No. 676,569. Patented June 18, 1901.

G. L. MOUCHEL.

WALL, PARTITION, SLAB, BLOCK, &c.

(Application filed Oct. 17, 1900.)

(No Model.) 3 Sheets—Sheet 1.

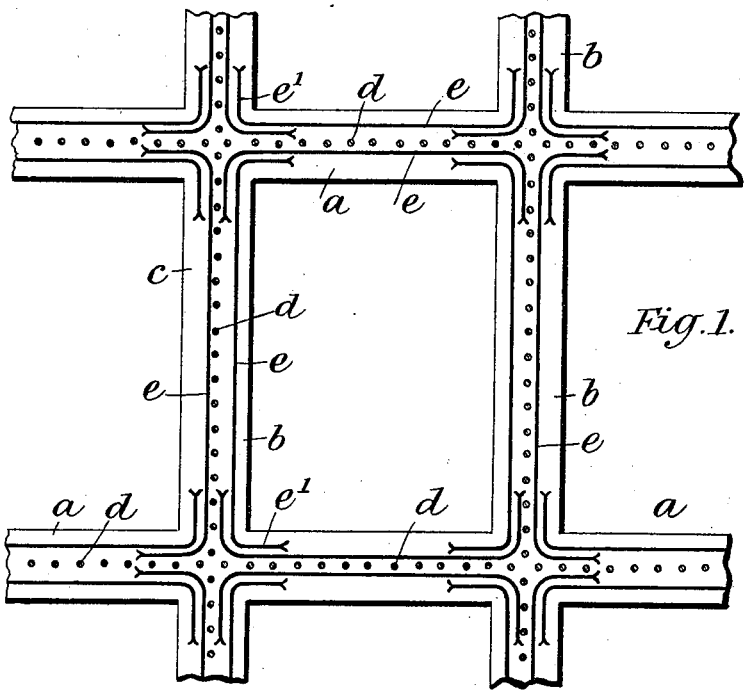

Fig. 1.

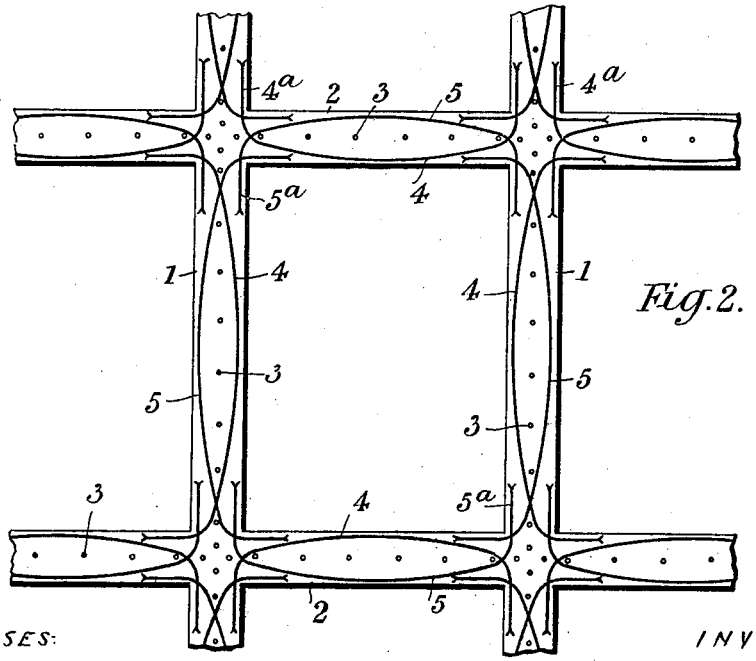

Fig. 2.

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Fig. 7.

