Feb. 18, 1969 HANS-PETER DRESCHER ET AL 3,428,363

GALLERY DRIVING MACHINE

Filed Sept. 23, 1966 Sheet 1 of 3

FIG. 1

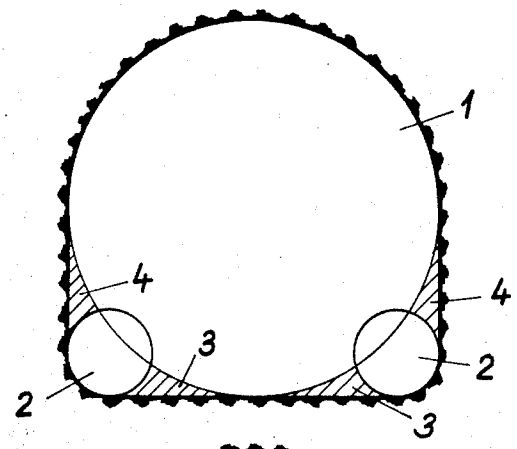


FIG. 2

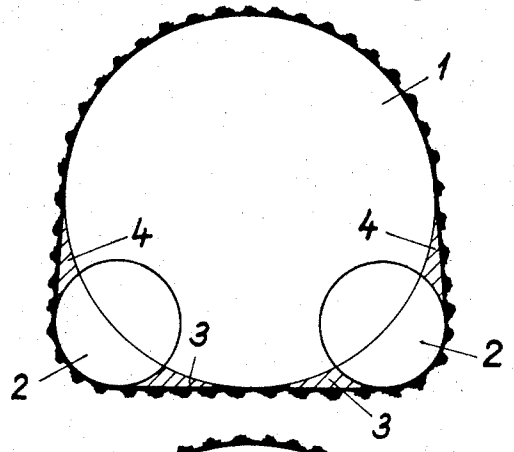


FIG. 3

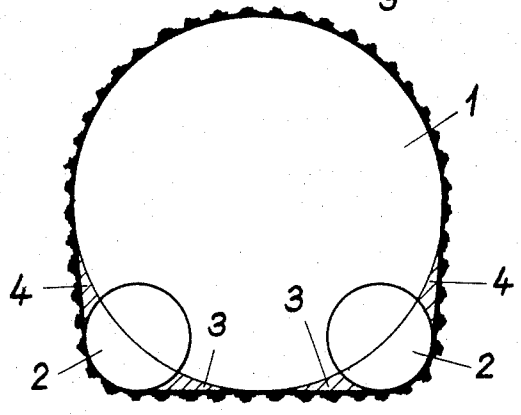


FIG. 4

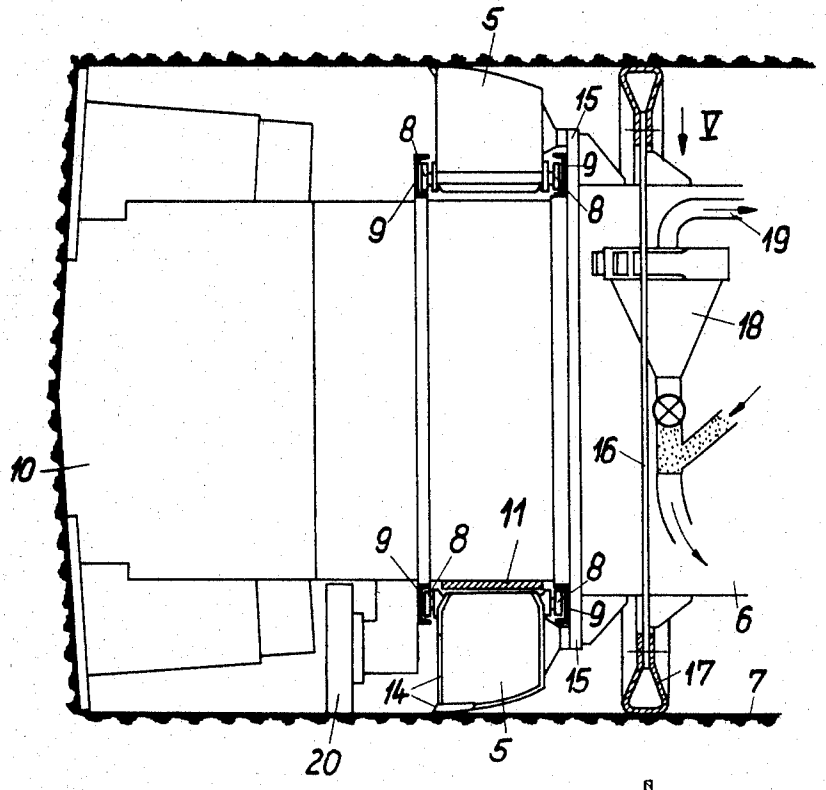


FIG. 5

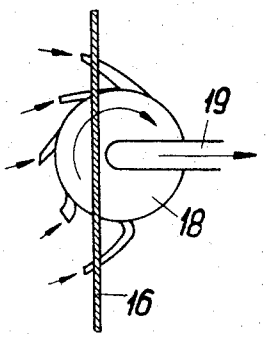
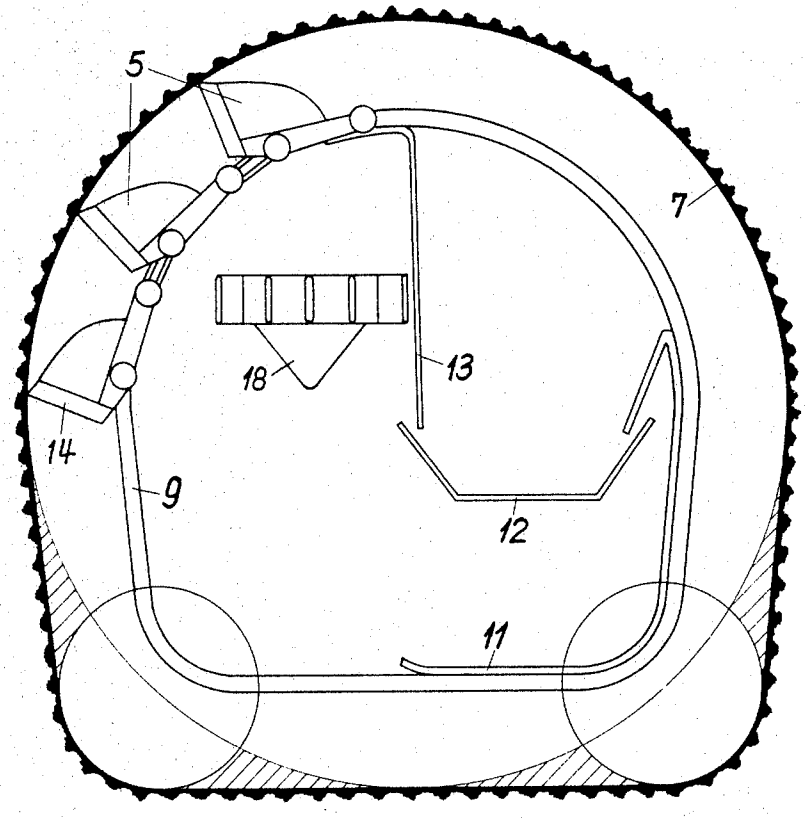


FIG. 6



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GALLERY DRIVING MACHINE

Hans-Peter Drescher, Luneburg, and Paul Hoever, Krefeld, Germany, assignors to Beteiligungs- und Patentverwaltungsgesellschaft mit beschrankter Haftung, Essen, Germany

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U.S. Cl. 299—57 3 Claims
Int. Cl. E21d 1/00; E21c

ABSTRACT OF THE DISCLOSURE

A self-propelling rock working machine comprising a drilling-head rotatable about a horizontal axis, two rotatable cutting tool means arranged behind said drilling-head when viewing the latter from the front surface thereof for producing a substantially plane bottom surface of the dugout being excavated, bucket chain conveyor means arranged behind said tool means and within said rock working machine for picking up material in the path of said bucket chain conveyer means and unloading the picked up material onto other conveyor means.

