

Oct. 11, 1927.

1,645,007

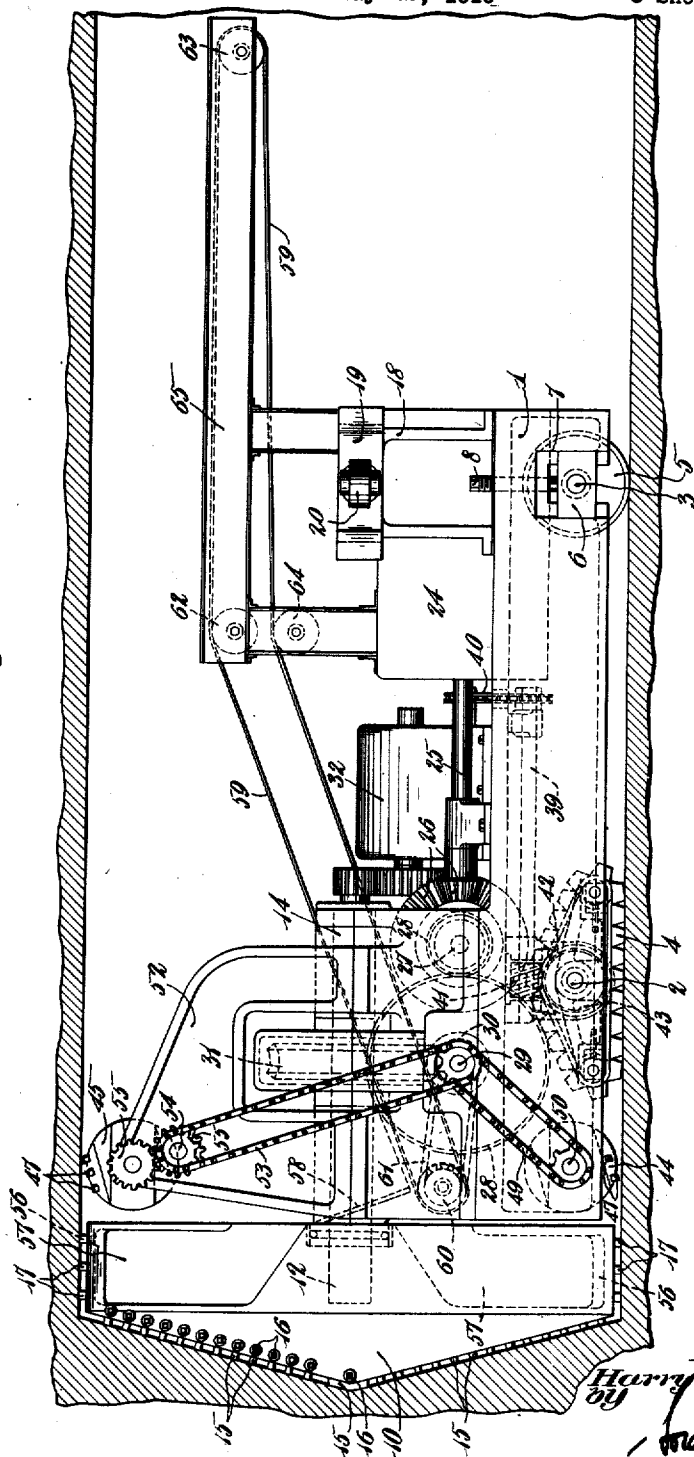
H. C. JOHANSEN

MINING MACHINE

Filed May 12, 1919

3 Sheets-Sheet 1

Fig. 1.



Inventor
Harry C. Johansen
by
[Signature]
Att'y.

Oct. 11, 1927.

