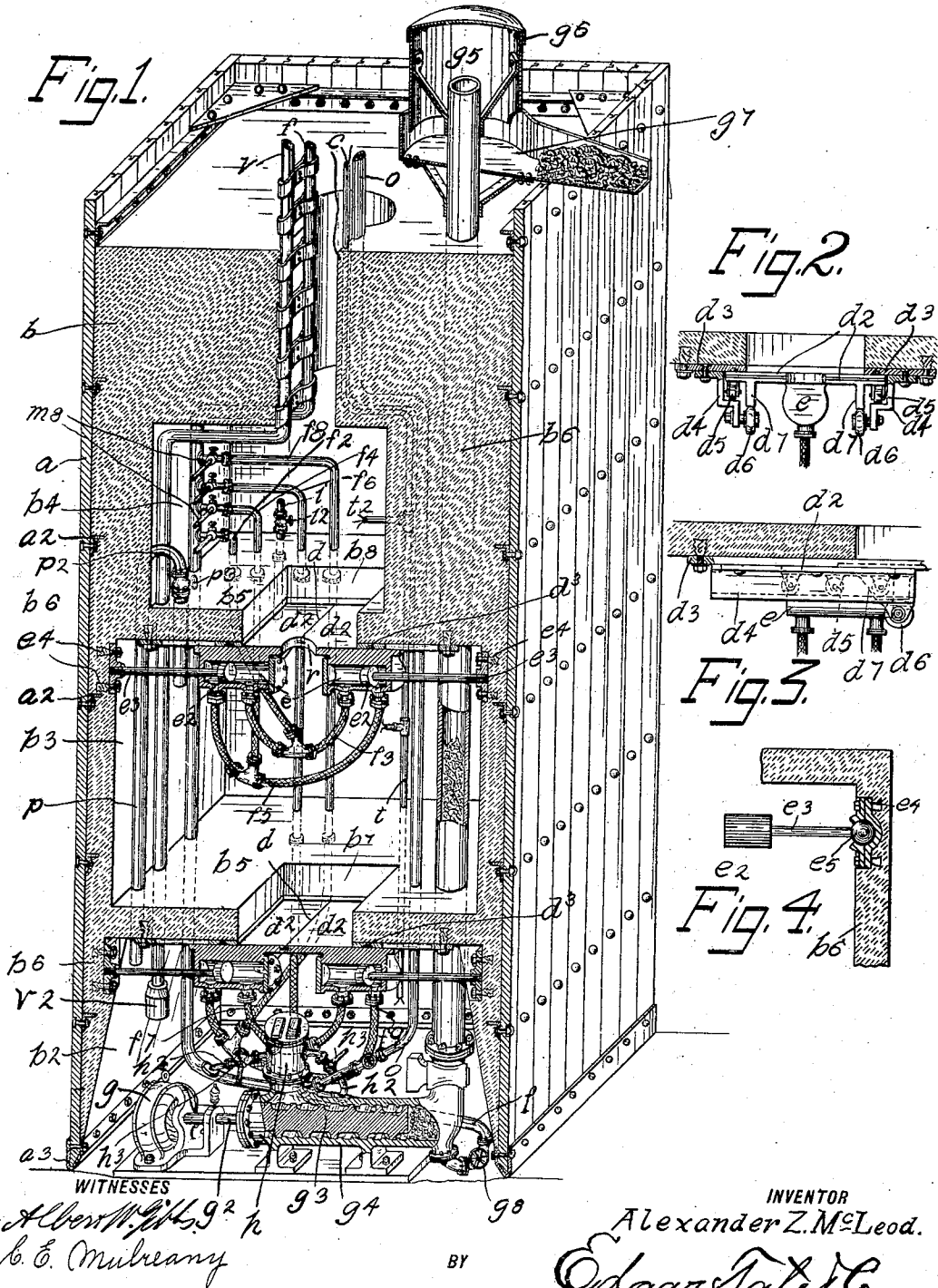


No. 873,069.

PATENTED DEC. 10, 1907.

