

Sept. 15, 1970

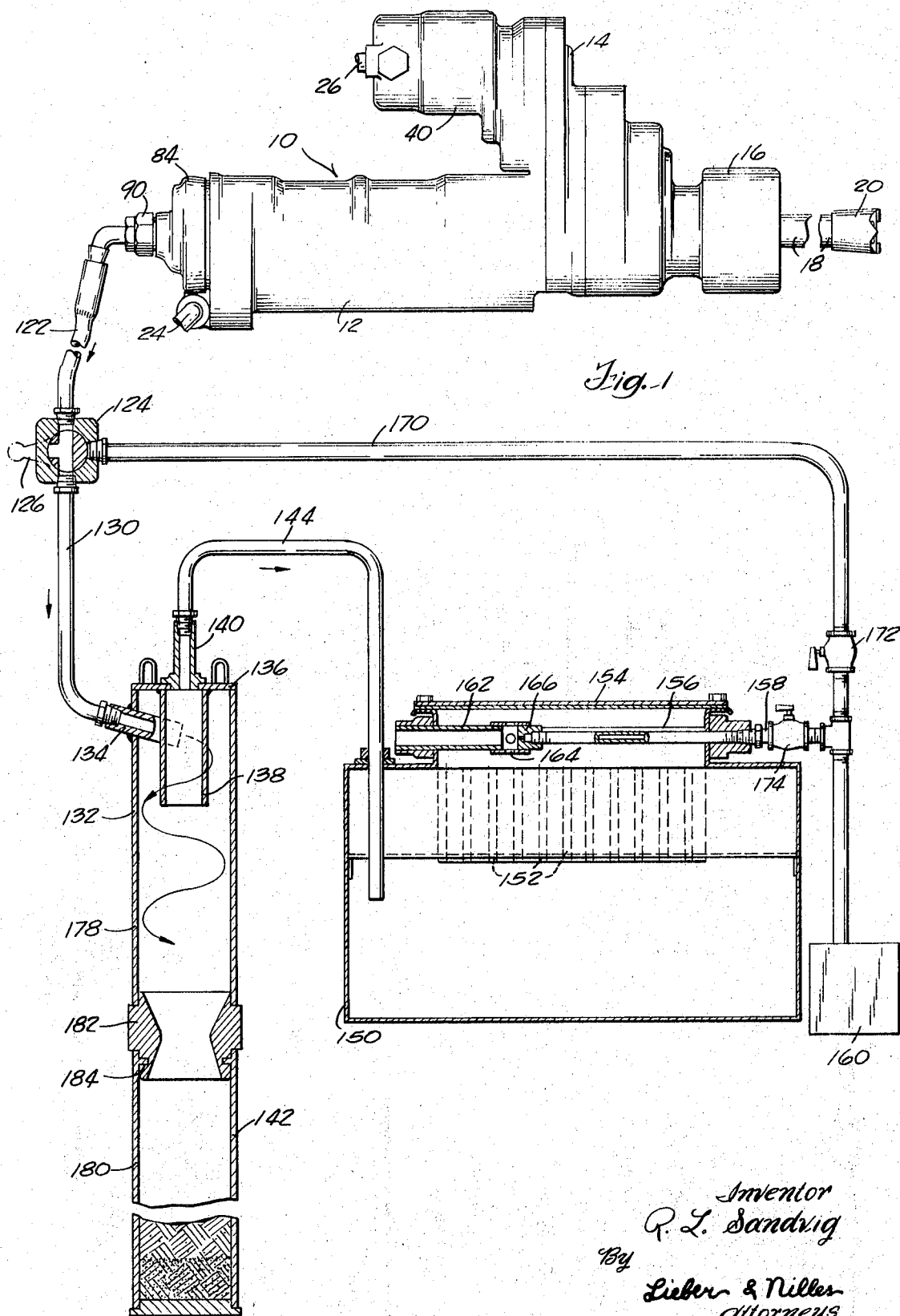
R. L. SANDVIG

3,528,514

ROCK DRILLING APPARATUS

Filed Oct. 23, 1968

2 Sheets-Sheet 1



Inventor
R. L. Sandvig
By