H. C. JOHANSEN

1,645,007

MINING MACHINE

Filed May 12, 1919

3 Sheets-Sheet 2

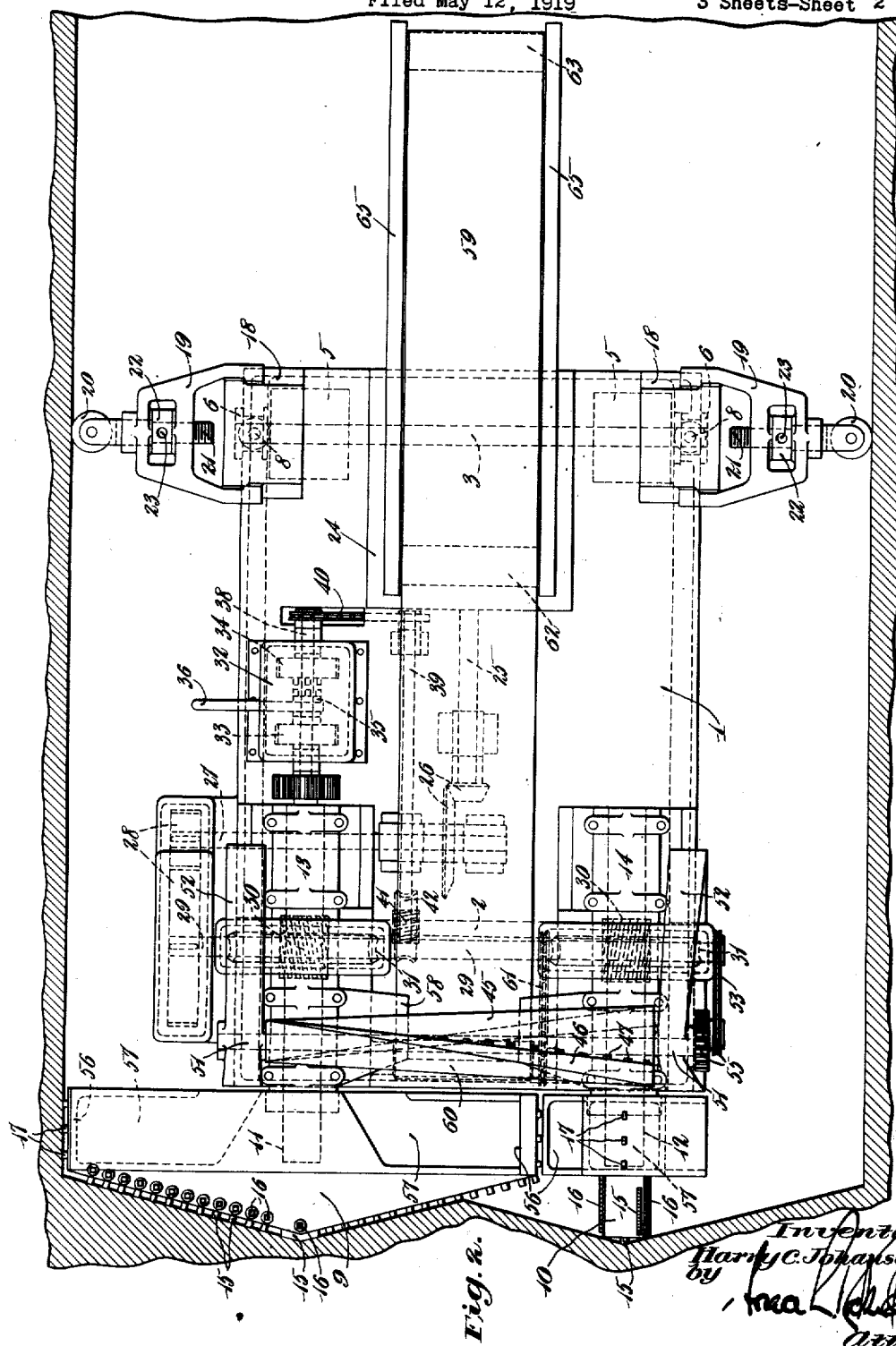


Fig. 2.

Inventor:
Harry C. Johansen
by
ma [signature]
Atty.

Oct. 11, 1927.

1,645,007

H. C. JOHANSEN

MINING MACHINE

Filed May 12, 1919

3 Sheets-Sheet 3

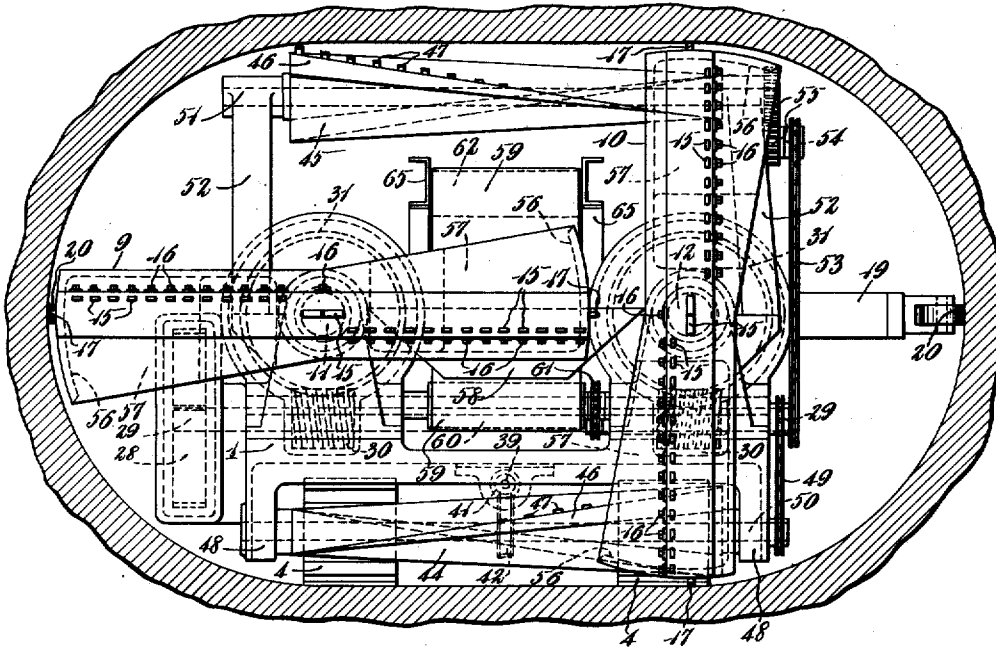


Fig. 3.