A. Z. McLEOD.
CAISSON CONSTRUCTION.
APPLICATION FILED DEC. 27, 1906.

2 SHEETS—SHEET 1.

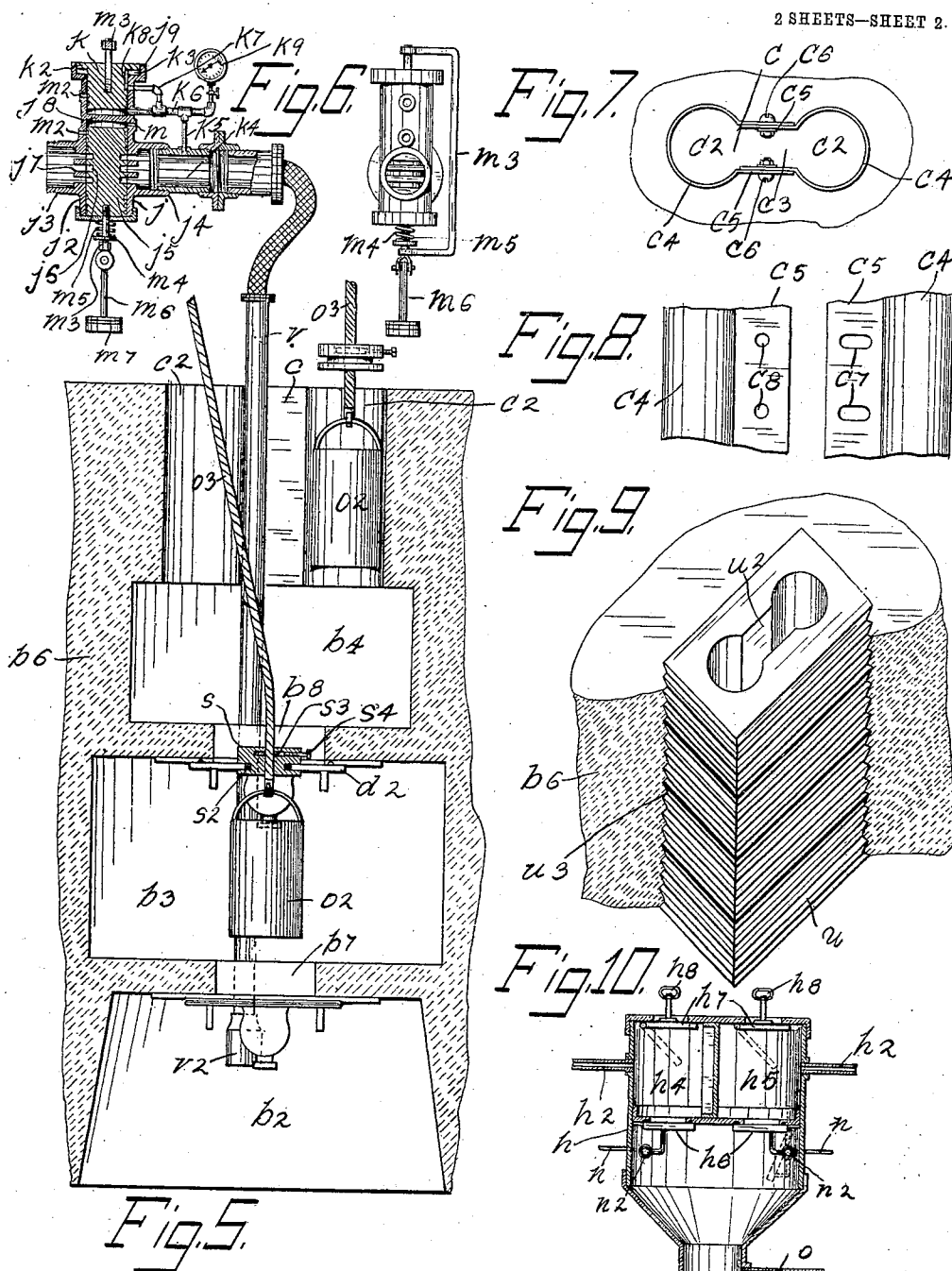


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2 SHEETS—SHEET 2.



WITNESSES
Albert W. Phelps
L. E. Mulvaney

INVENTOR
Alexander Z. McLeod.
BY *Edgar Tate & Co.*
ATTORNEYS

UNITED STATES PATENT OFFICE.

ALEXANDER Z. McLEOD, OF NEW YORK, N. Y.

CAISSON CONSTRUCTION.

No. 873,069.

Specification of Letters Patent.

Patented Dec. 10, 1907.

Application filed December 27, 1906. Serial No. 349,642.

To all whom it may concern:

Be it known that I, ALEXANDER Z. McLEOD, a subject of the King of Great Britain, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Caisson Constructions, of which the following is a specification, such as will enable those skilled in the art to which it appertains to make and use the same.

This invention relates to caissons for use in sinking the foundations of bridges, piers, buildings and other structures; and the object thereof is to provide an improved device of this class in which the working chamber, air lock chamber and all the operative mechanism pertaining to the air lock chamber and working chamber are located in the caisson, and with this and other objects in view the invention consists in a caisson constructed as hereinafter described and claimed.

