

Feb. 16, 1954

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2,669,441

COAL BORING UNIT

Filed Jan. 4, 1950

4 Sheets-Sheet 1

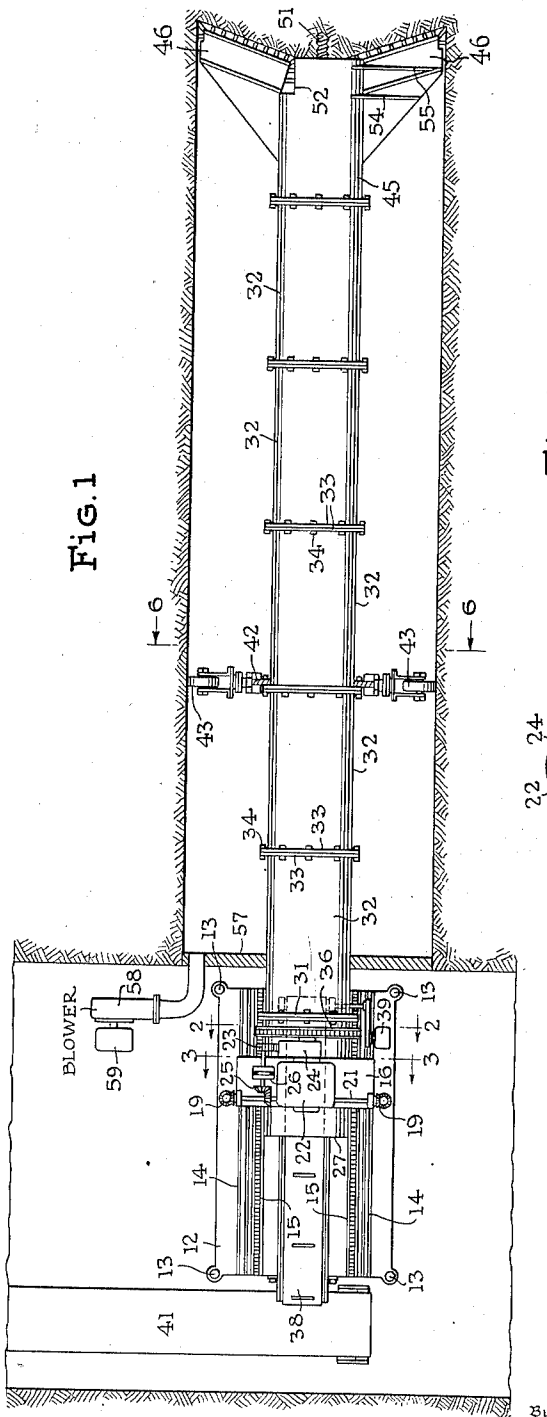


Fig. 1

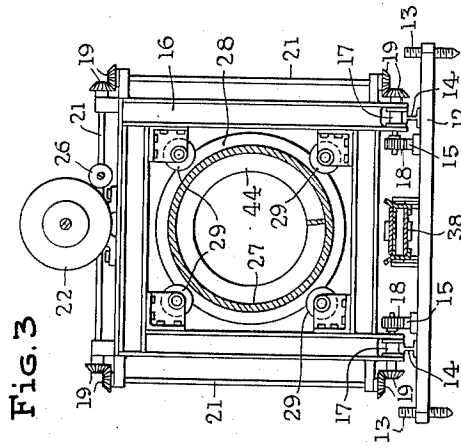