Lieber & Niller
Attorneys

Sept. 15, 1970

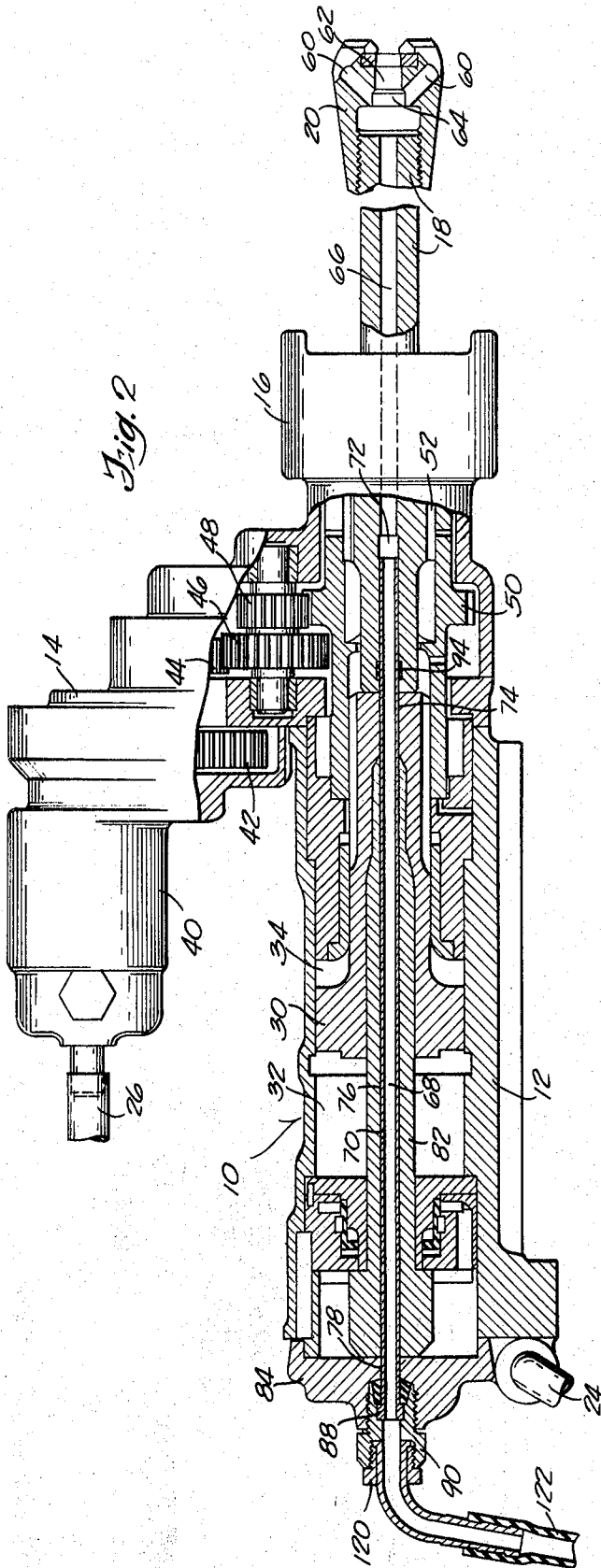
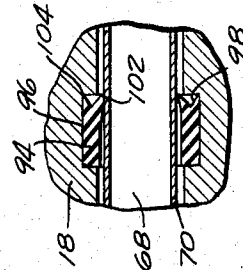
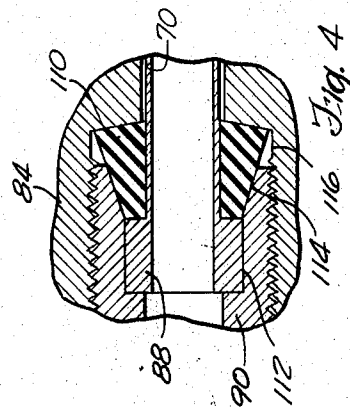
R. L. SANDVIG

