Jan. 23, 1968 W. HEYER ET AL 3,365,234

APPARATUS AND METHOD FOR CONTROLLING THE PATH OF A MINING MACHINE ALONG A MINE FACE

Filed March 8, 1966 2 Sheets-Sheet 1

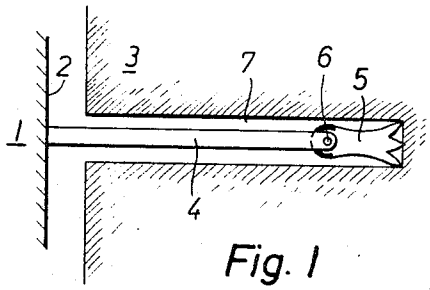

Fig. 1

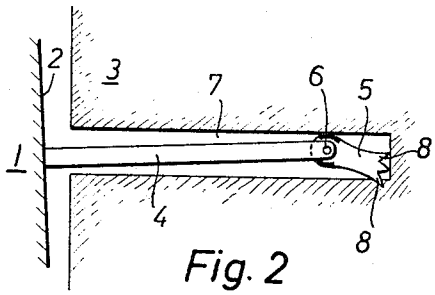

Fig. 2

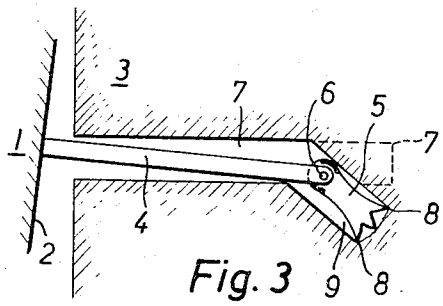

Fig. 3

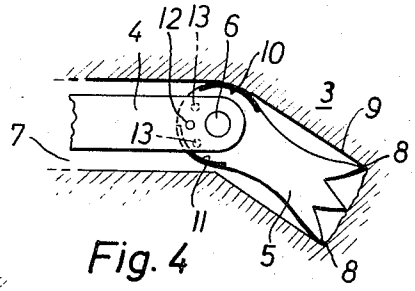

Fig. 4

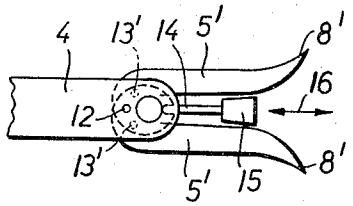

Fig. 5

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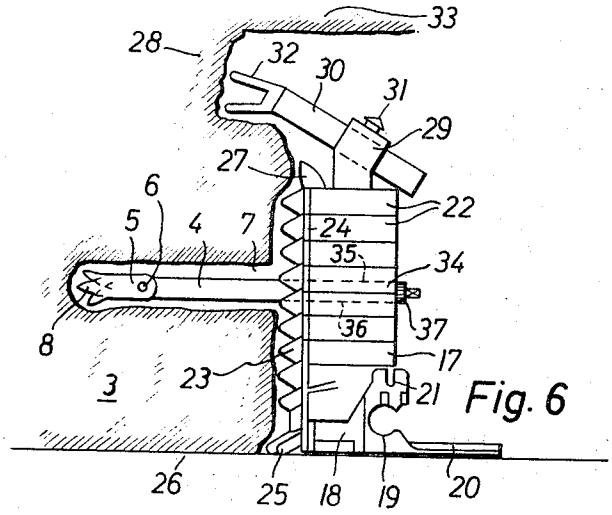