Fig. 3

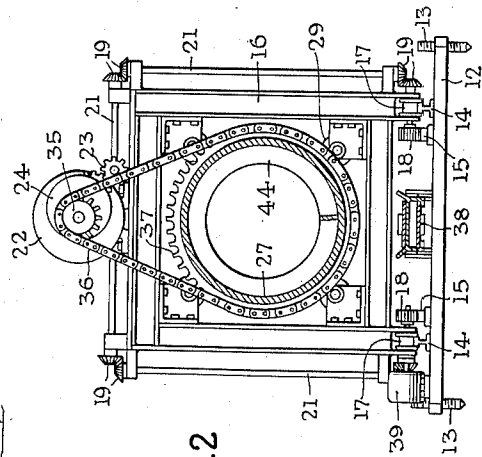


Fig. 2

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4 Sheets-Sheet 2

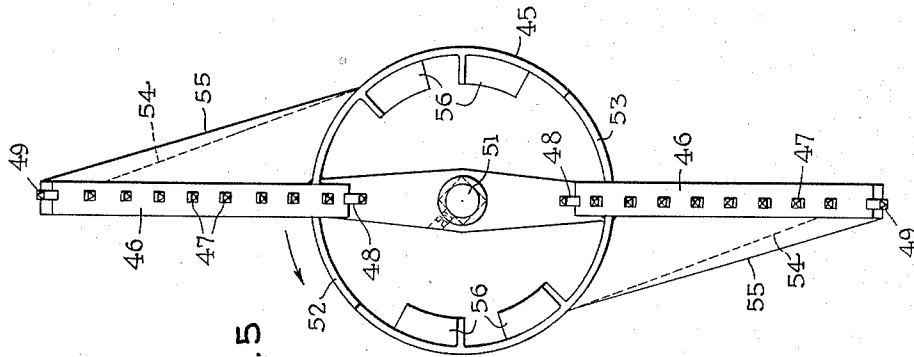


FIG. 5

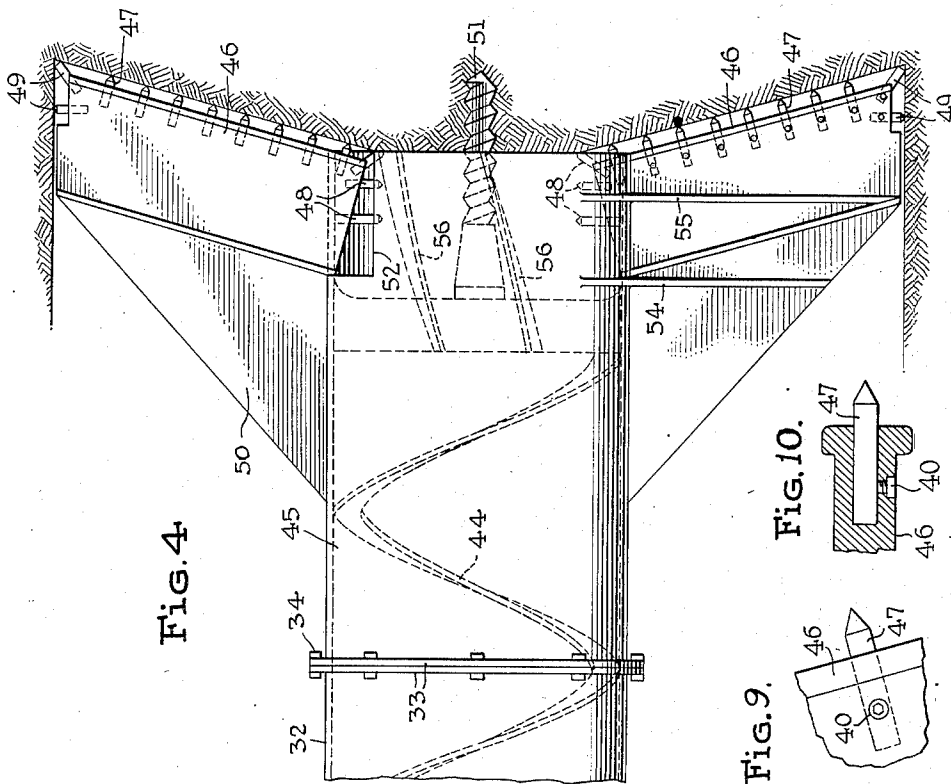