The invention is fully disclosed in the following specification, of which the accompanying drawing forms a part, in which the separate parts of my improvement are designated by suitable reference characters in each of the views, and in which:—

Figure 1 is a perspective sectional view of a caisson constructed according to my invention; Fig. 2 a sectional view of one of the door locks of the air lock chamber taken at right angles to the view shown in Fig. 1; Fig. 3 a view at right angles to that shown in Fig. 2; Fig. 4 a sectional view of a modified form of a detail of the air lock mechanism; Fig. 5 a view similar to Fig. 1 but showing an air valve for admitting air to the working chamber of the caisson and showing other details of the construction omitted from Fig. 1, the air valve being in section; Fig. 6 a view of the air valve shown in Fig. 1 but taken at right angles thereto; Fig. 7 a plan view showing the means which I employ for making the hoisting and passage opening in the top portion of the caisson; Fig. 8 a view of the details of the construction shown in Fig. 7; Fig. 9 a perspective and sectional view showing a modification of the construction in Figs. 7 and 8, and, Fig. 10 a sectional detail view of a hopper employed in the working chamber of the caisson.

In the practice of my invention, I provide a caisson casing a which is of the usual form and which is rectangular in cross section and composed of heavy boards bolted to or connected with angle-irons a^2 , and the bottom of

which is provided with a metal covering a^3 V-shaped in cross section so as to facilitate the passage of the bottom of the caisson downwardly through earthy material in the operation of the caisson in sinking a pier, foundation column or similar construction. The interior of the casing a is filled in with concrete as shown at b , and in this operation a working chamber b^2 is formed in the bottom of the caisson, and over the working chamber b^2 is an air lock chamber b^3 , and over the air lock chamber b^3 is an operator's chamber b^4 .

The working chamber b^2 is separated from the air lock chamber b^3 by a floor and ceiling construction b^5 , and the air lock chamber b^3 is separated from the operator's chamber b^4 by a similar floor and ceiling construction b^5 , and in practice the working chamber b^2 is formed by a suitable core, framework or casing built in the bottom of the caisson and of less dimensions than said casing, and the walls of which are preferably tapered inwardly as clearly shown in the drawing, and around which concrete is packed as shown at b^6 , and over which concrete is placed to form the floor and ceiling construction which separates the working chamber b^2 from the air lock chamber b^3 . Another framework, core or casing is then built in the casing a over said floor and ceiling construction b^5 to form the working chamber b^3 and the concrete is packed around the same to the top of said framework, core or casing as clearly indicated in the drawing, and the floor and ceiling construction b^5 which separates the air lock chamber from the operator's chamber is placed thereover, after which another framework, core or casing is built to form the operator's chamber b^4 , and the concrete b^6 is packed in around the same as clearly indicated in the drawing.

The floor and ceiling construction b^5 which separates the working chamber from the air lock chamber is provided with a doorway b^7 , and the floor and ceiling construction b^5 which separate the air lock chamber from the operator's chamber is provided with a similar doorway b^8 , and extending from the top of the operator's chamber b^4 is a passage way c the form of which, in cross section, is shown in Fig. 7 and comprises two approximately tubular members c^2 connected by a central passage c^3 , and in practice the passage way c is formed by tubular metal casings c^4 having side flanges c^5 through which

are passed bolts c^6 , the flanges c^5 of one of the parts c^4 being provided with slots c^7 , and the flanges of the other part with holes c^8 through which the bolts c^6 are passed as clearly shown in Figs. 7 and 8, and after the concrete b^0 has been packed in around the casings c^4 the bolts c^6 are loosened so that the flanges c^5 move inwardly in order to permit of the removal of the casings c^4 .

After the body of the caisson has been formed in the manner described, the framework, core or casing around which the working chamber b^2 , the air lock chamber b^3 , and the operator's chamber b^4 are formed, are removed from the caisson and the operative mechanism placed in position as hereinafter described.

