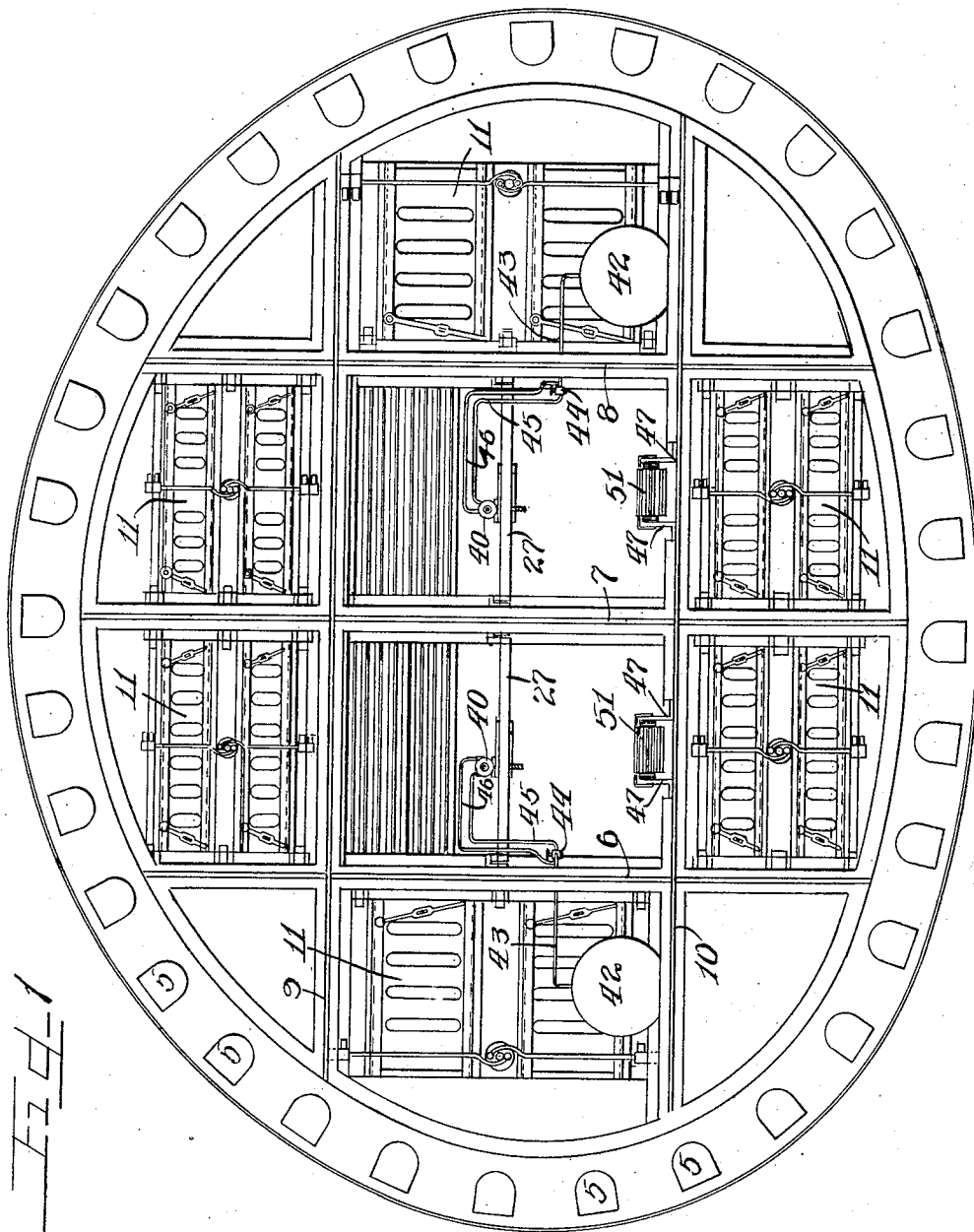


C. G. HASTINGS.
TUNNEL SHIELD,
APPLICATION FILED NOV. 26, 1915.

1,240,446.

Patented Sept. 18, 1917.
5 SHEETS—SHEET 1.