3,528,514

ROCK DRILLING APPARATUS

Filed Oct. 23, 1968

2 Sheets-Sheet 2



Inventor
R. L. Sandvig
By
Lieber & Nilles
Attorneys

1

3,528,514

ROCK DRILLING APPARATUS

Robert L. Sandvig, Sidney, Ohio, assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Filed Oct. 23, 1968, Ser. No. 770,040

Int. Cl. E21b 7/00

U.S. Cl. 175—49

9 Claims

ABSTRACT OF THE DISCLOSURE

Rock drilling apparatus, particularly of the drifter drill type, embodying means for the removal of cuttings from the area of the bit and the collection of mineralogically accurate samples of rock from the section being drilled while also providing for optional reverse flow for flushing.

BACKGROUND

In percussive and rotary-percussive type drilling operations, the drill bit performs its work on the rock or other solid material by grinding and/or chipping operations. The material thus ground or chipped by the bit must accordingly be removed from the hole being drilled in order to prevent its becoming impacted and thus clogging the hole and interfering with effective bit operation.

For the purpose of removing the cuttings from the end of the hole, it has heretofore been proposed to employ either air or water conducted through the drill steel to the working face of the bit under pressure to thereby flush the cuttings from the working area. It has also been proposed to utilize a vacuum for removing the cuttings from the area about the working face of the bit and collecting the same in a dirt or dust collector.

In addition to the fact that water flushing cannot be used in many underground mines, both air and water flushing have proven relatively slow and ineffective for displacement and removal of chips. Additionally, the use of pressurized air blown through the drill steel and into the hole creates a dust hazard which requires the provision of expensive and bulky dust collecting and air purifying apparatus which is likewise not always effective in removing the dust thus created.

The vacuum methods for the removal of cuttings require that the operating mechanisms of the drilling apparatus be effectively segregated and sealed from the dust chambers and passageways and that the collecting apparatus be effective for the separation of dust from the exhaust air. Also, it is desirable to provide means for the precipitation of rock and ore cuttings and the segregation thereof for the purpose of obtaining mineralogical data with respect to the material being worked. Prior vacuum removal methods and/or apparatus have left something to be desired in these respects.

SUMMARY

The present invention contemplates the provision of an improved rock drilling apparatus wherein the cuttings are effectively removed from the area adjacent the working face of the drill bit by vacuum drawn through the bit, drill steel and drill proper, the cuttings being then passed through a cyclone wherein virtually complete precipitation is achieved with any remaining fines being passed through a final filtering device as the vacuum is maintained throughout the entire circuit.

An important object of this invention is to provide a percussive and/or rotary-percussive rock drill with novel means for collecting mineralogically accurate rock and ore samples from the area being worked from depths up to two hundred feet or more.

2

A further object of the invention is to provide percussive and/or rotary percussive rock drilling apparatus adapted to operate in a relatively dust-free atmosphere with an extremely high degree of efficiency.

Still another object of this invention is to provide an improved large bore drifter type rock drill with means for rapidly and effectively removing cuttings from the working area whereby precision drilling capabilities up to one hundred or more feet in depth may be achieved in cases where long-wall mining methods are employed.

Another object of the present invention is to provide a rock drilling machine having vacuum removal means for the cuttings which requires minimum air consumption and wherein optional reverse flow for flushing is provided.

These and other objects and advantages of the invention will become apparent from the following detailed description.

THE DRAWINGS

A clear conception of the present invention and of the construction and mode of operation of a typical rotary-percussive drifter type drill embodying the improvements may be had by referring to the drawings accompanying and forming a part of this specification, wherein like reference characters designate the same or similar parts in the several views.

