

Feb. 12, 1957

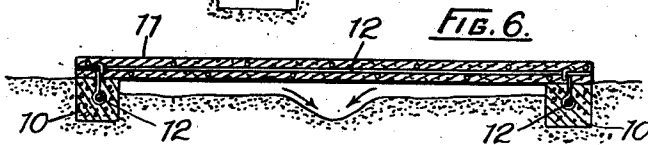
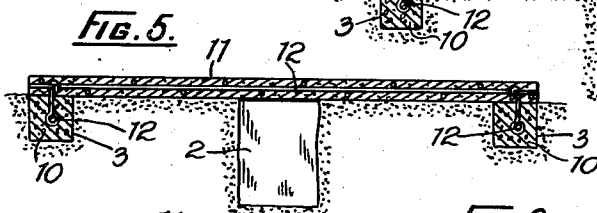
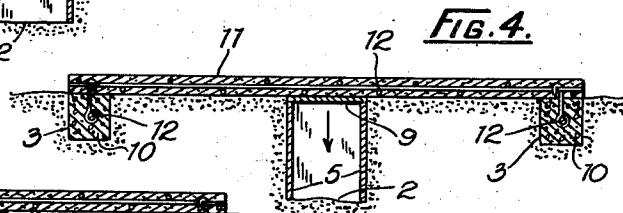
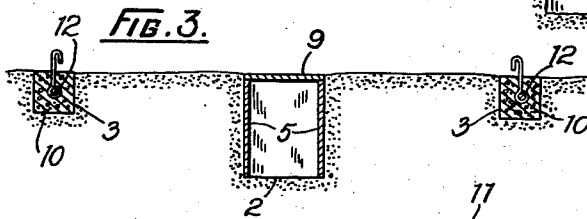
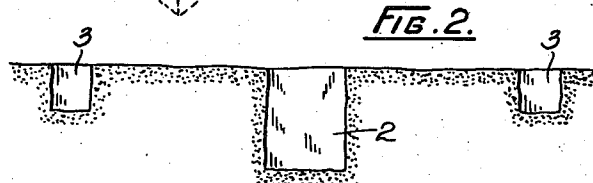
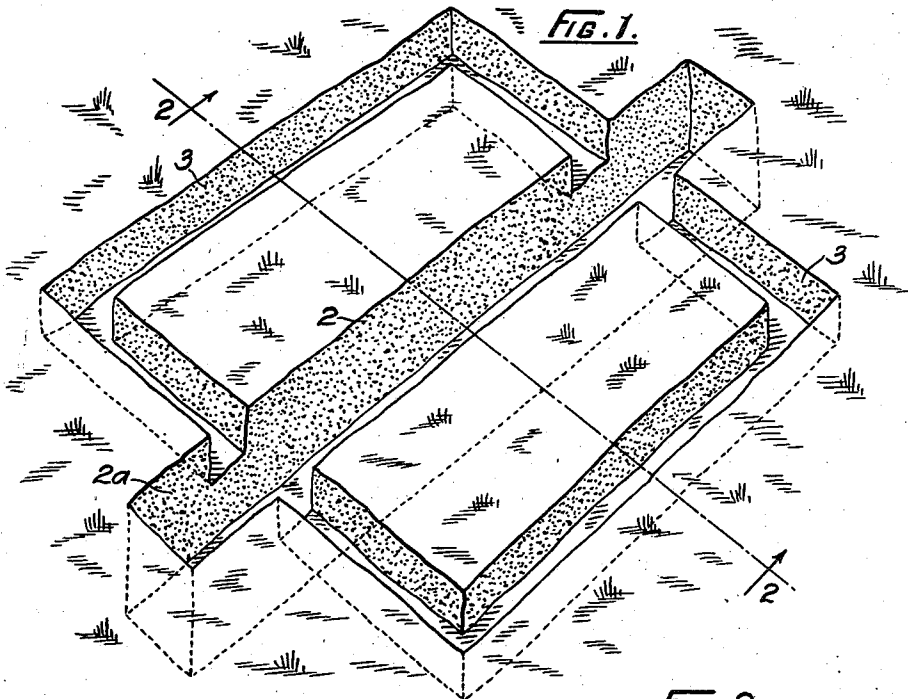
R. W. RUMBLE

