J. W. MORGAN.

MEANS FOR FORMING CIRCULAR TUNNELING.

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Fig. 2.

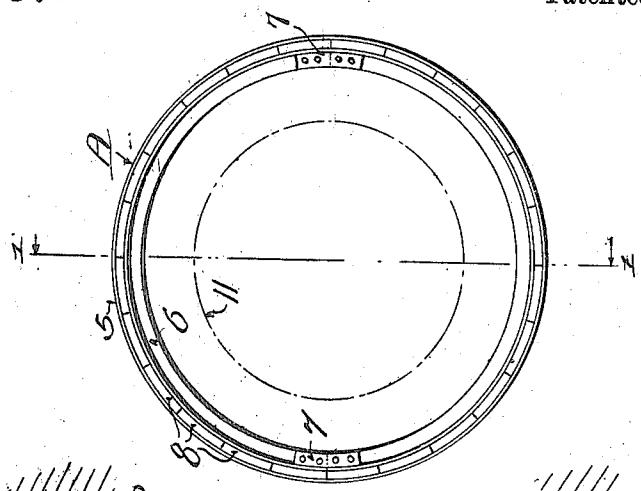
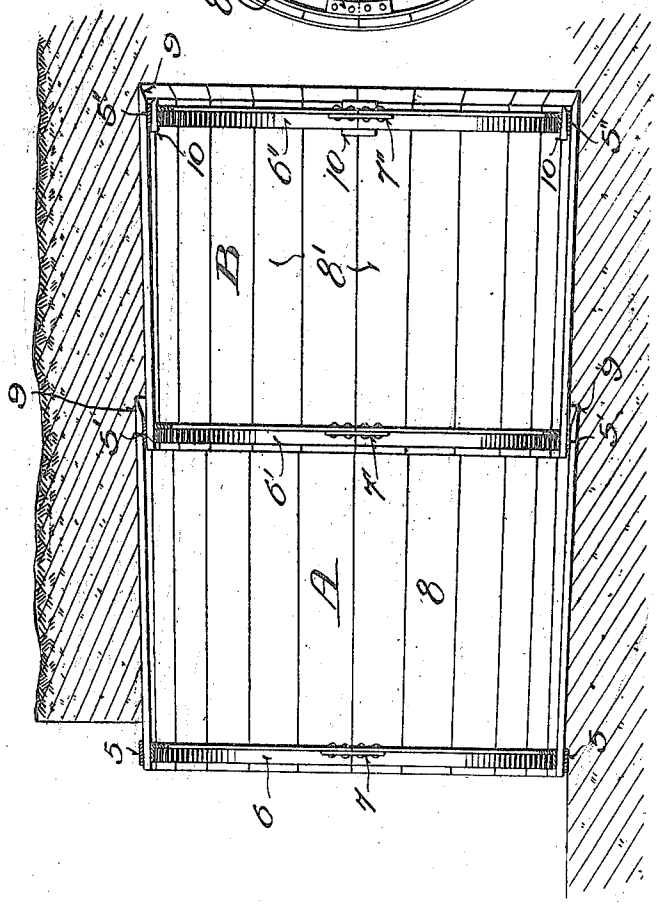


Fig. 1.



Witnesses:

Inventor:
John W. Morgan
By George Young
Attorneys

UNITED STATES PATENT OFFICE.

JOHN W. MORGAN, OF MILWAUKEE, WISCONSIN.

MEANS FOR FORMING CIRCULAR TUNNELING.

1,255,207. Specification of Letters Patent. Patented Feb. 5, 1918.

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To all whom it may concern:

Be it known that I, JOHN W. MORGAN, a citizen of the United States, and resident of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Means for Forming Circular Tunneling; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to new and useful improvements in means for forming circular tunnels for conveying sewage or other fluid and including a concrete body molded in place within the tunnel.

The usual method heretofore employed of projecting tunnels of this nature, particularly in soft ground has been to dig a tunnel of square cross section, lined with suitable bracing means to resist pressure of the earth, and then to mold concrete in the tunnel to form a cylindrical interior surface. In view of the clearance necessary between the bracing means and the minimum desired thickness of concrete, and in view of the square shape of the tunnel, which forms the outer mold of the concrete body, a great wastage of concrete is involved, this wastage amounting to substantially sixty per cent. of the amount of concrete necessarily employed in the formation of the sewer.

Although tunnel bracing means circular in cross section have heretofore been provided, such means has been adapted either for use only in hard ground, or has necessitated a complicated digging machine for use in soft ground.

