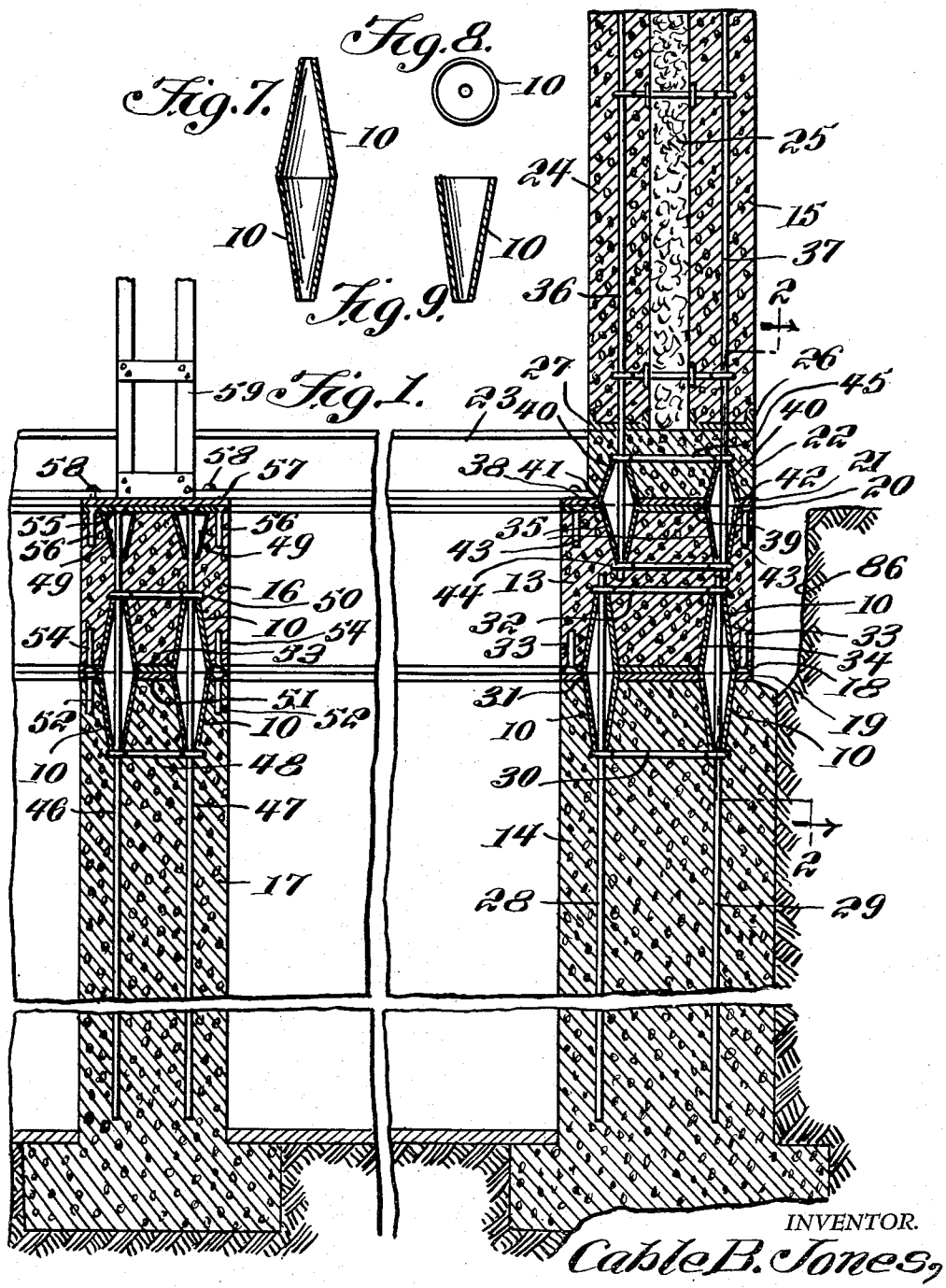
Sept. 28, 1954 C. B. JONES 2,690,074

EARTHQUAKE RESISTANT CONCRETE STRUCTURE

Filed March 27, 1952 3 Sheets-Sheet 1



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EARTHQUAKE RESISTANT CONCRETE STRUCTURE

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Fig. 2.

