Jan. 6, 1931. J. F. O'ROURKE 1,788,248

TUNNEL OR CONDUIT LINING

Filed Oct. 16, 1929

Fig. 1.

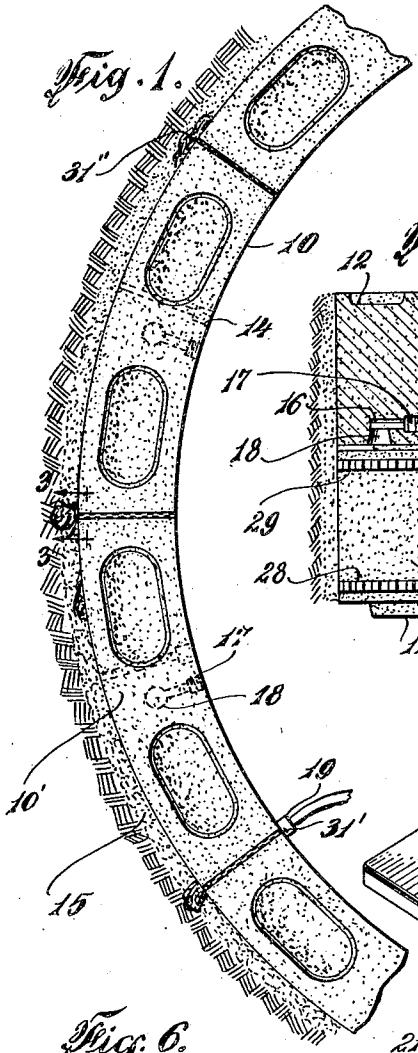


Fig. 5.

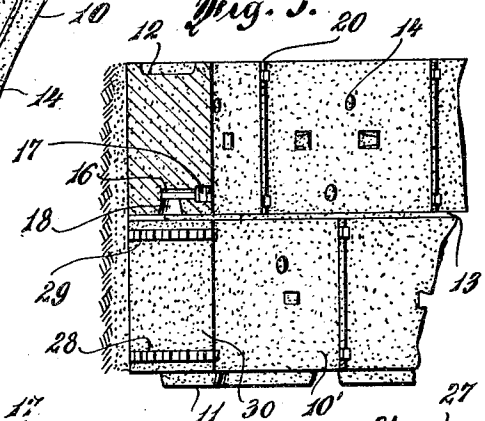
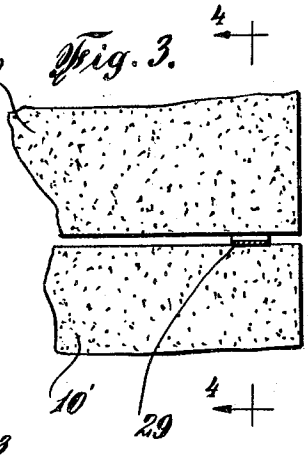


Fig. 3.



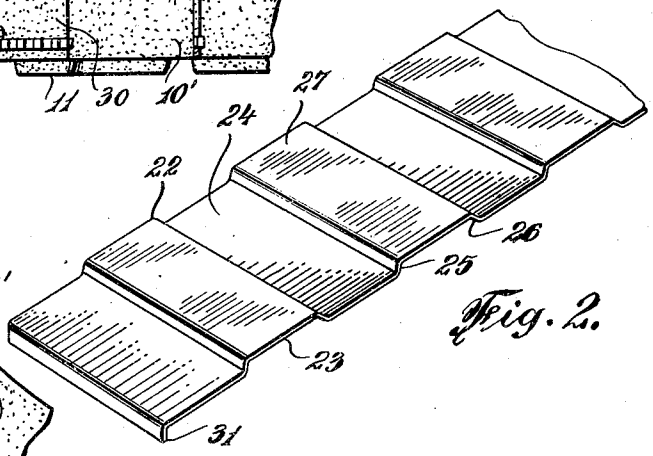


Fig. 2.

Fig. 6.

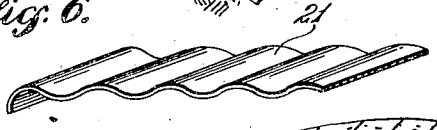


Fig. 4.

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TUNNEL OR CONDUIT LINING

Application filed October 16, 1929. Serial No. 400,108.

