

Jan. 31, 1950

J. G. FINDLATER
OIL SHALE MINING MACHINE

2,495,840

Filed March 16, 1946

5 Sheets-Sheet 1

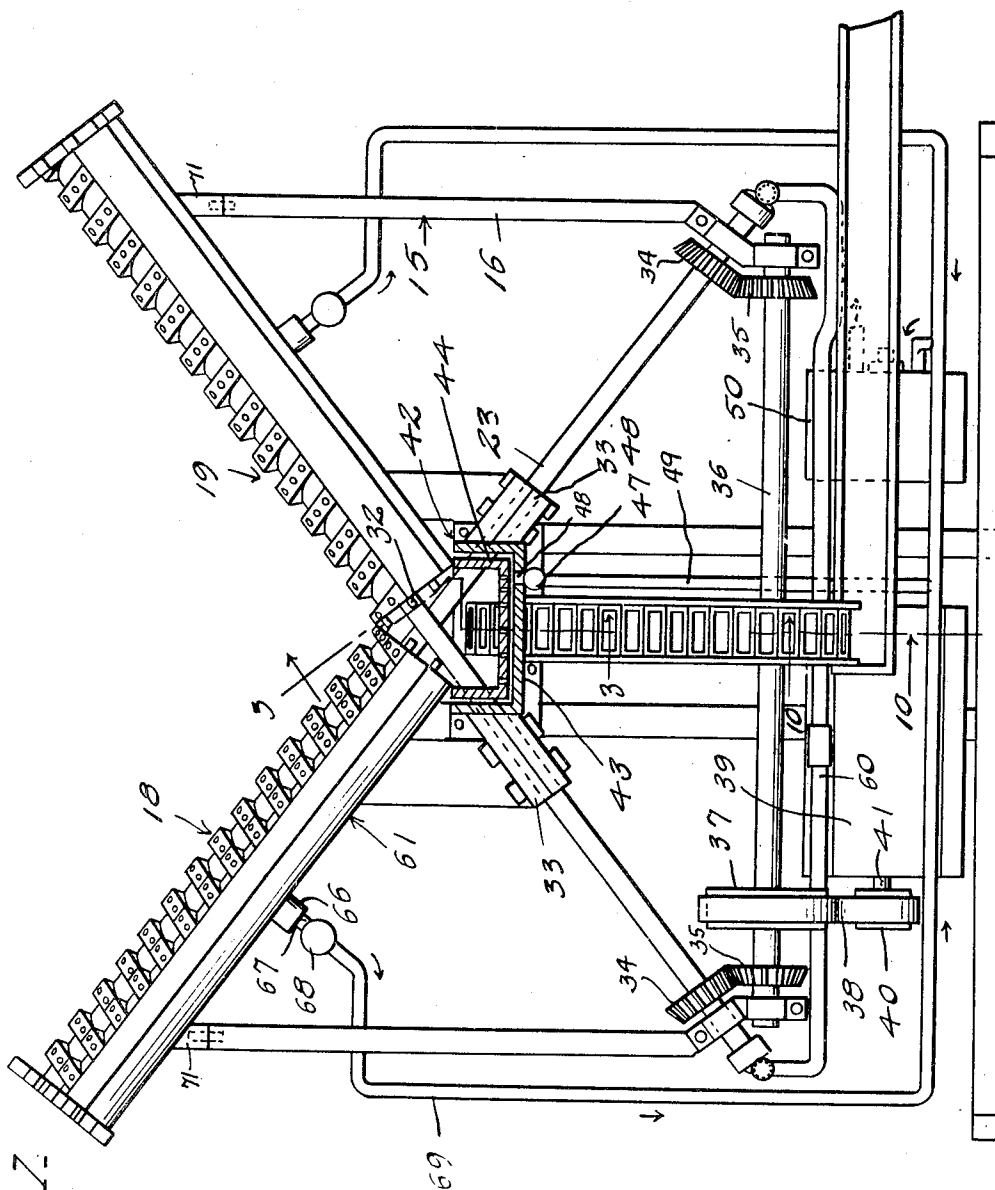


FIG. 1

Inventor
J. G. Findlater