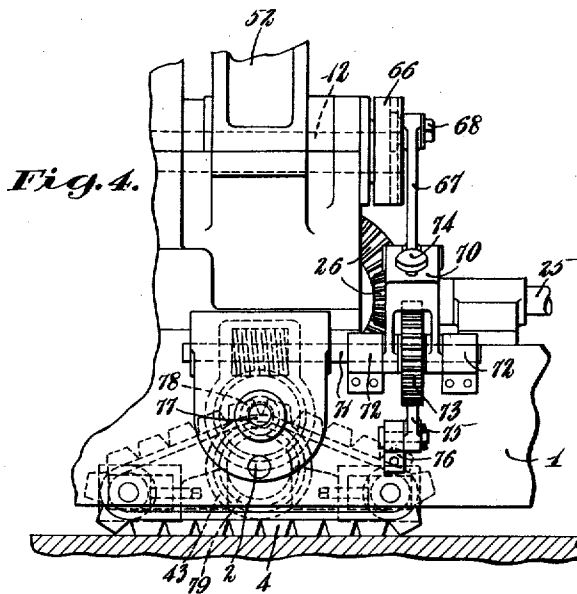


Fig. 4.

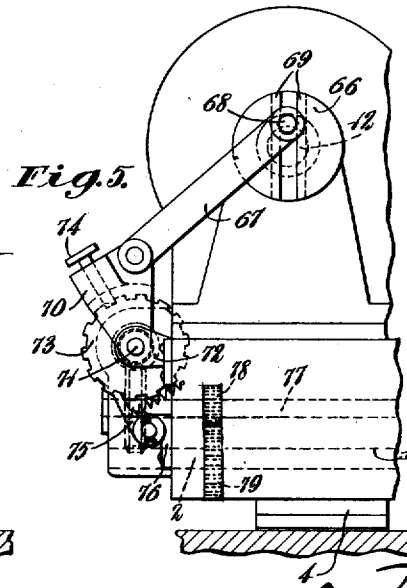


Fig. 5.

Invention
Harry C. Johansen
by
[Signature]
Att'y.

Patented Oct. 11, 1927.

1,645,007

UNITED STATES PATENT OFFICE.

HARRY C. JOHANSEN, OF MICHIGAN CITY, INDIANA, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

MINING MACHINE.

Application filed May 12, 1919, Serial No. 296,633. Renewed January 8, 1927.

This invention relates to mining machines and especially to a means for driving entries or tunnels.

One object of the present invention is to provide an improved mining machine. Another object of the present invention is to provide an improved mining machine for driving entries or tunnels and one of such a character that the machine produces a finished tunnel during a tunneling operation, it being unnecessary to use other tools or means for removing projections or leveling the floor. Still another object of the present invention is to provide an improved self-centering tunneling device which is automatically guided during a tunneling operation and which may be continuously operated to cut a tunnel head. Still another object of the present invention is to provide an improved tunneling device which operates on a tunnel head to drive the latter forward and which removes the cuttings to a point remote from the tunnel head and loads the cuttings onto a car. These and other objects and advantages of my improved construction will, however, herein-after more fully appear.

In the accompanying drawings I have shown for purposes of illustration several embodiments which my invention may assume in practice.

In these drawings,—

Fig. 1 is a side elevation of my improved mining machine in operative position in a tunnel.

Fig. 2 is a plan view thereof.

Fig. 3 is an end view of my improved mining apparatus.

Fig. 4 is a detail side elevation of a modified form of driving mechanism.

Fig. 5 is an end elevation thereof.

In the illustrative embodiment of my invention I have shown a truck 1 mounted on a plurality of axles 2 and 3 adapted to carry wheel elements on which the truck moves. The forward axle 2 preferably carries supporting caterpillar wheels 4 through which the truck is driven in order that the heaviest part of the machine, which in this embodiment of the invention is mounted on the forward end of the truck, will be provided with a broad supporting means which will not break in the mine floor and in order that

the more heavily weighted end may be availed of for securing proper traction on the mine floor. If desired, other types of wheels may be mounted on the rear axle 3, but because the weight on the rear end of the truck is relatively small, I herein preferably provide wide rimmed wheels 5 thereon. The axle boxes 6 carried on the ends of the axles 3 are preferably adjustable in gibs 7 herein shown formed integrally with the truck, the axle boxes 6 being vertically adjustable in the gibs upon an adjustment of an elevating screw 8 for adjusting the height of the rear end of the truck and thereby the inclination of the cutting mechanism to the axis of the tunnel or the tunnel head.