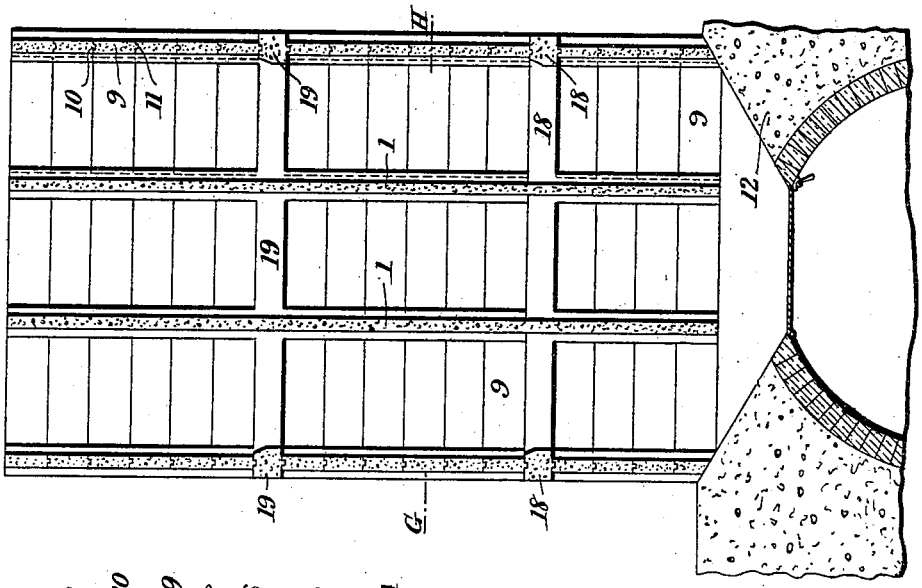

Fig. 5.

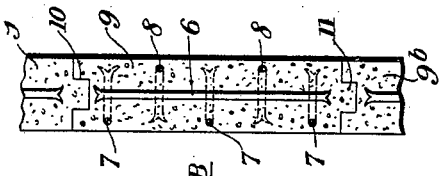

Fig. 3.

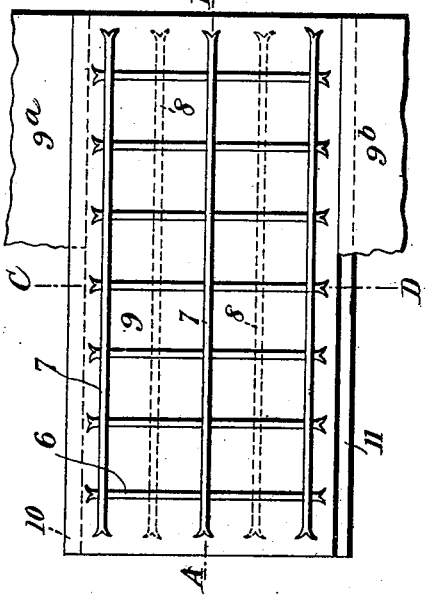

Fig. 4.

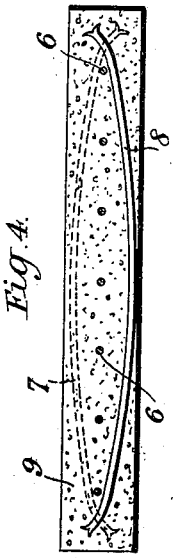

Fig. 6.

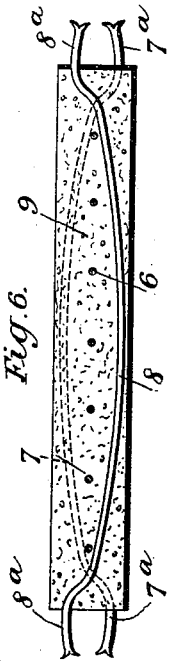

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Fig. 8.

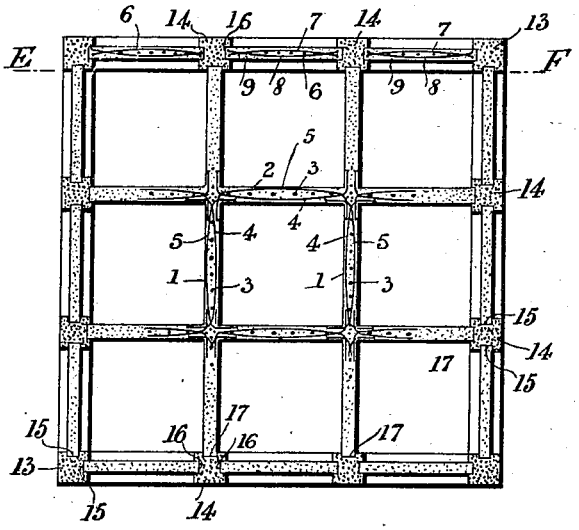


Fig. 9.