The doorway b^7 between the working chamber and the air lock chamber and the doorway b^8 between the air lock chamber and the operator's chamber are provided with doors d , said doors consisting of two parts d^2 and the construction and operation of each of said doors is the same. The separate parts of the doors d consist of slide plates mounted on the bottom of the floor and ceiling construction b^5 as clearly shown in Figs. 1, 2 and 3, and in order to do this, plates d^3 are secured to the bottom of the floor and ceiling construction, and connected with the plates d^3 are angular guide plates d^4 which form tracks or ways on which the slide plates, which constitute the separate parts d^2 of the doors d move, and said parts d^2 of the doors d are provided with rollers d^5 movable on said tracks or ways. The tracks or ways formed by the guide plates d^4 are provided with inwardly directed anti-friction rollers d^6 at their outer ends and the slide plates or parts d^2 of the doors d are provided with cam flanges or blocks d^7 , shown in full lines in Fig. 2, and dotted lines in Fig. 3, movable over and on the anti-friction rollers d^6 and which serve to press the outer parts of the slide plates or parts d^2 of the doors d upwardly in the operation of closing the same as hereinafter described. Each of the slide plates d^2 of the doors d is provided with a cylinder e , each of which is provided with a piston e^2 , and the pistons e^2 are provided with rods e^3 which may be rigidly connected with the opposite side walls of the air lock chamber b^3 as shown at e^4 in Fig. 1, or by means of a ball and socket joint as shown at e^5 in Fig. 4, and the cylinders e and piston rods e^3 range transversely of the doorways b^7 and b^8 and transversely of the door members d , and in practice the door members d^2 are movable while the cylinder and piston rods e and e^2 are stationary.

It will be understood, of course, that the doors d form the air locks proper, and for the purpose of the further description the door d at the top of the air lock chamber b^3 will be called the upper air lock while the door d at

the top of the working chamber b^2 will be called the lower air lock.

Passing downwardly through the passage way c and in the central part c^3 thereof is a high pressure air pipe f which also passes downwardly through the operator's chamber b^4 , through the air lock chamber b^3 and into the working chamber b^2 . A similar pipe v is similarly placed and terminates in the working chamber b^2 and is provided within said chamber with a valve device v^2 of the usual or any suitable construction. The pipe f is provided within the operator's chamber b^4 with a branch pipe f^2 which extends downwardly through the floor and ceiling construction b^5 between the operator's chamber and the air lock chamber b^3 and is connected within the air lock chamber with a pipe f^3 which supplies air to the inner end portions of the cylinders e of the upper air lock, and another branch pipe f^4 connects with the pipe f within the operator's chamber and extends downwardly into the air lock chamber and connects with a pipe f^5 which supplies air to the outer ends of said cylinders.

Another branch pipe f^6 connects with the pipe f within the operator's chamber, and extends downwardly through the air lock chamber into the working chamber b^2 and connects with a pipe f^7 which supplies air to the inner ends of the cylinders e of the lower air lock device, and another pipe f^8 connects with the pipe f within the operator's chamber and extends downwardly through the air lock chamber into the working chamber and connects with a pipe f^9 which supplies air to the outer end portions of the cylinders e of the lower air lock device.

Within the bottom of the working chamber b^2 is placed a motor g having a shaft g^2 provided with a screw g^3 mounted in a cylinder g^4 , the end of which opposite the motor is provided with a stand pipe g^5 which extends upwardly through the air lock chamber and through the top portion of the casing and is provided at its upper end with a hood g^6 , the bottom of which is open and communicates with a discharge spout g^7 , and the cylinder g^4 is provided at the end thereof adjacent to the motor g with a hopper h , a detail view of which is given in Fig. 10. The lower end of the air pipe f which extends downwardly into the working chamber b^2 is connected with the end of the cylinder g^4 with which the stand pipe g^5 is connected and is provided with a valve g^8 , and connected with said pipe f are two branch pipes h^2 which communicate with the opposite side portions of the hopper h and are provided with valves h^3 . A short pipe i is passed through the floor and ceiling construction b^5 between the operator's chamber b^4 and the air lock chamber b^3 , and is provided within the operator's chamber b^4 with a valve i^2 , and by means of this pipe the pressure in the

chambers b^3 and b^4 may be equalized or the pressure in the chamber b^3 reduced to atmospheric pressure whenever desired or in the process of lifting the buckets out of the chamber b^3 as hereinafter described.

It will be understood that in the operation of this device, air of a predetermined pressure, preferably about fifty pounds to the square inch, is maintained in the working chamber b^2 , and in order to properly accomplish this result I provide the pipe v with an air pressure regulator j shown in Fig. 5. This air pressure regulator consists of a vertically arranged tubular casing j^2 provided at its opposite sides with tubular extensions or couplings j^3 and j^4 with the latter of which the pipe v is connected, and mounted in the lower end portion of the casing j^2 is a vertically movable piston valve j^5 having annular grooves j^6 , which form in connection with ports or passages j^7 in the tubular couplings or extensions j^3 and j^4 , air ports or passages to permit of the passage of air through the casing j^2 . The upper end of the casing j^2 is extended and provided with a transverse partition j^8 , and at the top thereof with an enlarged and upwardly directed flange or rim j^9 , and mounted in the top of said casing is a piston valve k provided with a flange k^2 which fits in the flange or rim j^9 , and in the lowest position of the piston valve k there is an annular air space k^3 between the flange k^2 and the bottom of the flange or rim j^9 . The casing j is connected with the pipe v by means of a coupling k^4 with which is connected a pipe k^5 , which connects with a pipe k^6 , which communicates with that part of the casing j^2 above the partition j^8 , and the pipe k^6 is provided with a branch pipe k^7 designed to communicate with a by-pass k^8 in the piston valve k , and the pipe k^6 is provided with a gage k^9 . Below the partition j^8 , the casing j^2 is provided with an air vent m , and said casing is provided above and below said partition with lubricating ports or passages m^2 designed to lubricate the piston valves j^5 and k .