WITNESSES

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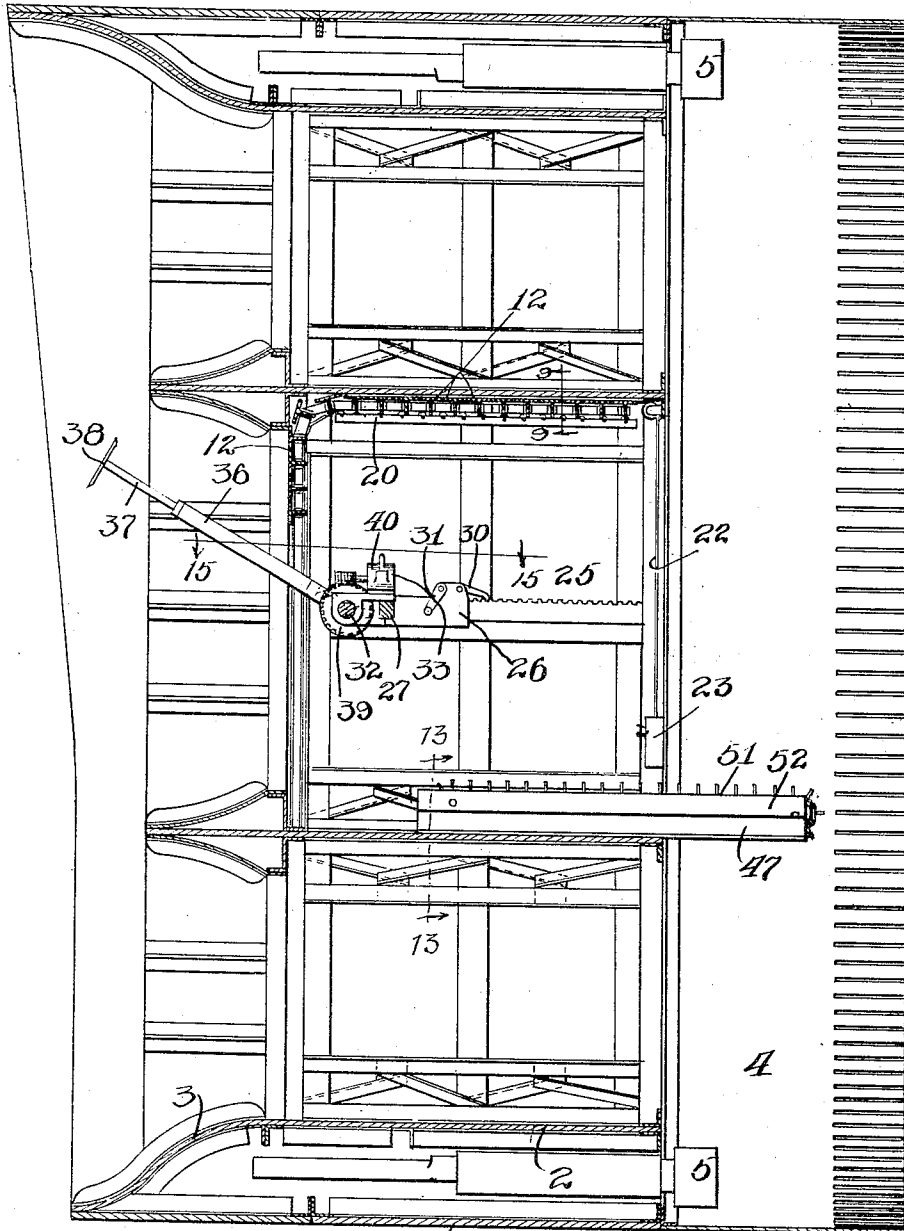
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Fig. 2



