

Feb. 7, 1928.

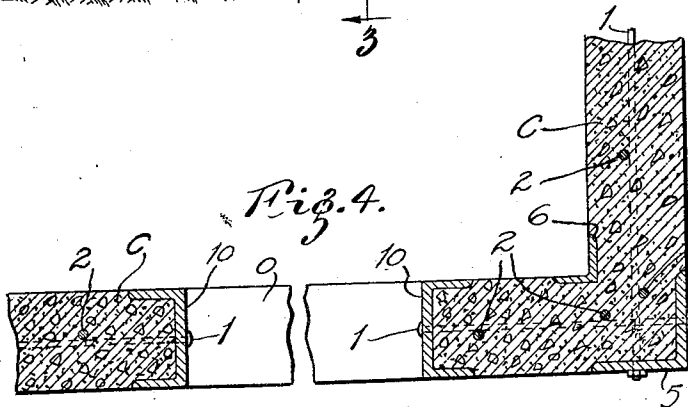
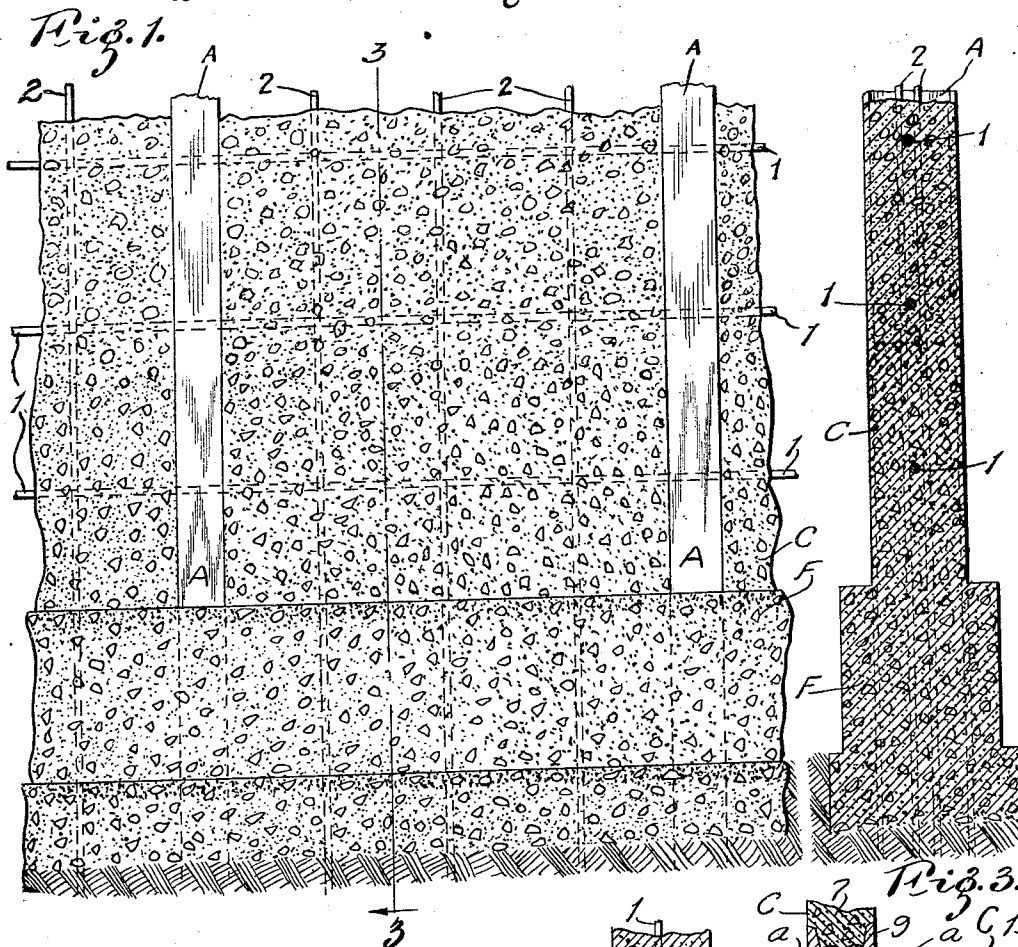
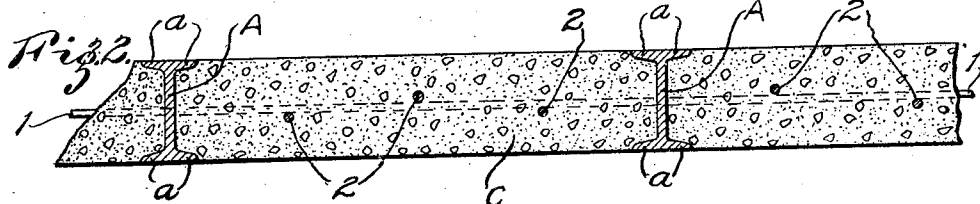
1,658,154