In the operation of this device a suitable air pressure apparatus is connected with the tubular extension or coupling j^3 and air is forced through the pipe v into the working chamber b^2 , and whenever the pressure in said chamber reaches the desired point, the air will pass through the pipes k^5 , k^6 and k^7 into the space j^9 beneath the flange k^2 of the piston valve k , and the piston valve k will be raised. The piston valves k and j^5 are connected by a yoke m^3 , and when the piston valve k rises the valve k^5 also rises and the flow of air through the regulator j is cut off. Connected with the piston valve j^5 is a rod m^4 having a spring m^5 which normally serves to force said valve downwardly, and connected with said rod is a supplemental rod or hanger m^6 having weights m^7 designed for a similar

purpose. A yoke m^3 is connected with the piston valve k and with the rod m^4 , and through said rod with the piston valve j^5 , and when the air passes back through the pipes k^5 , k^6 and k^7 and raises the piston valve k together with the piston valve j^5 as hereinbefore described, that part thereof which passes beneath the flange k^2 of the piston valve k is exhausted, and at the same time the flow of air through the pipe k^7 is cut off by the valve k and no more air can escape through the pipe k^7 , and no more air can enter the working chamber till the pressure therein is reduced and the spring m^5 and weights m^7 restore the valves j^5 and k to the position shown in Fig. 5, when air will be again forced into the working chamber b^2 .

My invention is not limited in its general form to the air regulating device j and any suitable device may be employed for this purpose.

In practice, an operator is always in the chamber b^4 and the air lock devices at the top of the air lock chamber b^3 and the top of the working chamber b^2 are under his control, and the said air lock devices consisting of the doors d may be opened and closed at will by simply manipulating the valves m^8 with which the pipes f^2 , f^4 , f^6 and f^8 are provided.

The hopper h , in the form of construction shown, is provided in the top thereof with two chambers h^4 and h^5 at the bottoms of which are doors h^6 and at the tops of which are doors h^7 . The doors h^7 open inwardly and may be closed by means of handles h^8 with which they are provided, or in any preferred manner, and are normally held closed by air pressure entering through the pipes h^2 . The doors h^6 open downwardly and may be closed by means of crank rods n which pass into the bottom portion of the hopper through stuffing boxes n^2 , and passing downwardly through the caisson is a water supply pipe o which connects with the base portion of the hopper and is intended to supply water to the end of the cylinder g^4 where the hopper connects therewith.

In practice, a certain amount of the material excavated in the working chamber b^2 may be thrown in the hopper h from which it passes into the chamber g^4 , the motor g being in operation, this material is carried through the cylinder g^4 and discharged into the stand pipe g^5 . At the same time water under pressure passes into the cylinder g^4 through the pipe o , and air under high pressure passes into the end of the cylinder g^4 at the bottom of the stand pipe g^5 , and the contents of said cylinder is blown out through the stand pipe g^5 and discharged into the discharge spout g^7 . In this operation the chambers h^4 and h^5 are employed alternately, and as each chamber is filled, the door h^7 thereof is closed and air under pressure is admitted through the corresponding pipe h^2 , the corresponding

door h^6 is opened and the contents of said chamber is dumped into the bottom portion of the hopper from which it passes into the cylinder g^4 . It will be understood that the doors h^7 may be closed by hand, or in any desired manner, and are held closed by the air pressure in the chambers h^4 and h^5 , while the doors h^6 are opened by an increase of pressure in the chambers h^4 and h^5 and are closed by the crank or crank shafts n , and are held closed by air pressure in the bottom portion of the hopper until the air is again admitted through the pipes h^2 . The details of this construction and operation will be readily understood by all those familiar with the operation of this class of apparatus.