If desired, various forms of cutting mechanism may be mounted upon the truck, but I preferably provide a plurality of cutting mechanisms which simultaneously cut a plurality of intersecting passages or chambers, herein in the form of two bores uniting to form a mine entry which may easily be made into one in such a manner as to provide at once a suitable bottom or roadway on which the tunneling machine may be operated and on which trackways may be laid. In the preferred embodiment of my invention these cutting mechanisms comprise two cutter heads or arms 9, 10 rotatably mounted on shafts 11, 12 mounted in suitable bearings 13, 14 on the truck 1 in such a manner that the heads 9, 10 project in front of the truck, and the heads are set preferably at an angle to each other so that they may be simultaneously operated to cut intersecting or overlapping bores. The front ends of these cutter heads are preferably formed V-shaped or convex and the cutting bits 15 are preferably formed in two or more, herein parallel, series on the edges of the V-shaped section of the cutter head so that the transverse thrust of the bits will be equalized and no other means will be required to keep the head properly centered in the tunnel. The bits used are preferably removable for sharpening and are held in position by suitable means such as set screws 16. The proper clearance for the cutting heads is provided by the use of reaming bits 17 mounted on the sides of the cutter heads.

The cutter heads just described properly center the front end of the truck in the intersecting bores which are cut by this cutting mechanism, and to retain the rear end of the truck in proper alignment with the tunnel, I provide a guiding means mounted adjacent this rear end, this guiding means in the form shown being mounted on each side of the truck on standards 18. Projecting laterally from these standards are brackets 19 carrying guiding wheels 20 which may be adjusted laterally in the brackets as by means of bolts 21 in which the wheels are rotatably mounted, and adjusting nuts 22 threaded thereon. The adjusting nuts are manipulated by means of a pinch bar which may be inserted in a radial opening 23 formed in the adjusting nut, although as is obvious, other adjusting means may be used. By this improved adjusting means and also by the means above described for adjusting the elevation of the rear end of the truck, the position of the cutting mechanism relative to the axis of the tunnel may be varied so that a straight or a curved tunnel will be driven.

If desired, a plurality of actuating means may be used, but in the preferred form of my invention I preferably use a single motor 24 mounted adjacent the rear end of the truck, the cutter heads being driven from this motor by means of a motor shaft 25, beveled gears 26, jack shaft 27, spur gears 28, and a second jack shaft 29 which drives the shafts 11 and 12 by means of worms 30 fixed to the second jack shaft 29, and worm gears 31 fixed to the cutter head shafts 11 and 12. This drive provides a simple and powerful connection between the motor and the driving shafts 11 and 12 through a triple reduction gearing, that is, the gears 26, 28 and the worm drive 30.

While the mechanism for driving the truck may be taken from the truck shaft 25 or the jack shafts 27 and 29, I preferably drive the motor driving mechanism from the extended end of one of the driving cutter head shafts, as shaft 11, for the truck must necessarily move very slowly and the use of a second speed reducing means would lower the efficiency of the apparatus and increase its weight and the number of the wearing parts. The truck driving mechanism preferably has a reversing mechanism mounted in a gear box 32 in which oppositely driving gears 33 and 34 may be connected as by means of a clutch 35, controlled by lever 36, which may be thrown to drive a shaft 38 in either direction and thus impart a rotary movement to a driving shaft 39 through a chain 40 passed over suitable sprocket wheels mounted on the shafts 38 and 39. This last named shaft carries adjacent one end thereof a worm 41 which drives the axle 2 through a worm gear 42, the axle 2 in turn

imparting its rotating motion to the caterpillar wheels by means of a gear 43 which intermeshes with the caterpillar treads in a well known manner. By this improved mechanism, it is seen that a single motor is used to operate the cutting mechanism and to advance or retract the tunneling machine in a tunnel and that the proper speed reduction for the cutting mechanism and for the truck drive is produced with a very small number of moving parts.

As these two intersecting tunnels are driven forward it is seen that each comprises a substantially circular bore and that these tunnels are partially separated by V-shaped walls which project from the roof and floor of the tunnel. To form one tunnel of the intersecting bores, to provide a proper bottom or floor for the single tunnel, and to remove the obstructing wall which would project inwardly from the roof of this tunnel, I provide two cutter bars 44 and 45, the first of which removes the intervening wall at the bottom of the tunnel and prepares a level floor, and the latter of which removes the depending wall from the roof of the mine. In the preferred form of my invention, each of these cutter bars comprises a rotating member having a plurality of spiral ribs 46 carrying cutter bits 47 herein shown as similar to the cutter bits 15. The lower cutter bar 44 is mounted in the bearings 48 which project downwardly from the truck, and is driven preferably by a chain 49 which passes over suitable sprocket wheels on the jack shaft 29 and the shaft 50 of the cutter bar 44. The upper cutter bar 45 is mounted in suitable bearings 51 carried by standards 52 mounted on the truck, the cutter bar being driven in the proper direction by a chain 53 which passes over a second sprocket wheel carried by the jack shaft 29, and a sprocket wheel mounted on a stud shaft 54 carried by one of the vertical standards, this latter sprocket having a driving connection with the shaft of the cutter bar 45 through a pair of reverse gears 55.