W. J. ARMBRUSTER

WALL

Original Filed Sept. 20, 1923

2 Sheets-Sheet 1



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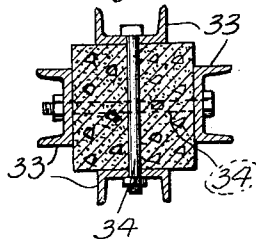
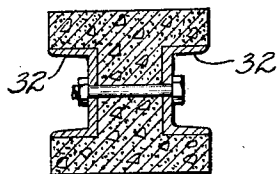
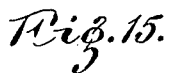
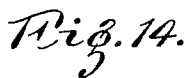
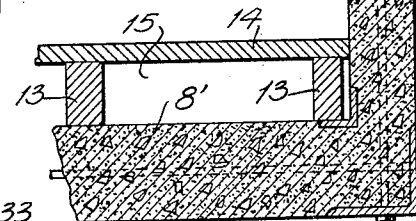
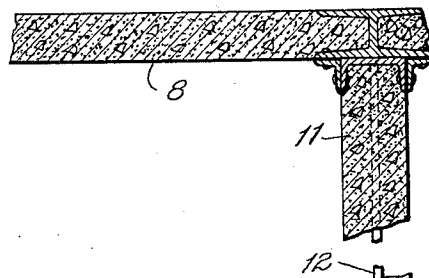
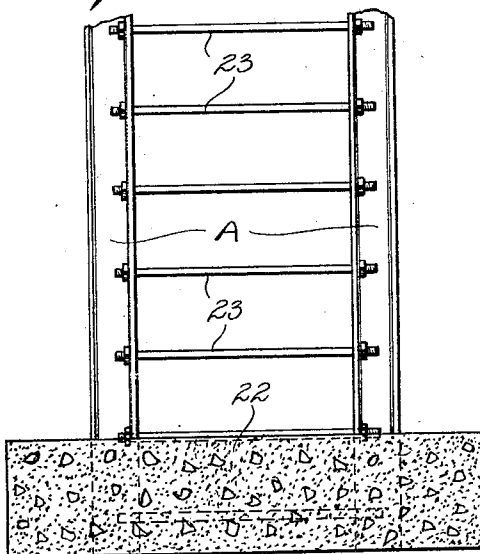
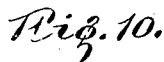
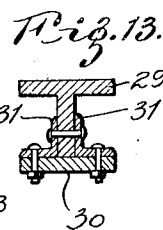
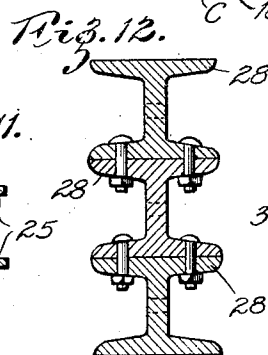
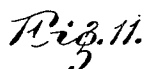
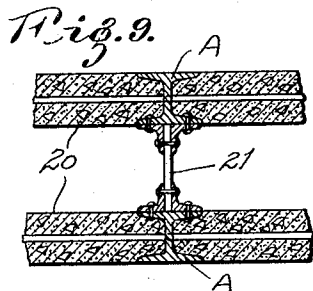
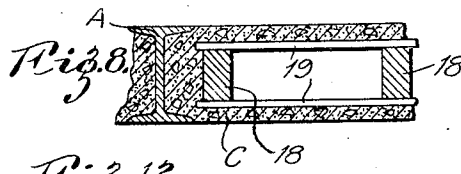
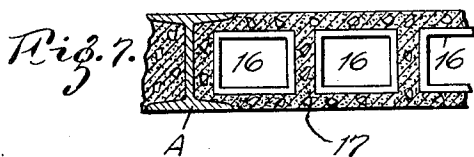
W. J. ARMBRUSTER

1,658,154

WALL

Original Filed Sept. 20, 1923

2 Sheets-Sheet 2



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WALL.

