A. LENNON.

AIR AND WATER TIGHT JOINT FOR TUNNELS AND SIMILAR STRUCTURES.

APPLICATION FILED MAR. 20, 1909.

935,376. Patented Sept. 28, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

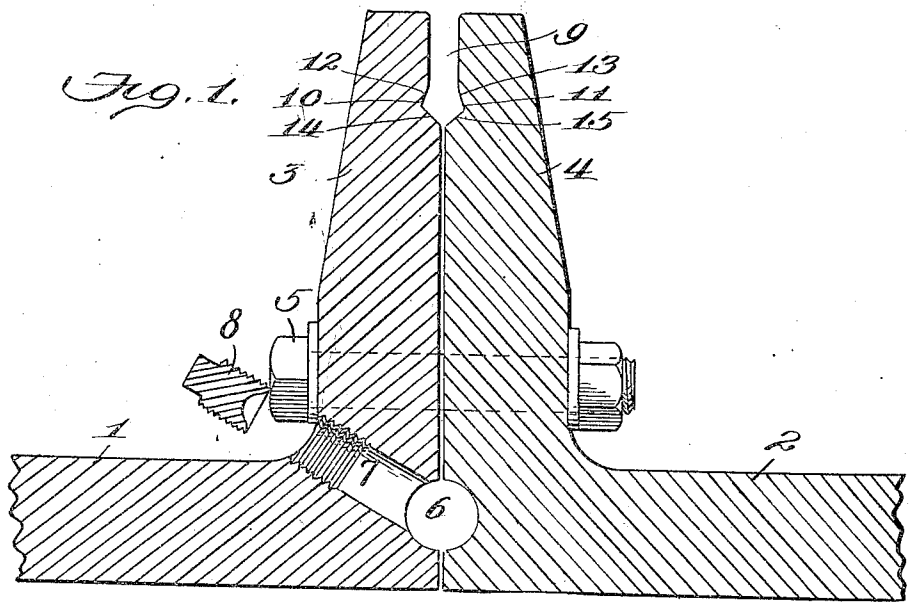
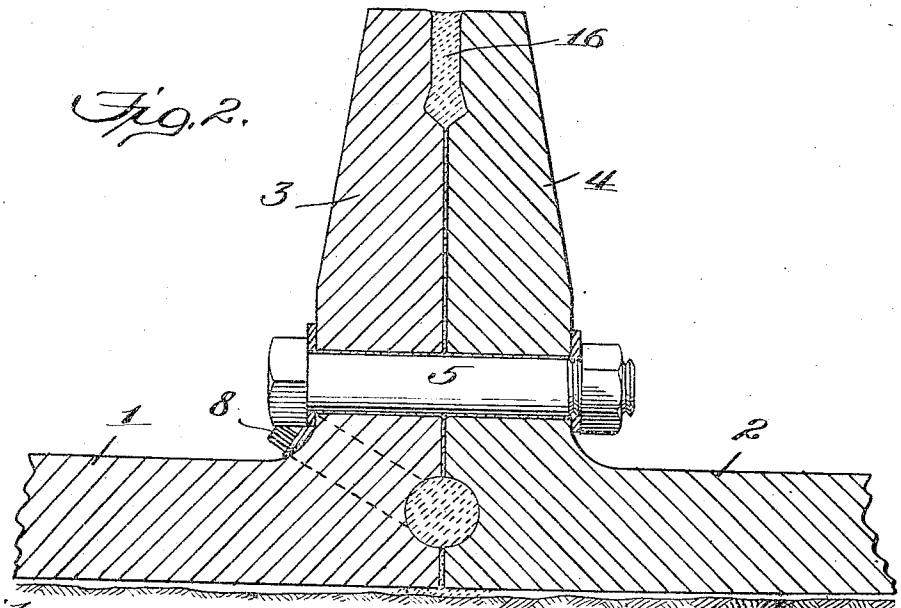


Fig. 2.