WITNESSES

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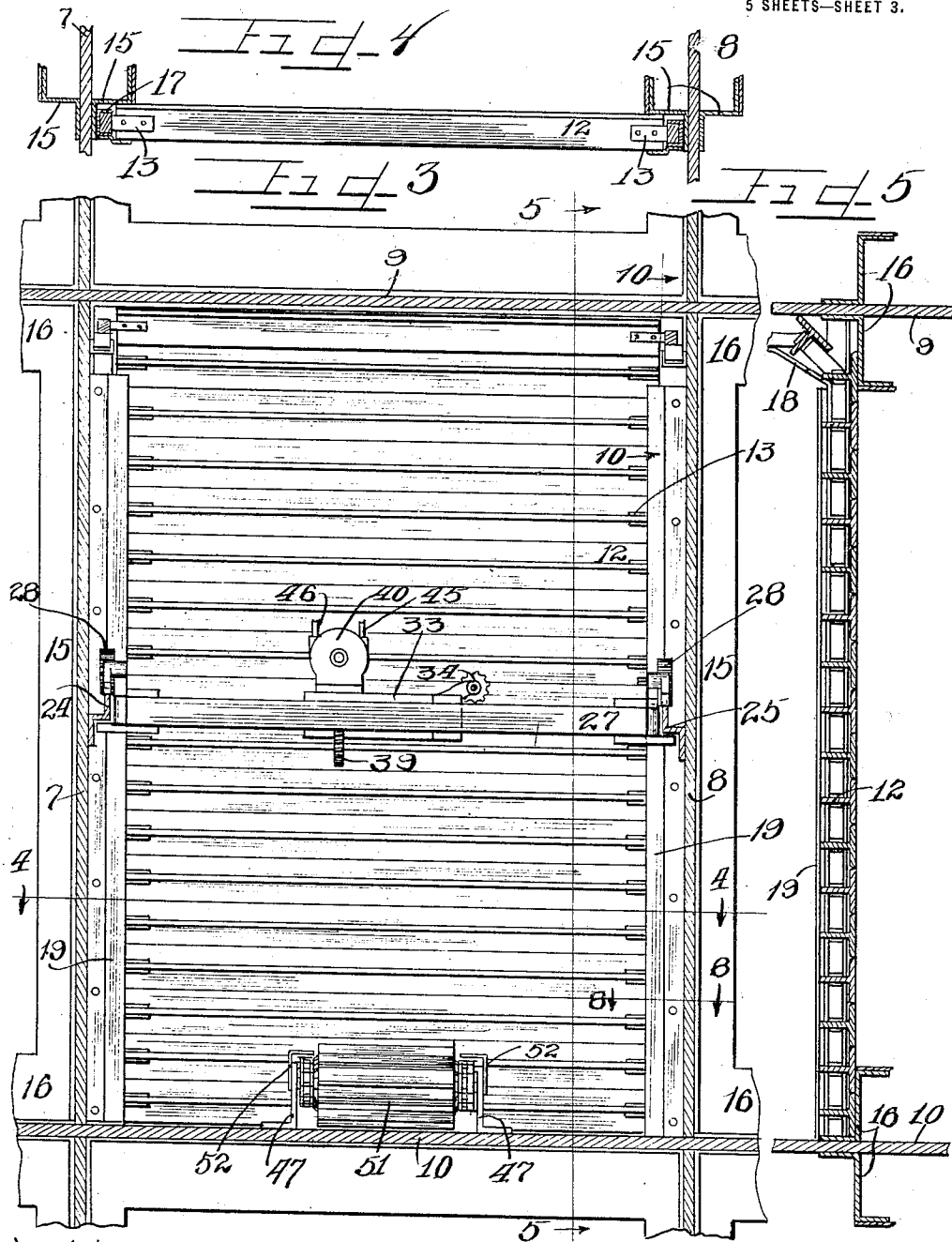
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5 SHEETS—SHEET 3.