This invention relates to building block constructions and more particularly refers to improvements in methods of and means for laying building blocks in position preparatory to grouting operations.

My invention is more especially intended for use in the building of tunnels, conduits and other arched constructions where concrete or similar blocks are used; but it may also be employed to advantage in the building of walls, piers, columns or other constructions where building units are to be properly spaced from one another and where interstices between adjoining units have to be grouted with mortar or other suitable material.

In a patent entitled Means for grouting masonry, Serial No. 1,487,354, issued to me March 18, 1924, I have described a system of construction in which the building blocks or units employed are spaced from one another so as to provide clearance through which the grout may flow. In said patent I also have described blocks having passages opening at one end into the exposed surface of the construction and at the other end into a space between adjoining blocks, the inlet end of such passages being threaded so as to afford a simple means for the attachment to the block of a pipe or hose of a grout gun or machine.

In the type of constructions to which this invention refers, the grout clearances form a network comprising intercommunicating horizontal and vertical tracts; for a thorough and efficient grouting it is therefore necessary that these clearances be at all times maintained free of obstructions, the nature of which might prevent the uninterrupted flow of grout therebetween.

In certain types of constructions accuracy in the spacing of adjoining blocks is a matter of great importance; this is particularly true in connection with tunnels, conduits and other arched constructions where a number of segmental blocks are employed to exactly complete a ring or arch of a predetermined angular extent.

In the lining of tunnels and like constructions it is customary to use segmental blocks having an even width forming rings laid in succession along the tunnel, the blocks composing each ring being in staggered relation to those composing the adjoining rings. The rings are preferably made interlocking with one another and to this end, the blocks are provided at one side with recesses and at the other side with corresponding projections, the projections on one set of blocks being adapted to project within and interlock with the recesses of the blocks of an adjoining set.

The height of the projections is somewhat in excess of the depth of the recesses so that a clearance is left between the adjoining surfaces without disturbing the continuity of the construction itself.

As stated, the ends also of circumferentially adjoining blocks must be spaced for grouting purposes; therefore, suitable means must be provided to this end, to maintain the blocks in their proper relation while the construction proceeds.

These means should preferably be of a type adapted to stand considerable crushing stresses, because upon them devolves the duty of resisting practically all the compression stresses to which the tunnel is subjected before the lining is finally formed into a monolith after the grouting has become hard. At the same time, it is to be observed that the means interposed between adjoining blocks in order to keep their ends at the proper distance should not interfere to any noticeable degree with the free flow of the grout through the various interstices.

In another patent entitled Tunnel or conduit lining, Serial No. 1,043,348, issued to me November 5, 1912, I have mentioned the possibility of using wedges adapted to be driven into the spaces between the adjacent ends of the blocks or sections of a ring, whereby said blocks or sections are firmly held in their proper relative positions; after any desired number of the rings have been set, the wedges may be removed either before or after the interstices have been filled or said wedges may be left in position if desired.

In the same patent, I have also illustrated the possibility of providing the ends of the blocks with grooves within which separating keys may be inserted maintaining adjoin-

ing blocks at the proper distance from one another. I have found however, that spacing means of the types advocated in the said patent are apt in practice to seriously interfere with the flow of grout along the longitudinal joints, and to prevent the grout from reaching all the open spaces between the blocks as well as the open ends of the clearance spaces at the rear.

Their use also involves a not inconsiderable amount of labor, owing to the fact that the wedges or tongues must be forced into position after the blocks are laid. This labor can be considerably reduced by using means adapted to be quickly laid by hand before each block is placed in position, without the use of any tools.

The primary object of the present invention is to provide a novel and improved method of spacing and supporting building blocks whereby the proper distance therebetween may be provided for before each block is laid and can be maintained without interfering with the flow of grout across and beyond said spacing means.

Another object is to provide a separating and supporting device of a novel and improved design adapted to effectually resist the pressure normally imposed upon structures of the character mentioned and adapted to maintain adjoining blocks at the proper distance from one another without materially interfering with the flow of grout therebetween, said device being adapted to be placed in position by hand before each block is laid.

A further object is to provide a spacing and supporting device of a relatively simple and inexpensive character adapted to be laid by hand over the end surface of a block before an adjoining block is placed in position.