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Kimmer & Brownell
Attorneys

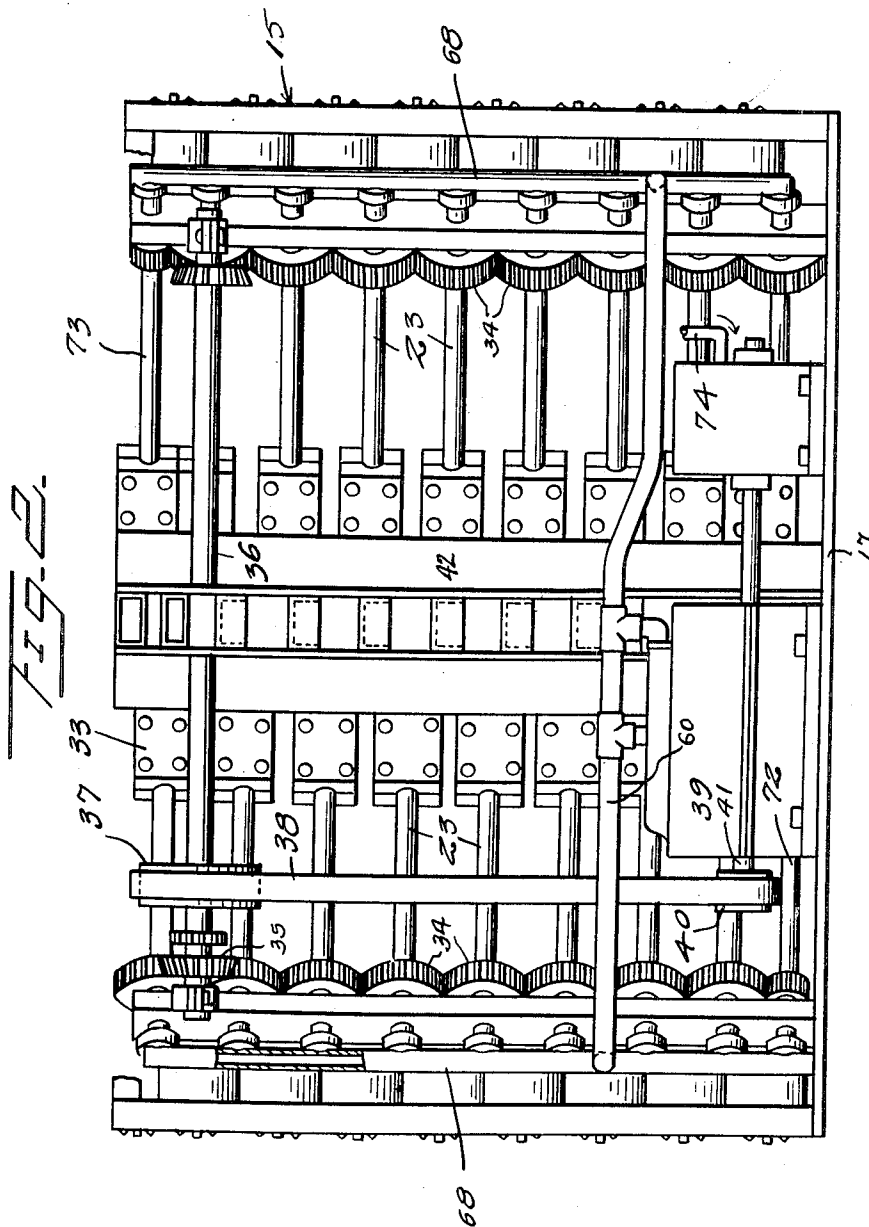
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Inventor
J. G. Findlater