Original application filed September 20, 1923, Serial No. 663,823. Divided and this application filed February 9, 1925. Serial No. 7,882.

My invention has relation to improvements in a wall for buildings of all kinds, also trestles, dams, levees, locks, chimneys, towers, reservoirs, defenses, fences, and
5 wherever a strong, incombustible wall is desired. The advantage of a wall constructed under this system is that it can be erected rapidly, and requires very little equipment in erection whether for molds or studding,
10 and does not waste any lumber or require labor for erection of any extensive false work as in the usual re-enforced concrete construction, no lumber being cut or nailed for molds or form work, but very little being used, and it can be repeatedly re-used.
15 Further, the system lends itself to the use of various kinds of raw materials, and, in many instances, instead of Portland cement, other materials can be used, such as pozzolani, volcanic tufa, hydraulic lime, calcined gypsum, or plaster of Paris, lime mortar, and even plastic clays, or other earth,
20 with or without coarse material such as sand, gravel, pebbles, crushed rock, broken brick, shells, cinders, etc. The value and strength of the wall will, of course, depend upon the character of the materials and manner of construction. Its adaptability for the use of such a varied amount of materials makes
25 it applicable to many and various districts or regions.

It may be stated that in general this wall consists of a plurality of metal standards spaced apart a suitable distance, said standards being grooved or flanged on the side
35 extending in the direction of the line of wall, tie rods extending between the standards or between and through the standards, and a filling between the standards of Portland cement concrete or other material, and tonguing into the grooves of the standards and held by the flanges of the standards as well as the reinforcing rods, forming an intimate, well bound section of wall.

45 The method of construction in general consists in setting up a series or plurality of standards grooved or flanged as stated, spaced apart at suitable distances, inserting horizontal tie rods through the standards, clamping or otherwise holding mold boards
50 or plates to the standards, and filling in between the mold boards with concrete or

other material. The present application contains no claims directed to the method, as these form the subject of my copending
55 application, Serial No. 663,823 of which the present case is a division.

In this way valuable gains are made over either the usual structural steel frame or the re-enforced concrete methods of construction, as walls of greater stability and
60 strength are obtained with a lesser amount of material. In the structural steel frame building, stability and resistance to tearing apart of the walls is dependent on the shearing strength of the rivets and material at
65 the junction of the beams at the floor levels or planes, whereas the filling in the walls between the steel members is merely a great burden on the frame structure. In this
70 method great strength is gained for stability and resistance to tearing apart of the building by the tie rods intervening between the floor planes, particularly in the cross-walls. At the junction of the floor planes with
75 the walls in the usual re-enforced concrete methods of construction, the tying of the rods is inefficient as it consists in lightly holding them in place with thin tie wires, or merely laying them over each other
80 and constituting a great weakness or source of carelessness, whereas in this method this feature is of great strength. Against buckling inwardly of the partition walls, in both the other methods the partition walls
85 are mere fillings which easily fall out in the case of movement of the buildings such as in earth-quakes, or during fires, whereas in this method the cross-walls add greatly to the strength of the building, tying the longitudinal walls together latitudinally between the floor planes as well as at the floor planes. Very thin walls can be built under the present method, yet have great stability and resistance to tearing apart or buckling.
95

Structural steel beams may also be used, as in the usual structural steel building, for joining the standards at the floor levels, and the tying rods used in addition to the same between the floor levels, or the use of beams
100 may be entirely eliminated in some cases, and only the tie rods used. The metal and material in this manner is better distributed, while much of the metal can be used in the

cheaper shapes such as tie rods, much less skilled labor is required, and in addition the metal standards in this system are used as permanent standards for the support of the mold boards or forms during erection of the structure, which lends itself thereby to rapidity of construction. Further advantages will be better apparent from a detailed description of the invention in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of a fragment of my improved wall in the course of construction, with the clamps for the top mold boards still in place; Fig. 2 is a top plan of the section of wall shown in Fig. 1; Fig. 3 is a vertical cross-section through the wall taken on the line 3—3 of Fig. 1; Fig. 4 is a horizontal cross-section through a side and an end wall joining it showing the construction at the corner, an opening for a door being shown in the side wall; Fig. 5 shows the construction at cross walls; Fig. 6 shows two parallel walls connected by a cross wall which ties the parallel walls together; one of the parallel walls is shown as a double wall; Figs. 7 and 8 show my invention applied to various double walls; Fig. 9 shows a double wall constructed by my method; Fig. 10 is an end elevation of standards and forms for a heavy wall such as required for dams; Figs. 11, 12, and 13 are modified cross-sections of standards; Figs. 14 and 15 are cross-sections of pillars made according to my method.

