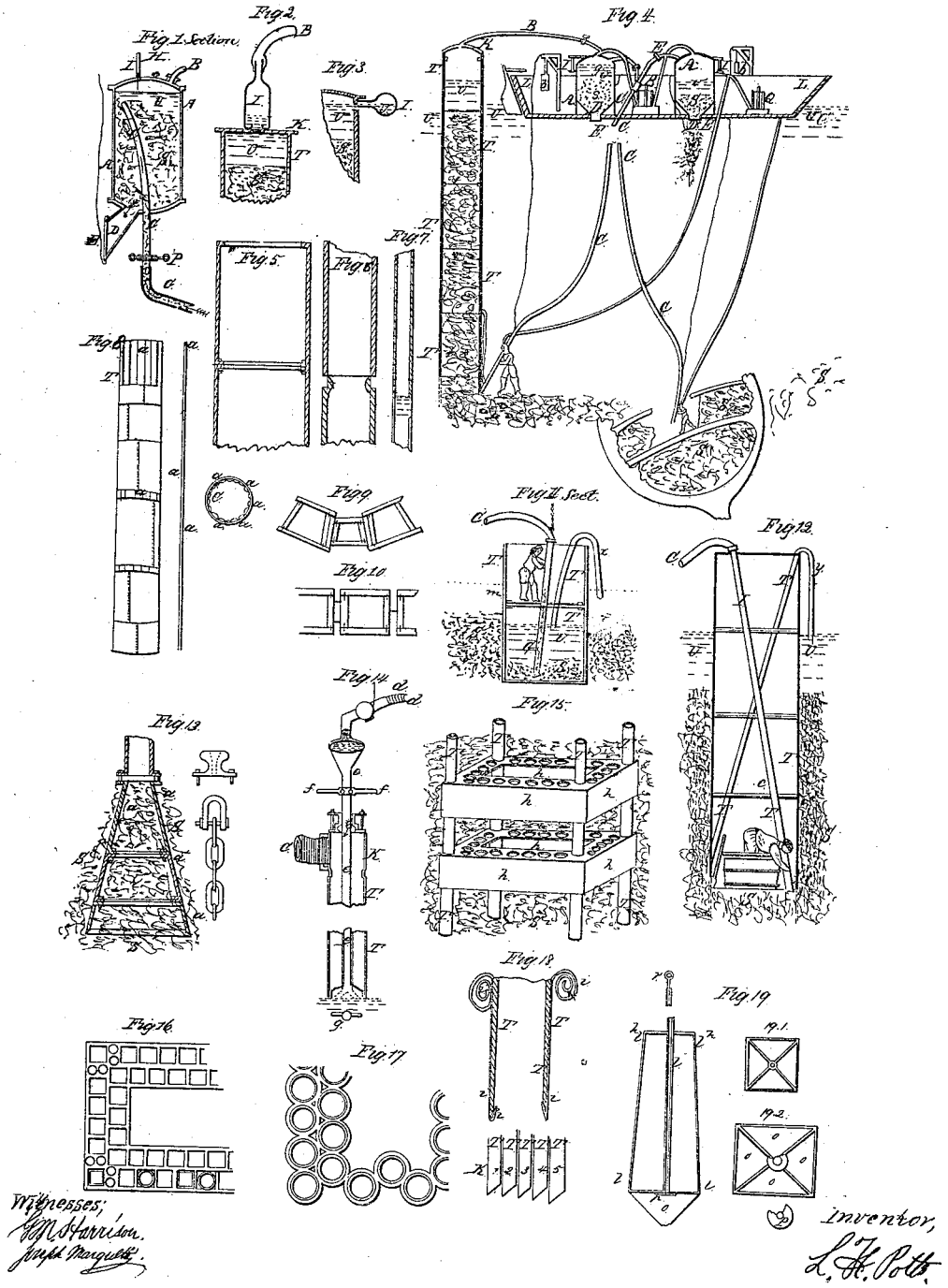
No. 7,060. PATENTED JAN. 29, 1850.

