G. W. JACKSON.

CONSTRUCTING CONCRETE AND LIKE WALLS IN THE EARTH.

APPLICATION FILED MAR. 19, 1910.

960,941.

Patented June 7, 1910.

2 SHEETS—SHEET 1.

Fig. 2.

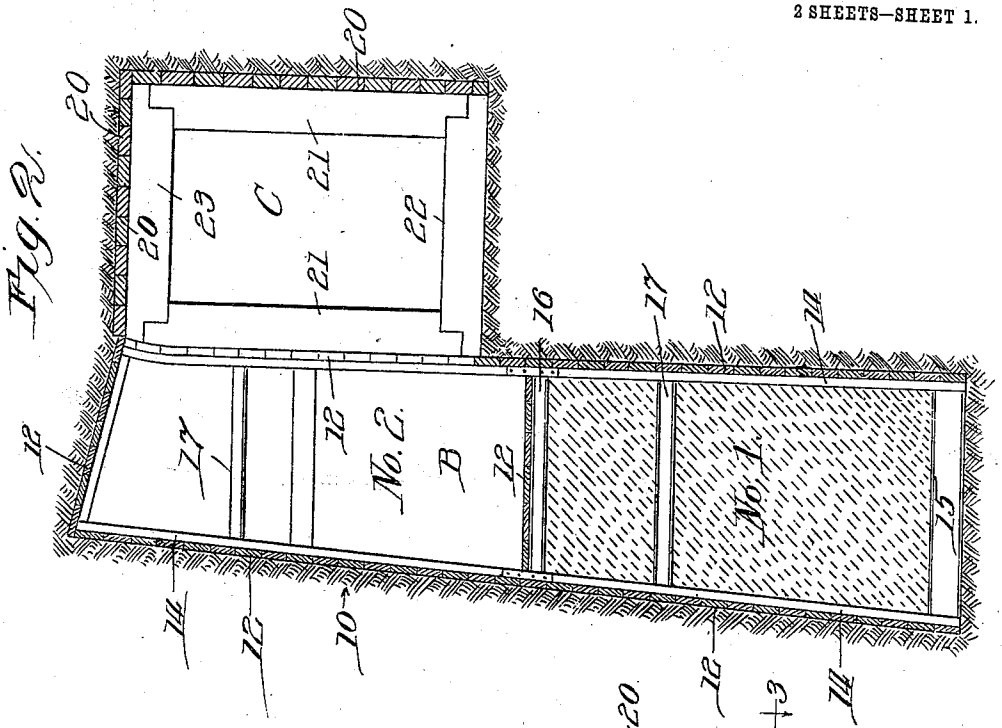
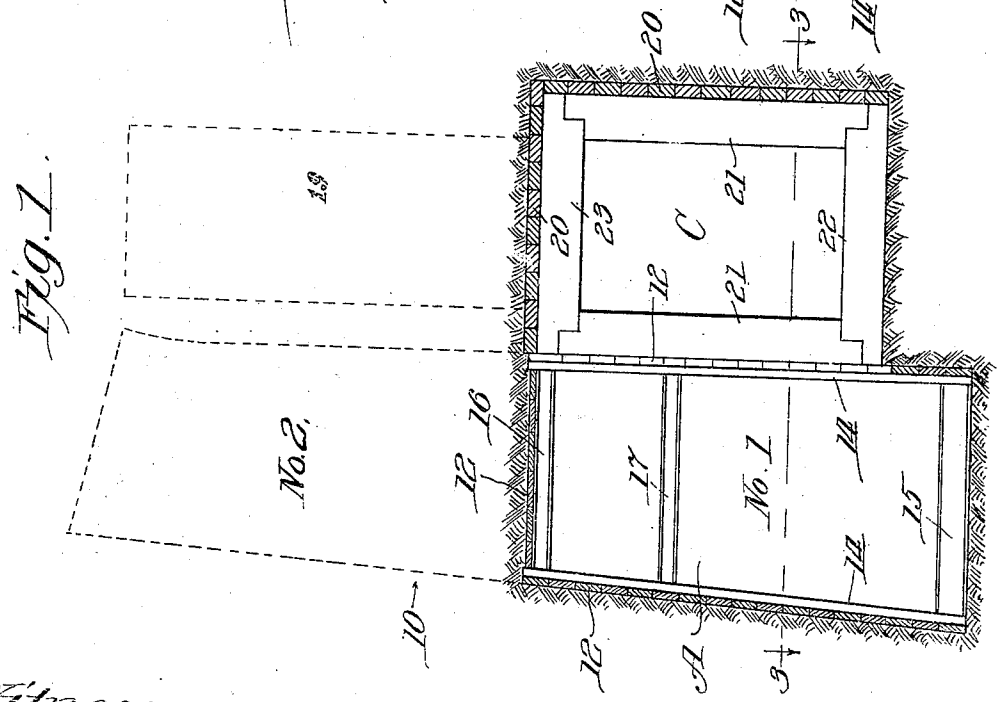