FIG. 4

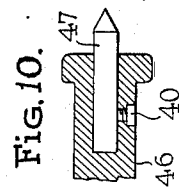


FIG. 10

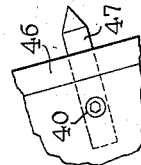


FIG. 9

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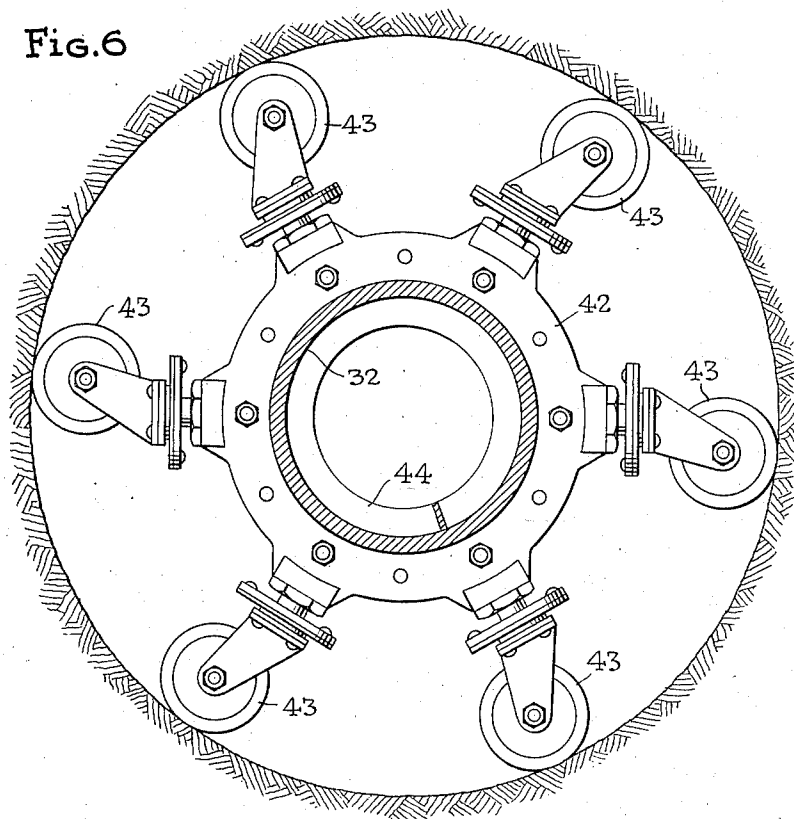
2,669,441