Referring to the drawings, and for the present to Figures 1 to 5 inclusive, A represents a plurality of standards, in the present case of I-beam shape, set suitable distances apart in a concrete foundation F laid in the usual manner. The I-beam standards A are of a width over the flanges to correspond with the thickness of the wall to be erected, and are lined up on the line of the proposed wall so that the flanges *a, a* will extend in the direction of the wall. The standards are connected by reinforcing rods 1 which are shown as passing through the webs of the standards, although they may be bolted between two adjacent standards, or otherwise disposed, and if desired vertical reinforcing rods 2 may also be arranged between and in line with the standards.

In constructing a corner of a wall (Fig. 4) standards of angle iron shape may be used, that on the outside identified by the numeral 5 being larger than that on the inside lettered 6. In Fig. 5 I show a partition wall 7 abutting a main wall 8, the standard A of the main wall having channel iron standards 9, 9 of the partition wall secured to it in some suitable manner. In any case, it will be observed, the standards become a unitary part of the wall.

In forming wall openings for doors or windows, channel iron standards 10, 10 may

be used (Fig. 4) with the flanges turned in so as to present a smooth face for door and window frames.

Of course, while I show certain structural shapes for a given purpose, these shapes are not invariable, as any shapes or combination of shapes may be used that will give the desired result.

In Fig. 6 I show two side walls 8, 8', connected by an end wall 11 which has a tie rod 12 extending through it and anchored in the side walls. The side wall 8' has a row of studding 13, 13, etc., on the inside to receive lathing 14 for plaster. A double wall with an air space 15 is thus provided.

In Figs. 7 and 8 I show various hollow walls made according to my improved method; Fig. 7 showing a series of hollow tile 16 imbedded into the concrete filling 17, and Fig. 8 showing a row of studding 18 between the standards A covered with lath 19 said studding and lath being embedded in the concrete C.

In Fig. 9 is shown a double wall made by my method, the components 20, 20 of which are connected by a rod 21 passed through aligned standards A, A.

Fig. 10 shows in end elevation standards A, A, spaced apart for a heavy wall. The standards are imbedded in a suitable footing 22, and held in spaced relation by rods 23.

Figures 11 and 12 show standards that are built up. The former consists of two metallic plates 25, 25, clamping between them boards or timbers 26, 26, the bolt 27 serving to hold them in assembled relation, while the latter consists of three I-beams 28, 28, 28, bolted together to make a heavy standard. Fig. 13 also shows a standard made into I-beam shape by assembling a T 29, a plate 30, and two angle bars. This arrangement is useful when it is desired to fill in between the standards with monolithic slabs or blocks, avoiding hoisting them to the top of the standards. They can be placed between the standards horizontally and the plate afterward bolted or riveted to the angle bars.

Figs. 14 and 15 show composite columns made by my method. In the former, two channels 32, 32 are bolted in spaced relation and then boxed by a suitable form (not shown) which is filled with concrete so that the channels will be imbedded. When the channels do not have to be imbedded in the concrete, as shown in Fig. 15, four channels 33 are bolted together in spaced relation, one on a side, reinforcing rods 34 being arranged between them, and the concrete then poured into the form (not shown) of which the channels form a part. The composite columns may also be made of brick, concrete blocks, or other material, building them in position, placing therein during construc-

tion the standard attaching bolts to which the standards are afterward attached, or placing tubes therein through which the rods or bolts, or both, can be passed.

5 Structures or walls of a round or curved form can also be built, also standards curved to the form or arc of the circle desired can be used, as well as poly-angular walls built, and the method can also be applied to floors
10 and roofs.

For small structures re-enforced cross-walls are not necessarily required. In such cases cross-walls may be built of wood studding or other material, and the longitudinal
15 walls can be tied across at the floor or ceiling planes by steel beams or tie rods. Also, it is not necessary that standards be erected at the openings in the walls, or in the walls where cross-walls meet, as they may be
20 omitted where economy requires and the type of the structure permits; but it is the better practice to use the standards at not less distances than is required for convenient lengths of mold boards, and still better at
25 no greater distances apart than will provide contraction or expansion cracks or joints for the mass of molded material, the obviation of contraction cracks in a wall by this method being one of its advantages.