Fig. 1.



Witnesses.

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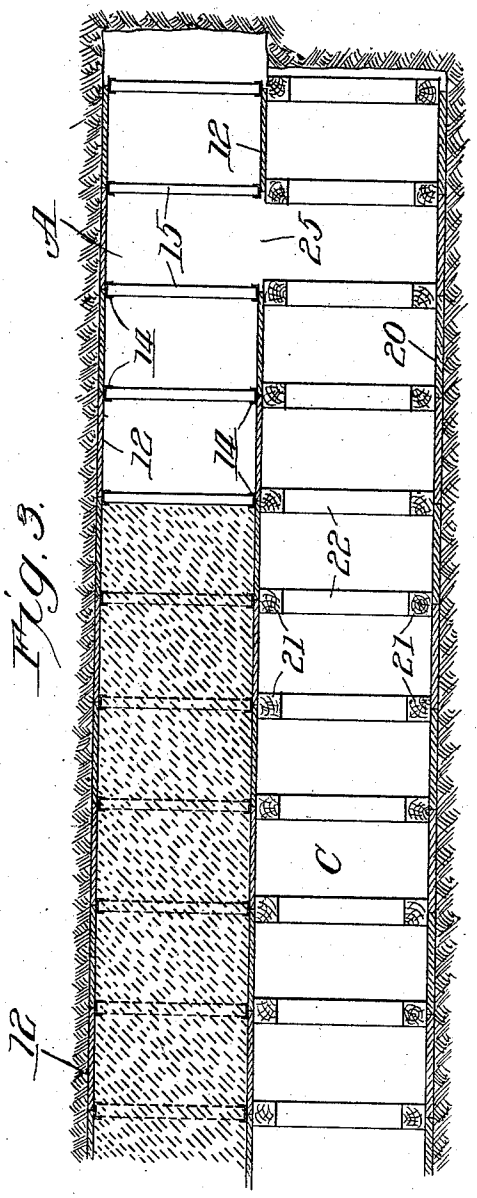

Fig. 3.

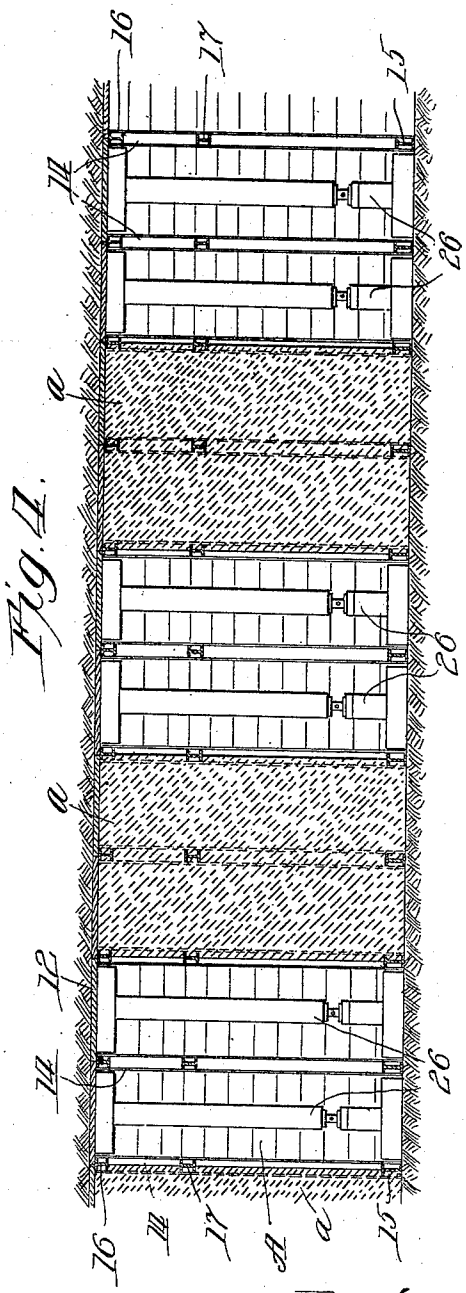

Fig. 4.