2,780,935

METHOD OF MAKING A FLOOR SLAB

Filed Nov. 26, 1952

3 Sheets-Sheet 1



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AGENTS

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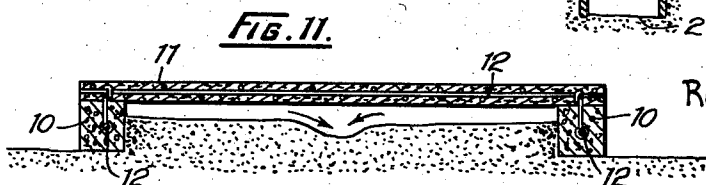
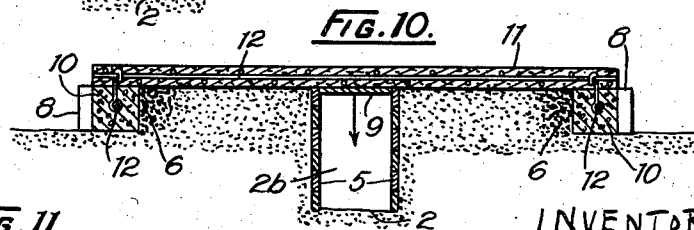
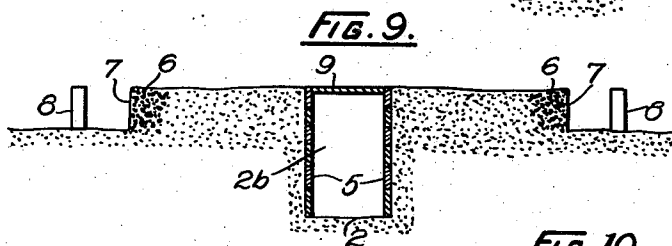
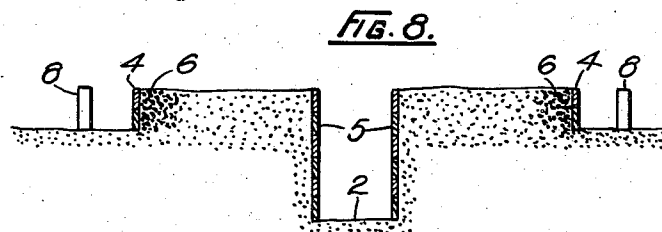
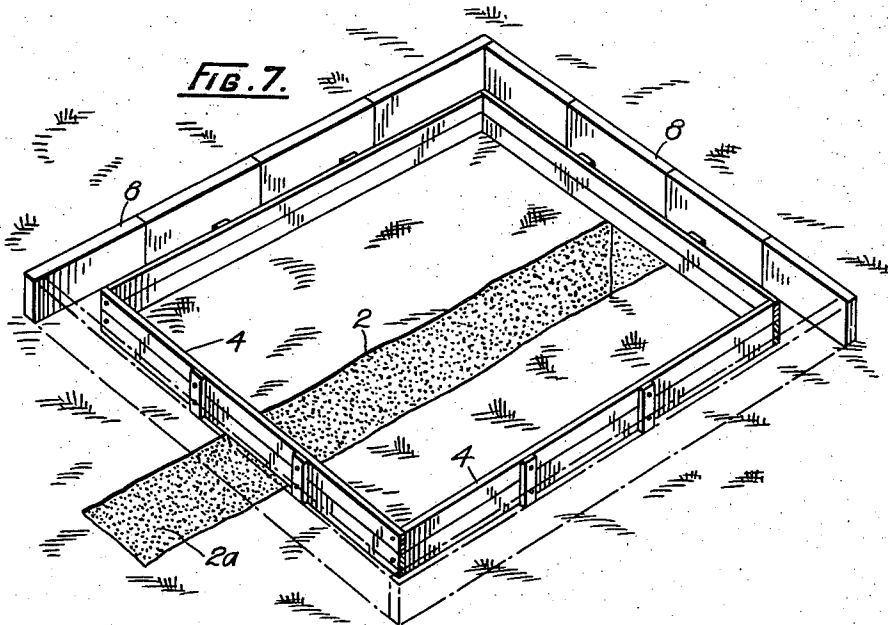
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METHOD OF MAKING A FLOOR SLAB