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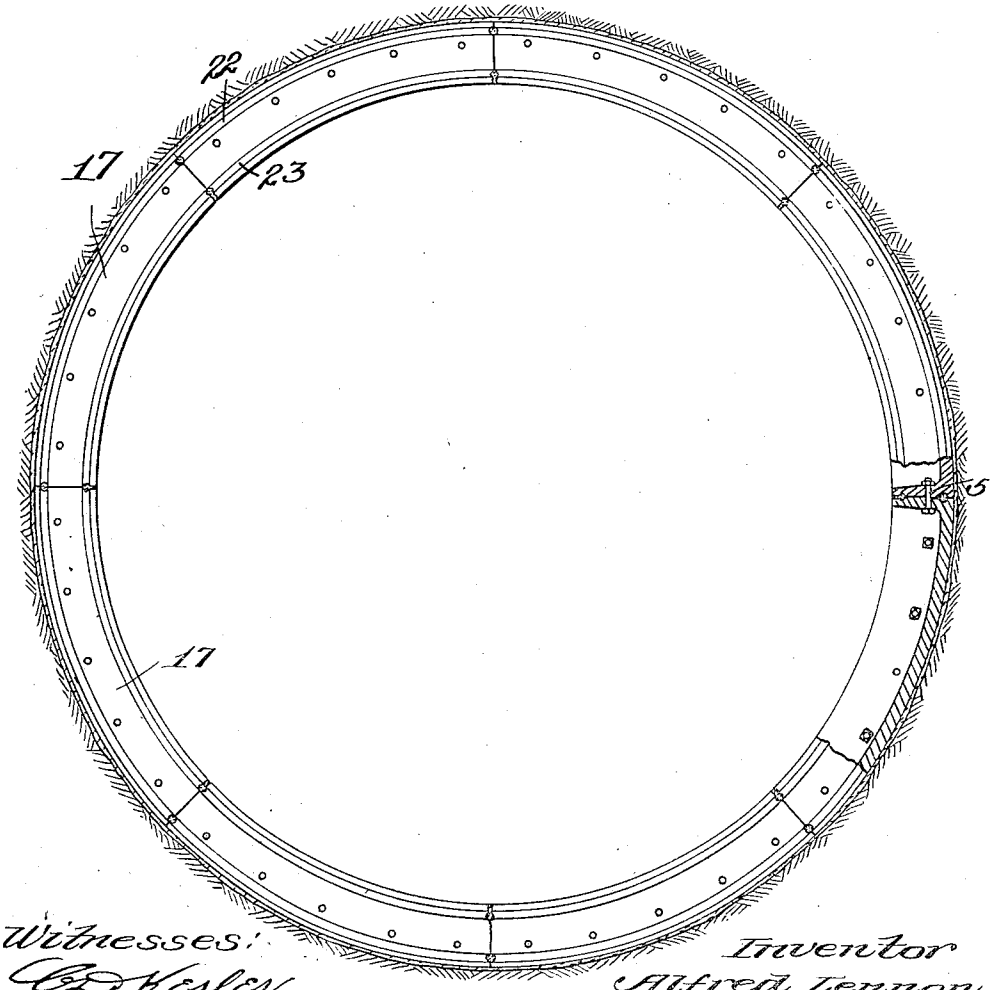
2 SHEETS—SHEET 2.

Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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AIR AND WATER TIGHT JOINT FOR TUNNELS AND SIMILAR STRUCTURES.

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To all whom it may concern:

Be it known that I, ALFRED LENNON, a citizen of the United States, residing at Olivebridge, in the county of Ulster and State of New York, have invented new and useful Improvements in Air and Water Tight Joints for Tunnels and Similar Structures, of which the following is a specification.

My present invention relates to improvements in fluid-tight joints for metal structures and it is especially adapted for use in sealing and keying together the flanged sections of tunnels, caissons, and other submarine structures, and it has for its object primarily to provide a novel and improved joint which is capable of effectually confining air under high pressure within the tunnel or structure and also preventing the entrance of water into the tunnel when such pressure is relieved, the joint being so constructed that the calking or packing material cannot possibly become dislodged, and when such calking or packing material is in place, a keying action is produced between the flanged sections that will effectually prevent relative shifting movement that would tend to shear the connecting bolts, the construction of the joint being such that the lining or flanged plates of the structure may be built up and sealed wholly from the interior of the tunnel or structure, a feature that is essential in building subterranean tunnels or similar structures wherein the sections are added as the boring or shaft progresses.

To these and other ends, the invention consists in certain improvements, and combinations and arrangements of parts, all as will be hereinafter more fully described, the novel features being pointed out particularly in the claims at the end of the specification.

In the accompanying drawing: Figure 1 represents a sectional view of the adjacent flanged portions of two sections of a tunnel or similar structure, such flanged portions being formed to enable a joint to be made in accordance with the present invention; Fig. 2 is a view similar to Fig. 1 showing the calking and packing material in position, the joint being complete; Fig. 3 is a perspective view of a segmental flanged section of a tunnel or analogous structure; and Fig. 4 represents a transverse section of a tunnel the sections of which are united and sealed by joints made in accordance with the present invention.