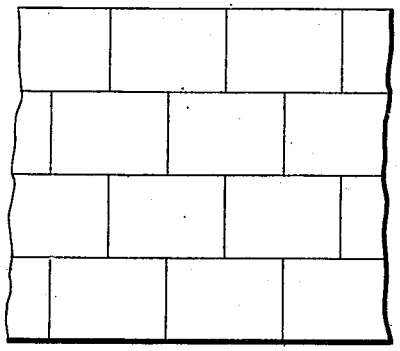
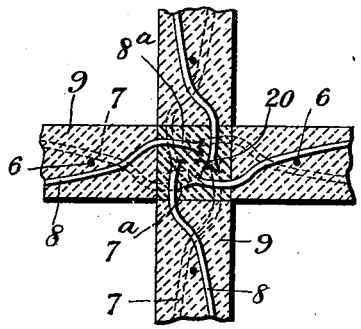


Fig. 10.



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UNITED STATES PATENT OFFICE.

GUSTAVE LOUIS MOUCHEL, OF LONDON, ENGLAND.

WALL, PARTITION, SLAB, BLOCK, &c.

SPECIFICATION forming part of Letters Patent No. 676,569, dated June 18, 1901.

Application filed October 17, 1900. Serial No. 33,341. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE LOUIS MOUCHEL, engineer, of 124 Holborn, in the city of London, England, have invented certain new and useful Improvements in Walls, Partitions, Slabs, Blocks, and the Like, of which the following is a specification.

This invention has for its chief object to provide an improved construction of concrete walls and vertical partitions capable of withstanding lateral or horizontal pressure—such, for example, as the outer and inner walls and partitions of silos, bins, granaries, warehouses, and other structures and receptacles. According to this invention I construct such outer and inner walls or vertical partitions of concrete having embedded in it a strengthening skeleton or framework of metal composed of vertical members—that is to say, members arranged substantially parallel with the inner or the outer sides of the wall or partition—in a suitable combination with rigid horizontal members—that is to say, members arranged substantially at right angles to the said vertical members. I make the vertical members of bars of iron or steel of any desired form in cross-section arranged parallel to one another at suitable intervals apart. I make the horizontal members of rigid bars of iron or steel curved or arched in a horizontal plane and having the convex side of the arch or curve directed in the opposite direction to that of the pressure the wall or partition is designed to withstand. In walls which are liable to horizontal pressure on both sides I arrange the horizontal members in two series—that is to say, I arrange one series of horizontal bars with their convex curvature or arch toward one side of the wall and I arrange another series of horizontal bars with their convex curvature or arch toward the opposite side of the wall. In general I prefer to arrange the ends of the one series of horizontal bars so as to overlap the ends of the other series of horizontal bars, so that the overlapping ends of the two oppositely curved or arched series of horizontal bars when seen in plan have the appearance of a swallow's tail. In the case of walls which are required to withstand horizontal pressure from one side only I may employ only one series of horizontal bars presenting their convex curvature or arch toward that side of the wall.

In constructing concrete walls or vertical partitions according to this invention I prefer to arrange the metal framework of the same in such a manner that the ends of the horizontal metal members or bars of each wall or partition will overlap in plan the ends of the horizontal members or bars of the adjacent and intersecting wall or walls or partition or partitions with the object of obtaining a better bond between the several walls and partitions at their junctions and intersections. Instead of making each wall in one solid piece at the time of erection I may construct such wall of self-contained wall bodies or slabs or blocks of concrete molded separately beforehand according to this invention. Such slabs may be made at their ends with tongues, grooves, or other suitable devices to facilitate making the joints on erection. The slabs may be made with the ends of their horizontal metal members either projecting from the concrete or embedded in the same. To form the angle or connection between four intersecting or adjacent walls, the slabs may be arranged in the form of a cross in such a manner as to inclose between them a rectangular cavity in plan and with the projecting ends of their horizontal metal members overlapping one another in plan in said cavity, which is then filled with concrete or cement to form the joint.

In the accompanying drawings, Figure 1 is a horizontal section of the walls of a silo, divided into vertical cells, constructed of concrete and iron in the manner hitherto practiced. Fig. 2 is a similar view of silo-walls constructed of concrete and iron in accordance with this invention. Fig. 3 is an elevation of a self-contained wall-body or slab constructed in accordance with this invention. Fig. 4 is a horizontal section on the line A B of Fig. 3, and Fig. 5 is a vertical section on the line C D of Fig. 3. Fig. 6 is a horizontal section of a modified form of slab. Fig. 7 is a vertical section on the line E F of Fig. 8 of a silo constructed in accordance with this invention. Fig. 8 is a hori-

zontal section on the line G H of Fig. 7. Fig. 9 is a diagrammatic plan illustrating a modified arrangement of the vertical silo-walls. Fig. 10 is a horizontal section illustrating a modified form of connection between four intersecting slab walls.