WITNESSES

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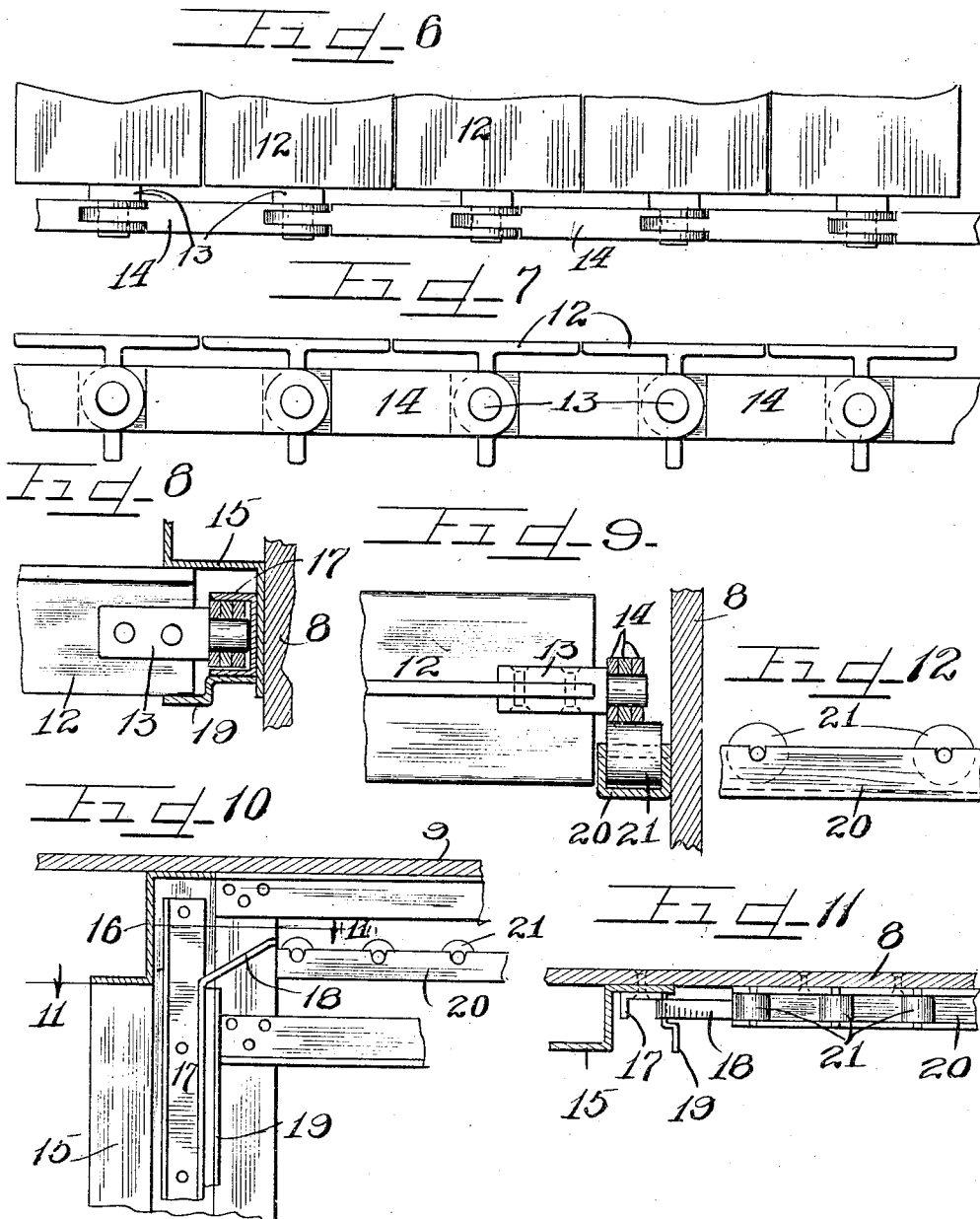
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5 SHEETS—SHEET 4.