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UNITED STATES PATENT OFFICE.

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CONSTRUCTING CONCRETE AND LIKE WALLS IN THE EARTH.

960,941. Specification of Letters Patent. Patented June 7, 1910.

Application filed March 19, 1910. Serial No. 550,529.

To all whom it may concern:

Be it known that I, GEORGE W. JACKSON, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Art of Constructing Concrete and Like Walls in the Earth; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the art of constructing concrete or masonry walls in the earth for tunnels and like purposes, and refers more specifically to an improved method of building such walls along the general method or plan outlined in my pending application for United States Letters Patent, Serial Number 544,527, filed February 18th, 1910. According to the method specifically outlined in said application, separately formed longitudinal sections of the wall are constructed in successively higher courses, beginning at the bottom, each course being formed by excavating a wall section tunnel for a given distance, lagging the excavation as it is formed and thereafter filling the excavation with wall forming material, such as concrete, beginning at the far or blind end of the tunnel or excavation and working backwardly.

In accordance with my improved method of constructing the tunnel or other wall, I propose to excavate along with the wall section tunnel a smaller inlet and outlet drift, disposed laterally at the side of and arranged to communicate with the wall section tunnel at different points throughout the length of the latter, through which drift access to the tunnel and egress therefrom, as its construction progresses, may be had to remove the excavated earth and to carry the filling material into the tunnel to fill the latter. The excavation of said drift is carried along with the wall section tunnel and is arranged to communicate with said tunnel at short intervals throughout its length so that the filling material may be delivered through the drift directly to the point in the tunnel in which it is used to fill the latter. The wall section tunnel may be filled or concreted therefore as rapidly as the tunnel is excavated and lagged, the filling or concreting work following the excavating work as closely as conditions will permit, while giving operating space or room for the excavating and filling gangs. The inlet and outlet drift, as well as the wall section tunnel, is lagged as the work of excavation proceeds, and said drift remains open so long as work continues on the wall section tunnel served thereby so as to afford safe ingress to and egress from said tunnel as it is being excavated and as the finished tunnel is being filled. The inlet and outlet drift is located so close to the wall section tunnel that the lagging at the side of the tunnel adjacent to said drift serves also as the lagging for the drift excavation. That is to say, a single lagging wall separates the drift and tunnel. Access from the drift to the tunnel may be obtained, therefore, by removing one or more sections or lengths of the lagging throughout the height of the drift to provide a communicating opening. Such point of communication will usually be adjacent to the breasts of the forming tunnel and drift and midway between said breasts and the point at which the filling work follows. After the required length of wall section or course has been made the lagging is removed from the inlet and outlet drift and said drift may be filled if desired. If a next higher wall section or course is to be formed, it is constructed in the same manner as hereinbefore set forth, it being built upon and bonded to the lower wall course. It will be understood that a wall consisting of a single section or course may be built in accordance with my improved method, with the full advantages appearing.

When the tunnel is being excavated in relatively unstable earth, or when operating beneath ground that is heavily loaded so that the roof of the excavation requires support in addition to that afforded by the body of green or unset concrete with which the excavation is filled, I may arrange to fill the excavation at separated points along the length thereof and to support the roof of the excavation intermediate the separated bodies of filling material by special temporary supporting means, such as jacks. When filling the excavation in accordance with this method the supporting means will be retained to support the roof until the bodies of concrete or other filling have set or hardened so as to safely take such sup-

port. Thereafter the special supporting means are removed and the spaces previously occupied thereby are filled in or concreted to complete the wall section or course. The arrangement whereby a single course of lagging constitutes the dividing wall between the tunnel and inlet and outlet drift permits ready access to the unfilled portions of the tunnel after the drift has been excavated beyond said unfilled portions, it being only necessary to remove the lagging at the points to be filled to establish the necessary communication between the tunnel and drift.