By *Kimmel & Crowell*
Attorneys

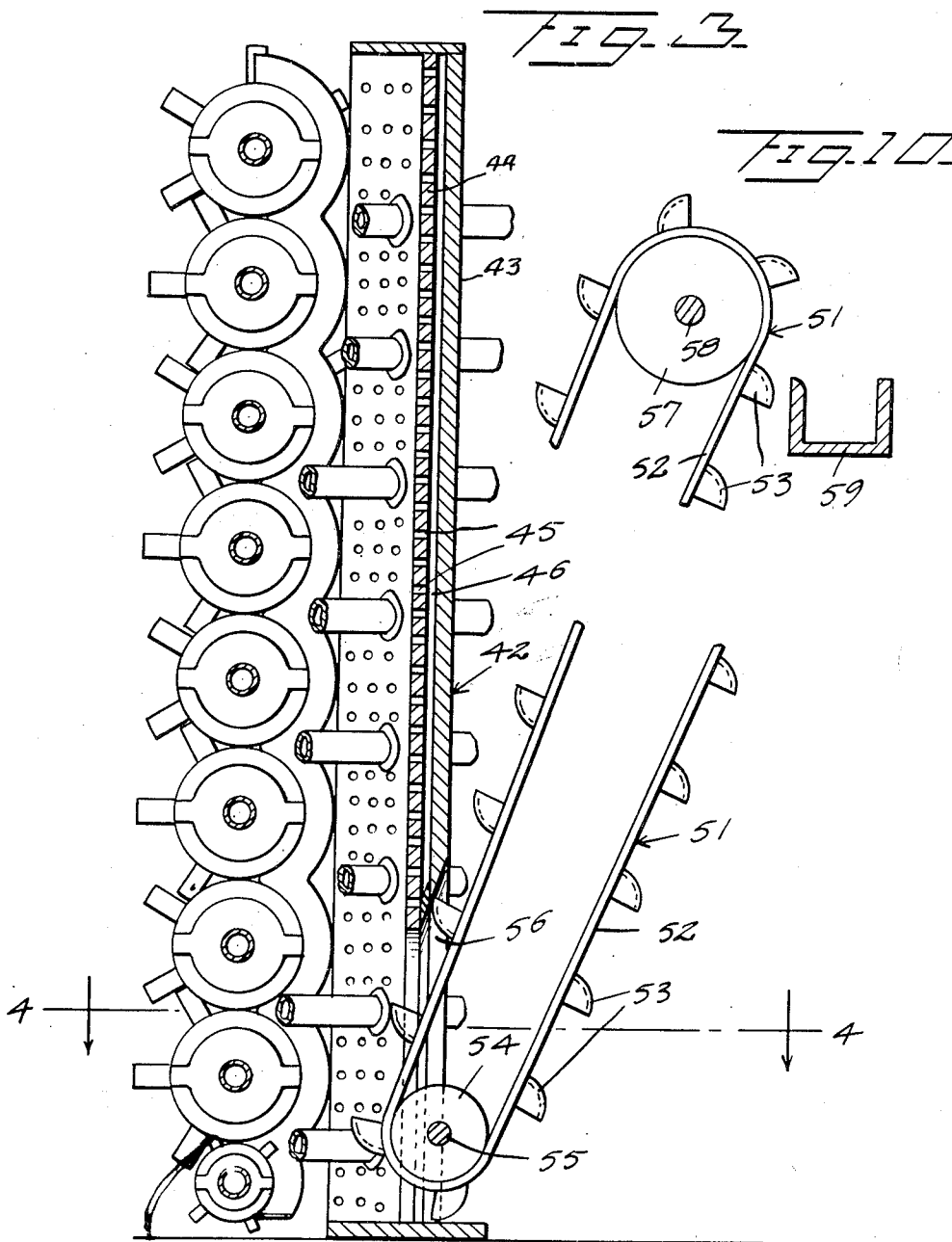
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Inventor