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3 Sheets-Sheet 2



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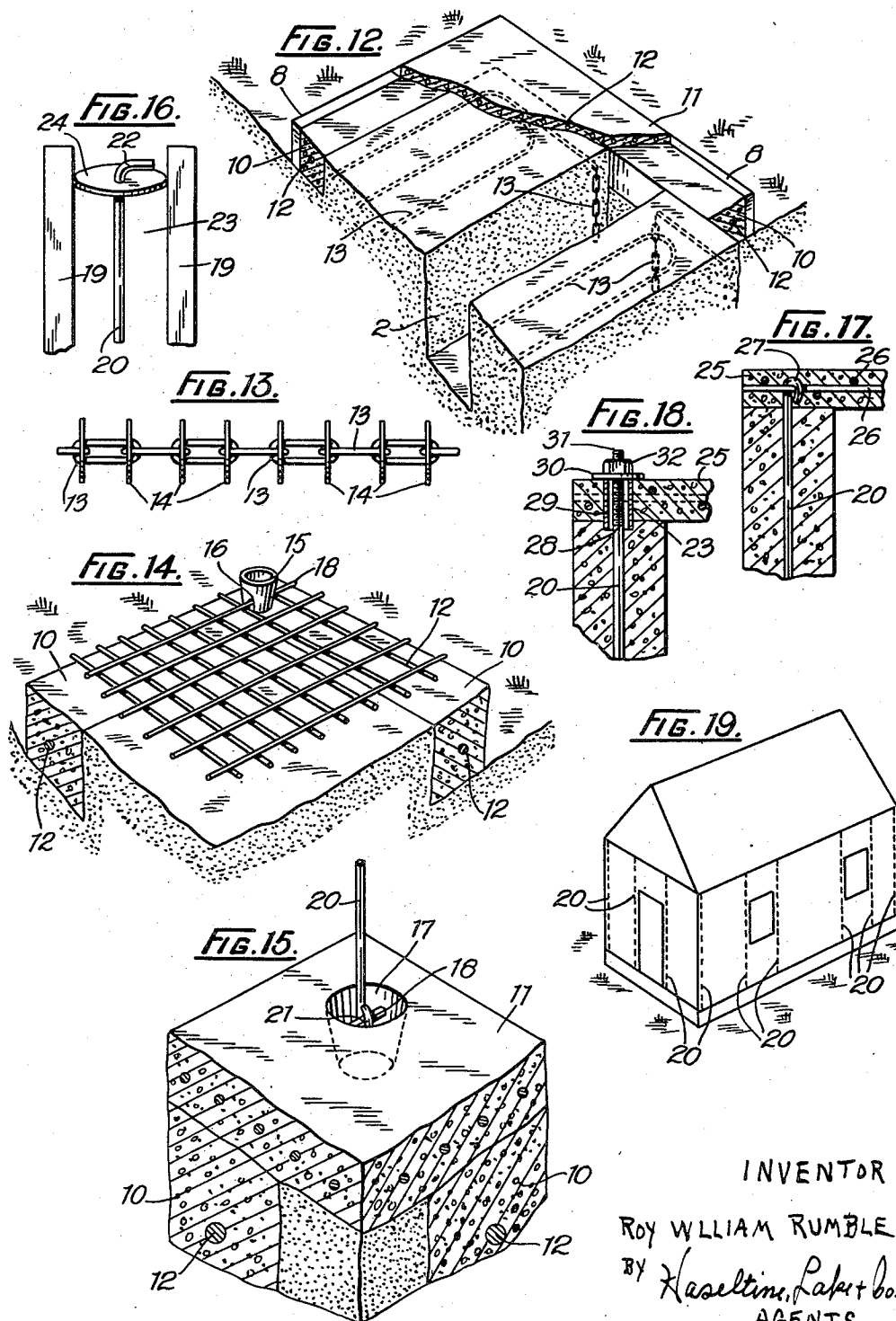
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METHOD OF MAKING A FLOOR SLAB