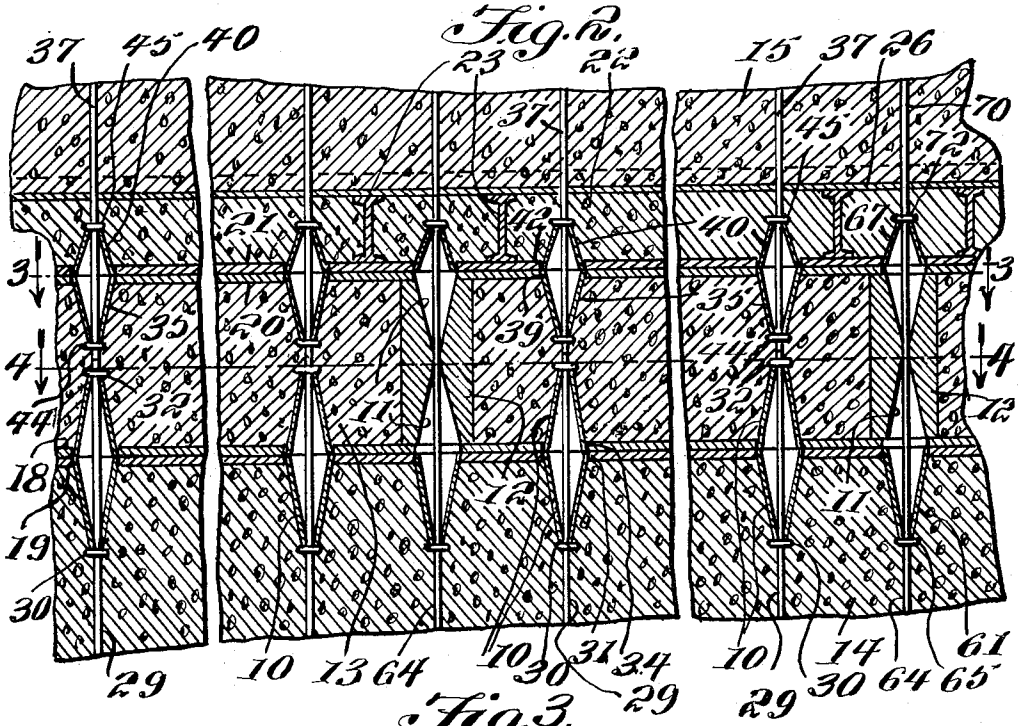


Fig. 3.

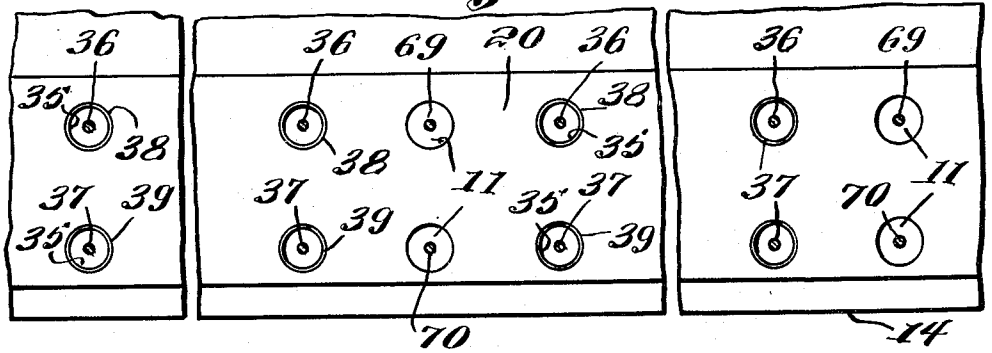


Fig. 10.



Fig. 11.

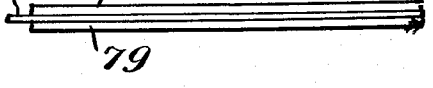
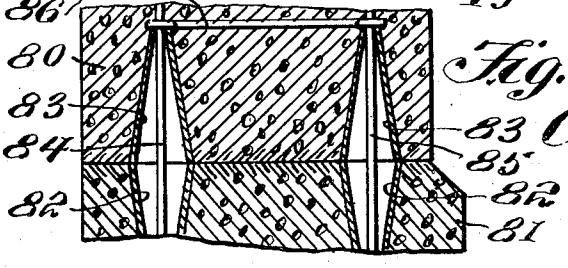


Fig. 12.