Fig. 6

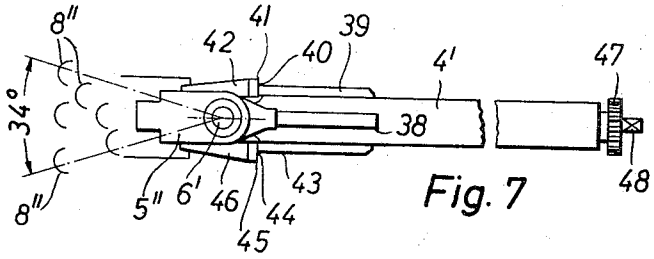

Fig. 7

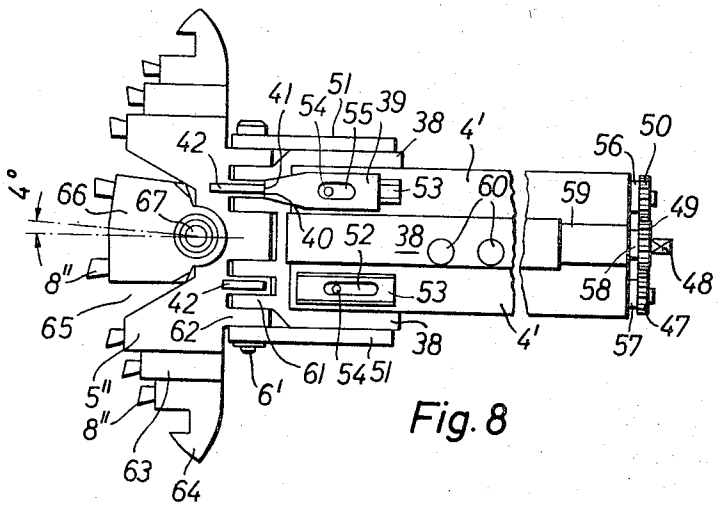

Fig. 8

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APPARATUS AND METHOD FOR CONTROLLING THE PATH OF A MINING MACHINE ALONG A MINE FACE

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11 Claims. (Cl. 299—10)

The present invention relates to apparatus and method for controlling the path of a mining machine along a mine face, and more particularly to apparatus and method for steering and guiding mining machines, such as coal planers or plows, moved along a mine face so that the normal horizontal path of the mining machine may be changed to meet changing conditions in the bedding, utilizing cutting arm means on the mining machine for producing a preliminary slit in the mine face being worked of configuration tending to control the guidance desired.

In the extraction of mineral, such as coal, from thick and difficultly extractable mine seams, various mining machines have been used whereby to overcome the usual problems attendant the working of such thick seams. The seams and the resultant more or less horizontally extending mine faces in question are usually of extraordinary height. Therefore, not only do problems exist in the attaining of support for the mine roof to protect the workmen as the mining operation advances in step-like manner with each increment of extracted mineral from the particular mine face, but also the mining machines of contemporary design are more often than not inadequate for the intended purpose. Mining planers or plows are often used which are formed as three-part combination planers, with a pair of spaced apart base planers being articulatedly interconnected by a bridge-like upper planer. The three members normally contain cutting means thereon for engaging the mine face throughout the height thereof. Although the built-up structure provided permits the extraction of mineral to be undertaken over an extended height, as compared with planers of conventional design, the extended height thereof causes problems due to the operative instability of the arrangement, considering the force met by the planer when in extractive engagement with the mine face. An expedient in this regard is to provide the lower spaced apart base members with a keel or sword-like projection extending rearwardly from the particular planer member which may underlie the guide means for the composite planer. Usually, a mining conveyor of conventional design, which may have guide means at the side thereof adjacent the mine face, is situated on the mine floor for guiding the planer into engagement with the mine face. However, due to the extended height of a composite planer of the foregoing type, less support against tilting is possible from the conveyor guide means than in the case of the shorter height conventional planers utilized. Even where a keel is provided underlying the conveyor and attached to the planer, because of the excessive forces generated during planer operations, this expedient is not completely satisfactory. The use of a supporting keel has been provided even in the case of single component planers which extend upwardly beyond the normal height for attaining a greater degree of extractive engagement with the mine face, and in this case as well the keel support is not generally sufficient. The various prior art planer construction, whether in the form of a pair of base planer members interconnected by an upper member or in the form of a single component planer, with sub-elements being used to build

up the planer or plow in the form of new layers, stacked one upon the next, to attain greater heights than heretofore, have become more and more useful for the purposes in question, and the elements forming the separate built-up layers are preferably interchangeable and often carry hinged cutting plates so that the same can reach considerable heights for effective extraction of mineral, such as coal.

However, such built-up plows or planers are usually not built as high as the coal seam being worked, especially because of the instability of the planer and the excessive forces generated with increase in height, but instead such built-up planers are provided at their upper end portion with a boom or jib, or the like, displaceably mounted in a direction transverse the mine face. Such boom or jib generally extends at an angle with respect to the horizontal, i.e., mine floor, and is usually positioned obliquely to the mine face whereby to cut the upper coal in such a manner that a slope is formed in the coal bank to aid the trajectory of the falling mineral extracted thereat. Additionally, the mining planer or coal plow may be built so that its center of gravity lies outside of its normal longitudinal plane, i.e., outside its surface thereby producing a continual moment toward the mine face being worked. This continual moment or instable center of gravity construction permits the planer to oppose those forces which are met by the planer during extractive engagement with the mine face. The foregoing concept and specific constructons for attaining the same are disclosed in copending U.S. application Ser. No. 367,380, filed May 14, 1964, and now abandoned, as well as U.S. application Ser. No. 510,410, filed Nov. 29, 1965, and now Patent No. 3,310,346, which latter application is a continuation-in-part of said application Ser. No. 367,380.