The material which is cut from the tunnel head is preferably removed so that an accumulation of cuttings will not change the depth of the tunnel and impede the forward movement of the cutting mechanism as the tunnel is advanced. For this purpose, I provide, in the improved form of my invention, a plurality of scoops or shovels 56 herein shown as formed in the cutter heads 9 and 10 in such a manner that as the cutter head revolves, these scoops will pick up the cuttings from the bottom. As the arms of the head approach their upper vertical position, the material picked up by these scoops will be transferred therefrom by chutes 57 to a hopper 58 also carried by the truck from which the cuttings are removed as by an endless belt 59. This endless belt preferably

passes over a driving roller 60, driven from the jack shaft 29 as by a chain 61, the belt being carried rearwardly over suitable rollers 62, 63, and 64 mounted on elevated support 65 so that the material removed by the cutting mechanism may be deposited at the rear of the tunneling machine in small mine cars which may be run under the rearwardly projecting end of the support 65 for this purpose. This hopper 58 is preferably extended laterally from the belt conveyor 59 so that it receives the cuttings from the plurality of chutes carried by the two cutting heads 9 and 10 with the result that but a single conveyor 59 is required to remove the cuttings from the two cutting mechanisms which drive the two intersecting bores. As is obvious, other well known conveying means may be used in place of the belt conveyor shown.

If it is desired to move the mining machine forward intermittently instead of at a constant velocity, the driving means shown in Figs. 4 and 5 may be substituted for the continuous driving means above described. In this modified form of my invention, a driving disc 66 may be mounted on one end of the shaft 12 and this disc may be attached to a driving link 67 as by an adjustable connection as shown at 68, this connection being such that when this end of the link is moved outward between the gibs 69 carried by the disc, the throw of the link will be greater and the machine will be driven forward more rapidly. Attached to the other end of this link 67 is a rotating support 70 pivotally mounted as shown on a shaft 71 carried by a bracket 72 rigidly secured to the truck frame. Mounted also on this shaft 71 is a ratchet wheel 73 securely fastened to the truck drive shaft 71, this ratchet wheel being driven by a pin 74 having a beveled edge on the inner end thereof by means of which the pin may be moved about the axis 71 in one direction independent of the ratchet wheel 73 but the pin 74 when rotated in the opposite direction will catch the ratchet teeth and rotate the shaft 71. If desired, the truck may be driven in various ways but I preferably provide another speed reducing means between the truck driving means and the driven wheel, this speed reducing means being illustrated in Figs. 4 and 5 as a pinion 78 mounted on a jack shaft 77, the latter being driven by the shaft 71 by a pinion drive and the worm 78 in turn driving the axle 2 through a spur gear 79. A pawl 75 pivotally mounted on a suitable bracket 76 and held in operative position against the ratchet wheel 73 by means of a spring is also provided to prevent a backward movement of the ratchet wheel. As is clearly shown in Fig. 5 if the positions of the pin 74 and pawl 75 be reversed, the ratchet wheel will be driven in a reverse di-

rection and the mining machine will be backed away from the tunnel head. Further it will be seen that the driving mechanism may be adjusted to drive the cutting mechanism forward at varying speeds according to the quality of the material being cut, by adjusting the link end 68 between the gibs 69 so as to get a greater or smaller throw of the link 67.

From the foregoing, it will be clear that when it is desired to drive a tunnel or entry, the mining machine above described may be used for this purpose and that this machine will drive the tunnel, prepare the bottom for the reception of ties or to serve as a road bed, will remove all obstructions in the tunnel, and that the tunnel may be driven straight forward, curved to right or left or driven at different grades. It will further be noted that if only a small tunnel is desired, one of the heading machines alone may be used, and that the lower cutter bar may be used to flatten out the lower section of the tunnel to serve as a roadway. When using my improved mining machine in the preferred form as shown in Figs. 1, 2, 3, it will be seen that the cuttings made at the heading will be automatically elevated by the cutter bars, dropped into a suitable hopper, and carried to the rear of the machine where this material may be dumped into dump cars such as are commonly used in mines, thus removing at once all the debris from the tunnel head and keeping the cutting tools working to their maximum efficiency.