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Fig. 6.

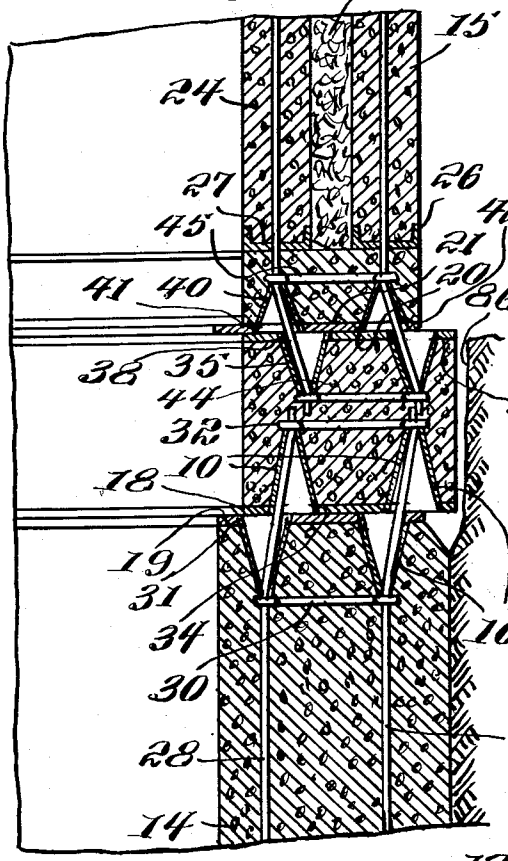


Fig. 5.

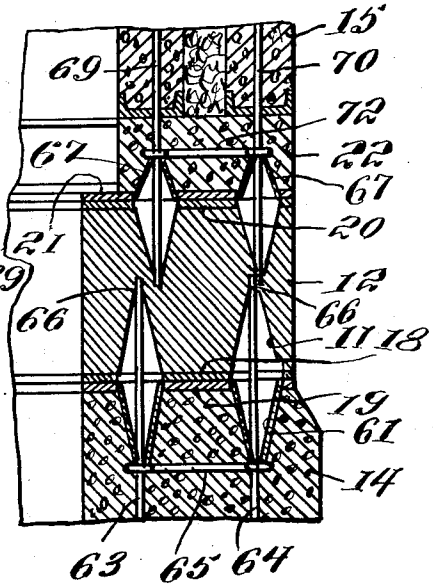
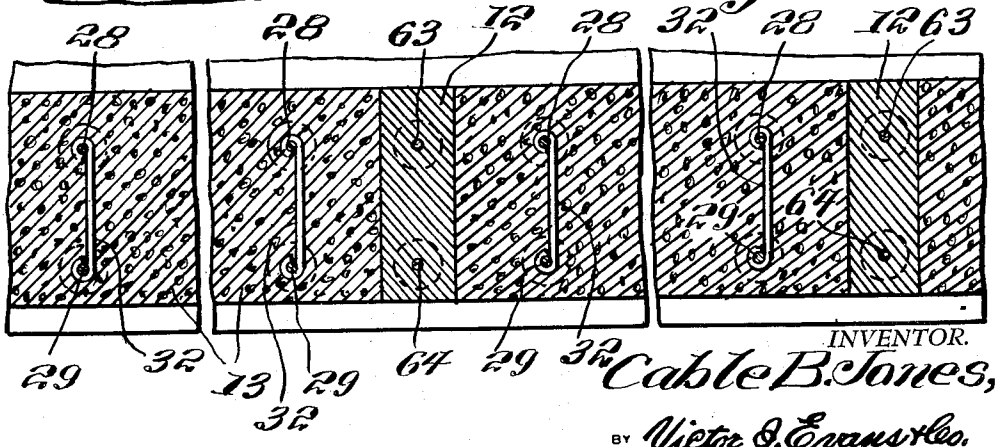


Fig. 4.