In practice, buckets or similar devices o^2 are also employed for removing material from the working chamber b^2 , and these buckets are suspended by cables o^3 which are raised and lowered through the side members c^2 of the passage way c in the top portion of the casing, the usual apparatus being provided for this purpose, and in order to raise and lower the buckets o^2 the locks formed by the doors d must be opened and closed. It is necessary, of course, to maintain the air pressure in the chamber b^2 at the predetermined point, or at about fifty pounds to the square inch, and this pressure is also normally maintained in the air lock chamber b^3 by means of a pipe p which passes through the air lock chamber b^3 , and the lower end of which extends into the working chamber b^2 , and the upper end of which extends upwardly into the operator's chamber b^4 and has a return bend p^2 which passes downwardly into the lock chamber b^3 and is provided in the operator's chamber with a valve p^3 . In the operation of lowering one of the buckets o^2 the upper air lock is first opened and said bucket passes into the air lock chamber b^3 , after which the upper air lock is closed, the normal pressure is restored in the chamber b^3 , and the lower air lock is opened and the said bucket passed downwardly into the working chamber b^2 . In the removal of a bucket the lower air lock is first opened, the bucket is raised into the air lock chamber b^3 and the lower air lock closed after which the upper air lock is opened and the bucket passed out into the operator's chamber, after which the upper air lock is closed and the bucket raised to the top of the caisson. It will be understood that this operation is repeated with each bucket, and in practice, the separate parts of the doors d which form the air locks are provided in their adjacent surfaces with semi-circular recesses forming circular openings r through which the cables o^3 pass, and said cables are provided with circular stop blocks s having annular grooves s^2 adapted to receive the adjacent edges of the door members d^2 and the annular grooves s^2 are provided with packings as shown in

Fig. 5, the blocks s are also provided above the grooves s^2 with interior grooves s^3 through which the cables o^3 pass and which are filled in with fine shot or similar material to form a packing, and set screws s^4 are passed through the sides of the blocks s and adapted to bear on the shot or other material so as to compress the same around the cables o^3 and thus pack the apertures or holes in the blocks through which the cables pass. When a bucket is passed down through one of the locks and the door members d^2 of the locks are closed they fit in the grooves s^2 and the blocks s are held stationary while the cables o^3 are free to pass therethrough and the openings r are thus closed while the buckets are being raised and lowered, but when the locks are open to permit the buckets to pass therethrough the blocks s move with the cables as will be readily understood, and said blocks may be adjusted on said cables by hand to any desired point.

I also place in the caisson a tube t which passes downwardly therethrough or through the passage way c , the operator's chamber, the air lock chamber and into the working chamber, and this pipe is provided in said chambers with branch tubes t^2 , and is intended to serve for the purpose of passing telephone wires therethrough, and each chamber is provided with a telephone by means of which signals may be sent from parties in either of the chambers of the caisson to parties at the top thereof, or by parties at the top of the caisson to parties in either of the chambers thereof, or by a party or parties in one chamber to a party or parties in another chamber of the caisson.

It will also be understood that, in practice, the height of the caisson may be extended by applying additional casings a to the top of the one shown in the drawing, and in this event the space above the operator's chamber b^4 will be continued upward by means of cement through which the passage way c is also continued, and instead of forming the passage way c by means of the separate casing c^4 shown in Figs. 7 and 8 and hereinbefore described, blocks u shown in Fig. 9 formed from concrete and having apertures u^2 similar to the passage way c in cross section formed therein may be placed together, one on another and the concrete b^6 filled in around the same as indicated in Fig. 9, and the faces of the blocks u will be provided with grooves or recesses as shown at u^3 in order that the concrete b^6 will adhere thereto and securely hold said blocks in position.

It will be observed that the openings r in the doors d^2 of the separate air locks are approximately in the middle of the caisson or in vertical line therewith, while the separate parts c^2 of the passage way c are arranged laterally thereof and it is necessary, in practice, for a man to be placed in the operator's cham-

ber b^4 to swing the cables o^3 in the operation of raising or lowering the buckets o^2 out of a direct vertical line so that they will pass through the doorways b^7 and b^8 as indicated in Fig. 5.

Caissons made in this manner may be continued to any desired height by simply adding on other casings a and by filling in the additional casings with concrete and forming therein the passage way c and this passage way c may be made as indicated in Figs. 1, 7 and 8 or as indicated in Fig. 9.

When the desired depth has been reached, the operative apparatus in the working chamber b^2 and in the air lock chamber b^3 and in the operator's chamber b^4 , or all the parts of the same that can be easily or conveniently detached are removed from the caisson by means of the cables o^3 and hoisting apparatus with which said cables are connected, and after this is done the chambers b^2 , b^3 and b^4 and all the open spaces within the caisson are filled in with concrete and the caissons are left in position and forming the foundation for the structure which it is intended to place thereover.

