Feb. 9, 1932. H. SCHAEFER ET AL 1,844,184

LINING CONSTRUCTION FOR MINE GALLERIES, SHAFT TUNNELS, AND THE LIKE

Original Filed June 3, 1927 2 Sheets-Sheet 1

Fig. 1

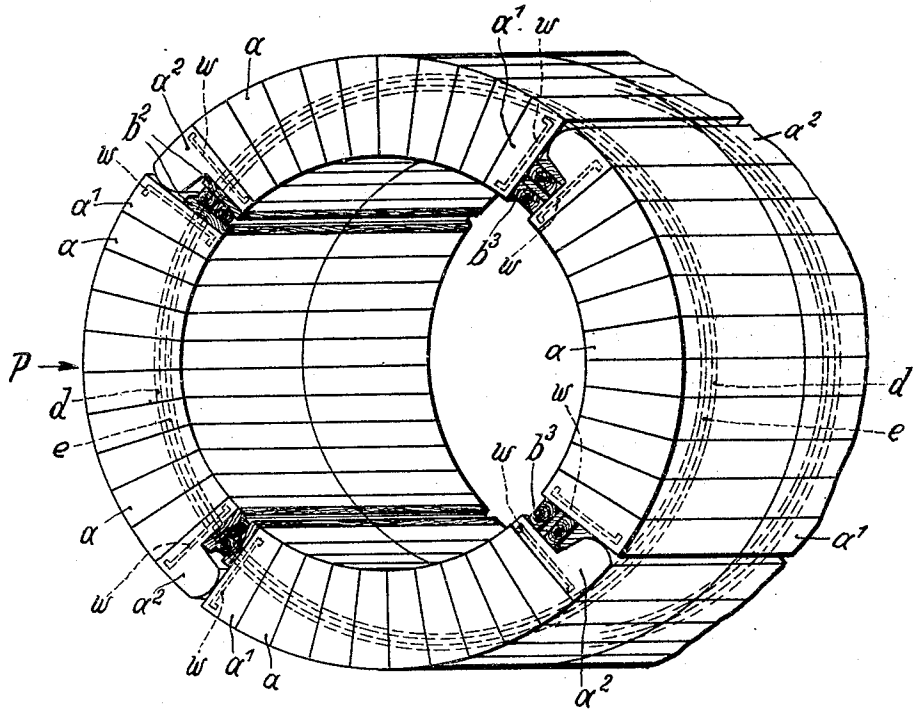
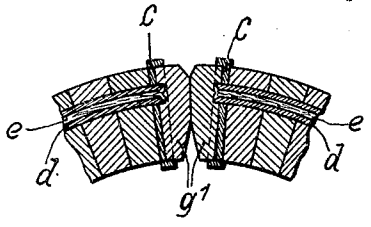


Fig. 4



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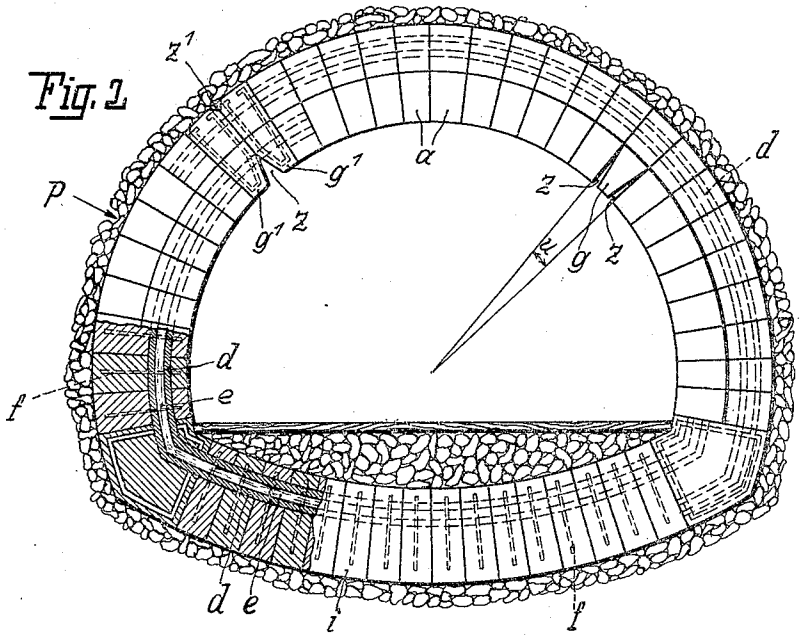
By Fitzpatrick, Cooper & Co Attys.

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Fig. 1.