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3 Sheets-Sheet 3



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2,780,935

METHOD OF MAKING A FLOOR SLAB

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Claims priority, application Union of South Africa
December 11, 1951

5 Claims. (Cl. 72—77)

This invention relates to the art of building on ground that is subject to occasional or more or less continuous heaving. Ground of this nature has been encountered in many areas where it has been found that the foundations and walls of buildings erected by conventional methods are apt to be badly damaged due to earth movements.

The object of the present invention is to provide a method that produces buildings suited to this type of terrain.

According to the invention, a method of erecting the floor of a building includes the steps of digging a trench across the levelled site of the building, roofing the trench with deck shuttering (the molding face of which is at site level) to form a tunnel, casting the perimetrical foundation of the building, casting a floor slab on and between the foundations, withdrawing the shuttering through the tunnel, and finally withdrawing earth from under the slab and into the tunnel to leave the underface of the slab substantially fully exposed with the slab supported by the perimetrical foundation.

The walls of the trench are shuttered so as to prevent caving, the shuttering being removed after the foundation and slab have been formed and before earth is withdrawn into the tunnel.

The invention provides also that the molding spaces for the foundations be shuttered. If the foundations are to be above existing ground levels, inner and outer shuttering are provided to project thereabove and define the outline of the foundation. The space inclosed by the inner shuttering is filled with earth which is rammed at least adjacent the inner shuttering. The inner shuttering is then removed, and the foundations cast between the outer shuttering and the exposed vertical surfaces of the earth fill. Internal beams are cast in the same way save that the shuttering used to define the sides thereof are removed and the beams are cast between the resulting earth walls. Preferably the surfaces of the temporary shuttering that face away from the molding space are smooth and plane, to facilitate removal of the shuttering.

The invention provides further that the walls of the building are to be built on foundations made as specified above and tied directly to the foundations along their complete height. To achieve this purpose, cores are located in the foundations to expose a portion of a reinforcing rod or rods at intervals along the length of the foundation. The lower end of a tie is engaged with each exposed rod portion and the ties are held vertical during casting whereby they are embedded in the walls.

The upper ends of the ties are secured at the tops of the walls.

The preferred method of the invention, with some alternative details, is illustrated in the accompanying drawings in which:

Figure 1 is a perspective view of an excavation for a foundation in accordance with the invention;

Figure 2 is a vertical section of the excavation of Figure 1 along lines 2—2;

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Figure 3 shows an advanced stage of the process wherein the central ditch is provided with shuttering and the foundation is cast in peripheral ditches;

Figure 4 shows a further stage of the process wherein flooring is supported by the foundation;

Figure 5 illustrates the structure of Figure 4 with the shuttering removed from the central ditch;

Figure 6 illustrates the levelling of the earth intermediate the foundation walls by the filling in of the central ditch;

Figure 7 is a perspective view of foundation excavation in accordance with a second embodiment of the invention;

Figure 8 is a vertical section of Figure 7 taken transverse to the central ditch;

Figure 9 shows the section of Figure 8 at a later stage of the process;

Figure 10 illustrates the incorporation of flooring by means of the process;

Figure 11 shows the lowering of the level of earth under the flooring due to removal of the earth to the central ditch;

Figure 12 is a schematic perspective view, with layers of concrete and earth broken away, to show one method of scraping earth from under a cast floor slab;

Figure 13 is a view of a part of a scraping chain;

Figures 14 and 15 are schematic views in perspective of a method of providing anchorages for vertical ties;

Figures 16 to 18 are vertical elevations (Figures 17 and 18 being in section) showing various methods of treatment of the upper ends of the vertical ties, and

Figure 19 is a diagrammatic view of a completed house.