In all apparatus of this class, as heretofore made, air locks, air lock chambers and operating mechanism have been placed above the caisson and carried upwardly therewith, the caisson being provided in the bottom thereof only with a working chamber, but with my improvement the working chamber, air lock chamber and operator's chamber are all placed in the caisson itself, or in the bottom section or member of the caisson if two or more of such members or sections are employed. This construction not only facilitates work of this kind but places all the operators in close communication and the air lock chamber being adjacent to the working chamber the manipulation of all parts of the apparatus are facilitated and the work simplified and rendered more safe and free from accidents.

One of the advantages of my caisson is that in the operation thereof a number of buckets filled with material may be raised from the working chamber into the air lock chamber without disturbing the upper air lock, and when this is done the lower air lock may be closed and all the buckets removed from the air lock chamber without disturbing the lower air lock, and in the operation of raising the buckets from the working chamber into the air lock chamber the lower air lock may remain open, and other processes may be employed for raising the material in the working chamber into the air lock chamber.

It will be understood that in the use of caissons of this class and in the operation of building the caisson higher, or extending the height thereof as the same descends into the ground, means must be provided for keeping

the constant pressure in the working chamber b^2 and in order to do this a T-coupling is connected with the pipe v at the top thereof and another pipe connected therewith which will admit air to the working chamber after the regulator j is detached in order to continue the pipe v upwardly and after the pipe v has been raised to the desired height the regulator j , or any suitable regulator, may be again connected therewith, and it will also be understood that the pipe connected with the T-coupling as above described will be provided with a regulator which will control the admission of air under pressure to the working chamber.

The motor g may be operated by air pressure or by electricity, and when operated by air the latter may be obtained from the chamber b^2 or it may be obtained through an extra pipe or in any preferred manner, and if operated by electricity it will, of course, be necessary to pass circuit wires down through the caisson, and it will also be understood that in addition to the telephone wires other electric wires and electric lights may be employed for the purpose of illuminating the different chambers in the caisson.

In the accompanying drawing, I have shown an air regulating device applied only to the pipe v , but it will be understood that, in practice, an air regulating device is also applied to the pipe f and any suitable air regulating device may be employed for this purpose. It will also be apparent that various changes in and modifications of the construction herein described may be made without departing from the spirit of my invention or sacrificing its advantages, and I reserve the right to make all such alterations therein as fairly come within the scope of the invention.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent, is;—

1. A caisson composed of a suitable casing filled in with concrete, said caisson being provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, said chambers being separated by floor and ceiling constructions having air lock doors.

2. A caisson composed of a suitable casing filled in with concrete, said caisson being provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, said chambers being separated by floor and ceiling constructions having air lock doors, composed of two similar sliding parts mounted beneath the floor and ceiling constructions.

3. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above

which is an operator's chamber, above which is a passage way extending through the concrete to the top of the caisson.

4. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending through the concrete to the top of the caisson, said chambers being separated by floor and ceiling constructions having door ways, and doors mounted beneath the said floor and ceiling constructions and adapted to close said doorways and composed of two similar sliding parts and adapted to be operated by air pressure applied thereto.

5. A caisson composed of a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending to the top of the caisson, said chambers being separated by floor and ceiling constructions provided with doorways having sliding air pressure operated doors, and the working chamber and air lock chamber being placed in communication by a pipe which extends from the working chamber into the operator's chamber and back into the air lock chamber.

6. A caisson composed of a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending to the top of the caisson, and air operated door locks placed between said chambers.

7. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending to the top of the caisson, said chambers being separated by floor and ceiling constructions provided centrally with doorways, air pressure operated door lock members for closing said doorways, said working chamber and air lock chamber being placed in communication by a pipe which extends into the operator's chamber, a high pressure air pipe extending downwardly through the caisson into the working chamber, another high pressure air pipe extending downwardly through the caisson and provided with branch pipes for operating the door locks, said branch pipes being controlled by valves in the operator's chamber.

8. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending to the top of

the caisson, said chambers being separated by floor and ceiling constructions provided centrally with doorways, air pressure operated door lock members for closing said doorways, said working chamber and air lock chamber being placed in communication by a pipe which extends into the operator's chamber, a high pressure air pipe extending downwardly through the caisson into the working chamber, another high pressure air pipe extending downwardly through the caisson and provided with branch pipes for operating the door locks, said branch pipes being controlled by valves in the operator's chamber, and the operator's chamber and air lock chamber being placed in communication by a pipe provided with a valve located in the operator's chamber.

9. A caisson provided with a casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way which extends to the top of the caisson, said chambers being separated by floor and ceiling constructions having doorways controlled by sliding door locks, means for operating said door locks, means for supplying air under pressure to the working chamber and air lock chamber, and means for removing material from the working chamber.

