(No Model.) 2 Sheets—Sheet 1.

P. A. J. MONIER.

CONSTRUCTION OF TANKS, RESERVOIRS, SILOS, &c.

No. 486,535. Patented Nov. 22, 1892.

fig. 1.

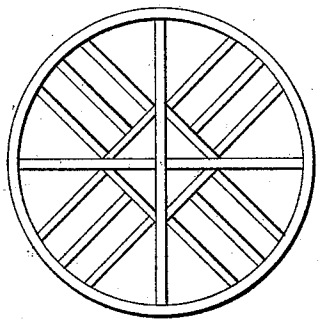

fig. 2.

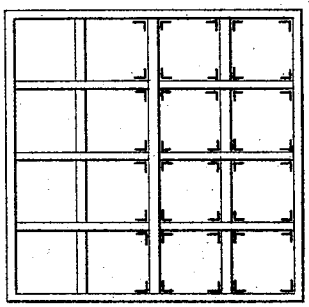

fig. 3.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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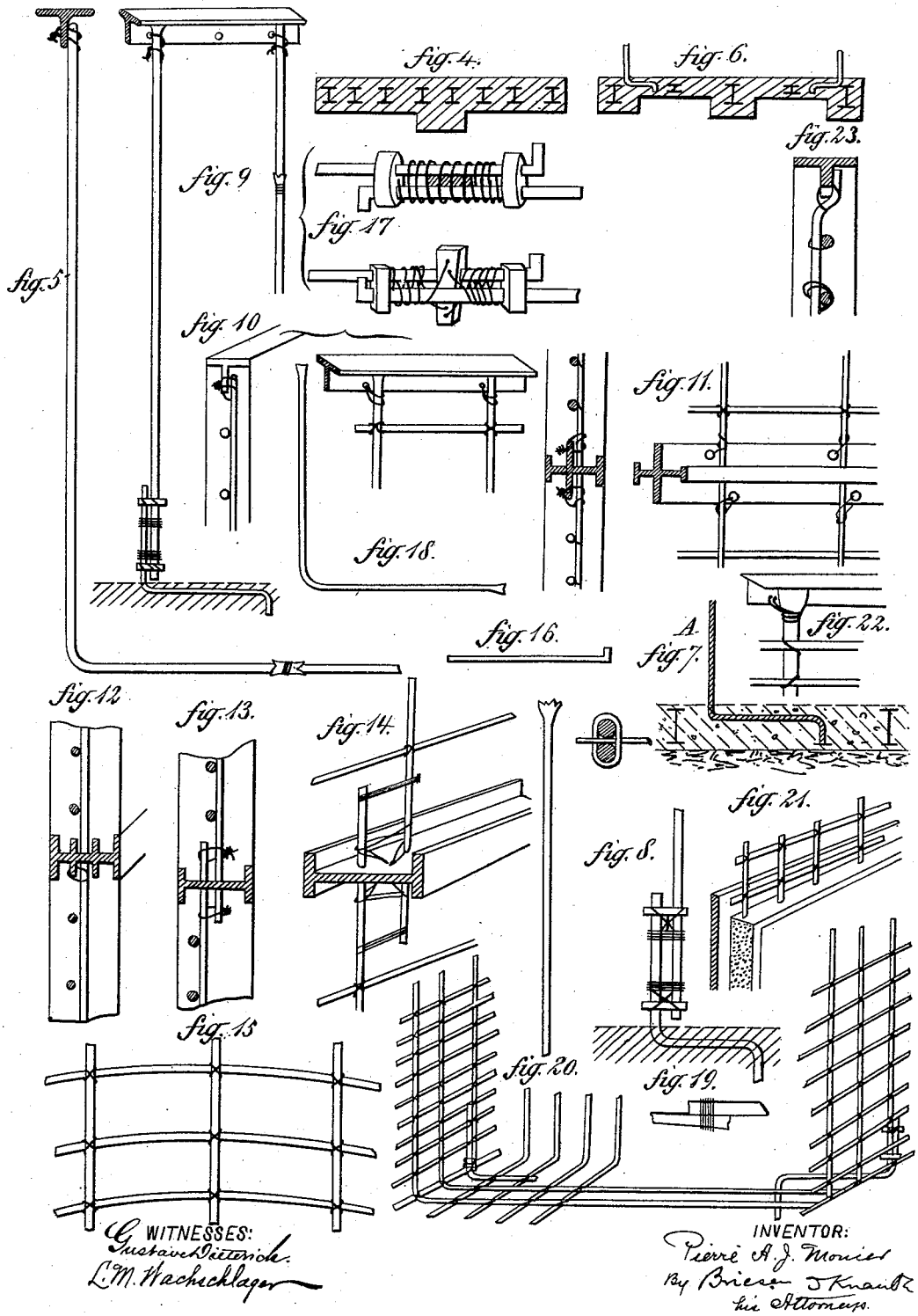

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UNITED STATES PATENT OFFICE.