FIG. 1 is a side elevational view, partly in section, showing a typical rotary-percussive drifter drill and associated cuttings removal, collecting and separating circuit embodying the present improvements;

FIG. 2 is a somewhat enlarged part-sectional view of the drilling machine per se;

FIG. 3 is an enlarged fragmentary section showing the sealing means for the cuttings exhaust tube within the drill steel portion of the drilling machine; and

FIG. 4 is a similarly enlarged fragmentary section through the impact absorber and seal at the rear end of the cuttings exhaust or removal tube.

DETAILED DESCRIPTION

The typical rock drill shown herein as embodying the invention is designated generally by the numeral 10, and for purposes of illustration, the drill shown is of the large bore drifter type adapted to be mounted in a customary manner on a carrier vehicle, not shown.

The drill 10 comprises, generally, a main housing 12 for the percussive fluid motor, a secondary housing 14 for the rotary fluid motor secured to the front portion of the main housing 12, a drill steel chuck 16 carried by the forward end of the housing 12, and a drill steel rod 18 carried by the chuck 16 and having a work performing bit 20 at its free outer end. Pressurized operating fluid is supplied from a suitable source, not shown, to the percussive motor via inlet 24 and to the rotary motor via conduits 26.

Generally speaking, the percussive motor includes a striker or impact piston 30 mounted within the housing 12 for reciprocatory movement toward and away from the adjacent end of the drill steel or rod 18, the piston 30 being driven by fluid under pressure admitted to and exhausted from the chambers 32, 34 by suitable valving in a known manner. In addition, to the percussive action thus imparted to the drill steel 18, the chuck 16 is also mounted for selective rotary motion by a rotary hydraulic gear unit housed in the section 14 and adapted to be driven in a known manner by fluid pressure admitted and exhausted via conduits 26 communicating with fluid motor 40 which, in turn, drives gear 42 carrying gear 44 which meshes with gear 46 carrying gear 48 meshing with the teeth of a rotatable member 50 which has a sliding spline connection 52 with the drill steel 18 or drill steel chuck to rotate the same.

3

Thus, the drill steel 18 is percussively actuated by the impact piston or member 30 by fluid pressure admitted through conduit 24 under the control of an operator, and the drill steel 18 may also be selectively rotated through the gears 42 to 48 by fluid pressure admitted to the motor 40 under the control of an operator. Accordingly, drilling may be performed by the bit 20 by either rotary or percussive action or a combination thereof, the drill assemblage thus far described being more-or-less conventional.

In accordance with the present invention, cuttings created as the bit 20 performs its work are removed by suction from the working area and are precipitated out in a collecting device with any remaining fines being thereafter removed prior to exhaustion of the low pressure air to the atmosphere. To accomplish this, it is necessary to expose the working face of the bit 20 to a source of low pressure.

Thus, the drill bit 20 is formed with passages 60, 62 communicating the exposed outer peripheral and central portions respectively of the bit 200 with the hollow interior 64 thereof. In turn, the drill steel or rod 18 is formed with a central longitudinal passage 66 communicating at its forward end with the hollow interior 64 of the bit 20 and at its opposite end with the central longitudinal passage 68 of a tube 70 having its forward end slidably received within a somewhat enlarged counter-bored portion 72 of the passage 66. The hollow tube 70 extends through axially aligned bores 74, 76, 78 in the impact piston 30, guide member 82 and rear closure cap or drill housing backhead 84 respectively, and the rear end of the tube 70 is formed with a head 88 held captive in a connector fitting 90 threaded in the backhead 84.