30 When the foundation or footing is under construction, additional re-enforcement can be provided by inserting rods therein to extend upwardly in the wall. Also, additional re-enforcement in the form of iron rods, bars,
35 lathing and the like can be inserted or embedded in the concrete between the standards.

Walls thicker than the cross-section of the standards can be built by placing thin removable wooden or other vertical studding
40 against either or both sides of the standards, or butts on the mold boards to hold them the desired distance from the metal standards.

Light steel standards may also be used
45 in many cases made of light sheet steel pressed to shape or pressed and riveted together to form standards of the desired shape. Such light steel shapes are sometimes called "steel lumber".

50 In all cases referred to, except in case of Fig. 14 it will be seen that the standards provide metal flanges, lugs, or faces, to which the mold boards may readily be clamped or held.

55 In some cases, particularly of one-story buildings or structures low in height, no horizontal or longitudinal rods or rigid re-enforcement for tying the standards together would be required between floor levels, so that the longitudinal reinforcement could be
60 provided by tie rods at or in the region of the floor level or levels. The aggregation of several tie rods in the region of a floor level, when filled with cement would act as a compound reinforced concrete beam.

The method of erection may be carried out as follows: Standards substantially as described are set up in their proper positions and held in position temporarily by means of braces or stays, or in any other suitable
70 manner. The rods are inserted through the standards and fastened by means of the heads on the ends of the tie rods and the threaded ends of same and nuts to match. When the frame has been erected the form
75 for the foundation is placed and the concrete poured in the form. When the form has been filled to the proper height, and the concrete has set sufficiently, the temporary stays, or part of them, may be removed. 80 The mold boards can then be applied to the standards, the concrete filled in, and the wall rapidly completed.

Or, without departing in principle from my method, the foundation may be molded
85 first, with suitable holes in the same where the standards are to be positioned, to receive the standards. When the foundation is set and sufficiently strong, the standards are set in the holes, and also, if necessary,
90 held to position by temporary stays or braces. The standards are then cemented solidly in the foundation, and the tie rods inserted and fastened. The mold boards are then applied to the standards, the concrete
95 filled in, and the wall completed.

In either case any additional tie rods or re-enforcement is added as the work progresses. For high buildings or dams or the like, after the lower tier is under way the
100 next higher tier can be constructed by bolting or riveting the extensions of the standards to the lower standards, tying them together with the rods as before and proceeding with the application of the mold boards
105 and filling in with concrete, and so on tier upon tier until the full height has been reached.

As soon as the concrete at any position lower down has set sufficiently the mold
110 boards can be removed and used higher up. In this manner dams and walls of great height can be built with little material for forms and without studding, and, due to the combination of structural steel and tie rods in conjunction with the concrete, with less
115 mass of material in the dam or wall, or total cost, yet of greater strength.

The term "metal standard" is to be understood in the sense of a principal member or members of a structure, usually structural
120 steel and to act as a column, pier, or pillar, and is intended to be used where desirable in lengths not less than one-story in height, and if applicable, in lengths of two or more stories in height, thus obviating the use of
125 many short sections or lengths, and thereby avoiding structural weakness, as well as difficulty and extensive labor in bolting or connecting numerous small metal frames or composite slabs together. The tie rods need
130

not be round but may be deformed to provide a better grip on the concrete, except that at their ends where threads are required for the nuts they are rounded for the purpose.

It is understood that I need not confine myself to the exact details in every case, but the same may be modified according to circumstances, and the wall may be adapted to many conditions not mentioned or described, of all of which I wish to avail myself.

Having described my invention, I claim—

1. A wall provided with a suitable footing, a series of metal standards in spaced relation longitudinally of the wall, said standard having flanges extending in the direction of the wall erected on said footing, tie

rods extending longitudinally between the standards, and a mass of concrete or equivalent material between the standards and extending between the flanges thereof.

2. A wall comprising a plurality of perpendicular structural steel standards spaced longitudinally of the wall, and having flanges extending in the direction of the wall, tie rods connecting said standards, and vertical tie rods transverse to the first mentioned tie rods, and a mass of concrete between the standards embedding the tie rods and having marginal tongues extending between the flanges of the standards.

In testimony whereof I hereunto affix my signature.

WILLIAM J. ARMBRUSTER.