For convenience's sake, the discussion on the building method will initially be confined to a single-roomed building.

The building site, by which is meant the area which will be covered by the building, is first cleared, and a trench 2 is dug across it from end to end as indicated in Figures 1 and 7. At least one end 2a of the trench is extended beyond the site, although both ends may be, as illustrated in Figure 1.

The depth and width of the trench are such that the cavity of the trench will admit a man in crouching or at least crawling posture.

The next step is to excavate the foundations, which, in the case under present discussion, is a perimeter foundation only. The excavation may consist of a ditch 3 dug into the ground as shown in Figures 1 and 2. Preferably, however, the molding space for the foundation is provided as follows:

Vertical forms 4 (Figures 7 and 8) are set up to define the inner faces of the molding space, and spoil from the trench 2 is packed up against the forms. When the trench has been dug, vertical forms 5 (Figure 8) are set up against its walls, and the spaces between the forms 4 and 5 are completely filled with earth which is levelled. The filling in the perimeter zone 6 adjacent the forms 4 is damped and rolled to consolidate it, and the forms 4 are then removed (Figure 9) leaving a plateau of earth 6 over the site, with steep perimeter walls 7, which will act as the inner molding faces for the foundation.

Shuttering 8 is erected around the walls 7 to constitute the outer molding face (Figures 8—10).

It will be appreciated that where a ditch 3 crosses the trench 2, suitable forms are set up to define the base of the ditch over the trench.

Deck shuttering 9 is mounted to enclose the trench and so to form a tunnel 2b (Figures 3 and 9); and the foundation 10 and a floor slab 11 are cast with the necessary reinforcement 12.

When the foundations and slab have set, the forms 5 and shuttering 9 (and the shuttering 8 if it has been used)

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are removed, the shuttering 9 being removed by being dropped into the trench and removed through its end 2a. The resulting structure is seen in action in Figure 5.

A laborer then descends into the trench and scrapes away a layer of earth into the tunnel. This is done progressively from end to end of the tunnel, or from the center outwards and continued until the slab 11 is suspended above the earth as seen in Figures 6 and 11; the tunnel being partially filled with the spoil. Any heaving movements of the earth beneath the site are thus not transmitted directly to the slab 11, while movement transmitted to the foundation 10 tends to rock the foundation and slab as a unit.

Scraping away of the earth under the slab by hoes or other tools is of necessity a burdensome task. Accordingly, applicant has established the procedure illustrated in Figure 12, and which is applicable only to the method illustrated in Figures 7 to 11. Here, as earth is being packed between the forms 4 and 5 (Figure 8) a length of chain 13 or several lengths is or are laid in snake-like fashion about midway in the depth of the filling, as shown in Figure 12. The chain is ordinary commercial chain with scraping elements, for instance, discs such as washers 14 (Figure 13) threaded on to the chain and welded or crimped one between each pair of links. The ends of the chain are dropped into the trench 2. When the foundations and slab have set, two laborers descend into the tunnel and pull the chain into the tunnel, thereby scraping away a layer of earth into the tunnel to produce the result of Figure 11.

It will be appreciated that mere production of a suspended floor structure by the method described above only partially solves the problem posed by unstable ground with regard to a building. If the building walls, ceiling and roof are erected on the perimeter foundation 10, in the conventional way, either by bricks or blocks, or by casting the walls of concrete, movement of the foundation and slab will tend to cause cracking of the walls and in extreme cases possibly even their collapse. To minimize cracking, the invention provides that the walls be reinforced by vertical ties.