The tube 70 is thus restrained from longitudinal movement while both the impact piston 30 and the drill steel 18 are freely slidable relative thereto. However, to prevent migration of dust to the interior of the housing 12 and particularly to the piston displacement chamber 32, 34, a seal 94 is provided between the tube 70 and counter-bored portion 72 of the drill steel 18. This seal is shown in detail in FIG. 3 and consists of a resilient ring received in an annular recess 96 formed in the counter-bored portion of the drill steel 18 so as to slidably embrace the tube 70, the forward end of the sealing ring 94 being formed with an annular V-shaped groove 98 to provide a pair of flexible sealing lips 102, 104. Also, to permit the tube 70 to absorb impacts while retaining the same in position as described, a resilient buffer 110 is positioned between the head 88 of the tube and the backhead 84 of the drill housing 12. Such impact absorber is shown more particularly in FIG. 4 wherein the head 88 of the tube is shown seated within the annular recess 112 in the fitting 90, the entry portion 114 of the recess being of conical shape for receiving the resilient buffer or grommet 110 of similar conical shape and having its reduced rear face seated against the head 88 while its front tapered face of greater dimension is seated against the end wall of the recess 116 formed in the backhead 84 receiving the fitting 90.

The fitting 90 is adapted to receive a threaded hose connector 120 which, in turn, receives one end of a flexible hose 122. The other end of the hose 122 is suitably attached to a selector valve 124 adapted for manual manipulation by means of a handle 126 to selectively connect the hose 122 to either a low pressure or high pressure source as will hereafter be more fully described.

The valve 124 is connected via a hose 130 to a cuttings precipitator 132 such as a cyclone type separator, the hose 130 entering the upper cyclone portion of the precipitator 132 via a tangentially and downwardly directed nozzle 134. The upper end of the precipitator 132 is closed by a cap 136 having a depending annular skirt 138 forming a vortex tube which terminates below the inner end of the nozzle 134, and a hose fitting 140 is secured centrally of the closure cap 136 to provide an

4

exhaust passage communicating with the tube 138 of the cyclone precipitator. At least the lower portion 142 of the precipitator 132 is preferably formed of transparent material such as plastic or glass, and one end of a tube 144 is connected in a suitable manner to the fitting 140, the other end of the tube 144 being placed in communication with a source of low pressure or vacuum.

While the hose or tube 144 may be connected in any desired manner with a suitable source of vacuum, it is preferred to interpose a final filter between the cuttings precipitator 132 and the exhaust of the lower pressure air to atmosphere so as to remove any remaining fines from the air thus exhausted. Accordingly, the end of the tube 144 remote from its connection 140 to the precipitator 132 is extended into the interior of a filter box 150 which may be of a type containing a plurality of spaced filter elements and/or baffles 152. The filter box 150 is associated with a vacuum generator 154 shown herein as consisting of a tube 156 connected via line 158 to a suitable source of pressurized air such as an air compressor 160, the end of the tube 156 adjacent the filter box 150 having a nozzle 162 and being in communication with the interior of the filter box through one or more orifices 164 adjacent a venturi 166 as formed by a restricted orifice between the tube 156 and exhaust nozzle 162.

Thus, as pressurized air from source 160 is conducted through the supply pipe or tube 158 and hose 156 through the venturi 166 and past the orifices 164, a low pressure vacuum is generated within the filter box 150 causing ambient air to be drawn along with the cuttings through the passageways 60, 62 of the bit 20 and through the passage 66 in the drill steel 18 and the hollow tube 70, hose 122, past valve 124, through hose 130 and into the cyclone portion of the precipitator 132. In the cyclone precipitator 132, approximately 99.5% precipitation of the cuttings drawn with the ambient air from the working face of the bit is precipitated out of the low pressure air, and the small amount of very fine dust particles remaining in the air are passed through the vortex tube 138 and hose 144 to the final separator or filter 150 where these dust particles are further precipitated or captured on the filters prior to exhaustion of the air through the orifices 164 and nozzle 162 to atmosphere.