Suitable arrangement of the cutting blades and tools, suitable choice of material for such cutting tools, and a number of such other measures have enhanced mining planer or mining plow technology to the point where the use of such measures has been possible to some extent to work those seams which have heretofore been considered unworkable or unplowable. The aforementioned modified planer or plow arrangements have to some extent been usable for working those seams which were in essence planable or plowable but indeed too thick, i.e., too great in seam height, for prior mining machines to be used effecitvely without the application of auxiliary cutting machines or manual extraction techniques. Actually, the harder or tougher the mineral, such as coal, becomes, the further removed is the planer or plow technology from the conventional manner of operation since practically every portion of mineral, e.g. coal, must be cut. This is true since none of the mineral, such as coal, falls by itself due to the very hardness and toughness of the mineral, whereas in the past in the usual instance the softer mineral would become dislodged and fall into the conveyor to some extent by itself.

Understandably, the aforementioned modified plows of greater effective operative height are very heavy in comparison with the supporting surface, i.e., mine floor, upon which the same are adapted to rest. Therefore, these heavier mining machines are correspondingly more difficult to steer or control to attain efficient extraction of mineral, considering the deviations from the normal horizontal of the particular mine seam which may be encountered, depending upon the condition of the bedding. Even the guide means normally utilized for the planer is insufficient to attain proper guidance of such heavy mining machine, and although such guide means may accommodate unevenness in the mine seam to some extent, excessive stresses are placed on the guiding parts which detract from their purposefulness. Measures

familiar until now for achieving proper steering and control of the extra-heavy mining machines contemplated, such as adjustment of the bottom cutting blade in order to follow more closely the uneven strata of the mine seam being worked, have proved to be of very little use considering the extremely heavy nature of the mining machines in question. Thus, using prevailing measures, the tendency under certain circumstances for the machine, such as a planer or plow, to climb upwardly from the mine floor or to cut into the foot wall or mine floor could not be prevented. Such tendency occurs, depending upon the forces met by the mining machine at the mine face and the propensity for the more or less unstable mining machine to tilt toward or away from the mine face with a concomitant deviation of the extraction operation from the desired path. Attempts to steer or guide such mining machines by appropriate angular formations on the guide means, for example disposed at the side of a mining conveyor adjacent a mine face, whereby to serve as a specific guide track for the machine, have proved on the one hand to be very expensive and on the other hand have led to the loading or stressing of the guide means and/or mining conveyor to such a degree that the arising disadvantages out-weighed the advantages produced by the steering or guiding control obtained with such measures.

The advancing technology of remote control systems has been explored in connection with the steering or guiding of mining machines, such as coal plows or planers, in an automatic manner or by remote control corresponding to the conditions of the mine seam being worked. However, any such method must act directly on the machine in question and produce the desired steering control with the highest possible speed, i.e., after the shortest possible travel of the planer or plow in order to be effective. A remote control steering of the guiding means, such as guide tracks, whereby to steer or control a planer or plow in dependence upon the angular position of the track, involves such a high expense that the obtaining of the automatic control sought is not justifiable on this basis.

From the very start of planer or plow technology, proposals have contemplaetd the use of a pre-cut slot or slit in the mine face such that the mineral bank, such as a coal bank, thereat would be unloaded or relieved of its support sufficiently to permit the extraction of the mineral therefrom in an easier manner. This slot was continually pre-cut in the coal bank in the usual coal-winning operation, by a plate-like cutting tool projecting toward the coal bank beyond the cutting plane of the main cutting tool. In this way, the unloading of the coal bank eased the main operation of removing the coal still to be extracted thereat.

It is also known to use cutting booms or jibs which are attached to the upper part of a mining machine, such as a coal plow or planer, with such boom or jib being preferably directed at an angle oblique to the hanging wall, i.e., the upper portion of the mine face, and extending outwardly beyond the mining machine transversely toward such mine face whereby to extract mineral from that portion thereof. Such cutting booms or jibs extract, in coal-winning operations, the upper coal in such a way that an inclined slope may be formed upon which the downward sliding of the extracted lumps of coal may take place so that such lumps will fall directly into the mining conveyor suitably disposed along the mine floor therebelow, but such booms have been limited to this purpose.