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EARTHQUAKE RESISTANT CONCRETE STRUCTURE

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8 Claims. (Cl. 72—77)

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This invention relates to buildings designed to resist earthquake tremors, and in particular a break or slip block section inserted between the upper edge of a foundation wall and the lower edge of a building wall which is designed to slip or slide when an earthquake shakes a building in which the block is installed to compensate for lateral strain between the foundation and wall structure and to provide means that may be repaired.

During an earthquake of high intensity that would be total destruction to an ordinary building, a slip block section including sections of concrete positioned between spaced metal blocks then becomes the break block section and is designed to give and break to save all walls above from damage. As the metal blocks are much stronger than the concrete they would be intact and in place after the concrete was broken to hold up the building. After the disturbance is over the damage may be repaired by cleaning out the broken concrete and refilling with concrete.

The purpose of this invention is to provide means for absorbing the shock load caused by earthquakes between foundations and walls of buildings whereby damage to the building structure caused by an average earthquake is substantially eliminated.

Various types of wall joints using ball and roller bearings, rocker arms, springs and other devices have been used to prevent damage to building walls but it is difficult to provide mechanically actuated instrumentalities that may actuate only once in several years that will not rust or corrode or become inoperative for lack of use. With this thought in mind this invention contemplates a shock absorbing structure adapted to be incorporated in the wall structure of a building or the like wherein a certain amount of give or slip is permitted between elements of the structure without damaging the superstructure and in which the affected elements may be repaired.

The object of this invention is, therefore, to provide means for constructing a slip joint for building structures that may be incorporated in the lower ends of walls which absorbs differences in strain between the elements of the structures caused by shock loads such as earthquakes and the like.

Another object of the invention is to provide a safety slip or break block section adapted to be incorporated in footings of walls of buildings

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that may be used without changing the general design or arrangement of the building.

A further object of the invention is to provide a slip or break block section for building walls and the like, which involves comparatively simple and economical construction.

With these and other objects and advantages in view the invention embodies a metal block having conical-shaped cavities extended into the interior thereof from the upper and lower surfaces with reinforcing rod openings extended from the small ends of the cavities into the block, and conical shaped forms positioned over reinforcing rods in the wall between the metal blocks with tie rods connecting the reinforcing rods extended through the inner ends of the forms.

Other features and advantages of the invention will appear from the following description taken in connection with the drawings wherein:

Figure 1 is a typical cross section through a concrete partition and outer wall of a building structure showing the conical shaped forms connecting the slip or break blocks to the foundation and upper wall structure.

Figure 2 is an inner elevational view of a building wall with the slip block positioned therein with parts broken away on line 2—2 of Figure 1, and shown in section.

Figure 3 is a sectional plan through the wall shown in Figure 2 being taken on line 3—3 of Figure 2.

Figure 4 is a similar sectional plan being taken on line 4—4 of Figure 2.

Figure 5 is a vertical section similar to that shown in Figure 1 showing a section through one of the metal slip blocks.

Figure 6 is a section similar to that shown in Figure 1 showing the slip block of the outer wall extended outwardly in the position to which it may be moved by an earthquake or the like.

Figure 7 is a vertical section through one of the conical shaped forms showing a combination of upper and lower forms.

Figure 8 is a plan view of one of the conical shaped forms.

Figure 9 is a vertical section through a single form.

Figure 10 is a detail illustrating a pair of plates positioned between the concrete areas of the wall and foundation.

Figure 11 is a similar view showing an intermediate plate of non-corrosive metal or stainless steel positioned between the plates shown in Figure 10.

Figure 12 is a portion of a section similar to

that shown in Figure 1 illustrating a concrete to concrete joint without metal plates between the sections.

Referring now to the drawings wherein like reference characters denote corresponding parts the slip or break block section of this invention includes conical shaped forms 10 or similarly shaped cavities 11 in a metal block 12 or slip block section 13 positioned between the upper end of a foundation wall 14 and a building wall 15, or blocks 16 positioned upon the upper ends of columns or partition footings 17.

The slip block section 13 is provided with a slip plate 18 that rests upon a slip plate 19 on the upper end of the foundation wall 14 and a similar plate 20 is used on the upper end of the section 13 with a corresponding plate 21 positioned to coact therewith. The plate 21 is provided on the under side of a section 22 that extends throughout the wall 15 between the floor joists 23.