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Filed Jan. 4, 1950

4 Sheets-Sheet 3

Fig. 6



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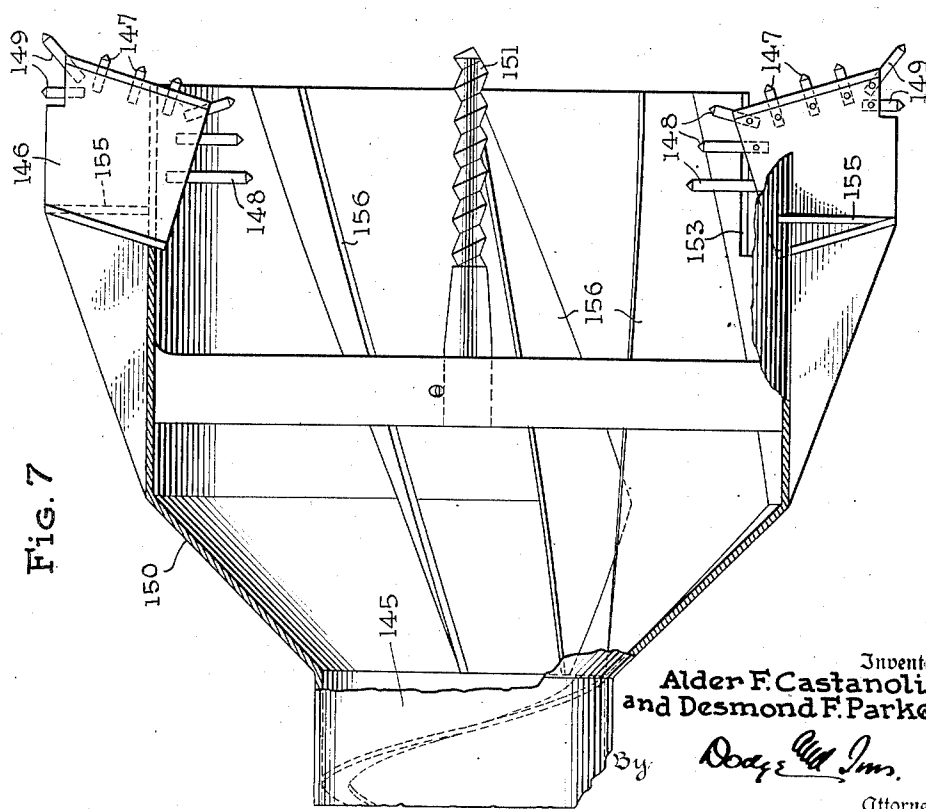
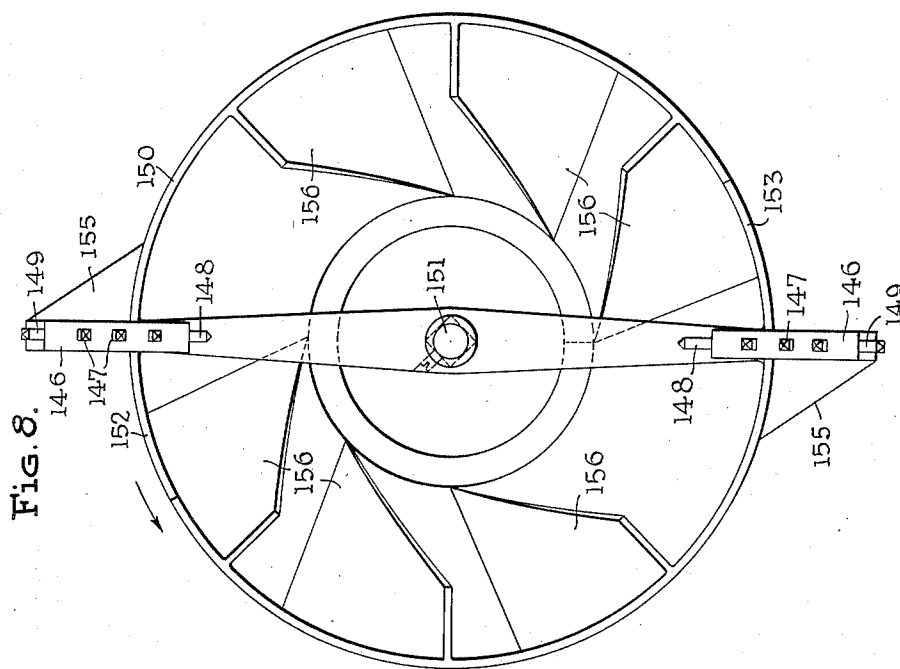
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A. F. CASTANOLI ET AL
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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COAL BORING UNIT

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4 Claims. (Cl. 262—7)

1

This invention relates to earth boring and is expected to have its chief field of use in the mining of bituminous coal. Without implying necessary limitation to that field, the invention will be described as embodied for that particular use.

Coal commonly occurs as veins or layers which vary in thickness and in slope. One method of removing coal from such veins has depended on the use of augers, which are rotated by power units located in the drift while being fed axially by said units. There are many objections to this practice, such as the excessive production of fines, inability to inspect the cutting portion of the auger while in action, severely limited penetration and inability to ventilate the bore hole, the last of these creating a serious explosion hazard.

The invention combines a number of features, some of which (individually considered) have been used with some success in other relations, and provides a mechanism having a number of important practical advantages arising partly from novel individual components and partly from the manner in which various components are combined.

Generally stated, a rotary boring head of special form, is fixed on the end of, and is rotated by, a much smaller tubular boring bar. The boring bar is rotated and fed axially by a power unit located in a drift.