It is an object of the present invention to overcome the foregoing drawbacks and to provide an apparatus and method for controlling the path of a mining machine along a mine face, especially in connection with the winning of mineral, such as coal, from a seam of unusual height, far beyond that which can be operated with existing mining machines of conventional dimensions.

It is another object of the present invention to provide

an apparatus and method for steering and guiding mining machines, such as coal planers or plows, moved along a mine face so that the normal horizontal path of the mining machine may be changed to meet changing conditions in the bedding, utilizing cutting arm means on the mining machine for producing a preliminary slit in the mine face being worked of configuration tending to control the guidance desired.

It is still another object of the present invention to provide an apparatus and method of the foregoing type whereby at first a longitudinal slot is cut into the mine face in question at a point about mid-height of the mining machine being used, whereupon the angle of such slot in the rearward recess thereof is changed by changing the angle of cut of the cutting tool on such cutting arm means, such that the newly formed angular slot recess serves as a positive guide for such cutting arm means and, in turn, the planer or plow to which the same is attached to control in turn the new path of such planer or plow.

It is a further object of the present invention to provide a mining machine, such as a planer or plow, of extended height, as compared with mining machines of conventional design and dimensions, having a cutting arm extending transversely beyond the forward face thereof in a direction toward the mine face with an angularly adjustable cutting tool at the end thereof, such constructional elements being inexpensive to produce, durable and efficient in use, and controllable by means of a produced slot in the mine face to tilt the mining machine toward or away from the mine face in order to achieve changes in the direction of the path of movement of the mining machine to accommodate changes in the disposition of the mine seam, especially where occasioned by synclines in the bedding.

Other and further objects of the present invention will become apparent from a study of the within specification and accompanying drawings, in which:

FIGS. 1 to 3 are schematic views, partially in section, of three phases of the method of controlling the path of a mining machine in accordance with the present invention, utilizing a cutting arm means having an angularly adjustable cutting tool at the free end thereof to cut a slit or slot in a mine face which is determinative of the direction of movement of the mining machine;

FIG. 4 is an enlarged schematic view, partially in section, of the cutting tool portion of the construction shown in FIGS. 1 to 3, illustrating the manner in which the upper and lower surfaces thereof rub against the confining wall of the adjacent slot;

FIG. 5 is an enlarged schematic side view of a portion of a cutting tool in accordance with a modified embodiment of the invention in which a sliding wedge, or the like, upon displacement, changes the distance of spread of the outer cutting blades of the cutting tool shown;

FIG. 6 is a schematic side elevational view of a mining planer or plow of extended height containing a cutting arm projecting outwardly therefrom toward the mine face, with an angularly adjustable cutting tool being disposed on the free end of such arm whereby to provide a slit in the adjacent mine face in accordance with the present invention;

FIG. 7 is a schematic side view of a particular embodiment of a cutting arm having an angularly adjustable cutting tool thereon in accordance with the present invention, and

FIG. 8 is a schematic top view of the cutting arm and cutting tool embodiment shown in FIG. 7.

It has been found in accordance with the present invention that an apparatus arrangement and method may now be provided for controlling the steering or guidance of a mining machine, such as a mining planer or plow, along a mine face of extended height, especially as compared with the smaller dimensions of conventional mine faces and mining machines, whereby to extract mineral

throughout said extended height under specific control of a pre-cut guiding slot disposed in the mine face being worked. The method and apparatus arrangement of the present invention effect such guidance while avoiding the aforementioned disadvantages which occur with known equipment and arrangements.

Thus, first a slot or slit is produced in the mine face, such as a coal seam of extended height, by movement back and forth of the mining planer therealong and by increasing the length of the cutting arm which extends into the pre-formed slit. The latter may be achieved by mounting the cutting arm displaceably on the mining machine for incremental further projection therefrom into the slit being formed, or the mining machine itself may be progressively urged closer and closer toward the mine face as the cutting tool at the end of the cutting arm extends deeper and deeper into the slit. Generally, the mining machine may be forced to assume an oblique position with respect to the coal seam by the use of a cutting head, i.e., cutting tool equipped with cutting blades, wider than the cutting arm, and movably attached at the free end of the cutting arm or jib for swinging or rotation about a horizontal axis running parallel to the mine face or about the longitudinal axis of the cutting arm in that direction in which the mining planer and its bottom cutting blades must move for the purpose of accommodating changed conditions at different locations along the mine seam.