WITNESSES

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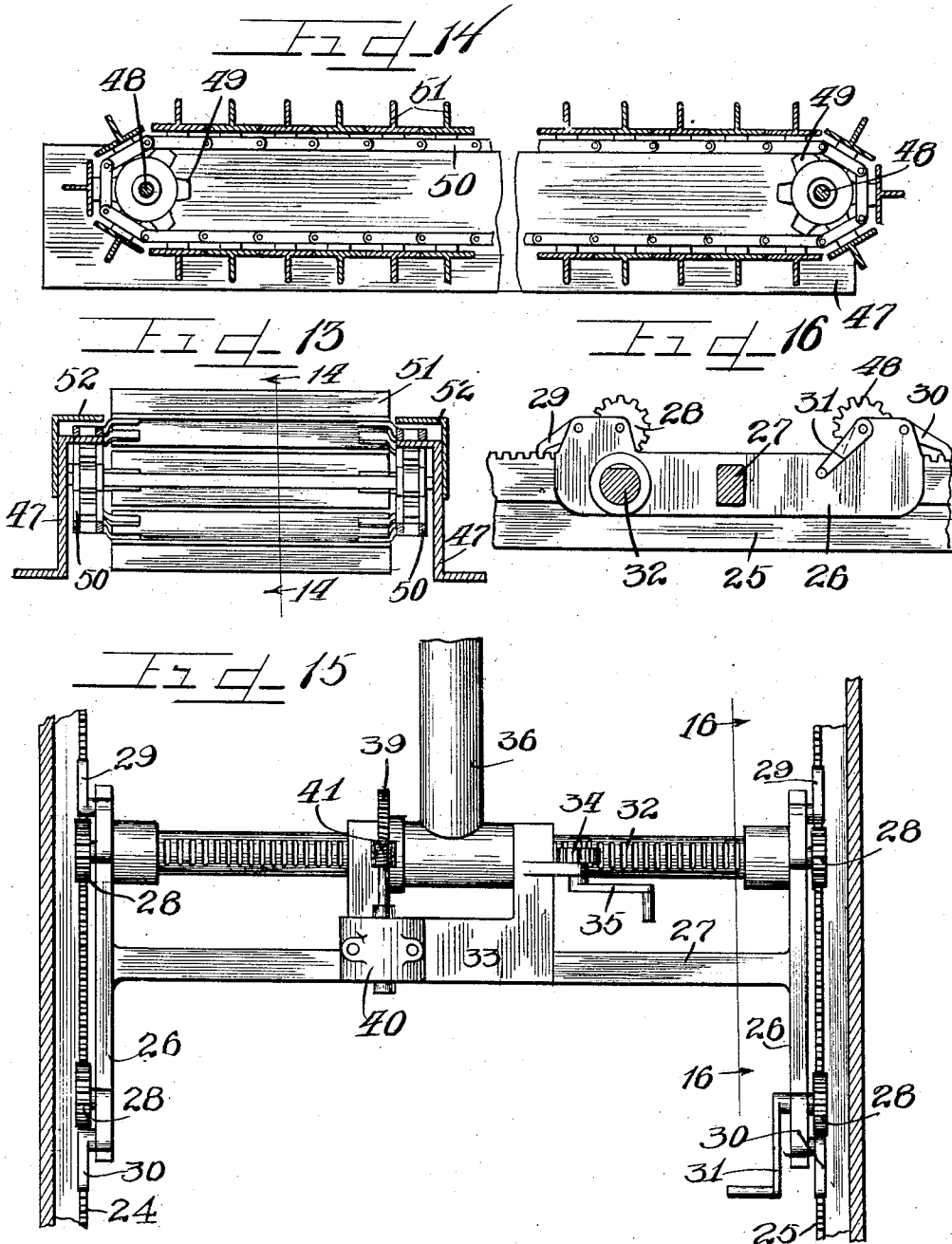
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5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

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TUNNEL-SHIELD.

1,240,446.

Specification of Letters Patent.

Patented Sept. 18, 1917.

Application filed November 26, 1915. Serial No. 63,494.

To all whom it may concern:

Be it known that I, CORNELIUS G. HASTINGS, a citizen of the United States, and a resident of the city of Glendale, in the county of Los Angeles and State of California, have invented certain new and useful Improvements in Tunnel-Shields; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the numerals of reference marked thereon, which form a part of this specification.

This invention relates to an improved tunneling shield of the same general type as that disclosed in my co-pending application for "Tunneling Shield" Serial No. 872,921, filed November 19th, 1914. In the present invention, however, an improved door construction is provided permitting certain of the doors to be opened without interference with any apparatus which may be disposed behind the doors within the shield.