L. H. POTTS.

METHOD OF SINKING HOLLOW PILES, &c, BY EXHAUSTING THE AIR FROM THE INTERIORS OF THE SAME.

2 SHEETS—SHEET 1.



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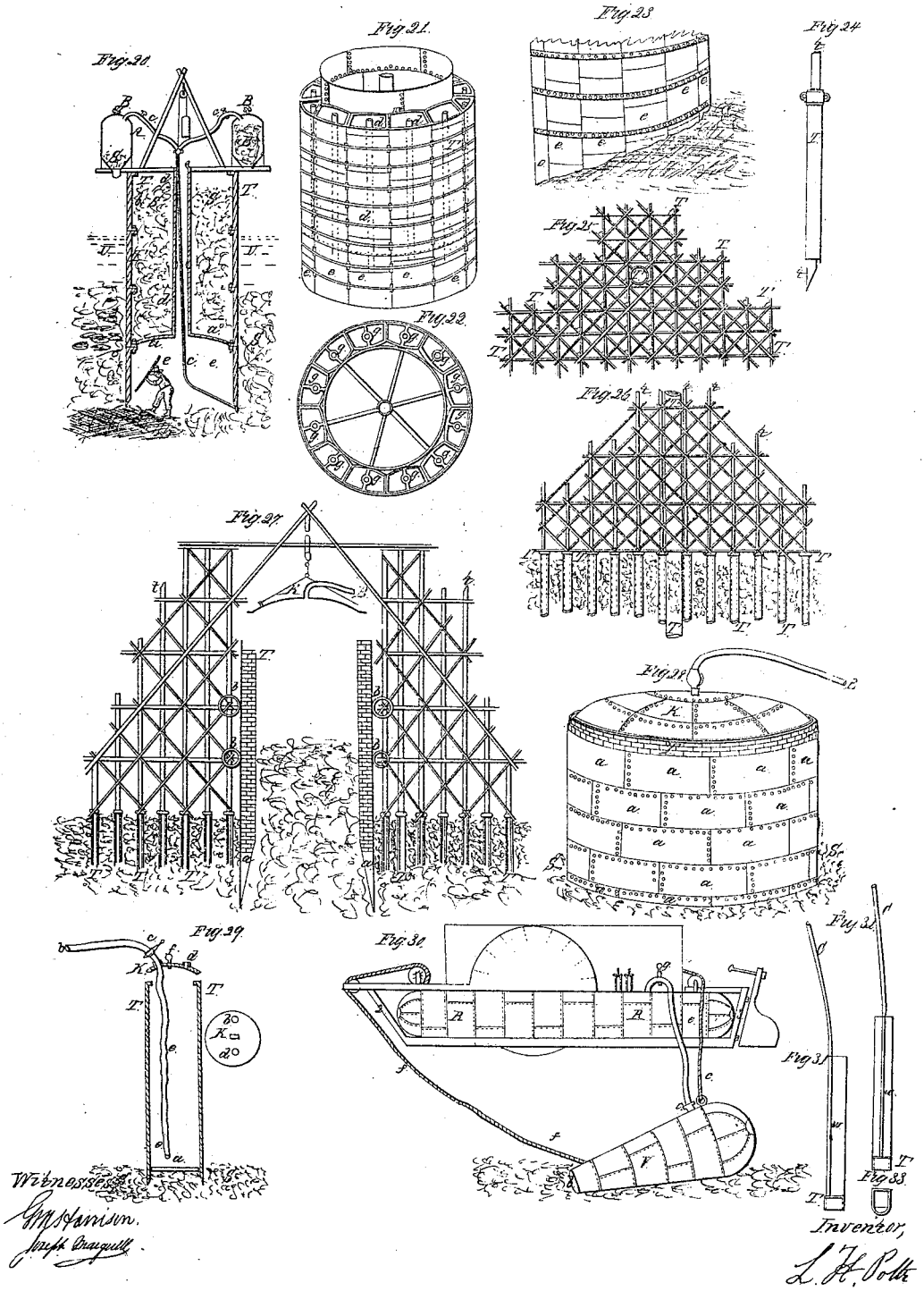

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METHOD OF SINKING HOLLOW PILES, &c., BY EXHAUSTING THE AIR FROM THE INTERIOR OF SAME.