The purposes and effects of the present invention are attained, for example, by using a specific construction contemplating a cutting arm which is preferably situated on the mining planer at about mid-height of the seam in question, depending upon the particular dimensions of the seam and mining machine in question. Such cutting arm thence cuts a slit into the adjacent mine face to a depth which is preferably several times that obtainable with the main cutting blades of the planer or plow, the cutting arm having at its free end a wider dimensioned cutting head with appropriately dimensioned cutting blades or tools which can be swung about a horizontal axis running parallel to the coal bank or rotated about the longitudinal axis of the cutting arm. It is expedient to have the separation between the outer ends of the cutting blades on the cutting head, and which determines the width of the pre-cut slot, greater than the thickness of the cutting head itself and to have the thickness dimension of such cutting head greater than the thickness of such cutting arm to which such cutting head, and in turn such cutting blades or tools, is articulatedly and/or pivotally attached.

It will be appreciated that the deeper the pre-cutting tool on such cutting head penetrates into the mine face, e.g. coal bank, whereby to form a slit or slot of deeper recess, the greater will be the leverage with which the forces on the free end of the cutting arm, especially at the ends of the cutting tool, act to keep the mining machine in the position desired at a given moment. The efficiency of the present invention rests on the fact that the actual cutting blade carrier head can be swung about a horizontal axis on the cutting arm or jib and that such arm or jib is capable of being displaced transversely with respect to the mine face, either by actual displacement with respect to the mining machine or by displacement of the mining machine and in turn the arm or jib progressively toward the mine face. If, for example, the cutting bit or tool at the end of the arm or jib is swung downwardly about such horizontal axis, then the end of the arm will drift gradually downwardly during the back and forth movement thereof within the slit, such that the arm will assume an angular position, i.e., slightly sloping toward the footwall or mine floor. In this way, the entire mining planer or plow will be compelled to tilt toward the mine face, e.g., coal bank, and the increased effect of the weight component thereof on the coal bank thereby produced as well as the changed position of the cutting blades on the cutting arm, will produce a resultant tendency of the mining planer or plow to drift concomitantly toward the footwall or mine floor. This steering control is of advantage where it is desired to change the direction of the path of the mining machine downwardly.

If, on the other hand, the cutting head is swung upwardly, then the reverse tendency will occur and the mining machine will move upwardly and away from the footwall or mine floor whereby to tilt the machine back from the mine face. This effect takes place, astoundingly, immediately after starting the further cutting of the slit, once a small angular displacement of the swingable or pivotable cutting head has taken place.

Unequivocal drifting of the mining machine toward the footwall or toward the mine roof is noticeable even after one or at best only a few meters of travel of the mining machine in the longitudinal direction, utilizing the method and apparatus of the present invention. Advantageously, it is no longer necessary to extract laboriously and gradually win the remaining mineral along the mine floor, i.e., footwall, by repeated passage of the planer or plow in the back and forth manner previously utilized. Instead, by the guidance achieved with the slit in the mine face, with respect to the mining machine, unevenness or steep or semi-steep bedding conditions may be accommodated, as in the case of a syncline.

Referring to the drawing, FIG. 1 shows the normal relationship between an upright planer 1 having a forward face 2 adjacent the mine face 3 with the cutting arm 4 extending transversely toward the mine face and carrying the cutting head 5 pivotally mounted thereon. Cutting head 5 pivots about a longitudinal axis of pivot 6 which is in the instance shown parallel to the mine face, i.e., coal bank, as well as to the mine floor, i.e., footwall. In the position shown, by reason of the back and forth movement of planer 1 longitudinally along mine face 3, i.e., in the direction of axis 6, a slot or slit 7 is formed more or less extending in the horizontal direction.

In FIG. 2, a second phase of the operation intended is carried out, by swinging cutting head 5 downwardly toward the lower wall of slit 7 such that the cutting tools 8 may cut more or less downwardly rather than farther inwardly into mine face 3. The mere change in angular position of cutting head 5 with respect to cutting arm 4 causes the upward and outward tilting of planer 1 and forward face 2 thereof with respect to the relatively vertical longitudinal plane of mine face 3. Of course, the slit 7 up to this point is achieved by extending arm 3 farther and farther inwardly under the urging force of planer 1, and this may be accomplished either by further displacing arm 4 with respect to planer 1 or by displacing planer 1 and in turn arm 4 closer to mine face 3. Auxiliary urging means may be utilized to accomplish the foregoing, as for example where planer 1 is disposed for travel along a guide means, such as a guide track on a mining conveyor of the conventional type, with auxiliary piston-cylinder urging means being disposed at the remote side of the guide means from the mine face to urge the guide means and in turn the planer progressively toward the mine face.