It is an object therefore of this invention to construct a tunnel shield equipped with a plurality of doors giving access to the various compartments thereof, certain of said doors constructed of grid plates and certain others of the doors of a strong flexible shutter-like construction, permitting the same to be retracted into a horizontal open position so disposed as to form no hindrance to entrance or egress through the doorway of the compartment, thus facilitating the use of excavating tools and conveying mechanisms whereby the material is cut away in front of the shield and conveyed to dump cars at the rear of the shield.

It is also an object of this invention to construct an improved type of tunneling shield provided with a plurality of vertical and transverse partitions affording a number of different working compartments with certain of said compartments provided with a heavy flexible folding door adapted to be drawn upwardly close to the roof of the particular compartment with which it is associated into a position out of use so as to form no interference to workmen, or the use of excavating or conveying mechanisms mounted within the compartments in the shield for use in projecting the tunnel bore.

It is also an object of this invention to

construct a tunneling shield equipped with excavating and conveying mechanisms, and divided into different compartments whereby the operation of said respective mechanisms may be confined to small areas and with strong sectional shutter-like doors within the shield for said compartments in which said mechanisms are mounted adapted to be opened into a position out of use and out of possible interference with the mechanisms within the compartments.

It is furthermore an important object of this invention to provide a tunnel shield divided into a plurality of compartments, certain ones thereof provided with grid plate doors through which material cut by the shield may be admitted into the compartments for transference away, and other of the compartments provided with heavy sectional flexible doors adapted to be opened into a position out of use and out of possible interference with apparatus mounted in the compartments, such as excavating machines, conveyers, and the like, and when closed capable of withstanding heavy crushing stresses on the exterior thereof.

It is finally an object of this invention to construct an improved type of tunnel shield equipped with different types of doors for the different compartments in which the tunneling shield is subdivided to facilitate use of the shield in projecting a bore.

The invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

In the drawings:

Figure 1 is an interior face view of a tunnel shield embodying the principles of my invention.

Fig. 2 is a central vertical section taken therethrough, with parts shown in elevation.

Fig. 3 is an enlarged detail section illustrating an interior face view of one of the folding metal doors for a compartment and with certain apparatus mounted within the compartment for use therein.

Fig. 4 is a detail section taken on line 4—4 of Fig. 3.

Fig. 5 is a detail section taken on line 5—5 of Fig. 3.

Fig. 6 is a fragmentary exterior face view of the edge of the door detached from the shield.

Fig. 7 is a fragmentary edge view thereof.

Fig. 8 is an enlarged detail section taken on line 8—8 of Fig. 3.

Fig. 9 is a detail section with parts shown in elevation, taken on line 9—9 of Fig. 2.

Fig. 10 is a detail section taken on line 10—10 of Fig. 3, with the door omitted.

Fig. 11 is a fragmentary detail view taken on line 11—11 of Fig. 10.

Fig. 12 is a fragmentary edge view of the rollers in the channels shown in Figs. 9 and 11.

Fig. 13 is a detail section with parts shown in elevation, taken on line 13—13 of Fig. 2.

Fig. 14 is a detail section with parts in elevation, taken on line 14—14 of Fig. 13.

Fig. 15 is a sectional detail taken on line 15—15 of Fig. 2, with parts omitted and parts shown in elevation.

Fig. 16 is a detail section taken on line 16—16 of Fig. 15.

As shown in the drawings:

The tunneling shield consists of two cylindrical shells concentric with one another, the outer one of which is denoted by the reference numeral 1, and the inner one by the reference numeral 2, and said shells are, as clearly shown in Fig. 1, of oval cross section, and rigidly connected and spaced from one another. The forward edge of the inner shell 2, is smoothly curved outwardly, forming a flaring hood 3, joined at its outer end to the forward edge of the outer shell 1, and the upper portion of the shield, as clearly shown in Fig. 2, projects a slight amount beyond the lower portion thereof and the cutting edge formed by said flaring ring 3, and forward edge of the outer shell 1, inclines inwardly and downwardly from the overhanging upper portion to slightly below the middle of the shield. A flexible slotted metal apron 4, is connected on the rear end of the shield, permitting the blocks forming the lining of the tunnel to be built up therewithin, after which the shield is moved forward in a familiar and well known manner by means of hydraulic rams 5. The interior of the shield is divided into a plurality of compartments by means of vertical walls 6, 7, and 8, and horizontal partitions 9 and 10, respectively. The intersection and connection of said respective walls and partitions with one another affords a number of operating compartments within the shield, and doors are provided at the forward ends thereof. For this purpose grid plate doors 11, are provided, for the outermost compartments within said shield, which, when the shield is used in soft sandy soil, may be opened to permit the soil to gravitate therethrough as the shield is forced forwardly, but the two central compartments of the shield are each provided with a peculiar heavy sliding shutter-

like door which may be opened to permit egress from said compartment for the use and operation of excavating machines. The doors for the two central or operating compartments are made up of a plurality of T-bars 12, and riveted to the webs of said T-bars are pintle brackets 13, which project beyond the ends of said T-bars and afford a means of connection for links of a chain 14. Secured upon each of the respective vertical walls 6, 7, and 8, on each side thereof, are rectangular Z-bar frames, the vertical sides of which are denoted by the reference numerals 15, and the horizontal top and bottom ends of which are denoted by the reference numerals 16, said Z-bar frames affording a part of the interior framework of the tunnel shield.

Brazed or secured in any suitable manner on the inwardly extending flanges of the upright portions 15, of said Z-bar frames, are upright channel guides 17, for the chains 14, of said T-bar doors, and the inner flange of each of said channels at its upper end, as clearly shown in Fig. 10, is inclined inwardly, as denoted by the reference numeral 18. Brazed or otherwise rigidly secured to the inner flange of said channels 17, from the lower end to near the upper end thereof, is a Z-bar 19, which projects inwardly and together with the vertical portions 15, of the Z-bar frame mentioned, affords a guide for the ends of the T-bars 12, constituting the door. Secured in horizontal position at each side of the middle compartments of the shield on the vertical walls 6, 7, and 8, respectively, thereof, are channels 20, in which are journaled rollers 21, adapted to receive the links of the chains 14, rolling thereon when the door is elevated into open position.

A cable 22, is connected to the uppermost T-bar member 12, of the door at one side thereof, and is also connected to a counterweight 23, which moves adjacent the framework of the shield at one side and at the rear of the compartment and the mass of the counterweight is slightly less than that of the door, so that the door, when moved into closed position, will remain closed by gravity, but when swung upwardly into the open position shown in Fig. 2, is retained in such position by the counterweight.

Secured upon the vertical side walls of each of the middle compartments are toothed racks or tracks 24 and 25, respectively, and adapted to be moved thereon and supported thereby is a carriage comprising end members 26, parallel to the tracks joined by a cross brace or transverse member 27, and journaled in each of said end members are pinions 28, which rest upon and mesh with the teeth of said tracks 24 and 25, respectively. Pawls 30, are pivoted at the front end of each of the end members 26, and

pawls 29, at the rear end of each of said end members, so that when said pawls are thrown downwardly into engagement with the teeth of the respective tracks, the carriage is prevented from moving either forwardly or rearwardly thereon. For the purpose of moving said carriage on said tracks when the pawls are elevated, a handle or crank 31, is provided adapted to engage upon the inwardly extended shaft of one of the pinions 28, to rotate the same and due to its engagement with the teeth on the track to move the carriage.

Secured transversely between said end members 26, is a rod or bar 32, having teeth cut on the upper surface thereof, and resting slidably upon said bar and upon said transverse member 27, is a small carriage 33, provided with a pinion 34, meshing with the teeth on said rod 32, and adapted to be rotated by a handle 35, to thereby move said carriage 33, transversely in either direction. Pivottally mounted upon said rod 32, between the arms of said carriage 33, is a long arm 36, and adjustably mounted therein is a rod 37, on which is secured a cutter head 38, for excavating purposes. Keyed or otherwise rigidly secured to the inner hub extension of said pivottally mounted arm 36, is a worm wheel 39, and mounted upon the carriage 33, is a compressed air engine or turbine 40, secured upon the shaft of which is a worm 41, meshing with said worm wheel, so that the angular position of the arm 36, may be varied at will, and if desired caused to swing vertically in a reciprocating manner by reversing the turbine 40, from time to time. Accordingly, as clearly shown in Fig. 1, air or other fluid reservoirs 42, are mounted in the side compartments of the shield and from which lead supply pipes 43, to be connected into three way valves 44, from which branch pipes 45 and 46, respectively, lead to the respective turbines 40.