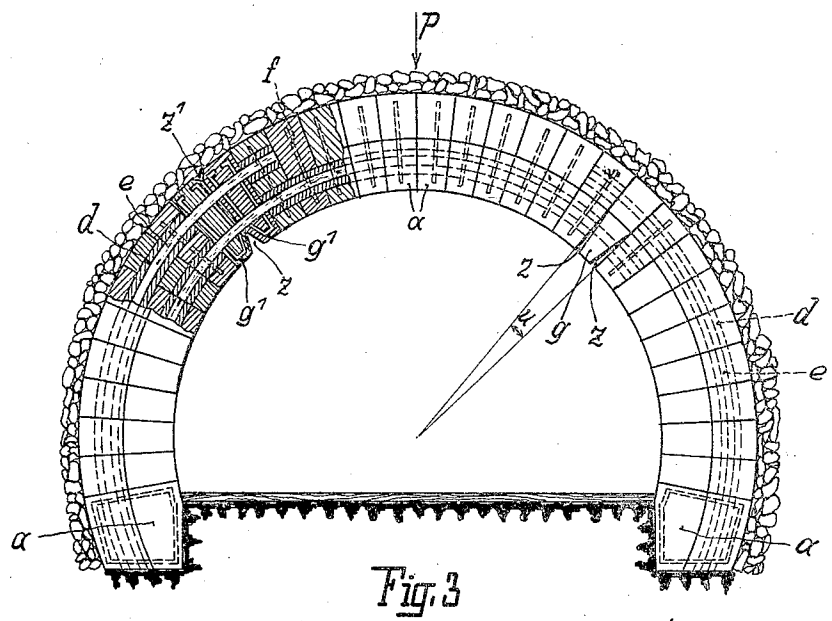


Fig. 3

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UNITED STATES PATENT OFFICE

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LINING CONSTRUCTION FOR MINE GALLERIES, SHAFT TUNNELS, AND THE LIKE

Original application filed June 3, 1927, Serial No. 196,327, and in Germany July 3, 1926. Divided and this application filed November 9, 1928. Serial No. 318,206.

Our invention relates to improvements in lining constructions for mine galleries, shaft tunnels and the like, and the object of the invention is to devise a lining composed of ring or arched sections of construction blocks in which the respective segments of each section shall be capable of being swung relatively to the remaining segments to alter the conformation of the cross sectional shape of the lining section upon the application of inward rock pressure in any particular direction.

A further object is to devise yieldable means between the inner portions of the end blocks of each section.

A still further object is to provide means for reinforcing the end blocks of each segment so that their compressive strengths will be greater than that of the remaining blocks of the segments.

Another object is to provide bonding means in the sections of the lining to take care of tensile stresses.

In our copending application Serial No. 196,327 filed June 3, 1927, of which this is a divisional application we have disclosed yieldable means whereby the peripheral length of each section may be shortened under the application of external rock pressures acting in an inward direction. In contradistinction to this, in the present application, the peripheral length of the section does not vary substantially under the application of the rock pressures, the cross sectional shape merely changing to compensate for such pressures. In other words, the section is solely distortable in shape, and not in shape, and in peripheral length as in the above referred to copending application.

We are aware that it has hitherto been proposed to construct linings of section segments of integral construction in which the ends of the segments are separated by longitudinally extending members. Such construction, on account of the rigid section segments would only lend itself to distortion as to shape to a very limited degree.

According to our invention the segments being constructed of individual construction blocks, permit of considerable distortion as the individual segments are themselves susceptible to a certain degree of distortion as to shape. Moreover, the end blocks of adjacent segments abutting each other and there being no longitudinal members between sections, each section is permitted individual distortion depending upon the stresses applied to it.

The preferred embodiments of our invention are illustrated in the drawings in which:—

Fig. 1 depicts a cross sectional view of a lining construction according to our invention in which the end blocks of adjacent segments abut one another toward the outer periphery of the section and yieldable inserts are introduced toward the inner periphery of the section.

Figs. 2 and 3 illustrate in cross section modified constructions to that illustrated in Figure 1.

Fig. 4 represents in cross section a fragmentary view of a joint of modified form between adjacent segments of a section.

In the construction depicted in Fig. 1, each segment of each section of the lining is composed of individual construction blocks a, one end block a^2 of each segment only abutting the end block of the next segment for the part of its depth extending inwardly from the outer periphery of the section. A deformable insert b^2 can be inserted between the end blocks of each segment.

If desired, the blocks a^1 may be reinforced to have a greater compressive strength than the remaining blocks of the segments as, for instance, by introducing the reinforcement w, or the blocks may be made of a stronger mix of concrete. The same may apply to the blocks a^2.

Or if desired, several insertions b^3 may be used as illustrated in the right hand bottom joint of the lining shown in Fig. 1.

Figs. 2 and 3 each illustrate a lining construction in which non-deformable members g are inserted between the lining blocks in place of yielding insertions. These insertions have the same specific compressive strength as or higher compressive strength than the blocks, being for example produced from a better concrete mixture. The said

insertions are tapered towards the inner circumference of the lining, for a part of their depth, to an extent greater than that determined by the angle u which the insertions subtend at the center, this taper being on one or both sides. There is in consequence a wedge shaped gap z between the insertions g and the adjacent blocks and the insertion presents to the adjacent blocks a a surface at an angle thereto or an arcuate surface on which the blocks a are able to tilt inwardly and thus approach one another at their inner circumference. In order that the blocks of the lining shall be stressed over their entire surface these insertions g' are preferably arranged in pairs with the tapered portions z towards each other (see Figs. 2 and 3, left hand side). Apart from that at the inner circumference a small gap z' may be provided at the outer circumference also, as is also illustrated on the left hand side of Figs. 2 and 3, in order that the lining shall be able to yield somewhat without destruction of the blocks at those places also where the blocks tend to approach one another at the outer circumference. If necessary these insertions may also be set in an iron shoe c (Fig. 4) or the like.