Once the angular adjustment of cutting head 5 with respect to arm 4 has been made, then a recess 9 at the inner portion of slit 7 is formed during the farther movement of planer 1 in the desired direction. The change in configuration and angular disposition of recess 9 with respect to slit 7 longitudinally therebehind is seen in FIG. 3. It will be noted that as the planer moves along the mine face, such that the cutting tools 8 engage the adjacent portion of the slit 7, the recess 9 begins to form and immediately the angular disposition of planer 1 and in turn forward face 2 thereof changes. As recess 9 increases in length with further longitudinal movement of cutting head 5 in the desired direction, the angular disposition of arm 4 changes from an upwardly inclined angle with respect to the mine face to a downwardly direction and accordingly the forward face 2 of planer 1 changes from a back-

wardly tilting disposition of the mine face shown in FIG. 2 to a forwardly tilting disposition as shown in FIG. 3.

In connection with the construction shown more specifically in FIG. 4, the cutting head 5 is provided adjacent the connection with cutting arm 4 at pivot axis 6, i.e., along the upper and lower surfaces thereof, with thickening portions 10 and 11 made from material of increased wear resistance, whereby to offset the pronounced wear which would otherwise occur at the upper and lower walls of the slit 7 and/or the angular recess 9 caused by the change in angular disposition thereat. In this embodiment, an optional means for achieving the fixed disposition of cutting head 5 with respect to arm 4 is shown, a suitable pin 12 being insertable at an appropriate opening in arm 4 into locking engagement with one of several apertures 13 disposed along the periphery of the portion of cutting head 5 adjacent axis 6, apertures 13 being of shape and dimension suitable for lockingly receiving pin 12 therein.

In the modification shown in FIG. 5, the cutting head 5' is provided which contains the outwardly diverging blades 8' having an operative dimension greater than that of cutting head 5' which in turn has an operative dimension, i.e., thickness or width, greater than that of arm 4. The same is generally true in connection with the embodiment of cutting head of FIGS. 1 to 4, i.e., the cutting tools 8 in that embodiment are also of operative dimension greater than that of cutting head 5 which in turn has an operative dimension greater than that of arm 4.

The angular adjustment of cutting head 5' in the embodiment of FIG. 5 is achieved in a manner similar to that shown in the embodiment of FIG. 4, i.e., with pin 12 of arm 4 passing through arm 4 into appropriate locking engagement with a given aperture 13' disposed along the periphery of cutting head 5' near axis 6. In the case of the angular connection of the cutting head 5 or 5' to arm 4, it will be realized that a simple side-by-side swinging connection is provided using a pin as pivot axis 6. Alternatively, of course arm 4 may be provided as a forked arm carrying appropriate ears between which the particular end of the cutting head may be placed for articulate disposition thereat.

The modification of FIG. 5 provides advantageously for the change in operative width of the cutting blades 8' by reason of the lug means 15 displaceably positioned on the shank 14 attached to the base portion of head 5'. Such lug means is displaceable in the direction of arrow 16 and because of its irregular longitudinal dimension, the same will guidingly contact the medial edges of blades 8' to force such blades outwardly a greater or lesser extent. It will be appreciated by the artisan that similar means may be used for this purpose, such as any cam means, or the like (which exert a separating force between a pair of blades 8' normally disposed at a predetermined distance from one another, yet being displaceable outwardly from one another a given distance and preferably resiliently returnable to their predetermined distance upon release of the guiding contact or engagement with such cam means, lug, or the like.