PIERRE ANTOINE JOSEPH MONIER, OF PLAINE ST. DENIS, FRANCE.

CONSTRUCTION OF TANKS, RESERVOIRS, SILOS, &c.

SPECIFICATION forming part of Letters Patent No. 486,535, dated November 22, 1892.

Application filed October 31, 1891. Serial No. 410,518. (No model.) Patented in France September 15, 1890, No. 208,250.

To all whom it may concern:

Be it known that I, PIERRE ANTOINE JOSEPH MONIER, of the city of Plaine St. Denis, near Paris, France, have invented Improvements in the Construction of Reservoirs, Tanks, Silos, Vats, Cisterns, and other Containers, Pipes, and Conduits, (for which I have obtained Letters Patent in France for fifteen years, dated September 15, 1890, No. 208,250,) of which the following is a full, clear, and exact description.

This invention relates to improvements in the construction of reservoirs, tanks, silos, vats, cisterns, pits, accumulators, generators, receivers, pipes, and conduits of all kinds.

I first commence by preparing a bed or foundation upon which to build the reservoir or other structure and upon it arrange the main iron framing of the desired form and dimensions, by means of which the requisite strength is imparted.

In Figs. 1 and 2 of the drawings I have shown two forms of arranging the iron; but these can be varied as desired. For example, in order to construct a large reservoir or basin entirely above ground upon a loose soil, having an internal diameter of from ten to twenty meters or upward and of a proportional height, I proceed as follows: I commence by establishing the bed upon which to support the reservoir, which bed I form of a frame composed of iron beams of I, I, ‡, J, Z, ⅄, H, +, or other preferred shaped iron and of the desired strength, which may be either simply laid at a distance apart or connected by bolts or rivets or fitted together in any form desired, one or other of the ways indicated in Figs. 1, 2, 4, and 6, the form, dimensions, mode of construction, and assemblage being varied to suit the size, form, and dimensions of the reservoir, &c., for which they form the support. The bed-frame having been thus arranged in position, I make a concrete with lime or cement, sand, and pebbles, or, failing these, of clinkers, slag, or other sufficiently-solid material, the proportions of the lime or cement contained in the composition varying with the degree of resistance required. I then, after the soil upon which the reservoir, &c., is to be erected has been leveled and rammed, spread thereon a first layer of concrete of the necessary thickness and well ram it, after which I lay upon this concrete bed the iron bed-frame above indicated and completely fill it in with concrete over its entire surface, in which concrete are embedded angle-irons, such as represented at A in Fig. 7, to serve as a primary means of securing in place the structure to be erected. These angle-irons are formed by bending the lower portion at right angles to the vertical portion and then turning the end down at right angles to the bent or horizontal portion, as shown in Figs. 7, 8, and 9. These embedded iron fixings may be of various forms and dimensions, according to the purpose for which they are intended, and would be placed at from one meter to one and a half meters (or more) apart. Two or three days after having laid the iron frame in position and when the concrete is sufficiently set to permit of working on it without injury I proceed to fix the main vertical iron frames, which are all cut to exactly the same length—say three, four, or five meters, according to requirements—and each having one end cut square and the other flattened, care being taken to place the square end at bottom against the angle-iron embedded in the concrete and secure it thereto by means of rings or clamps placed upon said angle-iron, as shown in Figs. 3 and 8, and held in place by means of ties, ligatures, or iron wires and a perforated key through which the wire is passed to prevent it slipping in the space separating the two parts to be assembled. To the top of this iron upright is then fixed a T or other shaped iron girder, as shown in Figs. 5, 9, and 10, when the structure is not to exceed three, four, or five meters in height; but where the height is to exceed ten meters I employ T-iron of the same form for the top, and for the bottom I employ iron of ⊢, U, H, ⊢⊢, ⊢⊢⊢, or other section. In this case the uprights would be connected in the manner shown in Figs. 9, 10, and 11, according to the form of T-iron used. For uprights of less height the T-iron, disposed as represented in Fig. 10, serves to form a top flange and at same time a guide for placing and giving the necessary thickness to the cement. For uprights of greater height the upper ends may terminate in the same manner and the lower ends be arranged as in Figs. 9, 10, and 11,

the interior ribs of the ⊢⊢ or ⊢⊢⊢ irons serving to support the ends of the uprights and the exterior ribs like those of the top to form a guide for placing and giving the necessary thickness of cement. They may either remain exposed or be entirely or one-half covered with cement.

In the case of ⊢⊢ iron the web is pierced with holes at intervals where the uprights are to be fixed by double ties of twisted wire. In the case of ⊢⊢⊢ iron, Fig. 12, it is not indispensable to provide holes, as this form of the iron will hold the uprights without ties, although their use is preferable.