For the purpose of removing the material excavated by the cutter head 38, or transferring the same rearwardly in the shield into dump cars or other receiving means therefor, a portable conveyor driven in any suitable manner is provided, consisting of Z-bar side frame members 47, having journaled in each end thereof, shafts 48, on which are sprocket wheels 49, adapted to engage with chains 50, the links of which have secured transversely thereacross outwardly directed T-bars 51. The upper flights of said chains 50, as clearly shown in Fig. 13, rest upon the inwardly directed flanges of said T-bars 47, and brazed or otherwise suitably secured to the web of each of said T-bars is an angle bar 52, which extends upwardly and projects inwardly over the chains 50, to afford a guard therefor.

The operation is as follows:

When the shield has been advanced by

the hydraulic rams 5, forwardly through the soil the folding shutter doors 12, in the respective middle compartments may be opened by pulling downwardly upon the counterweights 23, and then advancing the carriages bearing the excavating mechanisms forwardly by rotating the cranks 31 until the desired positions are obtained. By manipulating the respective valves 44, the turbine engines 40, may be caused to rotate in either direction to swing the arms 36, vertically, so that the cutter heads 38, cut away the material in front of the shield and said cutter heads may be advanced from time to time by rotation of the cranks 31, of course elevating the pawls 29, during such movement. The material broken away by cutter heads 38, may be shoveled upon the conveyers 51, by which it is transferred rearwardly of the machine to a point of discharge, such as into dump cars or the like.

I am aware that various details of construction may be varied through a wide range without departing from the principles of this invention, and I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. In a tunneling shield of the class described divided into a plurality of compartments, means for closing certain of said compartments, sliding shutter doors for other of said compartments comprising T-bars, pintle brackets secured thereon, and chains connected to said pintle brackets, counterweights for said shutter doors, and guides disposed at the upper ends of the compartments in which the shutter doors are mounted to receive the same when the same are in open position.

2. In a tunneling shield of the class described divided into a plurality of compartments, a flexible metal door for one of said compartments comprising a plurality of T-bars, brackets rigidly secured to the ends of said T-bars, and chain links attached to said brackets for holding said T-bars associated with one another, vertical guides disposed at the forward end of the compartment to afford a guide and support for said door when in closed position, and horizontally disposed guides in the upper end of the compartment to receive a door drawn thereinto when the same is drawn open.

3. A tunneling shield comprising a plurality of compartments, doors at the forward ends of said compartments, certain of said doors comprising a plurality of hingedly connected T-bar sections, and guides for said latter doors to receive the same disposed in horizontal position at the upper ends of certain of the compartments when the doors are opened.

4. In a tunneling shield of the class described divided into a plurality of compart-

ments, vertical guideways afforded by the frame structure of said tunneling shield at the forward end on the sides of certain of said compartments, a sectional flexible door
5 of T-bar sections slidable in said guideways of one of said compartments, and horizontal guides to receive the flexible door drawn thereover and disposed at the upper end of the compartment out of interference with
10 excavating operations performed from within said compartment.

5. In a tunneling shield divided into compartments, sectional flexible metallic doors provided therefor comprising T-bars, chains

at each end of said T-bars to which said 15 T-bars are connected in associated relation, guides built into the framework of said tunneling shield for said sectional doors, and means receiving said sectional doors disposed thereon when the door is moved into 20 open position out of said guides.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

CORNELIUS G. HASTINGS.

Witnesses:

CHARLES W. HILLS, Jr.,
ELMER E. PETERSON.

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