In this design the wall 15 is provided with an inner wall section 24 and the area between the inner and outer wall sections may be filled with rock wool 25 or other suitable insulating material. The lower ends of the sections 15 and 24 of the wall may be provided with channels 26 and 27, respectively, as illustrated in Figure 1.

In pouring a foundation wall with a slip block section incorporated therein the concrete is poured up to about 20 inches of the first or ground floor joist with the vertically disposed reinforcing rods 28 and 29 therein and these rods are carefully positioned so that they will register with the forms or cavities of slip block sections. Where the cone forms are used, the forms 10 are positioned over the upper ends of the rods 28 and 29 and with the forms suspended in the position shown in Figure 1 the rods 28 and 29 are connected by tie rods 30 which extend through the concrete below the lower ends of the forms 10. Pouring of the concrete is then continued until the upper level of the wall substantially corresponds with the upper ends of the forms and the bearing plate 19, which is provided with openings 31 to receive the large ends of the forms, is positioned on the upper surface of the foundation wall.

Inverted conical shaped forms 10 are then placed over the rods 28 and 29 and the upper ends of the rods are connected by tie bars 32. The plate 18, which is secured to the lower surface of the section 13 is held in place by studs 33 and this plate is also provided with openings 34 similar to the openings 31 in the plate 19 and through which the upper or inverted cones 10 pass.

The section 13 is also provided with conical shaped forms 35 that are suspended from a plate 20 on the upper surfaces thereof.

The forms 35, which are held on the lower ends of reinforcing rods 36 and 37 of the upper building wall 15 are positioned in openings 38 and 39 in the plate 20 and the openings and forms register with similar forms 40 in openings 41 and 42 of the plates 21 on the lower end of the floor joist section 22. The plate 20 is secured on the upper end of the section 13 by studs 43 similar to the studs 33. The lower ends of the rods 36 and 37 are held together by tie bars 44 and the upper part of the rods above the forms 40 are held by tie bars 45.

The lower ends of the rods 36 and 37 are offset in relation to the upper ends of the rods 28 and 29, as shown in Figure 1, whereby the reinforcing rods of the wall section are not connected to the reinforcing rods of the foundation wall.

The abutting ends of the cones of the slip block section, building wall and foundation are not joined whereby the cones are free to slide laterally, bending the rods, as shown in Figure 6.

With the slip or brake block section incorporated in a building wall in this manner a sudden shock, such as that resulting from an earthquake may shift the blocks, which breaks a continuous joint between the foundation wall and upper wall section whereby the break block will slip laterally, as illustrated in Figure 6, toward either side and in this movement the conical shaped forms will be offset as illustrated in Figure 6. The upper wall section may, however, remain in the correct position upon the foundation wall, as shown.

A slip block section 16 on the wall or column 17 is formed in a similar manner with conical shaped forms 10 embedded in the upper end of the column 17 and positioned over reinforcing rods 46 and 47 with the rods tied together by tie rods 48. Upper forms 10 are positioned in the block 16 and the upper part of the block may be provided with cavities 49 through which the rods 46 and 47 extend. The upper parts of the rods may also be tied or held together by tie rods 50. The upper surface of the column 17 is provided with a plate 51 that is secured in position by studs 52 and the lower surface of the section 16 is provided with a plate 53 that is secured in position by studs 54. The upper surface of the section 16 is provided with a plate 55 that is secured in position by studs 56, and a corresponding plate 57 is secured to the floor joist 23 by rivets 58. An upper column section 59 may be positioned on the plate 57.

As illustrated in Figures 2 and 5 the slip block section 13 is provided with spaced metal blocks 12, the upper and lower surfaces of which are provided with cavities 11 corresponding with the conical shaped forms 10 and the cavities in the lower side are positioned to register with conical shaped forms 61 in the foundation wall 14, the forms 61 being positioned over reinforcing rods 63 and 64 and the rods being secured together by tie bars 65. The upper ends of the bars 63 and 64 extend into openings 66 positioned beyond the ends of the cavities 11 in the blocks 12.

The metal blocks 12 are positioned at spaced intervals in the slip block section and, in the event of rupture, carry the load of the building while the concrete sections are being repaired.