J. G. Findlater

By *Kimmel & Crowell* Attorneys

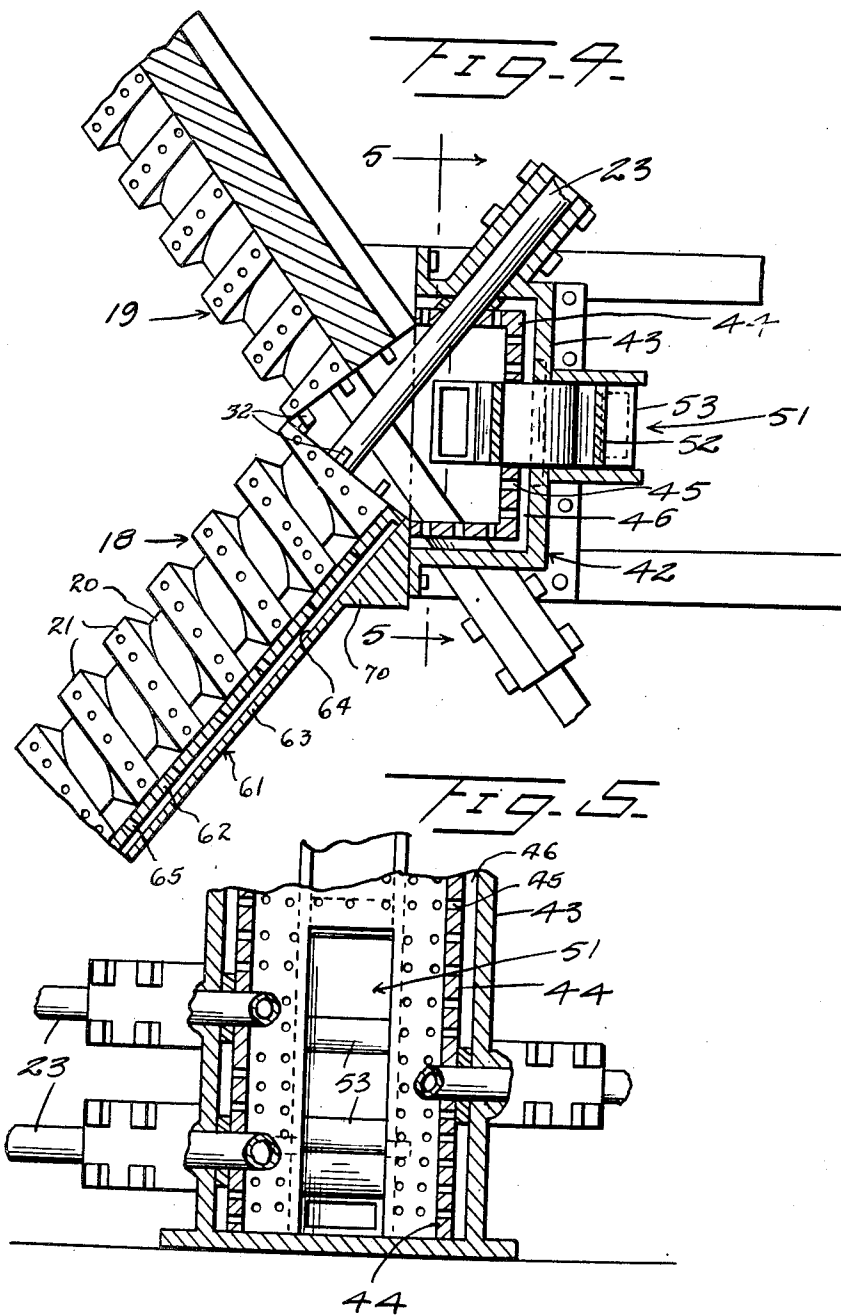
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Inventor