As shown in the drawings, Figure 1 is a cross section showing the manner of constructing a wall in accordance with my improved method, the view illustrating the construction of the lower course of the wall. Fig. 2 is a similar section showing the lower course completed and the upper course in process of construction. Fig. 3 is a longitudinal section of a length of the tunnel and drift, said view being taken on the line 3—3 of Fig. 1. Fig. 4 is a vertical section taken through a partially completed wall section tunnel, showing special means for temporarily supporting the tunnel roof at longitudinally separated points between short complete sections of the wall course.

The wall 10 shown in Figs. 1 and 2 is made of two separately formed superposed sections or courses designated as No. 1 and No. 2. In Fig. 1 the wall section tunnel for lower course, No. 1, is shown in the process of construction, while the position of course No. 2 is indicated in dotted lines. In Fig. 2 the lower course, No. 1, is shown as completed while course No. 2 is in the process of construction. The earth removed to receive the wall sections or courses is excavated in the manner of small tunnels, herein designated as wall section tunnels, the tunnel for the lower wall course or section being designated by A and the tunnel for the upper section or course of the wall being designated by B. As each wall section tunnel is excavated it is lagged and braced to support the tunnel walls. The lagging 12 is supported by suitable forms consisting of open, generally rectangular frames, comprising the side uprights 14, 14, the bottom and top cross members 15, 16, respectively, and intermediate braces 17. The said lagging is made of convenient length, usually about three feet. In setting the bracing or forms of an upper excavation or tunnel, the side members or uprights thereof may be attached rigidly to the uprights of the forms of a lower completed course, which latter forms will remain in the concrete body of the lower course to reinforce the same; and the top cross members 16 of the forms of the lower course may constitute the bottom members of the forms of the next upper section or course.

C designates a horizontal drift, of smaller cross section than the tunnel, which is excavated alongside and parallel to the wall section tunnel, immediately adjacent thereto, to constitute an inlet and outlet drift through which the operatives may pass into and out of the tunnel, and through which also the earth excavated from the tunnel may be removed and the filling material and forms and lagging may be conveyed or passed to the tunnel. The said drift may be reached from the ground level through the vertical shaft 19 indicated in dotted lines in Fig. 1. The excavation of the drift is carried along with that of the tunnel, as indicated in Fig. 3, and the walls of the drift are supported by the lagging 20 and supporting forms therefor, the latter consisting of the uprights 21 and the bottom and top members 22, 23, respectively. The lagging at the inner side of the drift consists of the lagging 12 of the adjacent side of the tunnel, so that communication between the inlet and outlet drift and the tunnel is afforded by removing one or more sections of the lagging, as indicated at 25 in Fig. 3, and also in Figs. 1 and 2. The forms and lagging are placed as the excavation proceeds in both the wall section tunnel and the drift.

The communication between the tunnel and drift, afforded by the removal of one or more sections of the lagging, as shown at 25, is carried along adjacent to or at a suitable distance in rear of the breasts of the tunnel and drift as shown in Fig. 3, the said communicating opening being advanced or carried forward as the excavating work proceeds. As the positions of said communicating openings are advanced by the removal of sections of the lagging constituting the wall between the tunnel and drift, the lagging is placed in position to close the openings theretofore constituting the communicating openings between the tunnel and drift so as to provide continuous lagging walls against which to form the concrete as the work of filling the tunnel progresses or is carried forwardly. The filling of the tunnel with concrete or like wall forming material is carried on closely adjacent to the communicating opening 25 between the tunnel and drift so that the tunnel may be filled or concreted practically as soon as it is excavated. In this manner the period of time in which the forms and lagging are required to support the earthen walls of the tunnel is reduced, as compared to the method of constructing the wall set forth in my aforesaid application, wherein the tunnel is first completed throughout a given length and is thereafter filled or concreted, beginning at the far or blind end of the tunnel.

After a lower course has been completed in the manner described, the upper course may be constructed in the same manner as

the lower course, a new inlet and outlet drift being constructed alongside the upper tunnel to afford direct access to and egress from the tunnel for the purposes specified. When the superjacent wall section tunnel is being excavated, the top lagging of the lower completed course is removed before the concrete of said upper course is placed, so that the upper and lower courses of concrete may be bonded together.