A still further object is to provide in a spacing and supporting device of the character specified, anchoring means preventing the same from sliding along inclined surfaces, said means acting to retain the device in the position in which it has been set.

Other objects and advantages of the present invention will more fully appear as the description proceeds and will be set forth and claimed in the appended claims.

An embodiment of my invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a face view of a portion of a tunnel lining or arch comprising moulded blocks having adjoining ends and sides spaced in accordance with my invention;

Fig. 2 is a fragmentary view in perspective of the preferred type of separating and supporting device to which my invention more particularly refers;

Fig. 3 is a fragmentary longitudinal section on an enlarged scale through the ends of two adjoining blocks of the same ring, across line 3—3 of Fig. 1;

Fig. 4 is a transversal section of the tunnel lining through line 4—4 of Fig. 3;

Fig. 5 is a fragmentary longitudinal section of the tunnel lining illustrating the network of intercommunicating longitudinal and transversal interstices between adjoining blocks; and

Fig. 6 is a fragmentary view in perspective of an alternative form of spacing and supporting device.

Referring to said drawings, 10 designates segmental blocks of the type used for forming rings and tunnel constructions, said blocks being made of concrete, terracotta or other material suitable for moulding building blocks.

Said blocks are formed with projections 11 at one side and recesses 12 at the opposite side, the recesses of the blocks composing a ring receiving the projections of the blocks composing an adjacent ring. The projections are higher than the depth of the recesses so that when a number of rings are laid, clearance spaces 13 will be left between the sides of adjoining rings, forming interstices adapted to receive grout surrounding the projections. Such an arrangement of blocks is similar to those described in my two previous patents above referred to.

Each block is provided with a gravel passage 14 extending from the inner to the outer face of the block, the inlet of said passage being threaded to engage the threads of a steel nipple attached to a gravel shooting hose, when a gravel packing 15 is formed by impact between the outer surface of the tunnel lining and the surrounding ground. Each block is furthermore provided with a grout passage 16, opening through the inner face of the block at 17 and leading to one of the sides as at 18 for the exit of grout into the clearance spaces separating adjoining rings.

The inlet 17 is provided with a screw thread which can be used to engage similar threads in a steel nipple attached to a grout hose 19. As stated in the premises, the blocks composing each ring must also be spaced between their ends to provide a transversal clearance space 20 connecting the clearance space 13 between adjoining rings and forming therewith a network of passages extending around each individual block. According to my present invention after each block is laid, a spacing and supporting device of a suitable design is placed near each side thereof on top of the exposed end of the block, and the next block in the ring is then laid in position with its end resting against said spacing and supporting devices.

These devices are preferably of a light and inexpensive construction and are adapted to be easily and quickly laid in position by hand, and their structure is such that adjoining

blocks will be spaced with the greatest accuracy and the flow of grout through the transversal clearance spaces will not be affected to any noticeable extent.

The spacing can be effected by means of corrugated plates laid on top of the exposed end of a freshly laid block with their corrugations extending in a direction parallel to the clearance tracts 20, that is, at right angle to the plane of lateral clearance spaces 13; the total height of the corrugations corresponding to the thickness of the clearance space to be provided. Such a type of device is shown at 21 in Fig. 6 and can be made out of corrugated sheets of the proper gauge and height.

In practice however, I prefer to use separating and supporting devices of the type shown at 22 in Fig. 2, consisting of metallic strips alternately offset at one side and then at the other to form depressions 23, 24, having a substantially trapezoidal or rectangular section. The sides 25, 26 of said depressions are at right angle or slightly inclined to their bottom parts 27 and therefore are well adapted to stand crushing stresses without undergoing any deformation. The total height of a strip thus formed, corresponds of course to the spacing distance to be provided for between the ends of adjoining blocks, and such a distance will be permanently maintained by the strips which will be made of metal of sufficiently heavy gauge.

By using cold rolled steel, strips of comparatively light gauge can be used, so that the sides and the bottoms of the depressions do not materially obstruct the flow of grout across the spaces occupied by the strips. The manner of using these separating and supporting plates is illustrated in Fig. 5 where 28, 29 designate two plates laid upon the exposed end surface 30 of block 10′. It will be observed that preferably two plates are used for each block, said plates being preferably laid in a front to rear direction, one in proximity of and parallel to each side of the block; so that their corrugations are directed at right angle to clearance spaces 13.