A convenient procedure which has been amply proved in practice with cast-in-situ walls is illustrated in Figures 14 to 18.

Before the casting of the foundations 10 and floor slabs 11, tapering cores 15 (Figure 14) are located around the perimeter, at each corner and also to each side of planned openings for doors and windows. The cores 15 are slit at points 16 to straddle reinforcing rods in the molding spaces for the foundation 10. After casting, the cores are removed, to leave a series of recesses 17 in the foundation crossed by a reinforcing rod 18, see Figure 15.

While the wall shuttering 19 is being erected, a vertical tie 20 of ordinary reinforcing rod, with a hooked end 21, is passed into the recess for the hook to engage around the exposed rod 18.

The upper end of the tie 20 is so treated that when the house is completed it is firmly secured at or above the top of the walls. There are many ways in which this may be done. In Figure 16 the upper end of the tie is bent over at 22 and located in the molding space 23. Alternatively, the anchorage in the wall of the upper end of the tie may be made firmer by threading a washer 24 (Figure 16) on to the end of the tie before it is bent over.

In Figure 17, the ceiling of the building is a cast slab 25 reinforced by a mat of rods 26. In this case, the upper ends of the ties 20 are hooked at 27 to engage the mat 26.

In alternative methods, the ties may be placed in tension. In Figure 18 the upper part of each rod is screw-threaded at 28. The rod is greased along its length so that the concrete does not adhere to it. The threaded end of the rod within the molding space 23 is shielded by a sleeve 29, and projects upwardly beyond the sleeve and the space 23. After the walls have been cast (and also

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the ceiling slab if one is provided) a washer 30 is passed over the projecting end 31 of the tie rod to bear against the top of the wall or against the upper face of the ceiling slab 25; and a nut 32 is screwed down tightly on to the washer to stress the tie.

As stated above the vertical ties 20 are provided at each corner and to straddle each opening. This arrangement is illustrated in Figure 19.

The procedure when erecting a multi-roomed building is substantially the same as has been described except that foundations for the inner walls are dug and cast when the work is at the Figure 8 stage. A scraping chain is provided within each bay, and the removal of the earth below the cast slab causes subsidence below the inner foundations which thus become beams. Vertical ties are provided at all internal corners and to straddle internal openings, in the same fashion as has been described above.

A building made according to the method of the invention rests stably on its perimeter foundations, the internal members of the foundation having no support directly under them. As the underside of the slab and the internal foundation members do not rest on the soil, upheavals occurring under the slab are of no moment, while earth movements under the perimeter foundations tend to rock the building as a whole, due to its monolithic character, without the serious cracking of the walls that is inevitable when the slab and internal foundation members rest on the earth.

I claim:

1. A method of erecting the floor of a building which includes the steps of digging a trench across the site of the building, levelling the site to each side of the trench with spoil from the trench, during such levelling embedding flexible scraping elements in the spoil so that they are accessible from within the trench, roofing the trench with deck shuttering to form a tunnel, casting the perimetrical foundation of the building, casting a floor slab on and between the foundations, withdrawing the shuttering through the tunnel, and finally withdrawing earth from under the slab by hauling the elements into the tunnel to leave the underface of the slab substantially fully exposed with the slab supported by the perimetrical foundations.

2. The method claimed in claim 1 in which each element is a chain.

3. The method claimed in claim 2 in which each chain is provided with projecting scraping formations.

4. The method of claim 3, in which vertical forms are erected to define the inner faces of the perimetrical foundations, spoil from the trench is packed against the inner faces of the forms, vertical forms are erected to extend upwardly from the walls of the trench, the spaces between the two sets of forms are filled in to form a level plateau, and the floor slab is cast directly on the plateau.

5. The method of claim 4, in which the spoil is consolidated in the immediate vicinity of the perimetrical foundation forms, and the latter are then removed leaving a perimetrical earth wall; in which shuttering is erected around and spaced from the earth wall and in which the foundations are cast between the shuttering and the wall.

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