J. G. Findlater

By *Kimmel & Crowell*
Attorneys

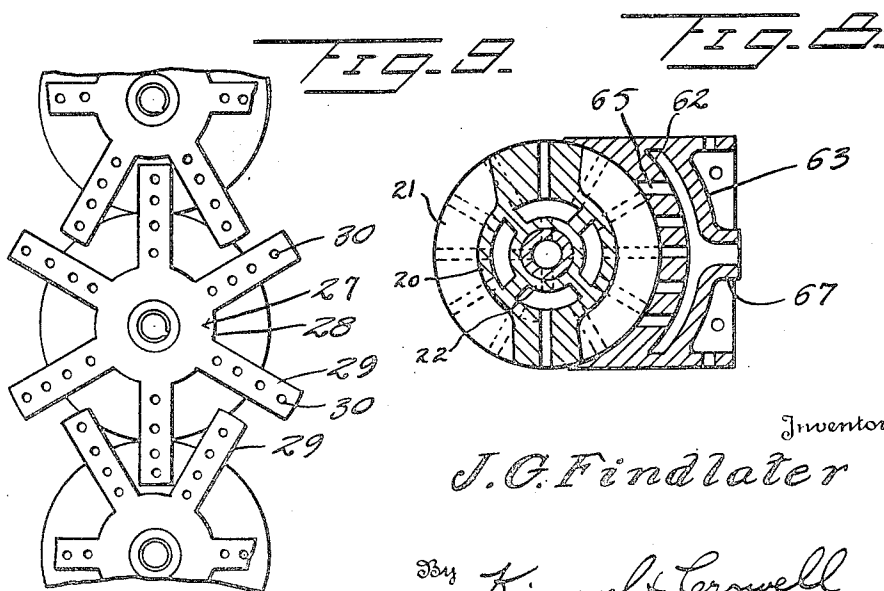
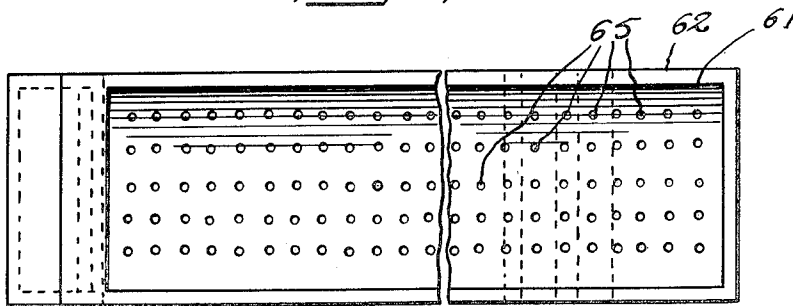
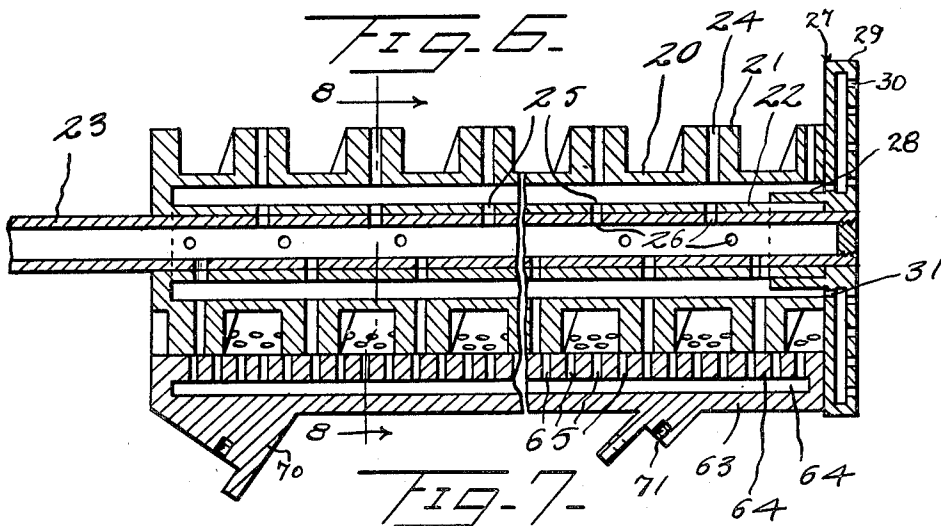
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Inventor
J. G. Findlater

By *Kimmel & Crowell*
Attorneys

UNITED STATES PATENT OFFICE

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OIL SHALE MINING MACHINE

John G. Findlater, Baker, Mont.

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9 Claims. (Cl. 262—19)

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This invention relates to mining apparatus.

An object of this invention is to provide a machine for mining shale which is designed to reduce the material to small particles so that oil or other liquids may be recovered from the shale.

Another object of this invention is to provide a mining machine which is formed of a plurality of spiral cutters arranged in superposed relation and designed to move the loosened material to a central collector from which the material is continuously removed.

A further object of this invention is to provide a mining machine wherein the loosened material is heated as it is removed by discharging the exhaust gases of an internal combustion engine into the rotary cutters, the machine also including suction means for removing the gases so that no poisonous or explosive gases will remain in the tunnel formed by the machine.

A further object of this invention is to provide a mining machine which includes means for heating the material through dynamic action and also through the application of heated air, gases, or steam, the machine including means for separating liquids and gases from the pulverized material as the machine moves forwardly so that the residue or waste may be disposed of within the mine and thereby eliminate transporting the waste to the surface for disposal on a dump or other surface area.