While I have in this application specifically described several embodiments which my invention may assume in practice, it is to be understood that these forms are used for illustrative purposes only and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a tunneling device, a plurality of cutting mechanisms adapted to cut parallel entries, and supplemental cutting mechanism for joining said entries.
2. In a tunneling device, a plurality of cutting mechanisms adapted to cut intersecting entry passages, and means for removing a wall partially separating said passages.
3. In a tunneling device, a plurality of cutting mechanisms adapted to cut intersecting entry bores uniting to form a mine entry, and supplemental cutting mechanism for joining said bores to form a single tunnel.
4. In a tunneling device, a plurality of cutting mechanisms adapted to cut intersecting entry bores uniting to form a mine entry, and a cutting mechanism for removing irregularities left by said first named cutting mechanisms.

5. In a tunneling device, a plurality of cutting mechanisms, means for simultaneously operating said mechanisms to cut a plurality of intersecting entry bores uniting to form a mine entry, and means for removing a wall partially separating said bores.

6. In a tunneling device, a plurality of entry passage cutting mechanisms, means for operating said mechanisms in intersecting curves to form a mine entry, and means for removing a wall partially separating said passages.

7. In a tunneling device, a plurality of axes, entry passage cutting mechanisms mounted thereon and comprising cutting heads cooperating to form a mine entry, the cross sectional dimension of said heads being greater than the distance between the axes at the points of connection between the heads and axes, and means for removing a wall partially separating said passages.

8. In a tunneling device, a plurality of parallel axes, passage cutting mechanisms rotatively mounted thereon and comprising a plurality of transversely disposed cutting arms whose length is greater than the distance between the axes, and means for removing a wall partially separating said passages.

9. In a tunneling device, a plurality of entry cutting mechanisms, means for operating said mechanism to cut a plurality of longitudinally disposed entry chambers forming a mine entry, means for removing a wall separating said chambers, and a single means for connecting said cutting mechanisms and wall removing means.

10. In a tunneling device, a plurality of entry cutting mechanisms, means for operating said mechanisms to cut a plurality of longitudinally disposed entry chambers forming a mine entry, and means comprising a transversely disposed cutting mechanism disposed between said cutting mechanisms for removing a wall separating said chambers.

11. In a tunneling device, a plurality of entry cutting mechanisms, means for simultaneously operating said mechanisms to cut a plurality of intersecting entry chambers forming a mine entry, and means comprising a plurality of transversely disposed cutting mechanisms for removing walls partially separating said chambers.

12. In a tunneling device, a plurality of entry cutting mechanisms, means for simultaneously operating said mechanisms to cut a plurality of intersecting entry bores forming a mine entry, means for removing a wall partially separating said bores, and a single means for actuating said cutting mechanisms and wall removing means.

13. In a tunneling device, a plurality of entry cutting mechanisms, means for simultaneously operating said mechanisms to cut

a plurality of intersecting entry bores forming a mine entry, and means comprising a transversely disposed cutting mechanism for removing a wall partially separating said bores.

14. In a tunneling device, a plurality of entry cutting mechanisms, means for simultaneously operating said mechanisms to cut a plurality of intersecting entry bores forming a mine entry, and means comprising a plurality of transversely disposed cutting mechanisms for removing walls partially separating said bores.

15. In a tunneling device, an entry cutting mechanism for removing the face and forming a mine entry, and a cutting mechanism for removing irregularities in a surface of the entry left by said first named mechanism.

16. In an entry driving device, a plurality of entry cutting mechanisms rotatable in an upright plane for removing the face and forming a mine entry, and cooperating cutting mechanism movable in a single plane for removing the bottom section of the entry to form a roadway substantially between the axes of said cutting mechanisms.

17. In an entry driving device, entry cutting mechanism rotatable in an upright plane for removing the face and forming a mine entry, and cooperating cutting mechanism for removing a top and bottom section of the entry.

18. In an entry driver, entry cutting mechanism comprising a plurality of heads rotating in an upright plane to form intersecting bores forming a mine entry, and cooperating cutting mechanism for removing the bottom section of the entry to form a roadway.

19. In an entry driver, entry cutting mechanism comprising a plurality of heads rotating in an upright plane to form intersecting bores forming a mine entry, and cooperating cutting mechanism for removing a top and bottom section of the entry.

20. In an apparatus of the class described, a plurality of rotary cutting mechanisms movable transversely of an entry to cut substantially the entire face thereof, a receiver, means carried by and rotatable with each of said mechanisms for elevating the cuttings and depositing them in said receiver, and a single conveying means for moving said cuttings from said receiver.

21. In a tunneling device, a truck, a plurality of rotating heads mounted to cut in intersecting paths adjacent one end of the truck, cutting mechanism carried by said heads, elevating means carried by said heads, and means for conveying cuttings from said elevating means to the opposite end of said truck.

22. In a tunneling device, a truck, a plurality of cutting heads mounted adjacent one

end of said truck, and rotatable about axes angularly disposed to the transverse face of the tunnel being cut, a hopper, automatically operative elevating means for periodically delivering the cuttings made by said cutting heads to said hopper, and a single means for delivering the cuttings to a point adjacent the opposite end of the truck.