10. A caisson composed of a casing filled in with concrete and provided with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way extending to the top of the caisson, said chambers being separated by floor and ceiling constructions provided with doorways and sliding air pressure operated door lock devices for closing and opening said doorways, means for supplying air under pressure to the working chamber and air lock chamber, means for maintaining the pressure in said chambers at substantially the same point, means for discharging air from the air lock chamber into the operator's chamber, and means for removing material from the working chamber.

11. A caisson composed of a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, said chambers being separated by a floor and ceiling construction provided with a doorway having sliding door lock members, means for operating said door lock members by air pressure, means for removing material from the working chamber, and means for regulating the air pressure in said chamber.

12. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which

is a passage way extending to the top of the caisson, said chambers being separated by floor and ceiling constructions provided with doorways, air operated door lock members for closing said doorways, means for regulating the air pressure in the working chamber and air lock chamber, a stand pipe extending from the working chamber up through the caisson to the top thereof, a cylinder located in the working chamber and connected with said stand pipe and provided with a hopper, a conveyer screw mounted in said cylinder, means for operating said screw, means for supplying air under pressure to the bottom of the stand pipe, and means for supplying water to said cylinder and air under pressure to said hopper.

13. A caisson, comprising a suitable casing filled in with concrete and provided in the bottom thereof with a working chamber, above which is an air lock chamber, above which is an operator's chamber, above which is a passage way which extends upwardly to the top of the caisson, said chambers being separated by floor and ceiling constructions provided with doorways having sliding door lock devices composed of two similar parts mounted under the floor and ceiling constructions, means for operating the sliding door lock devices by air pressure, means for supplying air under pressure to the working chamber and air lock chamber, means for regulating the pressure in said chambers, hoisting buckets adapted to operate through said doorways, a stand pipe extending from the working chamber up through the caisson to the top thereof, means for supplying material to the bottom of the stand pipe within the working chamber, and means for also supplying water and air under pressure to the bottom of said stand pipe.

14. An air lock device for caissons, comprising a floor and ceiling construction having a doorway or opening, and sliding lock devices mounted beneath said doorway or opening and provided with transversely ranging cylinders, pistons mounted in said cylinders and secured to the opposite sides of the caisson, and means for supplying air under pressure to the opposite end portions of said cylinders, said sliding lock devices being provided with anti-friction rollers, and with means for forcing them upwardly against the bottom of the floor and ceiling construction.

15. The herein described means for forming a passage way in the concrete of a caisson comprising tubular casings open at one side and provided with parallel flanges having oblong slots or openings through which are passed bolts.

16. The herein described means for forming a passage way in the concrete of a caisson, comprising tubular casings open at one side and provided with parallel flanges, the

flanges of one casing being provided with oblong slots or openings and the flanges of the other casing being provided with holes through which are passed bolts.

17. The herein described means for removing material from the bottom of the casing involving a hopper having two chambers in the top thereof, doors in the bottom and top of said chambers, and means for supplying air to said chambers.

18. A packing block for cables, said block being provided with a central chamber and with a transverse aperture through which the cables pass, said chamber being filled in with compressible material, and a packing screw passed in through one side of said block into said chamber.

19. A packing block for cables, said block being provided with a central chamber and with a transverse aperture through which the cables pass, said chamber being filled in with compressible material, and a packing screw passed in through one side of said block into said chamber, said block being also provided with an annular groove or recess in the circumferential face thereof and packing material placed therein.

20. A caisson provided with a working chamber in the bottom thereof, a stand pipe extending up through the caisson and communicating with said working chamber, a hopper placed in the working chamber and in communication with the stand pipe, and means for supplying compressed air to said hopper for forcing material placed therein out through the stand pipe.

21. A caisson provided in the bottom thereof with a working chamber, a stand pipe extending downwardly through the caisson and into the working chamber, a hopper or other receiver placed in said chamber and in communication with said stand pipe, and means for forcing material placed in the hopper or other receiver out through the stand pipe, said hopper or other receiver being provided with chambers in the top portion thereof.

22. A caisson provided in the bottom thereof with a working chamber, a stand pipe extending downwardly through the caisson and into the working chamber, a hopper or other receiver placed in said chamber and in communication with said stand pipe, and means for supplying water and air under pressure to said hopper or receiver for forcing material placed therein out through the stand pipe.

In testimony that I claim the foregoing as my invention I have signed my name in presence of the subscribing witnesses this 22nd day of December 1906.

ALEXANDER Z. McLEOD.

Witnesses:

C. E. MULREANY,
ALBERT W. GIBBS.