In connection with the over-all arrangement shown in FIG. 6, a mining planer 17 of the conventional type, such as that shown in copending U.S. applications Ser. No. 367,380 and Ser. No. 510,410, is provided. Planer 17 contains a base 18 with a rearward configuration in the form of a groove 19 from which a keel or swordplate 20 extends rearwardly from mine face 3 for underlying a mining conveyor in the conventional way. Such conveyor or other guide means underneath which keel 20 is longitudinally displaced contains at its side adjacent mine face 3 a guide means having the configuration of a guide tube, or the like, upon which the groove 19 of base 18 may be mounted for achieving guided back and forth movement of planer 17 along mine floor 26 with cutting means 23 in operative engagement with mine face 3. The back and forth movement of planer or plow 17 may be achieved by a drive chain or cable attached at one end, for example in groove 21 of base 18, with the other end of such drive chain being attached in a similar groove (not shown) at the opposite longitudinal end of base 18. Such drive cable may be looped over appropriate drive drums or sprocket wheels, or similar drive means, disposed at the longitudinal ends of mine face 3 whereby to conduct planer 1 therealong via guide means therefor (not shown) with the cutting means 23 in extractive engagement with mine face 3. A conventional expedient in the art is the use of auxiliary urging means in the form of piston-cylinder urging means which act against the rearward side of the conveyor means or guide means used to force in turn the planer into the extractive engagement desired. Such auxiliary urging means are not shown but the artisan will appreciate the constructive arrangement thereof and the manner of using the same for the purposes of the invention.

In particular, in order to achieve an unusual height of planer 17, i.e., far above that normally contemplated by mining machines or planers or plows of conventional dimensions, planer 17 is composed of a number of superimposed stacked planer elements 22, whereby the common forward face 24 is defined by the front edges thereof together with the appropriate front edge of base 18, such that the cutting means 23 may be disposed on the forward vertical face 24 for engagement with mine face 3 thereat. Bottom cutting blades 25 are provided at the lower end of base 18 generally along a line determined by the mine floor 26, whereby to cut a preliminary slot thereat into mine face 3. These bottom cutting blades 25 serve normally to guide the base 18 and, in turn, the remainder of the planer along the mine floor to accommodate unevenness therein. However, as aforesaid, this expedient is insufficient for positive and more accurate guidance of planer 17 in the desired manner.

A further expedient utilized, and which is more fully covered in said copending U.S. applications Ser. No. 367,380 and Ser. No. 510,410, is the provision of a sloping boom or jib 30 carried in an angular sleeve 29 for longitudinal displacement with respect thereto. Set screw 31 or similar means are used to fixedly attach jib 30 with respect to angular sleeve 29 in any given position of axial displacement of said jib 30. At the outer free end of jib 30, cutting means 32 are provided and at the upper end of planer 17, an upwardly directed cutting tool 27 is provided. As between such cutting tools, the roof coal 28 adjacent the mine roof 33 is cut so as to achieve the extraction of mineral from the entire extraordinary height of the mine seam being worked. Cutting tool 27 prevents an undue jutting out of unremoved coal in mine face 3 to occur in the area between the uppermost cutting means 23 and the outwardly projecting cutting tools 32 on jib 30.

In accordance with the present invention, a planer or plow of the foregoing type, which is provided with as many planer elements 22 as are necessary to achieve an adjustable height for extracting mineral from a seam of comparable height, is able to be guided in a controlled longitudinal path along mine floor 26 for the more efficient removal of mineral, as in the case where a syncline condition is met in the bedding. While heretofore, deviations in the normal horizontal disposition of the mine floor have caused the planer to tilt rearwardly away from the mine face or undesirably forwardly toward the mine face, or where the planer has not followed the undulations of the mine floor in the desired manner for more efficient extraction of mineral especially along the mine floor, in accordance with the present invention the provision for the cutting arm 4 having the cutting head 5 thereon leads to the desired accurate and positive control of the path of the planer 17.

Specifically, cutting arm 4 is disposed on planer 17 by insertion between a pair of adjacent planer elements 22 which are provided with corresponding hollowed out portions 35, 36 to accommodate rearward portion 34 of arm 4 thereat. Preferably, arm 4 is displaceably received with-

in hollow portions 35, 36 and attached to the corresponding planer elements thereat by suitable means (not shown). However, such means may comprise pins extending through the appropriate receiving planer elements 22 and also through appropriate openings in portion 34 of arm 4. A control means 37 is provided at the rearward end of arm 4 to achieve remote control of the angular disposition of the cutting head 5 with respect to arm 4 about pivot 6. Such remote control means are not shown but are of conventional design, as the artisan will appreciate, the same being an alternative to the use of the means shown in FIGS. 4 and 5 to achieve such angular displacement. The arm 4 is progressively inserted as the slit 7 is made in mine face 3 by tools 8 on cutting head 5, and this is achieved by changing the pin connections between the appropriate openings in rearward portion 34 of arm 4 and the given planer elements having the hollow recesses 35, 36. An adjustable sleeve or pin connection may be utilized, if desired, at the forward face 24 of planer 17 to prevent rearward displacement of arm 4 with respect to such forward face 24 during the engagement of cutting tools 8 with mine face 3. While such adjustable connection means are not shown, their construction is conventional and the method of progressively attaching the same to the arm 4 at different axial points thereof, when the same is progressively displaced outwardly, is well known to the artisan. The actual operation for control of planer 17 along its desired longitudinal path is carried out as defined with greater particularity hereinbelow in connection with the function of the cutting arm and cutting head assembly shown in the embodiments of FIGS. 1 to 4 and 5.