The present invention concerns a self-propelled gallery driving machine with a drilling head rotatable about the longitudinal axis of the machine, for driving a subterranean drift, for instance a gallery, tunnel, or mine shaft.

Machines of this type are known in the form of various designs. Such machines drive a gallery by causing the rotating tools to attack the facing wall and removing the same. Galleries of circular cross section can relatively easily be driven by means of machines. Such galleries have the advantage that they can better withstand the roof pressure than is the case with galleries having, for instance, rectangular or trapezoidal cross section or have only slightly arched roofs. The stability of such galleries is of considerable importance, particularly for mining operations in which in contrast to driving a single gallery in otherwise nonmined adjoining rock, the mining causes the formation of large cavities whereby considerable movements of rock will be produced. On the other hand, the driving of a gallery with circular cross section has some drawbacks; thus, for instance, when designing a corresponding gallery driving machine, problems occur with regard to the arrangement and the designing of the carriage, with regard to preventing the machine from turning about its longitudinal axis, and with regard to the removal of the mined rock. These problems can be solved only by relatively complicated machinery and at correspondingly high costs.

It is, therefore, an object of the present invention to provide a gallery driving machine of the above-mentioned general type which will overcome the above-mentioned drawbacks.

It is another object of this invention to provide a gallery driving machine of the type set forth in the preceding paragraph, which will make it possible to drive galleries upper portion of which will have a semi-circular cross section, whereas the lower portion will have a straight floor and substantially straight side walls.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIGURES 1 to 3 respectively illustrate different cross sections of galleries.

FIGURE 4 is a side view, partially in section, of the front portion of a gallery driving machine.

FIGURE 5 illustrates a portion of FIG. 4 as seen in the direction of the arrow V.

FIGURE 6 is an end view of the conveyor system arranged on the gallery driving machine.

The present invention consists primarily in that, preferably within the lower range of the gallery driving machine, in forward driving direction behind the drilling head, there are arranged tools which are spaced from the longitudinal axis of the machine to such an extent that they will be able to mine material which was not removable by the drilling head, so that there will be formed a gallery which has at least an approximately plane floor and the wall ends of which, at least the lower wall portions, are plane. It will be appreciated that such an arrangement permits the provision of customary carriage structures one behind the other on the machine and to have said carriage structures move on the floor of the gallery, so that no special steps have to be taken in order to prevent the machine from carrying out undesired rotative movements about its longitudinal axis. Also, the exploitation of a gallery driven by a machine according to the present invention is better than with a gallery having a circular cross section. While it is possible also, with galleries circular cross-section to build a horizontal gallery floor, for instance by partially filling in the cut hollow chamber of the gallery of circular cross section, it does, however, not make much sense to reduce the cross section of a just driven gallery by filling the same in with material and thereby giving away valuable space. It is, of course, also theoretically possible to provide a plane floor in galleries having circular cross section, specifically by building a partition therein, for instance, of concrete. In such instance, the space below the partition can be used for storing cables, pipes, and for withdrawing water, however, such an arrangement is expensive, and the space below the partition is hard to get into, while on the other hand the building of such partition is not customary in mining operations.

In conformity with the present invention, the gallery driving machine may be equipped with two rotatable drilling or milling tools, the axes of which are at least approximately parallel to the longitudinal axis of the machine, while the outer ends of said tools extend downwardly at least to the same extent as the drilling head. Furthermore, the said rotatable drilling or milling tools are so arranged as to be able in forward driving direction, behind said cutting or milling tools to remove the material down to the bottom of the gallery and below the semi-circular gallery roof tangential to the adjacent side walls. In this way, a widening of the gallery with a circular cross section will be made possible in a rather simple manner.

For purposes of conveying the loosened rocks, in contrast to heretofore known arrangements, no scraper conveyors, bucket wheels, or so called lobster scissor loaders are employed. Instead, for receiving the loosened material and for the purpose of transferring said material onto a belt leading from the face wall, there is provided at least one bucket chain conveyor the buckets of which are movable in the direction transverse to the longitudinal axis of the machine and along a path corresponding to the eventual cross section of the gallery. The bucket chain conveyor and the two rotatable drilling or milling tools may be driven by a driven common thereto.