Specification of Letters Patent No. 7,060, dated January 29, 1850.

To all whom it may concern:

Be it known that I, LAWRENCE HOLKER POTTS, doctor of medicine, residing in the city of London, and a subject of the Queen of Great Britain and Ireland, have invented and made and applied to use certain new and useful improvements in the mode of sinking piles, tubes, caissons, shafts and other structures, for which improvements I seek Letters Patent of the United States, that Letters Patent for similar improvements were granted to me by the Queen of Great Britain and Ireland on the fifth of December one thousand eight hundred and forty three and the specification of the same was duly enrolled the fifth day of June one thousand eight hundred and forty four, and that the said improvements are fully and substantially set forth and shown in the following description and in the accompanying two sheets of drawings, making part of this my specification thereof, by which it will appear that these improvements differ with all preceding inventions or appliances for the like or other similar purposes; first, by sinking hollow piles of iron in any convenient or proper shape to form piers, embankments, or similar structures, which hollow piles may be either guided into or fixed in place by skeleton iron frames; in any case furnishing the means of sinking them by withdrawing from and by their interior the sand or other earthy matter on which the hollow piles may be placed, whether they stand in water or on the land; the hollow of the piles also allows the introduction of such chemical mixtures or solutions as will solidify or consolidate the sand or earthy matter on which the feet of the piles stand; and piles thus formed may be placed to inclose a space within which a pier, wall, embankment, or breakwater or other similar structure may be constructed by means described and shown hereinafter as parts of the uses to which this invention may be applied.

In order to secure foundations it is necessary either to remove such substances as are yielding or plastic, or to force into them hard materials which become firm by their penetration to a medium of greater resistance. The latter mode has been long in use and is called filing or pile driving. Both these processes are united in a cheap and ready manner by my invention which consists of using tubes of various sizes forms and materials and causing the plastic or permeable matters, the silt or alluvial debris to ascend by the pressure of the atmosphere commonly called "suction." The tube caisson tower or pile then descends till it reaches a firm foundation, the silt clay mud or other debris being removed from the interior of the tubular pile, which may be effected by the same means, stones and cement are inserted and by chemical combination form a solid rock. The means of effecting these objects are shown in the drawings, wherein—

Figure 1 Sheet 1 shows a vessel or receiver A formed of iron or any other material or shape capable of resisting the pressure of the atmosphere when exhausted of its air.

B is a suction pipe from which the air is drawn by air pumps the condensation of steam or any other competent means.

C is a service tube which conveys all materials capable of being carried up by a stream of water into the receiver A, and this effect is not limited to sand and gravel shingle from the shores and even boulders being manageable by machinery of proper proportionate size.

D is an exit pipe or aperture through which the contents are discharged on opening; E the valve by which it is to be closed.

F is a stop cock or sliding valve which being suddenly opened after exhausting the air from the receiver A causes the water and debris mixed with it to rush up with great force and rapidity into the receiver A. This pipe may be made flexible with metallic joints caoutchouc gutta percha or other means.

I is the indicator which shows when it is time to open the stop cock H or shut the valve F that the water may not get into and injure the air pumps it consists of a graduated glass tube hermetically closed at the top with floating ball and stem which rise when the water reaches them. Similar contrivances are shown at Fig. 2 where I is a bottle with a hole bored in its bottom and fitted on to the cover, and Fig. 3 where a flask is inserted into its side. Fig. 4 shows the receivers and pumps fitted to a large barge or vessel L with their application to sinking tubes sinking slabs or plates of metal or stone which may often be useful in forming sluices and defending water courses also

clearing vessels so as to arrive at their treasures or assist in raising them in such cases the helmeted diver will sometimes be found useful to assist in the operations. Here L is the ship, P the air pump to exhaust the receiver, Q the forcing pump to supply the diver with air, K the cover to the tubes T T (the capital letters of reference correspond in all the figures). Here I the indicator is a glass tube on the side of the receiver in the manner usual in steam boilers.

b, *b*, are counterbalance weights to support the service pipes.