Similar parts are designated by the same reference characters in the several views.

In the accompanying drawing, I have shown one specific embodiment of the invention wherein the same is applied to a tunnel, caisson or shaft lining, and the invention is especially applicable to such use owing to the fact that the abutting edges of the sections composing the structure must be sealed to the entrance of water as well as to the escape of air from the interior of the structure, and moreover, the keying action of the calking or packing material effectually prevents relative shifting of the sections that might cause shearing of the connecting bolts. It will be understood, however, that I have shown but one embodiment of the invention as an example, and that certain changes or modifications may be made in applying the invention to different uses.

In the present instance, 1 and 2 designate the adjacent sections of a tunnel or similar structure, these sections having inturned flanges 3 and 4 respectively, the faces of which are arranged in parallelism and are drawn together as near as practicable by means of a suitable number of connecting bolts 5, these bolts being arranged within the outer walls of the two sections. A channel 6 is formed between the abutting sections, this channel in the present instance being substantially circular in cross section and is produced by providing an approximately semi-circular groove or recess in the abutting face of each section, these recesses being complemental, and when the sections are assembled, forming the channel. A passage 7 leads into this channel from the inner side of either one or both of the tunnel sections, this passage being shown in Figs. 1 and 2 as extending into the channel from a point where the inturned flange 3 joins the body portion of the plate or section 1 and its inner end is preferably threaded to receive a plug 8, the latter being removable or insertible from the interior of the tunnel.

The packing material for the channel 6 is preferably pumped or otherwise conducted into the channel through the passage 7, grout in a plastic condition being preferable, this grout while in a plastic or semi-liquid form flowing readily into the channel 6 and after settling or hardening, it forms a packing

that will fill every crevice between the abutting tunnel sections. In practice, difficulty is usually experienced in drawing the flanged faces of the two sections into contact, a space being thereby left between the sections. This grout, however, when forced into the tunnel 6 in a liquid or semi-liquid form will flow through the channel into the space left between the opposed faces of the two sections so as to thereby fill such space, and a portion of the grout may also escape to the exterior of the tunnel. Such grout as may escape, however, in this way will not be wasted as the space between the outer wall of the tunnel and the earth is usually filled with grout or cement. This channel 6, it will be observed, is arranged exteriorly of the bolts 5 and hence the grout injected into this channel will fill not only the channel but also any space that may exist between the opposed faces of the flanges, and a portion of this grout may also flow into the space surrounding the bolts 5, it being therefore impossible for any water to enter the tunnel through the joint either through the bolt openings or through the space between the opposed walls of the flanges and, moreover, as this channel which contains the grout is formed partially in one section and partially in the other section, a keying action is produced that will effectually prevent a relative shifting of the sections that would tend to shear the connecting bolts.

After a sufficient amount of grout has been forced into the channel, the plug 8 may be screwed into the inner end of the inlet passage. In order to further seal the joint from the entrance of water from the exterior and also to prevent the escape of compressed air within the tunnel, a second channel 9 is formed between the opposed faces of the flanges 3 and 4 at their inner ends, this channel extending the full length of these flanges and leading outwardly from their inner ends, and the outer edge of the channel 9 terminates in an enlargement which is formed by angular offsets 10 and 11 that are formed in the opposed walls of the two flanges, the walls 12 and 13 of the channel being inclined in divergent relation until the widest portion of the channel is reached, and the bottom of the channel being formed by the convergent surfaces 14 and 15, the latter surfaces reaching an apex which is coincident with the plane occupied by the opposed faces of the two flanges. A packing 16 of appropriate material is forced into the channel 9 from the interior of the tunnel, a calking material being preferred such as lead which may be hammered into the channel so that the enlargement therein shall be completely filled. This packing 16 will prevent any water from reaching the interior of the tunnel through the space formed between the opposed flanges, it will prevent compressed air from the interior of the tunnel from escaping through any space that may exist between the opposed flanges and, moreover, the offset construction of the channel which is formed partially in each flange will enable the lead or other packing material to effectually key the flanges so as to prevent relative movement thereof that might cause shearing of the connecting bolts.