To the foregoing objects, and others which may hereinafter more fully appear, the invention consists of the novel construction, combination and arrangement of parts, as will be more specifically referred to and illustrated in the accompanying drawings, but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of the invention as claimed.

In the drawings:

Figure 1 is a detailed top plan of a mining machine constructed according to an embodiment of this invention,

Figure 2 is a detailed rear elevation of the device,

Figure 3 is a sectional view partly broken away taken on the line 3—3 of Figure 1,

Figure 4 is a fragmentary sectional view taken on the line 4—4 of Figure 3,

Figure 5 is a fragmentary sectional view taken on the line 5—5 of Figure 4,

Figure 6 is a fragmentary longitudinal section of one of the digging members,

Figure 7 is a front elevation of one of the vapor collecting members, and acts as filtering

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medium to separate particles from gases and liquids,

Figure 8 is a sectional view taken on the line 8—8 of Figure 6,

Figure 9 is a detailed end elevation partly broken away of the digging members, and

Figure 10 is a fragmentary sectional view taken on the line 10—10 of Figure 1.

Referring to the drawings, the numeral 15 designates generally a frame structure which is formed of upright side frame members 16 and a base 17. A pair of banks of spiral digging members, generally designated as 18 and 19, are rotatably carried by the frame 15 and the two banks 18 and 19 are disposed in forwardly divergent relation as shown in Figure 1. Each bank of digging members is of like construction and the detailed description of one of these banks will apply equally as well to the other bank. The bank 18 is formed of a plurality of superposed parallel digging members which include a hollow cylindrical body 20 having spiral blades 21 on the periphery thereof, which may be multiple spirals or multiple fractions of spirals. The body 20 includes a cylindrical core 22 which is fixedly secured to a hollow shaft 23. The blades 21 are formed with a plurality of openings 24 communicating with the interior of the body 20 and the hub or bushing 22 is formed with openings 25 registering with openings 26 formed in the shaft 23, so that a heating medium under pressure in the shaft 23 will pass through the openings 26 and 25 and then out through the opening 24 and into the face of the mineral.

Each digging member has secured to the outer forward end thereof a spider-shaped digging member 27 which includes a hollow hub 28 having a plurality of radially arranged hollow arms 29 extending therefrom. The arms 29 are formed with openings 30 and the hub 28 is formed with openings 31 so that the heating medium within the body 20 may pass through the openings 31 into the interior of the arms 29 and then out through the exhaust openings 30. Each digging member is also formed at the inner end thereof with spaced teeth 32 which provide a means whereby the material at the convergent ends of the digging members will be broken up or pulverized prior to the discharge of the material into the collector as hereinafter disclosed. The hollow shafts 23 are journaled in bearings 33 and each shaft 23 has fixed thereto a gear 34. The uppermost ones of the shafts 23 have intermeshing gears and the upper one of the shafts 23 has the gear 34 thereof meshing with a driving gear 35 which is fixed to

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a driving shaft 36. The shaft 36 has a pulley 37 mounted thereon about which a belt 38 is trained. A power member 39 in the form of an internal combustion engine is fixedly carried by the frame 15 and has a pulley 40 mounted on the drive shaft 41 thereof.

Upon rotation of the digging members the material engaged thereby, which is preferably oil shale or the like, will be pulverized and the digging members are rotated in the direction whereby the removed material will be drawn inwardly toward the junction between the two banks of the digging members. The removed material which is pulverized and subjected to heat, as it is removed, is then discharged into a vertically disposed collector housing, generally designated as 42. The collector housing 42 includes an outer casing 43 which is fixed to the frame 15 and also includes an inner casing 44 which is spaced from the outer casing 43 and is provided with openings 45 which are of a size to prevent the pulverized particles passing therethrough. There is a suction space 46 between the inner and outer casings and a vertically disposed suction manifold 47 is disposed at the rear side of the housing 43 and communicates through a series of vertically spaced apart nipples 48 with the suction space 46. In this manner any gases or liquids which are discharged into the collector 43 will be drawn through the openings 45. The manifold 47 is connected by means of a pipe 49 to a suction source 50 which may be in the form of a suction or vacuum pump operated by any suitable operating means.