Referring first to Fig. 1, *a* indicates the vertical silo-walls extending in one general direction, and *b* indicates the vertical silo-walls extending at right angles to the walls *a*. The walls *a* and *b* are composed of concrete *c*, in which is embedded a metal skeleton composed of parallel vertical iron rods *d* and parallel horizontal iron rods *e*. The rods *d* extend, preferably, from top to bottom of the walls. The rods *e* extend a short distance beyond one intersection to another of the walls and are bent at their ends around the angles of the intersections of the walls, so as to strengthen the bond between the intersecting walls. This construction has, however, the great drawback that it requires a very large quantity of metal and concrete to withstand the stresses set up by the pressure of grain and the like materials in silos, granaries, &c.

Now in constructing silo-walls in accordance with my invention as illustrated in Fig. 2 I make the vertical walls 1 2 of concrete, in which are embedded vertical rods or bars 3, of any suitable metal and of any suitable shape in cross-section, arranged parallel to one another at suitable intervals apart, in combination with horizontal curved or arched rods or bars 4 5, of any suitable metal and of any suitable shape in cross-section, arranged parallel to one another at suitable intervals apart. One series of the horizontal bars—say the bars 4—are arranged with their convex curvature or arch toward one side of the concrete wall in which they are embedded, and the other series of bars 5 are arranged with their convex curvature or arch toward the opposite side of the said wall. The adjacent ends of the bars 4 5 overlap each other and are continued beyond the overlapping point and are bent at right angles, so as to be embedded in the concrete of the adjacent intersecting walls. As shown, the walls are formed in one piece by ramming or molding the concrete around the metal framework 3 4 5 without joint in the concrete at the time of erection. By using these curved or arched horizontal rods or bars of metal I am enabled to considerably reduce the quantity of materials (metal and concrete) as compared with the ordinary construction shown in Fig. 1.

In Figs. 3, 4, and 5, which show a vertical slab, 6 represents the vertical bars, and 7 8 are the curved horizontal bars, all embedded in the concrete 9 of the slab. The bars 7 are arched toward one side of the slab, and the bars 8 are arched toward the opposite side of the slab, the bars 7 and 8 being arranged in alternate order. The ends of the bars 7 8 overlap each other toward the ends of the slab and are continued beyond the overlapping point, but do not project beyond the ends of the slab. 10 is a groove, and 11 is a tongue, formed, respectively, at the top and bottom of the slab and adapted to engage and be grouted together with the tongue and groove of the next upper slab 9^a and the next lower slab 9^b, respectively, of a vertical wall. Any other suitable mode of connection and form of joint may be employed. Fig. 6 shows a slab in which the horizontal bars project from the slab, as represented at 7^a and 8^a.

In the silo shown in Figs. 7 and 8 the outer walls are formed of separate slabs, as illustrated in Figs. 3, 4, and 5, while the inner walls or partitions 1 2 are constructed in one piece in the manner illustrated in Fig. 2. 12 represents the foundation upon which the concrete and iron corner-pillars 13 are erected, with intermediate pillars 14, also composed of concrete and iron. The corner-pillars 13 are formed on their two inner sides with vertical grooves 15. Each intermediate pillar 14 is formed with similar corresponding grooves 16, situated opposite to the groove 15, and also with a groove 17 in its inner face. The network of inner vertical walls 1 2 is molded in position from each groove 17 in one intermediate pillar 14 across to the corresponding groove 17 in the opposite intermediate pillar. At the junction of the walls 1 2 with the pillars 14 the ends of the horizontal bars 4 5 are carried into the grooves 17, which are then rammed up with concrete, so as to effect a firm union of the walls 1 2 with the pillars 14. The grooves 17 may, however, be dispensed with and the pillars 14 be carried up simultaneously in one piece with the walls 1 2. To form the outer walls, slabs 9 (which are preferably made beforehand, so as to be properly set and hard when built in) are slipped one on top of the other in vertical succession in the grooves 15 and 16 of the pillars 13 and 14, the grooves 10 in the slabs being filled with grout to form secure horizontal joints between the slabs. Grout is run into the grooves 15 and 16 to make secure vertical joints between the ends of the slabs 9 and the pillars 13 14. When the walls have been carried up to a determined height, a horizontal beam 18 is molded around the top of the walls and in one piece with the pillars 13 14. This horizontal beam is formed with the grooves required to make joints between it and the slabs and the inner walls. The outer slab walls and the inner monolithic walls are then carried up to a further extent, whereupon a further horizontal beam 19 is carried around the top of the silo-walls, and so on. Instead of being supported on a solid foundation 12 the walls and pillars may be carried on pillars or the like.