Figs. 5, 6 and 7 show several forms of metal tubes. The modes of joining them with internal flanges sockets and screws are apparent without further description.

Fig. 8 shows a large circular tube made of planks of wood *a a* held together by sheets of metal united so as to form broad hoops.

C, is a plan of the wooden tube.

Figs. 9 and 10 are wooden tubes of angular forms with cuts made in their edges by a circular saw into which slips of sheet iron or hooping are fitted.

Fig. 11 shows a man employed in clearing the sand S from a tube T which has been forced down with the cover K on it.

U is the water.

m, is a hole left and, *y*, a siphon for admitting water.

Fig. 12 shows a man in a bucket clearing the tube of stiff clay. In some such cases water is supplied from above and returns up the service tube carrying the clay with it. This method of emptying the tube of water cannot of course be carried beyond 31 feet, but the sand shingle or other solid matter may be removed to any depth while covered with water, and cements and various kinds of beton capable of forming concrete may be introduced so as to form artificial rock.

Fig. 13 *a a a* is a cone of large size forced into the sand or silt by means of a cover and tube as before described. It will descend further than the screw pile and is much stronger being adapted for dolphins moorings &c., shackle bolts and chains may be readily attached to the necks of these cones. It is shown in drawing or sketch filled with concrete having been emptied of its sand or silt by the service tube which has not only this power but can cause it to descend with any inclination from the perpendicular by passing it round the interior lower edge of the cone as the well sinker lets down his kerb.

Fig. 14 shows the mode of passing tubes into hard materials such as earth chalk and the like. *d* is a supply pipe for water with a stop cock to regulate the stream.

e is a hollow rod with funnel through which the water passes and escapes at its lower end *e*, *e*, which is fashioned into a grouting tool and scrapes away the hard material, being turned by the handles *f*, *f*. *g*, is the plan of grouters.

Fig. 15, shows the mode of forming piers for bridges, some tubes T T having been forced down as before described. Cases *h*, *h*, are slid down on them and filled with concrete in succession thus obviating the necessity for using cofferdams masonry or diver.

Fig. 16 shows another form in which wooden tubes may be well connected with metallic piles.

Fig. 17 is a strong and ornamental frame work well adapted for quays and may as well as the last be useful on canals and for sluicing.

Fig. 18 shows the mode of sending down gasket or packing with the angular tubes so as to form large water tight caissons for surrounding wrecks and many other purposes.

T is the tubes; *i*, *i*, *i*, *i*, the flat rope or gasket. The tubes should for such purposes be made slanting at bottom so that each in succession tends to press itself up to the preceding one as at K, 1, 2, 3, 4, 5.

Fig. 19 is a contrivance for putting down portions of dry cement in succession so as to unite stones and shingle into rock of great hardness and immediate consolidation, the metallic box *l* into which the cement is put is divided internally into four compartments which are shown in the sectional plans where at *n* four flaps *o*, *o*, *o*, *o*, open in succession. This is effected by turning the ring *r* which causes the button *p* with which it is connected by a rod inclosed in a tube to revolve and liberate the flaps *o*, *o*, *o*, *o* in succession so as to discharge the cement among the stones which it is calculated to unite.

19^1, is a top view of Fig. 19, and 19^2 is a plan at *n*.

In Fig. 20 T is a large cylinder put together in lengths with internal flanges and screw bolts. It has a diaphragm *a* across it with an aperture large enough to admit a man. To this a tube *d d* of the same internal diameter as the aperture in the diaphragm is firmly secured, a cover being placed on the top of it connected with the air pumps or service tube on setting them in action. The whole descends until the lower compartment *e*, *e*, is filled with water sand or other material from below, the service pipe being then applied so as to clear the interior so a man can descend to work if necessary. The interior *b*, *b*, of the large tube is shown nearly filled with sand in this instance which may sometimes be useful to give it greater stability and weight against the action of the waves. If this tube be very large the pumps and receivers may be sometimes placed on the top of it, a man is