In order to provide for the discharge of the pulverized material from which the gases and liquids have been removed, I have provided an endless conveyor or elevator, generally designated as 51. The elevator 51 includes an endless belt 52 having a plurality of cups 53 secured thereto and the belt 51 is trained at its lower end about a driving pulley or drum 54 fixed to a shaft 55 operatively connected with the power member 39. The lower portion of the collector 42 is formed with an opening 56 within which the elevator 51 is adapted to project at its lower end so that the cups 53 will pick up the material dropping into the lower portion of the collector 42 and raise the material upwardly on the forward run of the elevator. The upper end of the elevator 51 is trained about an idler pulley or drum 57 carried by a shaft 58 and the material in the cups 53 is discharged into a trough 59. The trough 59 may be extended to any suitable point for removing the pulverized material from the rear end of the digging machine. This removed material, which is waste material, may be transported to any suitable point preferably within the mine or the tunnel formed by the digging member at a point remote from the machine.

After the first tunnel is made, the waste material would be forced into the tunnel immediately at the side of the machine. It is understood that portable refining equipment may be carried on the machine or the tractor if necessary. One object of replacing waste material is to save timbering costs.

The exhaust of the motor 39 is connected by means of a pipe 60 to the rear ends of the hollow shafts 23, so that the exhaust gases will be forced through the hollow shafts 23 for discharge against the face of the shale as the digging members are rotated. It will of course be understood that any other suitable heating means may be provided whereby heated air or gases may be forced

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through the hollow shafts for discharge against the face of the material which is being dug by this machine. Each digging member at the rear side thereof has mounted a suction housing generally designated as 61. The suction housing 61 includes an inner transversely arcuate wall 62 which is spaced from an outer arcuate wall 63 thereby forming a suction space 64. The inner wall 62 is formed with a plurality of filter openings 65 confronting the rear side of the associated digging member, so that any gases or liquids removed by the digging member or which may be present about each digging member, will be withdrawn before the pulverized material is discharged into the collector 42. The outer wall 63 is provided with a nipple 66 which is connected through a nipple 67 to a vertically disposed suction manifold 68. The suction manifold 68 is connected by means of a pipe 69 to the intake side of the suction member 50. The suction housing 61 has fixed thereto a pair of bracket arms 70 and 71 which may be fixed by suitable fastening means to the frame 15 for rigidly supporting the suction members 61 at the rear sides of the spiral digging members.

The digging members of one bank are alternately arranged with respect to the digging members of the other bank and the bank 18 at its lower end includes a small digging member 72 whereas the other bank 19 includes at its upper end a small digging member 73. These reduced diameter digging members are in every respect similar to the larger diameter digging members and have associated therewith suction housings 61 of reduced size.

In the use and operation of this mining apparatus the frame 15 with the digging members mounted thereon is coupled at its rear end to a pusher element, such as a tractor or the like, so that the frame may be moved forwardly and into contact at all times with the strata of oil shale. The engine 39 will rotate the two banks of the digging members as a unit and the loosened material, which is pulverized as it is loosened from the strata, is then moved toward the center of the machine and discharged into the collector 42. The suction member 50 will withdraw any gases and liquids which are removed and which may be present in the suction housings 61 and also in the collector 42. The exhaust gases from the engine 39 will be discharged through the hollow shafts 23 and the openings in the digging members against the face of the strata so that the strata will be heated simultaneously with the removal of the material therefrom. This removed or pulverized material will be additionally heated as this material is moved along the troughs or suction housings so that the liquids present in the pulverized strata will be in the condition for removal by the suction force in the suction housings 61 and the suction present in the collector housing 42. The gases and liquids which may be removed by the suction member 50 may then be forced to a remote point from the apparatus through the discharge pipe 74 which may be extended above the ground or to any suitable point. Through the medium of the suction which is used to remove the exhaust gases after they have heated the digging members, an internal combustion engine may be used with this apparatus without causing the accumulation of poisonous gases within the tunnel which is formed by this apparatus. This apparatus may be used for digging of oil shale or other suitable mineral and will provide a mining machine which will form

its own tunnel as it is moved along and which will remove the strata in a pulverized condition. It is, of course, understood that this apparatus may be made in any desired size to fit the desired strata or to form the desired tunnel. It is, of course, also understood that this mining apparatus may be used for other purposes than for the digging of oil shale and the removal of oil and liquids including gases from the shale. Refrigerating mediums or chemical solutions may, in certain instances, be better than a heating medium and may be substituted therefor.