Referring now to the drawings in detail, a gallery cross section according to FIGS. 1 to 3 is obtained by widening the lower portion of a gallery 1 of circular cross section by removing rock from said lower portion. To this end, a gallery driving machine is, in conformity with the present invention, directly behind the machine head 10 which produces the said cross section, provided with drilling or

milling heads **20** (FIG. 4). These heads **20** will produce cavities extending in the forward driving direction and having an approximately crescent-shaped cross section **2**. The said two heads **20** are arranged so low that the common outer tangent to the circles described by the outer ends of said rotating drilling or milling heads **20** will be tangent to the circular cross section described by the machine head **10** and, more specifically, to the lowest portion of the circular cross section. The diameters of said heads **20** are advantageously from 0.2 to 0.5 times the diameter of the drilling head **10** at the front of the gallery driving machine. Cutting and milling tools arranged behind said drilling heads **20** will remove the remaining rock portion **3** down to the above mentioned common tangent so that a plane gallery floor will be formed. Also the lateral remaining rock portions **4** will be removed by these tools up to the straight line which is tangent to the circles described by the outer ends of the drilling or milling heads and is also tangent to the circular cross section of the gallery. In this way, a gallery with arched roof and plane floor and with plane lower side wall portions will be obtained. The gallery walls and the floor will gradually merge with each other so that tension peaks in the surrounding rocks will be avoided.

As will be evident from FIG. 1, the side walls of the gallery may be vertical. However, it is advantageous to cause the side walls to flare somewhat so that in the lower range of the gallery more space will be available. When less stable rock is encountered, it may be advantageous to slightly taper the side walls of the gallery in downward direction. In this way, the circular cross section is only slightly deviated from so that the advantages of the circular cross section remain maintained to the major extent. The deviation of the gallery side walls from the vertical may for instance be 10°, however, the walls may be inclined to a greater or lesser extent.

The gallery driving machine rests on two track laying carriages arranged adjacent to each other. These carriages may be designed in a standard manner since the floor of the gallery is plane. These track laying carriages in combination with the plane floor of the gallery will prevent the machine from rotating about its vertical axis. The machine is guided by alternately retarding and accelerating the two vehicle tracks. In this connection it is advantageous that the tracks move on a plane so that they will not climb up on the side wall when the machine has to move through a curve as is frequently the case when the gallery has a circular cross section.

According to the embodiments illustrated in FIGS. 4 and 6, a bucket chain conveyor is provided on said gallery driving machine behind the tools producing the gallery cross section for picking up the loosened rock and transferring the same away from the facing wall to a conveyor belt. The buckets **5** are guided about the machine body **6** along the gallery wall **7**. This guiding is effected by rollers **8** which are journalled on the buckets **5** and roll in closed roller tracks **9** on the machine body **6**. The roller tracks **9** extend in conformity with the desired gallery cross section. The buckets **5** are connected to two endless chains (not illustrated) by means of which the bucket chain conveyor is driven. The drive is advantageously effected over the deviating path arranged in the lower corners. In this connection it is advantageous to provide a common drive for the bucket chain conveyor and the two drilling or milling heads **20** arranged behind the machine head **10**.

The front sides and those sides of buckets **5** which face the machine body **6** are open. As soon as a bucket **5** during its movement passes approximately below the longitudinal axis of the machine, its opening which faces the machine body **6** will be covered by a runway plate **11** connected to the machine body **6**. The runway plate **11** is within the upper range of the gallery driving machine bent inwardly and thus creates an access to a continuous conveyor **12** which faces away from the facing wall. The buckets **5** pick up the loosened rock at their front openings and move along the inner bucket cover in upward direction and transfer the rock through inner openings to the conveyor **12** by means of bent runway plate **11**. From conveyor **12** the rock is at the end of the gallery driving machine transferred to another conveyor belt or carriage. A shroud **13** prevents the rock from falling to the side of the conveyor **12**. The bucket chain conveyor permits a continuous pick-up as it is obtained for instance by means of a bucket wheel and does so with galleries which do not have a round cross section. It is, of course, understood that it can also be used with galleries having a circular cross section.