The location of the plates is also shown in Figs. 1, 3, 4, where plate 29 is shown laid on top of block 10′, the bottom end of block 10 resting upon said plate. In order to facilitate the placing of the plates and to retain them in the position in which they have been set, I prefer to bend one of the ends of the plates to form a downwardly directed lip 31 adapted to engage one of the edges of the block so as to prevent the plate from slipping down the inclined end surface thereof. During the building of a ring, the exposed end surfaces of the blocks composing the lower half of the ring are inclined outwardly, and therefore the lips will engage the inner edge of the blocks as shown at 31′ in Fig. 1.

On the other hand, the exposed end surfaces of the blocks composing the upper half of the ring will be inclined inwardly and therefore the lip will be caused to engage the outer edge of the block as shown at 31″ in Fig. 1.

In building walls, piers, and other constructions where the blocks are placed horizontally one on top of the other, the separating and supporting plates can, of course, be made without a retaining lip, as will be understood, there being no tendency on the part of the plates to slide down an inclined surface.

After any desired number of the blocks have been set and when the joints between the blocks have been pointed, caulked or otherwise closed by means of mortar or other suitable material as shown at 32, the grout pipe or hose may be connected to the inlet 17 of a passage 16 of any such blocks to enable the grout to be forced into the clearance spaces 13 and the intercommunicating clearance spaces 20 by flowing through the material of the block from inlet 17 through outlet 18, until the space between the blocks is completely filled with the grout. The grout will be free to flow all around because of the passages provided by depressions 23, 24 in the separating and supporting plates. When the grout pipe or hose is removed from the inlet 17 the latter may be closed by a suitable plug or screwed or forced therein.

A great advantage of my invention is that the grout will be forced under pressure throughout and beyond all the clearance spaces 13, 20 issuing through the outer edges thereof, and forming lumps about said outer edges which compress the surrounding gravel and further intensify the packing action thereof, the water contained in the grout being filtered through the gravel and through the surrounding ground.

Another advantage is that the blocks composing each ring are exactly spaced and will exactly interlock with the similarly spaced blocks of an adjoining ring; the blocks being permanently retained in their proper positions by the spacing plates, due to the ability of said plates to withstand thrust stresses. This feature is therefore important in insuring as it does, the stability and proper alignment of the structure until such time when grouting operations are completed and the grout has become hard.

Other advantages have already been pointed out in the course of this specification. Although Figs. 1 and 5 illustrate a portion of a horizontally extending tunnel lining, it is obvious that the device forming the subject of this invention can also be used in constructions such as towers or chimneys where the rings are in vertical alignment with one another; and in such cases, the spacing plates will be used between the ends of horizontally instead of vertically adjoining blocks.

My invention may be carried out in ways

different from those shown without departing from the inventive idea; the drawings will therefore be understood as being intended for illustrative purposes only and not in a limiting sense. Accordingly, I reserve the right to carry my invention into practice in all those ways and manners which may enter, fairly, into the scope of the appended claims.

I claim:

1. A tunnel or conduit lining comprising a plurality of alined rings separated by grouting interstices, each ring being composed of a plurality of segmental blocks, and corrugated plates interposed between the ends of adjoining blocks in the same ring, determining a proper spacing therebetween and providing passages permitting the flow of grout therethrough, said plates having corrugations directed longitudinally of said lining.

2. A tunnel or conduit lining comprising a plurality of alined rings separated by grouting interstices, each ring being composed of a plurality of segmental blocks, and bearing plates interposed between the ends of adjoining blocks in the same ring, said plates being substantially parallel to the adjoining faces of said rings, and having transversal corrugations determining a proper spacing between said blocks and providing longitudinal passages permitting the flow of grout between grouting interstices at opposite sides of said ring.

3. A tunnel or conduit lining comprising a plurality of alined rings separated by grouting interstices, each ring being composed of a plurality of segmental blocks, and bearing plates interposed between the ends of adjoining blocks in the same ring, said plates being substantially parallel to the adjoining faces of said rings, and having transversal corrugations determining a proper spacing between said blocks and providing longitudinal passages permitting the flow of grout between grouting interstices at opposite sides of said ring, said plates having one of their ends bent to form a retaining lip adapted to engage one of the edges of the block upon which said plates are laid.

JOHN F. O'ROURKE.