When employing ⊢— iron, as in Fig. 14, it is not necessary to perforate it; but it is preferable to provide it with both large and small holes. The large holes should be slightly larger than the diameter of the uprights in order to permit of their being readily inserted. The small holes serve for the insertion of the wires by which the uprights are secured, as shown in Fig. 13.

After all the main uprights have been fixed in any of the ways before indicated the main horizontal iron bars are then attached thereto at each point of intersection by means of double ligatures of wire twisted tight, as shown in Fig. 15, to prevent slipping. These horizontal bars form circles or hoops arranged in spirals extending from the bottom to a height of three, four, or five meters, with or without break. They are made of the longest length possible (from one hundred to two hundred or three hundred meters) in a single length, wound at the rolling-mill on special drums of two, three, or four meters in diameter, and in this manner I save the bending of the iron and obtain much greater strength than if employing bars of four or five meters in length, as commonly produced, a large number of which would require to be joined end to end to obtain the length required. Should, however, one of these drums not contain a sufficient length, I join the part already laid to that which has to be laid in the following manner: Each end of the iron rod or bar is first bent, as shown in Fig. 16, and upon the two ends to be joined are placed two flat rings similar to those employed for connecting the uprights to the embedded angle-irons, and a key or wedge pierced with small holes is then introduced, through which is passed a wire introduced between the key and the bent ends of the iron rods or bars to be united, as shown in Fig. 17. In this manner a joint of equal if not greater strength than that of the bar itself is obtained. I may also weld the end of a bar to that coiled on the drum, and thus obtain iron of great length in a single piece.

After all the main horizontal and vertical bars of the lower tier, for example, have been placed in position I then fix all the small intermediate uprights, which are made of the form indicated in Fig. 18 and are all joined at different points of the bottom, where they are connected together by wire ties, the ends of said bars to be joined, whether to the bottom or otherwise, being simply flattened when cold by means of a hammer and then strongly bound with wire, as shown in Fig. 19. Similarly all the small intermediate bars, whether horizontal or vertical, as in Fig. 20, are flattened at each end and united together by means of wire at all the intersections of the vertical and horizontal bars, both main and intermediate. This completes the first part of the work—viz., the construction of the skeleton framework, and I then proceed to construct a second and a third part, and so on, until the whole of the metallic portion of the structure is completed. This metallic structure is then to be covered on the outside or inside, and either entirely or partly, when of extremely-large dimensions, with paneling of wood, zinc, sheet metal, or other material of sufficient strength and capable of forming a mold for the cement. I then apply a first rough coat of cement mixed with sand, and after this is sufficiently set I apply a second coat of cement, containing a less quantity of sand, so as to form the structure shown in Fig. 21. The mold-panels are then removed and a layer of a similar kind is applied on this side, care being taken to make the surface on the interior as smooth as possible, while the exterior after being well dressed and smoothed is then slightly roughened, so as to render it less liable to contract and crack under the heat of the sun.

The above-described method of forming a round structure is applicable, also, for silos for containing grain, seeds, or liquids generally. In this case the silo instead of resting on a solid horizontal platform, as in the case of reservoirs, basins, vats, and other flat-bottomed containers, would rest upon a special foundation suited to the form of their conical bottoms, and similarly in the case of vats and other containers having spherical ends or of other form.

The skeleton iron uprights of the reservoir, whether of round or square form, are united at the top to a ring of special form, for which purpose the ends of the uprights are flattened and bent, as shown in Figs. 22 and 23, so as to facilitate the tying of the parts together by means of double or treble twisted wire. By bending the ends of the uprights in the manner shown in Fig. 23 their position in the cement filling can be more easily determined and the thickness of the latter be accordingly reduced.

What I claim as my invention is—

1. In metallic skeleton frames for reservoirs, tanks, and analogous containing-vessels, the combination, with a metallic skeleton base embedded in cement or similar material, of metallic supporting-rods having their lower ends bent at right angles to the vertical portion and secured in said cement, metallic uprights secured to said supporting-rods, and metallic caps secured to said uprights, all said

parts being secured together by wires, substantially as described, and for the purposes set forth.

2. In metallic skeleton frames for reservoirs, tanks, and analogous containing-vessels, the combination, with a metallic skeleton base embedded in cement, of supporting-rods having lower angular ends secured in said cement, metallic top and uprights supporting said top, and ferrules and wires adapted to secure said parts together, substantially as described, and for the purposes set forth.

3. In metallic skeleton frames for reservoirs, tanks, and analogous containing-vessels, a binding device adapted to secure the end portions of the parts of said frame together, consisting of clamping-plates, rings or bands securing said plates together, and wires adapted to hold said parts in position, substantially as described, and for the purposes set forth.

The foregoing specification of my improvements in the construction of reservoirs, tanks, silos, vats, cisterns, and other containers, pipes, and conduits signed by me this 17th day of October, 1891.

PIERRE ANTOINE JOSEPH MONIER.

Witnesses:
ROBT. M. HOOPER,
PIERRE ERNEST TISSIER.