When each wall course is finished the lagging and supporting form of the drift associated will be removed and the drift excavation may or may not be filled. If said wall constitutes the wall of a tunnel or subway, the said drifts will be located at the inner or tunnel side of the wall and will not require to be filled when the wall is completed, inasmuch as the area in which the drifts are contained will be removed in the completion of the tunnel or subway.

As shown in Figs. 1 and 2, the inlet and outlet drifts are located at the level of the tops of the wall section tunnels. This location or arrangement is advantageous, inasmuch as it permits the concrete at the top of the filling body to be tamped solidly against the lagging at the roof of the tunnel from the side of the filling body, and, obviously, the tamping will be more effectual than where the tamping is directed from the end of the filling body. In some instances, a single inlet and outlet drift may be located at the side of and midway between an upper and a lower tunnel so as to serve both tunnels.

In Fig. 4 is illustrated a method of supporting the roof of a tunnel that is excavated in earth which requires supporting means in addition to that afforded by a body of green or unset concrete. Such need for additional support may arise by reason of a relatively soft or unstable earth, or by reason of the loading of the ground above or along the side of the line of the tunnel wall. The method indicated in said Fig. 4 consists in placing separated bodies *a*, *a* of the filling material at points along the length of the tunnel and supporting the tunnel roof at points between the separated bodies *a* by temporary supporting means, as the jacks 26. The said temporary supporting means relieve the unset, separated filling bodies of the large part of the load of the top wall or roof of the tunnel until said bodies set or harden. Thereafter the temporary supporting means are removed, and upon their removal the roof load is borne by the bodies until the intermediate sections of the tunnel are filled and the filling material hardened or set. Inasmuch as the lagging between the tunnel and drift may be readily removed at any points desired to provide communicating openings from the drift to the tunnel, the subsequent filling of the tunnel sections intermediate the bodies *a* of filling material, after the temporary supporting means are removed, may be very conveniently and quickly effected.

I claim as my invention:

1. The improvement in the art of constructing concrete and like walls in the earth, which consists in excavating a tunnel along the line of the proposed wall, excavating an inlet and outlet drift laterally alongside of the tunnel, providing communicating openings between said tunnel and drift at separate points throughout the length of the tunnel and conveying filling material through said drift and said communicating openings into the tunnel and filling said tunnel therewith to complete the wall.

2. The improvement in the art of constructing concrete and like walls in the earth, which consists in excavating a tunnel along the line of the proposed wall, excavating an inlet and outlet drift laterally alongside of the tunnel throughout the length of the latter, bracing and lagging said tunnel and drift, having a single lagging wall arranged to separate the drift and tunnel, removing sections of the latter lagging wall at different points along the tunnel and drift to provide separate communicating openings between the tunnel and drift, and conveying filling material through said drift and said communicating openings into the tunnel and filling said tunnel therewith to complete the wall.

3. The improvement in the art of constructing concrete and like walls in the earth, which consists in excavating successively higher wall section tunnels, beginning at the lower level of the wall, separately filling each wall section tunnel with wall forming material, excavating inlet and outlet drifts laterally alongside the wall section tunnels, and providing communicating openings between the drifts and the tunnels at separate points throughout the length of said tunnels.

4. The improvement in the art of constructing concrete and like walls in the earth, which consists in excavating a wall section tunnel, filling the tunnel at separated points with spaced bodies of wall forming material, supporting the tunnel roof intermediate the spaced filling bodies with temporary supporting means, while the spaced bodies of filling material sets, and finally filling the sections of the tunnel previously occupied by said temporary supporting means with wall forming material to complete the wall.

5. The improvement in the art of constructing concrete and like walls in the earth, which consists in excavating a tunnel along the line of the proposed wall, excavating an inlet and outlet drift laterally

alongside of the tunnel, providing communicating openings between said tunnel and drift at separate points throughout the length of the tunnel, filling the tunnel through said drift at points along its length with spaced bodies of filling material, supporting the tunnel roof intermediate the spaced filling bodies with temporary supporting means while the spaced bodies of filling material set and finally filling the tunnel intermediate the spaced bodies to complete the wall.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this fifteenth day of March A. D. 1910.

GEORGE W. JACKSON.

Witnesses:
A. D. SHANKS,
W. M. CLARK.