It is therefore primarily the object of my invention to provide a means circular in cross section for simultaneously forming and bracing a tunnel projected through either hard or soft ground, which involves a minimum amount of material, which presents a circular cross section whereby the minimum necessary amount of concrete may be employed in molding the shell of the sewer, and which may be assembled in the tunnel coincident with the digging thereof without the provision of initial means for holding back the earth.

With the above and other objects and advantages in view, the invention resides more particularly in the novel combination, formation and arrangement of parts hereinafter described and pointed out in the appended claims.

In the drawings:

Figure 1 is a vertical sectional view through a sewer shaft and bracing embodying my invention.

Fig. 2 is an end view of a section of the bracing and molding.

Referring now more particularly to the accompanying drawings, the tunneling operation is first started by the provision of a vertical shaft from which the horizontal tunnel is projected, and in carrying out my invention I first dig a section of the horizontal tunnel in which to place an initial section A of my bracing means. This section of bracing means comprises at its rear end a circular band 5 formed of semi-circular sections of transversely flat metal and of a diameter substantially equal to the desired diameter of the tunnel. Disposed within this band and of slightly lesser diameter is a second band 6 formed of semi-circular angle iron strips, the ends of which are secured together by bolts passed therethrough and through connecting plates 7. The diameters of these bands are such as to provide an annular space therebetween, and in this space are disposed the rear ends of a series of lagging boards or staves 8, the forward ends of these lagging boards being sharpened at 9 to permit said boards to be driven into the ground. Disposed within this series of lagging boards and bearing against said boards at their inner ends to support them is the transversely flat circular band 5′ of a second section B of bracing, including the inner rear end band 6′ and lagging boards 8′.

In the operation of digging the tunnel, the first bracing section A is assembled within a previously dug tunnel section. The circular band 5′ of the next bracing section is then inserted in the first bracing section and disposed at the inner end thereof. The inner band 6′ is then inserted, in a disassembled position. It is then expanded to its proper diameter, with its ends secured by the connecting plates 7′. Wedges, such as shown at 10 in connection with the bands 5″ and 6″ of a third bracing section are then driven between the rings to hold them in concentric relation and the lagging boards of the second section are then driven between the rings, it being understood that this driving action of the lagging boards is effected coincident with the removal of

earth from the tunnel portions bounded thereby.

Thus the tunneling may proceed for any desired length, and in view of the relatively small amount of material embodied in the bracing, together with the circular shape thereof, an exceedingly great economy of material and of concrete is procured, it being appreciated that any suitable and preferably conventional core member, the outer periphery of which is indicated at 11, would be provided within the sections, in pouring the concrete.

In gravel or water laden earth wherein the earth has a tendency to run, the usual breast boarding is set up at the head of the tunnel and the upper curved bracing portions are set in place and held by the usual needle beam structure while the bracing section is completed, this needle beam structure comprising a longitudinal beam which is disposed at the top of the tunnel to engage and support the semi-circular strips, the needle beam structure being supported by a standard set up in the tunnel and being thus readily removable upon completion of the section. Thus my improved method of projecting circular tunnels may be utilized in ground of any nature. I am aware that heretofore circular tunnel bracing means has been employed in the nature of arcuate sections of liner plates bolted together to form a cylindrical body, and by arcuate cant boards fitted together and affording a mutual bracing. The provision of such bracing means is not possible without the use of an initial means for digging and holding back the pressure of the earth such as the relatively expensive digging shields.

While my improved bracing means, when disposed in place forms an outer cylindrical mold wall for the body of concrete, the essential feature of my invention resides not in the provision of a cylindrical mold wall, but in the provision of a means for tunneling involving the assembly of a cylindrical bracing means simultaneously with the tunneling operation.

What is claimed is:

1. The method of projecting circular tunnels which consists in positioning concentric spaced rings transversely in the tunnel, in driving lagging boards between said rings, in removing the dirt in the space inclosed by the lagging boards, in positioning a second pair of circular rings within the forward ends of series of lagging boards, and in driving a second series of lagging boards between said second pair of rings and removing the dirt from the space bounded by said second set of lagging boards.

2. A tunnel comprising a circular series of lagging boards having their ends disposed in overlapped relation, and circular bracing rings disposed within each end of each series of lagging boards, certain of said rings being disposed between the overlapped ends of the boards.

3. A tunnel comprising a series of lagging boards having their ends disposed in overlapped relation, bracing rings engaging one end of each series of lagging boards at the inner wall thereof, retaining and guiding rings engaging the ends of said lagging boards engaged by said bracing rings at the outer wall thereof, said retaining rings being disposed between the overlapped ends of the boards, substantially as described.

In testimony that I claim the foregoing I have hereunto set my hand at Milwaukee, in the county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

JOHN W. MORGAN.

Witnesses:

FRANK S. RATCLIFFE,

M. E. DOWNEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."