Since the boring bar operates in positions in which its axis is at most only moderately inclined from the horizontal, it is provided with internal spiral flights and serves by its rotary motion as a conveyor. The boring head is so contrived as to deliver the coal cut thereby to the interior of the bar, so that it is fed through the tubular bar, and is delivered adjacent the power unit, to any suitable transport device such as a belt conveyor.

The boring head is preferably of such large diameter relatively to the boring bar that a man can enter the bore hole at either side of the bar and reach the boring head for purposes of inspection or repair, particularly replacement or adjustment of the cutting bits.

The axial feed range of the power unit is necessarily limited by the width of the drift in which it must operate. To meet this condition the boring bar is constructed in sections not longer than the axial feed range of the power unit. In this way the boring bar may be periodically lengthened by inserting sections.

At appropriate intervals the bar is sustained in the bore hole to maintain its alinement, For

2

this purpose the use of peripherally wheeled spiders is contemplated. These are attached to and turn with the boring bar, their wheels tracking in the bore hole.

The boring head is specially contrived to cut an annular peripheral groove. The coal removed from this groove is unavoidably considerably degraded in size. The encircled portion or core, is split into lumps by a central point or "gimlet," tapered in form, and designed to develop large wedging bursting forces at the center of the core. Hence, a high percentage of lump coal and a satisfactorily low percentage of fines characterizes the performance of the machine.

By closing the bore hole around the tubular boring bar it becomes possible to use a blower to circulate air or some other protective gas over the boring head. Probably the better of the two possible flow patterns is first inward through the interval between the bar and the wall of the bore hole and then outward through the tubular bar with the recovered coal.

The invention thus attains a number of important objectives. Production of lump coal is favored. The cutting head is always reasonably accessible for inspection and repair, and the depth of penetration is large. The boring head can be guided to some extent. Friction losses are minimized. The coal is delivered by the tubular boring bar at a level well above the bottom of the bore hole, and so may fall directly into a conveyor in the drift, without imposing troublesome limitations on the design of that conveyor.

Finally the cutting space can be adequately ventilated by simple means, so that safer conditions are attained than can be had with prior art boring operations.

Preferred embodiments of the invention will now be described by reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a drift, a bore hole leading therefrom, and a machine embodying the invention in place.

Figs. 2 and 3 are cross-sections taken respectively on the lines 2—2 and 3—3 of Fig. 1, and drawn on a slightly larger scale than that of Fig. 1.

Fig. 4 is an enlarged view of the boring head shown in Fig. 1.

Fig. 5 is an end elevation of the boring head shown in Fig. 4.

Fig. 6 is a section on the line 6—6 of Fig. 1, showing a sustaining collar for the tubular boring bar.

Fig. 7 is a view similar to Fig. 4 but showing a

preferred type of boring head designed to produce the minimum practicable percentage of fines.

Fig. 8 is an end elevation of the head shown in Fig. 7.

Figs. 9 and 10 are fragmentary views, illustrating one possible removable mounting for the cutting bits.

Refer first to Figs. 1 to 3 inclusive. The power unit is mounted on a base 12 which is leveled and retained in position by the screw spuds 13. Additional means to hold the base 12 would commonly be used but they are conventional and are not illustrated in the drawings.

Mounted on top of the base 12 are parallel track rails 14 and adjacent each rail is a rack rail 15. A generally rectangular frame structure 16 is supported by rollers, two of which appear at 17 and all of which run on one or the other of the track rails 14. A positive drive is secured by toothed pinions 18 which engage the teeth on the rack rails 15. The pinions 18 are connected to rotate in unison by sets of miter gears 19 and three connecting shafts 21 which are best shown in Figs. 2 and 3.

A motor 22 drives a pinion 23 through a reduction train in the housing 24. The pinion 23 rotates the horizontal one of the three shafts 21 through miter gears 25 and a manually operable clutch 26. Thus, the motor 22 can move the carriage 16 at slow speed in the direction of the lengths of the track rails 17.