If a pressure acting uniformly from all directions is exerted on the lining then the said lining resists the same undeformed, that is without alteration of shape, provided naturally that this uniformly acting pressure does not exceed a value corresponding to the compressive strength of the blocks. If on the other hand the lining is subjected to a non-uniform pressure acting for example in the direction of the arrow p (Fig. 2) or acting more strongly in that direction and tending to force the lining inwardly at points of pressure then the lining can, as is the case when deformable insertions are employed, yield under this pressure by displacement inwardly, the blocks a and the insertions g tilting towards each other. Consequently the insertions have the same effect as those described above which deformed on one side, that is, they cause the lining blocks to be compressed over their full bearing area even when the pressure acts in one direction only and thus protect the same against too high compressive stresses acting on one side thereof.

If the blocks a are provided with internal bonding increasing their coherence and disposed inside the individual ring or arch sections or with external armouring for the same purpose and providing that it is known that the lining will be subjected to pressure acting in one direction only without a counter-pressure acting in the opposite direction, so that the pressure acting on one side tends to force the whole lining in one direction, the bonding of the blocks should be arranged, at the parts of the lining subjected to the said uni-directional pressure, on the inside, that is at or in the neighbourhood of the inner circumferece of the lining and elsewhere at the outside, that is at or in the neighbourhood of the outer circumference of the lining. Unnecessary gaping of the blocks at the parts of the lining subjected to the rock pressure and consequent too high edge pressures on the blocks at these points are prevented in this case by internally disposed bonding. Fig. 2 illustrated a lining construction constructed on these principles, it being assumed that the lining is subjected to a rock pressure acting in the direction of the arrow p on the left hand side of Fig. 2. In this case the lining is given at this point a deformable bonding disposed towards the inside, that is at or in the neighbourhood of the inner circumference and consisting for example of an iron insertion e and a concrete filling d connecting this insertion with the blocks a. Furthermore, the floor arch i of the lining is furnished with a bonding d, e arranged at the inner circumference of the lining and the rest of the lining with a deformable bonding disposed at or in the neighbourhood of the outer circumference and consisting of an iron insertion e and a concrete filling d. The iron insertions e of the inner and outer portions of the bonding may, as is illustrated in Figs. 2 and 3, end abruptly. To increase the capacity of the bonding for resisting tension the ends of the iron insertions e may, as illustrated in Figs. 2 and 3, overlap to a certain extent.

If, as is frequently the case in tunnel construction and sometimes also in mine galleries, there is a rigid floor it is unnecessary for the bonding to be closed in itself to make it capable of resisting tension; in this case it is sufficient for the two ends of the lining, arch shaped only in this case, to be mounted (Fig. 3) by means of abutment blocks a', in the floor and to anchor the ends of the bonding d, e in the said abutment blocks. The lining is in this manner secured to the abutment blocks in such a manner as to be capable of resisting tension and the floor may be said to form a continuation of the bonding for the blocks. In the example illustrated in Fig. 3 it is assumed that a primary pressure p acts on one side only of the lining and accordingly the bonding for the blocks is disposed, at the upper part of the arch section, at the inner crcumference and for the rest at the outer crcumference of the lining.

To enable the concrete of the blocks to take up satisfactorily the sheer stresses due to the bonding, the blocks provided with bonding at the inside, or if necessary all the blocks, may be furnished with radial reinforcement f. This is illustrated in Figs. 2 and 3 in the blocks having the bonding at the inside.

Instead of passing the bonding through

the solid hinge-like insertions g or g' it may be made to end before reaching the same or when the hinge-like insertions are employed it may end therein. This arrangement is illustrated in Fig. 4.

Such constructions of yielding or deformable lining are applicable with advantage not only to mine galleries, shafts, tunnels and the like, but also to the construction of underground chambers such as machine rooms.

What we claim as our invention is:

1. In a lining construction for underground works, in combination, a plurality of sections, each comprising a plurality of segments built up of construction blocks, the end blocks of each segment abutting against each other only from their outside surfaces to a point intermediately of their depth, whereby a hinge-like joint between the segments of each section is constituted.

2. In a lining construction as claimed in claim 1 wherein a yieldable insert is inserted between the non-abutting portions of the end blocks of adjacent segments.

3. In a lining construction as claimed in claim 1 wherein the end blocks of adjacent segments have a compressive strength greater than the remaining blocks.

4. In a lining construction for underground works, in combination, a plurality of sections, each comprising a plurality of segments built up of construction blocks, the end blocks of each segment abutting each other directly for a part only of their depth extending inwardly from the outer periphery of the section, and tensile stress resisting bonding means extending through the blocks of each section and disposed at least mainly in the vicinity of the outer periphery thereof.

In testimony whereof we affix our signatures.

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