The exact configuration illustrated is regarded as the optimum, but some of the desirable results inherent in this disclosure may be obtained by various slight modifications including some departure from the exact configuration shown, and it is therefore requested that the scope of the invention should be regarded as limited only by the terms of the claims.

What I claim is:

1. A mining machine comprising a frame, a plurality of superposed horizontally disposed and forwardly divergent spiral digging members at the forward end of said frame, said members having passages therein for receiving and discharging a heating medium, means for rotating said members, and means for communicating said passages with a heating medium.

2. A mining machine comprising a frame, a plurality of superposed horizontally disposed spiral digging members, said members being arranged in forwardly divergent relation, means for rotating said members, and a collector disposed at the angle formed by said members.

3. A mining machine comprising a frame, a plurality of hollow spiral superposed digging members carried by said frame, said members arranged in forwardly divergent relation, means for rotating said members, said members having passages therein for receiving and discharging a heating medium, means for communicating said passages with a heating medium, a collecting means between pairs of said members, and a conveyor for conveying the collected material rearwardly of the machine.

4. A mining machine comprising a frame, a plurality of hollow spiral superposed digging members carried by said frame, means disposing said members in forwardly divergent relation, means for rotating said members, said members having passages therein for receiving and discharging a heating medium, means for communicating said passages with a heating medium, a collecting means between pairs of said members, and suction means for withdrawing the vapors and liquids from said collector.

5. A mining machine comprising a frame, a plurality of hollow spiral superposed digging members carried by said frame, means for rotating said members, means discharging a heating medium into said members, a collecting means between pairs of said members, a transversely arcuate suction housing at the rear side of each digging member, each housing including an apertured wall confronting a digging member, and suction means connected to said collector and said housings for withdrawing vapors and liquids from said collector.

6. A mining machine comprising a frame, a plurality of forwardly divergent rotatable digging members carried by said frame, means for rotating said members, each of said members being hollow and formed with openings in the periphery thereof, means forcing a heating medium through said members for exhaust through said openings, a collector for receiving the removed material, and means removing the material from said collector.

7. A mining machine comprising a frame, a plurality of forwardly divergent rotatable digging members carried by said frame, means for rotating said members, each of said members being hollow and formed with openings in the periphery thereof, means forcing a heating medium through said members for exhaust through said openings, a collector for receiving the removed material, and suction means for removing the fluids from said collector, and means removing the material from said collector.

8. A mining machine comprising a frame, a plurality of rotatable digging members carried by said frame, means for rotating said members, each of said members being hollow and formed with openings in the periphery thereof, means forcing a heating medium through said members for exhaust through said openings, a collector for receiving the removed material, said collector including a vertically disposed housing formed of inner and outer spaced walls, said inner wall being perforate, suction means connected to said housing for removing fluids from said collector, and means removing the material from said collector.

9. A mining machine comprising a frame, a plurality of rotatable digging members carried by said frame, means for rotating said members, each of said members being hollow and formed with openings in the periphery thereof, means forcing a heating medium through said members for exhaust through said openings, a collector for receiving the removed material, said collector including a vertically disposed housing formed of an inner perforate wall of U-shape in horizontal section, an outer U-shaped wall spaced from said inner wall, suction means connected to said outer wall for removing fluids from said collector, and means removing the material from said collector.

JOHN G. FINDLATER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
747,869	Drake	Dec. 22, 1903
981,201	Kuhn	Jan. 10, 1911
1,148,973	Kuhn	Aug. 3, 1915
1,808,649	Fleming	June 2, 1931
1,811,560	Ranney	June 23, 1931
2,105,505	Ramsay	Jan. 18, 1938
2,375,689	Reeder	May 8, 1945

FOREIGN PATENTS

Number	Country	Date
17,786	Great Britain	July 27, 1914