A tubular driving sleeve 27 has a flange 28 at approximately its mid-length and this flange which is circular engages four grooved rollers 29 mounted in the corners of the frame 16 as best shown in Fig. 3. It follows that the member 27 can rotate in the frame 16 but cannot move axially therein. The forward end of the member 27, i. e. the end toward the boring head hereinafter described is provided with a flange 31 to which may be attached the outermost one of a series of units 32 which collectively form the boring bar.

These units 32 have flanges 33, one at each end and the flanges are connected together by bolts 34, see for example Fig. 4. The length of each bar section 32 is slightly less than the range of travel of the frame 16 on the track rails 14. The motor 22 also drives through the reducing gear 24, a sprocket 35 and this drives, through a sprocket chain 36, a ring sprocket 37 which encircles and is attached to the member 27. It follows that whenever the motor 22 operates, the member 27 will be rotated counter-clockwise (as viewed in Figs. 2 and 3) at slow speed.

A belt or chain conveyor 38 extends longitudinally across the platform 12 so that its run is always beneath the outer end of the tubular member 27. This conveyor is constantly driven by the motor 39 which is mounted on the base 12 and which is connected to drive one of the pulleys on which the conveyor 38 runs. The conveyor 38 delivers coal to another conveyor 41 which as indicated in Fig. 1 extends along the drift in the mine. Of course, the conveyor 38 could deliver to any transport facility operable in the drift.

As best indicated in Fig. 1 the boring bar is made up of a plurality of sections 32. To reduce bending stresses in this boring bar, it is sustained at intervals by spiders of the type shown in Fig. 6. Only one such spider is shown in Fig. 1 but it will be understood that as the boring progresses additional spiders will be added.

Each spider has a central ring 42 which is bolted to the connected flanges 33 of the sections 32. The ring carries a plurality of peripheral casters 43 which are swiveled so as to track fairly in the bore hole. Their function is to keep the boring bar centered and aligned.

The sections 32 of the boring bar and the tubular section 27 which is connected thereto and drives the boring bar are equipped with a spiral conveyor flight 44 so that as the boring bar rotates, coal will be fed through the boring bar from the boring head through the tubular member 27 and will be discharged therefrom upon the conveyor 38. As better shown in Figs. 4 and 5, the boring head comprises a tubular unit 45 which forms an extension of the boring bar and which carries approximately radial cutter bars 46, two such bars being shown.

Each cutter bar 46 takes the form of an I-beam welded to the tubular unit 45 and inclined slightly forward. The forward flange portion of each bar 46 is provided with a row of sockets each of which receives a removable cutter bit 47. Each bit is retained by a corresponding socket-screw 40. At each end of each bar 46 there are similar sockets for bits 48 and 49, which respectively are directed inward toward and outward from the axis of rotation of the boring bar. A gusset plate 50 and triangular webs 54 and 55 welded in place on the trailing side brace the cutter bars 46, and serve also as pick-up members which lift coal cuttings and deliver them to the interior of member 45 through the notches 52, 53 formed in the forward end of member 45 for that purpose.

A gimlet 51 centered on the axis of rotation, serves to center the boring head, and also to split and shatter the core left at the center by the boring head.

As will be readily understood from an examination of Figs. 4 and 5, the teeth 47, 48 and 49 produce an annular cut. The cuttings are necessarily degraded considerably as to size but the core which is not cut but is split by the gimlet 51 produces a large percentage of lump coal.

It should be observed in Fig. 4 that the flights 44 extend forward nearly to the forward end of the tubular member 45 so that the more steeply pitched spiral flights 56 mounted within the member 45 assist in the feeding operation.

It is contemplated that the bore hole produced by the boring head will usually have a diameter of 6 feet or more so that when the boring machine is shut down, an operator can go through the bore hole alongside the boring bar and reach the boring head for purposes of inspection or repair.