The employment of a bucket chain conveyor has the further advantage that in soft or medium hard rock special cutting or milling tools are not necessary. The rock portions **3** and **4** which are left standing by the rotating drilling or milling heads **20** can be picked up by the buckets of the bucket chain conveyor. To this end, the front edges of said buckets are equipped with armed cutting edges **14** which can easily and quickly be exchanged. A rear bucket support **15** is provided in such an instance for relieving the rollers **8** and guiding means **9**. Advantageously, the cutting edges **14** protrude in advancing direction beyond the buckets **5** so that the rock to be removed will be pre-notched.

When the buckets **5** are connected to two spots of the pulling chains which in the direction of movement of the buckets are located one behind the other, the rollers **8** and roller tracks **9** are not required. The buckets **5** will then be guided by the correspondingly supported pulling chains. With each pulling chain, the buckets **5** are preferably connected to a chain link. With small deviating radii with which also the chain division has to be correspondingly small, small buckets are obtained which are not economical. In order to avoid this drawback, sufficiently large buckets which extend over a plurality of chain links are composed of a plurality of parts. Such parts may for instance be formed by arched steel sheet metal sections. Each arched section is fixedly connected by a chain link to each longitudinal side of the bucket. The arched sections are movable relative to each other and spread apart when passing around a drum, and again move toward each other when moving along a straight line. A bucket may also be composed of a cutting yoke forming the receiving opening of the bucket and connected to each pulling chain at each chain link, a web closing the bucket toward the rear, and a chain bag having its front end connected to a yoke while its rear end is connected to the web. The sides of the bag are connected to the two pulling chains. This bucket affords a maximum of movability and easily adapts itself to the cross section of the gallery. The web located in the rear is inclined in such a way that its edge which faces the machine body **6** will in the direction of movement of the bucket be located in front of the outer edge. This inclination of the closing web may for instance be 30°. Due to the fact that the web is inclined toward the runway plate **11**, the picked up fine material will be prevented from falling back onto the gallery floor through a gap between the web and the runway plate **11**.

It is also possible to produce a bucket of which only that portion which faces the gallery wall consists of chains or a similar wear-resistant flexible material while the side walls are formed by steel sheet metal. The walls may, if desired, consist of a plurality of parts movable relative to each other in conformity with the division of the pulling chain.

In order to be able better to pick up the loosened rock on the floor of the gallery, that edge of the buckets which faces the wall to be engaged thereby is advantageously not parallel to the axis of the machine but is inclined thereto in such a way that that corner which with regard to the advancing direction of the gallery driving machine is located in the rear protrudes with regard to

the other corner. When picking up the rock, a power component acts from the bucket in advancing direction of the machine upon the rock so that during the pickup operation no rock can evade against this direction.

Directly behind the bucket chain conveyor, the gallery driving machine is provided with a dust shield **16** extending transverse to the gallery being driven. This shield is equipped with a flexible seal **17** for engagement with the gallery wall **7** thereby separating the working chamber from the already dug gallery section. In this way, the dust forming when loosening the rock is prevented from entering the gallery. The dust shield **16** is provided with passages for the conveyor **12** and for intake openings for the cyclone separator **18**. The cyclone separator **18** separates the main portion of the occurring dust and the collected dust after being humidified with water is withdrawn by means of the conveyor **12**. Furthermore, in this way, also the filtering surface can be kept small which is intended for filtering the residual dust contained in the air discharged through a conduit **19**. Small filtering surfaces are of considerable importance in underground mining in view of the narrow conditions which prevail in these circumstances.

Behind the dust shield **16** on the machine body **6** there is a mounting device (not shown) mounted in such a way that it can be turned about the longitudinal axis of the machine. A drilling machine may be mounted on the mounting device for producing anchor bores preferably in the ceiling of the gallery. This is important in particular when driving a gallery in mined areas or soft rock (Gebrüch) because in such instances the rock has to be supported as quickly as possible after the gallery section has been driven. The provided bores make it possible to safeguard at least the gallery ceiling by corresponding anchoring means.