shown at work in the lower compartment by this method treasures otherwise inaccessible may be extracted. I call this combination a nautilus. Figs. 21, 22, 23 show a number of the last described compound tubes or nautilii connected together by hoops of metal and wedges. These may be gradually connected together at the edge or shore of a river or the sea and as each may be readily made buoyant or otherwise by expelling or admitting the water, can be floated out to the place where they are wanted to form an insular rock and immense hoop of wood or metal or combination of both being constructed within this floating caisson which may be easily done by making use of struts or shores with a center post as shown at Fig. 22 which is a plan of Fig. 21. *g g* are stays fixed on the tops of the internal tubes so as to keep them steady and are shown in this plan, each nautilus being unconnected with his neighbor except by the hoops which hold all together the tubes may be allowed to take the slope of the rock or bottom of the sea on which it is desirable to place it as shown at Fig. 23 or the bottom may be shaped by a man who may be supplied with condensed air through the top of the inner tube *d*, *d*, which being closed converts the lower segment or section of the large tube for the time into a kind of diving bell solid rock having been formed within the inner ring the wedges may be forced out the hoops withdrawn and the nautilii floated off for future operations.

Fig. 24 is a tube on which ears are cast with holes in them each tube is furnished with a socket at the top large enough to allow the faucet at the lower extremity of another such to fit loosely into it.

Figs. 25, 26, 27 show the method of forming a scaffold on a bed of debris of any description whether sand shingle mud or clay tubes of moderate size are to be forced into the bed or bank which is done with great celerity by means of the contrivance described and shown in Fig. 2 these tubes being partially or wholly emptied of their contents by the service tube serve as sockets wherein squared timber masts or small scaffold poles may be inserted; these being properly tied together horizontally and diagonally are very convenient and serve to support beacons or lighthouses and if of sufficient size and number pieces of ordnance, they also make a far better breakwater than the floating ones, not depending on chain cables and moorings but like Briareus with a hundred hands and from their number and effect in quieting the action of the waves causing the deposit of debris, amongst them. This is productive of two advantages the first is that by the accumulation of earthy matter around it the structure is strengthened and the second is, that the deposit thus made is abstracted from the navigable channels in the vicinity or is prevented from depositing in them should gullies or pools form in any direction tubes may be passed down into them so as to obviate the sapping action of the obstructed current—where the destruction of the structure is to be apprehended from the various moluscae which lodge and feed on the timber and the highly improved coatings of mastic or varnish are not sufficient metallic tubes may be made use of like that shown at Fig. 24 these being put together with proper cement and squared timber within them are rapidly united by flat bars and screws ready prepared they may also be readily removed if desirable by unscrewing them and softening the cement by the application of heat or chemical solutions.

Fig. 25 is a ground plan, Fig. 26 an elevation and Fig. 27 a section of such structures; in the latter a tube of masonry is seen resting on a shoe or kerb of cast iron *a*, *a*, put together like a cylinder in segments with flanges it rests on the sand at low water and the building on it is commenced, strong and quick setting cement being used and the exterior bounded and defended by zinced iron plates or sheets of some such material which may be soldered or riveted together as the work proceeds, if preferred vertical flat bars of iron may be used with hoops of the same material and the interstices smoothed externally by cement varnished with cheap and tough mastic or varnish when the work is sufficiently advanced and the top made smooth and level the top must be closed with a cover which if the structure be very large must be made of a dome shape with concentric rings or plates of metal these are readily united or luted with tough clay applied with the hands which is found to act admirably and which may be protected from the weather by a greased cloth or any competent cover the exhaustion of air being effected by air pumps either with or without the voider vessels or by the condensation of steam or other competent means the debris rises in the structure and it descends when it is full it must again be emptied. If the material sucked up be allowed to rise much above the level of that on the outside of the structure or tower it will be necessary to form an internal metallic coating to resist the pressure from within.

In Fig. 27 small rollers or fenders are shown to assist in causing the tower to descend perpendicularly but the best way to effect this purpose is to begin the sinking of the structure by the application of the service tube around the inside after the manner of well sinkers as described before in Fig. 13, when it has been started right at first it will have no tendency to swerve as it

descends if the material into which it descends be homogeneous or alike on all sides.