Reverting now to Fig. 1, it has been found desirable to mount a partition 57 in the mouth of the bore hole so that it surrounds the boring bar 32. This makes it possible to connect a blower 58 to the space between the boring bar sections 32 and the walls of the bore hole. The blower 58 is driven by a motor 59 and the air discharged by the blower flows outward around the boring bar units 32, then flows over the boring head and escapes through the interior of the boring bar sections 32. In this way ventilation is secured and the hazard of gas explosion is minimized.

In Figs. 7 and 8 there is illustrated a modified form of boring head. This is carried by a tubular section 145 analogous to the tubular section 45 already described. Attached to the forward end of the section 145 is a flaring shell 150. To

5

the forward peripheral portion of this are mounted cutter bars 146 which are of much smaller radial extent than the cutter bars 46 of Figs. 4 and 5. These are equipped with cutting bits 147, 148 and 149 positioned to form an annular cut of very moderate radial extent.

A gimlet 151 analogous to the gimlet 51 is used and performs a splitting operation on the core. A plurality of pick-up vanes 156 are mounted within the head 150 and serve to pick up the cuttings and the lump coal and deliver them to the interior of the boring bar. To permit this action, the peripheral portion of the member 150 has notches 152 and 153 analogous to the parts 52 and 53 shown in Figs. 4 and 5.

The boring head shown in Figs. 7 and 8 is functionally similar to that shown in Figs. 4 and 5 but the pick-up and conveying action is better and the percentage of lump coal which will be delivered is greater. These considerations will justify the more expensive construction in particular cases.

We claim:

1. The combination of a generally horizontal tubular boring bar comprising separable sections; means for releasably connecting said sections end to end; helical conveyor flights carried by and projecting radially from the inner surface of the tubular sections; a boring head comprising cutting means and elevating means, connected to one end of said boring bar, the boring head being of a diameter several times that of the bar and being rendered effective by rotation of the bar to lift cuttings and deliver them to the interior of the tubular boring bar; and driving means operatively associated with the other end of the boring bar and operable to rotate the boring bar and to advance it in the direction of its axis, said boring bar being the sole means to transmit torque between the driving means and the boring head.

2. The combination of a generally horizontal tubular boring bar comprising separable sections; means for releasably connecting said sections end to end; helical conveyor flights carried by and projecting radially from the inner surface of the tubular sections; a boring head comprising cutting means and elevating means, connected to one end of said boring bar, the boring head being of a diameter several times that of the bar and being rendered effective by rotation of the bar to lift cuttings and deliver them to the interior of the tubular boring bar; driving means operatively associated with the other end of the boring bar and operable to rotate the boring bar and to advance it in the direction of its axis, said boring bar being the sole means to transmit torque between the driving means and the boring head; and centering means for said tubular boring bar at intervals in the length thereof, each comprising a plu-

6

ality of circumferentially spaced casters connected to said boring bar, said casters engaging the bore hole produced by said boring head.

3. The combination of a generally horizontal tubular boring bar comprising separable sections, means for releasably connecting said sections end to end and helical conveyor flights mounted within said sections; a rotary boring head comprising cutting means and elevating means, the latter rendered effective by rotation of the head, to lift cuttings and deliver them to the interior of said boring bar, said boring head being of a diameter several times that of the bar and being connected with said bar to rotate therewith; a motor unit operable to rotate said boring bar and to feed it in the direction of its axis; a blower; and means for directing gas propelled by the blower so that it flows in two passes one to and the other from said boring head, one of said passes flowing axially through the boring bar and the other flowing through the interval between the boring bar and the wall of a bore-hole formed by the boring head.

4. The combination of a rotary tubular boring bar; a boring head carried by said bar and arranged to cut an annular groove of greater diameter than said bar encircling a core which is coaxial with said bar; a core splitting means coaxial with said bar and head carried by the head and adapted to penetrate and disrupt said core as the head advances axially; lifting means associated with said boring head and adapted to feed material from said annular cut and from said disrupted core to the interior of said bar; conveying means arranged to operate within said bar and to feed said material in a direction away from said head; and driving means operable to rotate said bar and advance it in the direction of its axis, said tubular boring bar being the sole means to transmit torque between the boring head and the driving means.

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