If the hardness of the rock requires particularly high advancing forces, the gallery driving machine will have to be braced in the gallery being driven thereby. To this end, the gallery driving machine is provided with upper running means in the form of a track, which upper running means is adapted by means of hydraulic power systems to be pressed against the gallery ceiling. The hydraulic power operable means and the upper running means are pivotally connected to each other. The upper running means may be driven whereby a higher advancing force is obtainable and jamming of the machine will be prevented. Instead of one upper running means, also a plurality of upper running means may be provided.

In spite of the upper running means, a buildup of the gallery is possible already directly behind the dust shield **16**. To this end, there is employed the above mentioned mounting means which feeds the built-up members around the machine body **6** upwardly to the ceiling of the gallery where they are connected to the already built-in members. The upper running means are in this instance supported by the building-up elements for the gallery.

The buildup of the gallery floor and the gallery walls is advantageously effected behind the gallery driving machine.

If due to the rock condition, still higher advancing forces are required which cannot be furnished by means of a slowly driving track laying vehicle system, the gallery driving machine is equipped with further feeding devices. These feeding devices rest on the machine body **6** which is braced in the driven gallery, and advance the working head **10** relative to the machine body.

In view of the limited space conditions, especially in galleries having a relatively small cross section, all of the operations are advantageously hydraulically controlled. The hydraulic system is actuated by a pump driven by an electric motor. For safety reasons, a further motor and a further pump may be arranged in parallel to the first supply unit. The hydraulic and electric driving units are for purposes of obtaining better conditions of movement in the gallery section, mounted in a special vehicle which is towed behind the machine or suspended thereon. If a repair is required, this vehicle can quickly be detached from the machine body **6** and can be removed from the gallery driving machine. The vehicle will also comprise the operator's cab or stand and the control devices.

For purposes of controlling the direction, which control operation must continuously be carried out in view of the high driving speeds, the movable head **10** of the gallery driving machine is equipped with a gyro-compass. This compass conveys its measured values to a subsidiary in the operator's cab where it is indicated.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawings but also comprises any modifications within the scope of the appended claims.

What we claim is:

1. A self-propelling rock working machine comprising a drilling head rotatable about a horizontal axis of the machine and operable to dig cutouts, especially of galleries, tunnels and mine shafts, with an arched top and an approximately straight bottom, which includes: two rotatable cutting tool means having their axes of rotation approximately parallel to the axis of rotation of said drilling head and having a diameter less than the diameter of said drilling head while the respective lowermost portions of said rotatable tool means extend downwardly at least as far as the lowermost portion of said drilling head, said rotatable cutting tool means resepectively being located on opposite sides of the vertical plane through the axis of rotation of said drilling head while said rotating tool means are spaced from each other by a distance corresponding approximately to the desired width of the desired straight bottom surface of the cutout to be dug, and bucket chain conveyor means forming part of said machine and located behind said tool means when viewing said bucket chain conveyor means from the front end of the machine for picking up material in the path of said bucket chain conveyor means and moving the same from the side walls of the cutout being dug for unloading the picked up material onto another conveyor, said bucket chain conveyor means being movable along a plane transverse to the longitudinal axis of said rock working machine.

2. A machine according to claim **1**, in which the buckets of said bucket chain conveyor means are open at that side thereof which faces the gallery driving machine, and runway means mounted on said gallery driving machine and covering those bucket openings which face said gallery driving machine over a portion of the path over which said buckets are being moved on said bucket chain conveyor means.

3. A machine according to claim **1**, which includes a dust shield arranged behind said drilling head, said dust shield being provided with flexible ceiling means for engagement with the adjacent wall portion of the driven cutout, said dust shield being provided with opening means for communication with a cyclon separator, and also being provided with opening means for the passage of material cut by said drilling head.

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ERNEST R. PURSER, *Primary Examiner.*

U.S. Cl. X.R.

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