The cavities in the upper surface of the block 12 are positioned to register with conical shaped forms 67 in the section 22 and the forms 67 are positioned on the lower end of reinforcing rods 69 and 70 positioned in a wall 15. The lower ends of the rods 69 and 70 are connected by tie bars 72.

Metal slip plates 20 and 21 are positioned between the blocks 12 and foundation wall 14 and similar plates 18 and 19 are positioned between the blocks 12 and floor joist section 22.

The metal blocks 12 are positioned at spaced intervals throughout the length of the wall and conical shaped forms 10, as illustrated in Figure 1 are positioned at spaced intervals between the metal blocks.

As illustrated in Figure 11 intermediate plates 77 may be positioned between slip plates 78 and 79 similar to the plates 18 and 19, or corresponding plates of the other sections and the plates 77 may be formed of stainless steel or other non-corrosive material. The intermediate plates 77 are used to prevent corrosion between the upper and

lower slip plates. It will also be understood that graphite or other suitable lubricating material may be used between the plates.

In the design illustrated in Figure 12 wherein the slip plates are eliminated a slip or break block section 89, similar to the sections 12 and 13 is shown on the upper surface of a wall 81 with a cold joint between the sections, the concrete of the wall 81 having set and being hard before the section 80 is placed thereon. In this design the wall 81 is provided with forms 82 and the section 80 with forms 83, similar to the forms 10. Reinforcing rods 84 and 85 are also extended through the forms and the rods are secured together by tie bars 86.

The split or brake block sections may, therefore, be formed as illustrated in Figure 1, or as illustrated in Figure 5 and the different types of sections may be used independently, or both may be used together as illustrated in Figure 4 wherein the sections illustrated in Figure 1 are spaced between the sections 12 illustrated in Figure 5. With the slip or break block sections installed in a wall and with the soil spaced from the outer surface of the wall and formed with a terrace line 88 the upper wall sections of a building are protected against shifting by the average earthquake tremor, the same as a shear pin protects a motor or other power source from a shock, or overload. The shock or lateral strain resulting from earthquake tremors or earthquakes may shift the slip or break block section laterally, as illustrated in Figure 6 without damaging the upper wall section and after the disturbance has subsided the slip block section may be repaired.

With the slip block section formed in this manner excessive shock loads may cause the concrete between the metal blocks to break or crumble and after the disturbance has subsided the broken concrete may be removed and the areas formerly occupied thereby filled with fresh concrete. In order to insert the fresh concrete it may be necessary to build forms around the damaged parts of the structure.

It will be understood that modifications may be made in the design and arrangement of the parts without departing from the spirit of the invention.

What is claimed is:

1. A building wall comprising a foundation wall, a slip block section positioned on the foundation wall, an upper wall section positioned on the said slip block section, the adjoining surfaces of the said foundation wall and slip block sections having registering cavities therein, and the adjoining surfaces of the said upper wall section and slip block section also having registering cavities therein, reinforcing rods in the foundation wall extended through the cavities in the adjoining surfaces of the foundation wall and slip block section, and reinforcing rods in the building wall extended through the cavities in the adjoining surfaces of the building wall and slip block section.

2. A building wall comprising a foundation wall, a slip block section positioned on the foundation wall, an upper wall section positioned on the said slip block section, the adjoining surfaces of the said foundation wall and slip block section having registering conical shaped cavities therein, and the adjoining surfaces of the said upper wall section and slip block section also having registering conical shaped cavities therein, reinforcing rods in the foundation wall extended through the cavities in the adjoining surfaces of the foundation wall and slip block section, and reinforcing rods in the building wall extended through the cavities in the adjoining surfaces of the building wall and slip block section.

3. A building wall comprising a foundation wall, a slip block section positioned on the foundation wall, an upper wall section positioned on the said slip block section, conical shaped forms positioned in the adjoining surfaces of the said foundation wall and slip block section, conical shaped forms positioned in the adjoining surfaces of the said upper wall section and slip block section, said conical shaped forms being positioned in registering relation, reinforcing rods in the foundation wall extended through the conical shaped forms in the adjoining surfaces of the foundation wall and slip block section, and reinforcing rods in the building wall extended through the conical shaped forms and adjoining surfaces of the building wall and slip block section.