Instead of arranging the silo-walls in the same plane as shown in Fig. 8 they may be arranged in staggered order, as shown in Fig.

9. The corner and intermediate pillars may also be made of any suitable metal or other material, and the slabs and inner walls may be connected to the pillars by any suitable means.

Fig. 10 illustrates the preferred mode of forming the angle or connection between four intersecting or adjacent self-contained wall-bodies or slabs of the kind shown in Fig. 6. As shown, the slabs 9 are arranged in the form of a cross, so as to inclose between them a cavity 20 of rectangular form in plan. The projecting ends 7^a 8^a of the horizontal metal members 7 8 of each slab are arranged to overlap one another in plan in the cavity 20, which is then filled with concrete or cement to form the joint.

What I claim, and desire to secure by Letters Patent, is—

1. In walls, the combination of a wall-body of concrete, straight stiffening metal bars embedded in said body, curved rigid metal bars embedded in said body and arranged approximately at right angles to said straight bars and with their convex curvatures toward that face of the wall on which the pressure acts which the wall is required to withstand, substantially as set forth.

2. In walls, the combination of a wall-body of concrete, straight stiffening metal bars embedded in said body, curved rigid metal bars embedded in said body and arranged approximately at right angles to said straight bars and with their convex curvatures directed respectively toward opposite faces of the wall, substantially as set forth.

3. In walls, the combination of a wall-body of concrete, straight stiffening metal bars embedded in said body, curved rigid metal bars embedded in said body and arranged approximately at right angles to said straight bars and with their convex curvatures directed respectively toward opposite faces of the wall, and with their adjacent ends overlapping substantially as set forth.

4. In walls, the combination of a plurality of intersecting wall-bodies of concrete, straight vertical stiffening metal bars embedded in each body, curved horizontal rigid metal bars embedded in each body, and arranged with their ends overlapping in plan the adjacent ends of the horizontal rigid metal bars in the intersecting wall-bodies, substantially as set forth.

5. In walls, the combination of a plurality of self-contained wall-bodies or slabs of concrete, straight stiffening metal bars embedded in each slab, and curved rigid metal bars embedded in each slab and arranged approximately at right angles to said straight bars, and with their adjacent ends overlapping, substantially as set forth.

6. In walls, the combination of a plurality of self-contained wall-bodies or slabs of concrete, straight stiffening metal bars embedded in each slab, and curved rigid metal bars embedded in each slab and arranged approximately at right angles to said straight bars, and with their adjacent ends overlapping and projecting from said slabs, substantially as set forth.

7. In walls, the combination of a plurality of intersecting self-contained wall-bodies or slabs of concrete, vertical stiffening metal bars embedded in each slab, curved horizontal rigid metal bars embedded in each slab and arranged approximately at right angles to said vertical bars and with their adjacent ends overlapping in plan, parallel pillars formed with vertical grooves in their sides to receive the ends of the slabs, and grouted joints between the said slabs and between the ends of said slabs and the said pillars, substantially as set forth.

8. In walls, a plurality of intersecting wall-bodies of concrete, straight vertical stiffening metal bars embedded in each body, curved horizontal rigid metal bars embedded in each body, with their ends projecting from said body and overlapping in plan the adjacent ends of the horizontal bars in the other intersecting wall-bodies, and cement concrete filling up the space inclosed by the intersecting wall-bodies and surrounding the said projecting ends of the horizontal bars, whereby a firm union is produced between the intersecting wall-bodies, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

GUSTAVE LOUIS MOUCHEL.

Witnesses:

GEORGE ALEXANDER ROSS,

RICHARD FRANKLAND RIGBY.