The action thus described takes place when the selector valve 124 is in the position shown in FIG. 1, but if it is desired to flush the cuttings within the zone of the drill bit 20, the valve 124 is shifted by means of the handle 126 so as to connect the tubing or hose 170 with the hose 122. Then, with the on-off valve 172 manually turned on to open the passage from the compressed air source 160 to the hose 170 and with the on-off valve 174 turned off to close the passage from the compressed air source to the vacuum generator 154, pressurized air will be conducted to the bit through tube 70, passage 66, and passages 60, 62 thus resulting in a flushing action.

In addition to its function of sealing the impact piston displacement chamber from dust, it will be noted that the seal 94 surrounding the tube 70 also prevents vacuum loss as the air and cuttings enter the tube, and the grommet 110 at the other end of the tube performs the same sealing function in addition to acting as an impact absorbing member. It will also be noted that the upper cyclone portion 178 of the precipitator 132 is effectively sealed from the lower transparent portion 180 by a restricted neck member 182 having an annular seal 184 which prevents vacuum loss between the upper and lower sections 178, 180 respectively of the precipitator. It is significant to note that the entire circuit thus shown and described herein is lower than ambient pressure or vacuum until the last particle of dust is removed from the system, and in actual practice, the apparatus has demonstrated an ability to precipitate 99.5% of the rock cuttings out in the precipitator 132 so that the stratification within the clear plastic portion of the tube is

5

capable of use for obtaining valuable mineralogical data.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A rock drill comprising, a housing closed at one end and having a drill chuck at its opposite end, a drill steel slidably carried by said chuck and having a work performing bit at its forward end, said drill steel having a central longitudinal passage extending therethrough and said bit having passages communicating the drill steel passage with the working face of the bit, a fluid operable impact member mounted for reciprocation within said housing for delivering percussive blows to said drill steel, said impact member having a bore extending therethrough in axial alignment with the drill steel passage, a hollow tubular rod extending through an opening in the end closure of said housing and through the bore of said impact member into the central passage of said drill steel, means for producing a vacuum within said rod to draw ambient air and cuttings from the area adjacent the working face of the bit through the passage in said bit and said drill steel and through said rod to the exterior of said housing, and means providing a seal between said rod and said drill steel and between said rod and the end closure of said housing to prevent vacuum loss within the passages and said rod while permitting sliding movement of said drill steel and said impact member relative to said rod.

2. A rock drill according to claim 1, wherein the means for producing a vacuum within the hollow rod is independent of the drill operating means.

3. A rock drill according to claim 1, wherein the drill steel passage has an area of increased diameter within which the end portion of the hollow rod is received and within which the seal between said rod and said drill steel is located.

6

4. A rock drill according to claim 1, wherein the hollow rod has an end head held captive by a fitting secured to the end closure of the housing and a conical resilient sealing and impact absorbing member is interposed between said rod end head and said end closure.

5. A rock drill according to claim 1, wherein the hollow rod is connected exteriorly of the housing with a cyclone type separator communicating with the vacuum source for precipitating and collecting the cuttings drawn from the area adjacent the working face of the bit.

6. A rock drill according to claim 5, wherein the cyclone has a transparent cuttings collecting portion for collecting and observing mineralogical rock samples of the area being worked.

7. A rock drill according to claim 5, wherein a final dust filter is interposed between the cyclone precipitator and the vacuum source.

8. A rock drill according to claim 7, wherein the entire cuttings withdrawal, transporting precipitating and filtering circuit is maintained lower than ambient pressure.

9. A rock drill according to claim 7, wherein means is provided for selectively flushing the area adjacent the working face of the bit.

References Cited

UNITED STATES PATENTS

1,985,157	12/1934	Friedman	175—206 X
2,167,393	7/1939	Muncy	175—49
2,919,901	1/1960	Sandvig	175—206 X
2,975,847	3/1961	Feucht	175—206 X

NILE C. BYERS, JR., Primary Examiner

U.S. Cl. X.R.

173—78; 175—206