4. In a building having walls positioned upon foundation walls the combination which comprises blocks with spaced cavities in the upper and lower surfaces positioned between the building and foundation walls, said building wall having corresponding cavities positioned to register with the cavities in the upper surface of the block, said foundation wall having spaced cavities positioned to register with the spaced cavities in the lower surface of the blocks, reinforcing rods extended from the foundation wall through the cavities in the upper surface thereof and into the cavities in the lower surface of the block, and reinforcing rods in the wall section extended through the cavities therein and into the cavities in the upper surface of the blocks.

5. In a building having walls positioned upon foundation walls the combination which comprises blocks with spaced cavities in the upper and lower surfaces positioned between the building and foundation walls, said building wall having corresponding cavities positioned to register with the cavities in the upper surfaces of the blocks, said foundation wall having spaced cavities positioned to register with the spaced cavities in the lower surfaces of the blocks, reinforcing rods extended from the foundation wall through the cavities in the upper surface thereof and into the cavities in the lower surfaces of the blocks, reinforcing rods in the wall section extended through the cavities therein and into the cavities in the upper surfaces of the blocks, and horizontally disposed slip plates between the adjoining surfaces of the building wall and blocks and foundation wall and blocks, respectively.

6. In a building having walls positioned upon foundation walls the combination which comprises blocks with spaced cavities in the upper and lower surfaces positioned between the building and foundation walls, said building wall having corresponding cavities positioned to register with the cavities in the upper surfaces of the blocks, said foundation wall having spaced cavities positioned to register with the spaced cavities in the lower surfaces of the blocks, reinforcing rods extended from the foundation wall through the cavities in the upper surface thereof and into the cavities in the lower surfaces of the blocks, reinforcing rods in the wall section extended through the cavities therein and into the cavities in the upper surfaces of the blocks, horizontally disposed slip plates between the adjoining surfaces of the building wall and blocks and foundation wall and blocks, respectively, and

means between the said slip plates for preventing corrosion therebetween.

7. In a building having walls positioned upon foundation walls the combination which comprises blocks with spaced cavities in the upper and lower surfaces positioned between the build- and foundation walls, said building wall having corresponding cavities positioned to register with the cavities in the upper surfaces of the blocks, said foundation wall having spaced cavities positioned to register with the spaced cavities in the lower surfaces of the blocks, reinforcing rods extended from the foundation wall through the cavities in the upper surface thereof and into the cavities in the lower surfaces of the blocks, reinforcing rods in the wall section extended through the cavities therein and into the cavities in the upper surfaces of the blocks, horizontally disposed slip plates between the adjoining surfaces of the building wall and blocks and foundation wall and blocks, respectively, means between the said slip plates for preventing corrosion therebetween, spaced metal blocks with conical shaped cavities in the upper and lower surfaces positioned in the said slip block sections, conical shaped forms in the upper surface of the foundation wall and lower surface of the building wall positioned to register with the cavities in the adjoining surfaces of the blocks, and reinforcing rods extended from the foundation wall and building wall through the said conical shaped forms and cavities, respectively.

8. In a building having walls positioned upon foundation walls the combination which comprises blocks with spaced cavities in the upper and lower surfaces positioned between the build- and foundation walls, said building wall having corresponding cavities positioned to register with the cavities in the upper surfaces of the blocks, said foundation wall having spaced cavities positioned to register with the spaced cavities in the lower surfaces of the blocks, reinforcing rods extended from the foundation wall through the cavities in the upper surface thereof and into the cavities in the lower surfaces of the blocks, reinforcing rods in the wall section extended through the cavities therein and into the cavities in the upper surfaces of the blocks, horizontally disposed slip plates between the adjoining surfaces of the building wall and blocks and foundation wall and blocks, respectively, means between the said slip plates for preventing corrosion therebetween, spaced metal blocks with conical shaped cavities in the upper and lower surfaces positioned in the said slip block sections, conical shaped forms in the upper surface of the foundation wall and lower surface of the building wall positioned to register with the cavities in the adjoining surfaces of the blocks, reinforcing rods extended from the foundation wall and building wall through the said conical shaped forms and cavities, respectively, and plates positioned on the adjoining surfaces of the building wall, and foundation wall and slip block sections.

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