Fig. 28 shows a Martello tower with its cover on in the act of descending by the action of the air pump. When the lower part is filled with beton below the walls may be made thick and a secure bomb proof retreat and magazine constructed in the interior below the level of the water *a*, *a*, *a*, are metallic plates or sheets united by rivets.

Fig. 29 shows a tube T which is placed perpendicularly on the sand *a* is a board covered with flannel coarse woolen cloth or any other slow conductor of heat *b* is a steam pipe with a stop cock or slide valve *c* an air escape valve is seen at *d* which of course opens upward *e*, *e*, is a tube of cloth or other fit material *k* the cover being placed on the top of the tube T, luted with clay and a soft washer and firmly held down by weights or screws the steam is admitted in a full current and escaping at the bottom of the tube *e*, *e*, drives out the air at the valve *d* which should be large and light on closing the steam cock or valve *c*, the steam will begin to condense the valve *d* closes and the tube descends. This operation may be hastened by means of jets of water at F. Hitherto the removal of the debris which chokes rivers has been carried on by means of a bag or bucket called a dredge or by a combination of them worked by steam, this mode of operation is only available in quiet and shallow waters. A mode of raising such substances in a more efficacious manner is represented at Fig. 30.

V, is a vessel which may be made of iron or other suitable material and of various shapes and sizes in this instance it is drawn like a bottle with a mouth *b* and an aperture at C to which is connected a tube communicating with a hollow air vessel or receiver R of considerable magnitude the air in which is rarefied by air pumps or other means. These vessels R in which the air is to be exhausted as much as possible we will call voiders they will be found useful in many ways in large operations and as they are very buoyant several of them may be joined so as to form a sort of raft on which a steam engine may be placed to move them to lower tubes through a center aperture work the air pumps and supply steam to rarefy the air by condensation. It will be seen that in Fig. 30 the voider R has a keel 1 stem 2 and stern post 3 connected to it suppose others beyond it and a paddle wheel working between them the line *e*, *e*, being tightened the line *f*, *f*, draws the mouth *b* which is made heavy into the mud sand or shingle the valve *g* being suddenly opened the air and water in V, are suddenly drawn up and the débris rushes into and fills it. I need not amplify on the various uses to be made of modifications of this dredging vessel or of the raft of air vessels as the variations of construction available are sufficiently obvious and the details unimportant cutting into turf moss or bog it is sometimes necessary to give the tube a conical form the lower or cutting edge being smaller than the upper this gives room for an internal flange in the interior and at the same time consolidates the material on its exterior into which it descends. In some situations it may be necessary to use a metallic cover to retain the water on commencing work.

Solid piles, as shown at Fig. 31 side view and Fig. 32 front view, may be sunk with great rapidity provided the soil in which they are required consists of sand or small shingle. They are to be fitted with a shoe T not solid and pointed but hollow. The pile may be placed on the shoe and held there by pins or the foot may be fixed into an aperture prepared to fit it. A tube C inserted into the shoe forms a communication between it and the exhausted receiver or voider into which the sand is sucked and the solid pile W descends with ease and rapidity. Fig. 33 plan of the shoe. All the processes above described for driving piles into an elastic or resisting medium may be applied to the construction of Artesian and other wells and for shafts in mines piers for bridges, &c. In certain cases the descent of the pipes may be facilitated by the action of common hydraulic pumps but I prefer the use of a vacuum produced either by air pumps condensation of steam or any other means.

Having described what I consider as generally the most attainable means for producing the required effects I do not intend to limit myself thereto but to use any known mechanical means that may be best adapted to any particular circumstances, as I hereby disclaim any invention of the parts employed irespective of the manner in which they are to be used for any of these purposes.

What I claim as new, and of my own invention is—

Improvements in the mode of sinking piles tubes caissons shafts and other structures and which I desire to secure by Letters Patent of the United States, consists in the attenuation of the air approaching to, or forming a vacuum in the interior of a hollow pile tube caisson shaft or other structure by any of the known means of producing what is termed "suction," by which the hollow pile tube shaft or other structure is made to descend as before described.

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