23. In a tunneling device, a truck, a plurality of cutting heads mounted adjacent one end of said truck, a hopper, elevating means carried by said heads for delivering the cuttings made by said cutting heads to said hopper, and a single means for delivering the cuttings to a point adjacent the opposite end of the truck.

24. In a tunneling device, a truck, a plurality of cutting heads mounted adjacent one end of said truck, a hopper, elevating means carried by said heads for delivering the cuttings made by said cutting heads to said hopper, and an endless conveyor for delivering the cuttings to a point adjacent the opposite end of the truck.

25. In a tunneling mechanism, a plurality of rotary cutter mechanisms, shoveling and discharging means on each of the same, and a hopper receiving the discharge from said shoveling and discharging means.

26. In a tunneling mechanism, a plurality of rotary cutter mechanisms, shoveling and discharging means on each of the same, a hopper receiving the discharge from said shoveling and discharging means, and a conveyor supplied from said hopper.

27. In a tunneling mechanism, a plurality of rotary cutter heads, cuttings collecting and discharging means on each of the same, said latter means being adapted to collect cuttings from a point outside of said heads, and means receiving the discharge from said means and delivering the same to a common point.

28. In combination, a truck, rotatable tunnel driving mechanism on one end thereof, and means for actuating said mechanism and truck including a motor, a plurality of parallel shafts driving said mechanism and whose axes are angularly disposed to the axis about which said mechanism rotates, and a second set of parallel shafts successively driven by said other shafts and adapted to drive said truck and whose axes are parallel to the axis of rotation of said mechanism.

29. In combination, a truck, a plurality of cutting mechanisms carried thereby and rotatable on parallel axes, and driving mechanism therefor comprising a shaft transverse to the axes of rotation of said mechanisms, worm gear connections between each of said mechanisms and said shaft, a motor having its axis angularly disposed to the axis of said shaft, a second shaft operatively connected to said motor and said first mentioned

shaft, and conveying mechanism for receiving the material removed by the cutting mechanism.

30. In combination, a truck, cutting mechanism carried thereby, means for actuating the same, and means for driving said truck including a motor having its axis disposed longitudinally of said truck and fixed at all times against longitudinal movement relative to the truck, a shaft parallel to said motor axis, a second shaft also substantially parallel to the motor axis and in spaced parallel relation to said first shaft, a driving axle, and driving connections between said motor and first mentioned shaft, said shafts, and said second mentioned shaft and axle.

31. In combination, a truck, cutting mechanism carried thereby, means for actuating the same, and means for driving said truck including a motor having its axis disposed longitudinally of said truck and fixed at all times against longitudinal movement relative to the truck, a shaft parallel to said motor axis, a second shaft also substantially parallel to the motor axis and in spaced parallel relation to said first shaft, a driving axle, driving connections between said motor and first mentioned shaft, said shafts, and said second mentioned shaft and axle, said driving connections including a reversible gear mechanism operatively connected to said first mentioned shaft.

32. In combination, a truck, tunnel driving mechanism on one end thereof, truck supporting means at opposite ends of said truck including caterpillar tread mechanism beneath the end of said truck carrying said tunnel driving mechanism, means whereby said caterpillar treads may travel upon a substantially flat surface, and power means on said truck for driving said tunnel driving mechanism and said caterpillar tread mechanism.

33. In combination, a truck, tunnel driving mechanism on one end thereof, truck supporting mechanism including caterpillar tread mechanism beneath and on opposite sides of the end of said truck carrying said tunnel driving mechanism and truck supporting means beneath the opposite end of said truck, means whereby said caterpillar treads are allowed to travel upon a substantially flat surface, and power means on said truck for driving said tunnel driving mechanism and said caterpillar tread mechanism.

34. In combination, a truck, tunnel driving mechanism on one end thereof, truck supporting and driving mechanism including caterpillar tread mechanism beneath the end of said truck carrying said tunnel driving mechanism and truck supporting means beneath the opposite end of said truck, power means on said truck for driving said tunnel and truck driving mechanism, and means between said truck and said truck support-

ing means for varying the elevation of said tunnel driving mechanism.

35. In a tunneling mechanism, a plurality of self-centering cutters mounted on shafts for rotation in an upright plane in intersecting paths, a support carrying said shafts and located in rear of said cutters, means for feeding said support longitudinally relative to the bottom, and guiding means by and movable with said mechanism adjustable laterally to maintain the rear end of said support in alinement with the tunnel during simultaneous movement of said cutting mechanism and support.

36. In a tunneling mechanism, a plurality of cooperating self-centering cutters rotatable in an upright plane in intersecting paths, a support carrying said cutters and located in rear thereof, means for feeding said support longitudinally relative to the bottom, and means carried by and movable with said mechanism for varying the elevation of the rear end of said support.