Obviously, joints of this character may be applied in various ways to tunnels, caisson and shaft linings and many other structures wherein a fluid-tight joint is desirable or necessary. As one example, I have shown the joint applied to a tunnel which is built up of rings which in turn are composed of segmental sections 17, each section having a pair of lateral flanges 18 and 19 and end flanges 20 and 21, the lateral flanges of one section coöperating with the corresponding flanges of the adjacent sections while the end flanges of each section coöperate with those of the adjacent sections, these sections being assembled as the boring of the tunnel progresses. The grout-receiving channel 6 of the joint is produced by forming a segmental recess 22 in each section which preferably extends entirely around the same, and the channel 9 is produced by forming an appropriate recess 23 which extends entirely around the section, the complemental portions of the channels 6 and 9 registering when the sections are assembled.

In Fig. 3, a pair of inlet passages 24 and 25 are shown, one in each of the lateral flanges of the tunnel section. Either of these inlet passages, however, might be omitted, or any desirable number of such passages may be provided and they may be located at any appropriate points in order that the grout may be introduced into its appropriate channel with the greatest facility, but in all cases, these passages are so formed that the grout may be introduced from the interior of the tunnel owing to the fact that the exterior of the tunnel is usually inaccessible. Any appropriate measures may be taken to prevent the escape of the grout along the end flanges of the sections while the tunnel is in course of construction, it being usually sufficient to insert a plug of lead or other material as a stopper for the exposed ends of the grout-receiving channels.

A joint constructed in accordance with my present invention may be applied inexpensively to tunnels and similar structures and, in practice, it enables the joints between the various sections to be readily and effectually sealed to the entrance of water or the escape of air and at the same time the sections of the tunnel or other structure are effectually keyed together so that shifting of the sections and a consequent shearing of the bolts is avoided.

I claim as my invention:—

1. A tunnel or similar structure built up of a plurality of sections provided with internal abutting flanges, devices extending through and connecting said flanges, and a pair of fluid-tight packings formed separately and arranged between the opposed faces of said sections, one packing being plastic and arranged exteriorly of said connecting devices and the other interiorly thereof.

2. A tunnel or similar structure built up of a plurality of sections having inturned cooperating flanges, devices extending through and connecting said flanges, a channel being formed by complemental recesses in the opposed faces of said sections at a point exteriorly of said connecting devices, and means for introducing a packing material into said channel from the interior of the tunnel.

3. A tunnel or similar structure built up of a plurality of sections having inturned abutting flanges, devices extending through and connecting said flanges, a channel being formed between the opposed faces of said sections at a point exteriorly of said connecting devices, and a passage leading into said channel from the interior of the tunnel and serving as means for introducing a plastic packing material into such channel.

4. A tunnel or similar structure built up of a plurality of sections having internal abutting flanges, devices extending through and connecting said flanges at points removed outwardly from their inner ends, a channel being formed between the opposed faces of said flanges and adjacent to their inner ends, such channel having offset enlargements formed in the respective walls of the flanges, and a packing filling such channel and the enlargement therein to produce a fluid-tight joint between the flanges and to serve as a key to prevent relative shifting thereof.

5. In a tunnel or similar structure, the combination of sections provided with inturned abutting flanges, devices extending through and connecting said flanges, a channel being formed by complemental grooves in the abutting faces of the respective flanges adjacent to their inner ends, such channel having an enlargement at its outer edge formed by lateral offsets in the respective flanges, and a packing calked into said channel and filling the enlargement therein.

6. In a tunnel or similar structure, the combination of sections provided with inturned abutting flanges, devices extending through and connecting said flanges, a channel being formed by complemental grooves formed in the opposed faces of the flanges adjacent to the inner ends, the outer walls of such channel being inclined in divergent relation to form an enlargement and then convergent toward the faces of the flanges as an apex, and a packing of non-yieldable material calked into such channel and the enlargement thereof.

7. A tunnel or similar structure built up of a plurality of sections, each section being provided with a pair of lateral inturned flanges and a pair of inturned end sections united to the lateral flanges, devices extending through and connecting the flanges of adjacent sections, a groove extending around one section and registering with similar grooves in adjacent sections to form a packing receiving channel, passages extending into such channel from the interior of each section and serving as means for introducing grout into such channel, the inner edges of the flanges being provided with grooves and lateral offsets to form a channel having an enlargement therein, and a packing calked into such channel and filling the enlargement therein.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ALFRED LENNON.

Witnesses:

LLEWELYN JAMES LEWIS,
WALTER JOSEPH GILLEN.