37. In a tunneling mechanism, a truck, tunnel driving mechanism thereon, a motor, reduction mechanism between said motor and said tunnel driving mechanism, and tunnel shaping mechanism driven by said reduction mechanism and including cooperating cutters operating to shape the top and bottom of the tunnel.

38. In a tunnel mechanism, a truck, tunnel driving heads thereon, a motor, reduction mechanism between said motor and said

tunnel driving heads, and tunnel shaping mechanism driven by said reduction mechanism and including a roadway forming cutter operating between said heads.

39. In a tunneling mechanism, a truck, tunnel driving mechanism thereon, a motor, reduction mechanism between said tunnel driving mechanism and motor, and tunnel shaping mechanism driven by said reduction mechanism and including cooperating oppositely rotating cutters operating to shape the top and bottom of the tunnel.

40. In an entry driving mechanism, a support movable longitudinally of an entry, a plurality of heads rotating in an upright plane in intersecting paths, cutters on said heads operating to deliver the cuttings on the bottom adjacent the face, and cuttings handling mechanism including cuttings collecting means carried on said heads and delivering to a central point.

41. In an entry driving mechanism, a support movable longitudinally of the entry, a plurality of heads rotating in an upright plane in intersecting paths, cutters on said heads operating to deliver the cuttings on the bottom adjacent the face, and cuttings handling mechanism including cuttings collecting scoops carried on said heads and having communicating cuttings guiding surfaces delivering to a central point.

In testimony whereof I affix my signature.

HARRY C. JOHANSEN.

CERTIFICATE OF CORRECTION.

ing means for varying the elevation of said tunnel driving mechanism.

35. In a tunneling mechanism, a plurality of self-centering cutters mounted on shafts for rotation in an upright plane in intersecting paths, a support carrying said shafts and located in rear of said cutters, means for feeding said support longitudinally relative to the bottom, and guiding means by and movable with said mechanism adjustable laterally to maintain the rear end of said support in alinement with the tunnel during simultaneous movement of said cutting mechanism and support.

36. In a tunneling mechanism, a plurality of cooperating self-centering cutters rotatable in an upright plane in intersecting paths, a support carrying said cutters and located in rear thereof, means for feeding said support longitudinally relative to the bottom, and means carried by and movable with said mechanism for varying the elevation of the rear end of said support.

37. In a tunneling mechanism, a truck, tunnel driving mechanism thereon, a motor, reduction mechanism between said motor and said tunnel driving mechanism, and tunnel shaping mechanism driven by said reduction mechanism and including cooperating cutters operating to shape the top and bottom of the tunnel.

38. In a tunnel mechanism, a truck, tunnel driving heads thereon, a motor, reduction mechanism between said motor and said

tunnel driving heads, and tunnel shaping mechanism driven by said reduction mechanism and including a roadway forming cutter operating between said heads.

39. In a tunneling mechanism, a truck, tunnel driving mechanism thereon, a motor, reduction mechanism between said tunnel driving mechanism and motor, and tunnel shaping mechanism driven by said reduction mechanism and including cooperating oppositely rotating cutters operating to shape the top and bottom of the tunnel.

40. In an entry driving mechanism, a support movable longitudinally of an entry, a plurality of heads rotating in an upright plane in intersecting paths, cutters on said heads operating to deliver the cuttings on the bottom adjacent the face, and cuttings handling mechanism including cuttings collecting means carried on said heads and delivering to a central point.

41. In an entry driving mechanism, a support movable longitudinally of the entry, a plurality of heads rotating in an upright plane in intersecting paths, cutters on said heads operating to deliver the cuttings on the bottom adjacent the face, and cuttings handling mechanism including cuttings collecting scoops carried on said heads and having communicating cuttings guiding surfaces delivering to a central point.

In testimony whereof I affix my signature.

HARRY C. JOHANSEN.

CERTIFICATE OF CORRECTION.

Patent No. 1,645,007.

Granted October 11, 1927, to

HARRY C. JOHANSEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 15, for the word "devise" read "device" and line 45, after the word "moves" insert a period; page 2, line 44, for "truck" read "motor", and line 46, for "motor" read "truck"; page 5, line 1, claim 22, after the word "truck" strike out the comma; page 6, line 9, claim 35, after the word "means" insert the word "carried"; same page, line 23, claim 36, after the syllable "tion" insert the words "and lateral position"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of November, A. D. 1927.

Seal.

M. J. Moore,
Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 1,645,007.

Granted October 11, 1927, to

HARRY C. JOHANSEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 15, for the word "devise" read "device" and line 45, after the word "moves" insert a period; page 2, line 44, for "truck" read "motor", and line 46, for "motor" read "truck"; page 5, line 1, claim 22, after the word "truck" strike out the comma; page 6, line 9, claim 35, after the word "means" insert the word "carried"; same page, line 23, claim 36, after the syllable "tion" insert the words "and lateral position"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of November, A. D. 1927.

Seal.

M. J. Moore,
Acting Commissioner of Patents.