Accordingly, where it becomes necessary in a certain long wall section of the mine face, such as where passing through a syncline, to have the rigidly connected bottom cutting blade 25 cut somewhat deeper than usual in order to expose the interface between the footwall, i.e., mine floor, and the mineral such as coal disposed therealong (see FIG. 6), then the cutting head 5 is swung slightly downwardly, either by hand or automatically, depending upon the mounting means used and the manner of fixing head 5 at any particular angular position with respect to arm 4, whereby to achieve, for example, the disposition shown in FIG. 2. This will cause the cutting means 23 on the front edges of the appropriate planer elements 22 to tilt into mine face 3, such that bottom cutting means 25 correspondingly tilts into the depression containing mineral thereat. The tilting of arm 4 which causes in turn the corresponding tilting of planer 17 in the desired direction is possible because the cutting head tools 8 provide a sufficiently wide slot 7, whereby a temporary slanting of arm 4 is possible. Once the continued longitudinal movement of planer 17 and arm 4 takes place, the downwardly directed cutting tool 8 starts the formation of the angular recess 9. The increased loading placed upon the lower surface of slot 7 by the downwardly directed tools 8, now tilted toward the mine floor, causes immediately and within a very short distance of longitudinal travel the formation of angular recess 9. This causes the shifting of arm 4 and in turn planer 17 from the position shown in FIG. 2 to the position shown in FIG. 3. As a consequence, the bottom cutting means 25 dig more deeply into the mine floor to follow the deformation thereat under the controlled guidance of the head 5 and arm 4 in such angular recess. At the same time, the cutting means 23 digs into the mine face 3 and achieves the more efficient extraction of coal thereat.

Alternatively, if instead of the downward swinging of cutting head 5 as shown in FIGS. 2 and 3, the opposite rotation is effected so that head 5 swings upwardly against the upper surface of slot 7, then at first planer 17 will swing toward mine face 3 and immediately upon the cutting of tool 8 into the upper surface of slot 7, whereby to form a corresponding upwardly directed angular recess thereat, planer 17 will be tilted upwardly and away from mine face 3. This will achieve the corresponding tilting of the bottom cutting means 25 so as to negotiate a rise in the mine floor rather than a depression, whereupon controlled guidance in the desired manner will be maintained and more efficient extraction of mineral will be achieved. Actually, under practical mining conditions, it has been shown that even small swinging movements of cutting head 5 suffice to produce considerable changes in the cutting depths and levels of the cutting means of planer 17, i.e., including not only cutting means 25 but also the main cutting means 23.

It will be realized that with increasing longitudinal movement of the angularly disposed cutting head 5, a more or less complete angular recess 9, whether downwardly directed as shown in FIG. 3 or correspondingly upwardly directed, will be carved into mine face 3 at the appropriate distance from the surface of the mine face adjacent the planer. The total length of the slot 7 actually remains the same, but a portion thereof as defined by recess 9 will be angularly disposed where it is desired to change the corresponding angular disposition of the planer being used. It will be realized that the weight components tending to tilt the planer toward the mine floor or toward the mine roof, depending upon whether cutting head 5 is swung downwardly or upwardly, will act more strongly on the cutting means 23 and 25, so that more efficient engagement thereof with mine face 3 takes place. While this is readily understandable by the gravity weight of the planer when tilted toward the mine floor, i.e., and also toward the mine face, the same is equally true where the planer is tilted away from the mine floor and mine face (see the disposition of planer 1 in FIG. 2, for example), since the lower portion of the planer will engage the mine face and cut increasingly farther thereinto under the guidance of the arm 4.

Accordingly, it is now possible to influence with great sensitivity the tendency of a planer to cut into or out of the footwall or mine floor by choice of the angular position of the cutting head 5 with respect to arm 4, and thus transmit to the planer the cutting tendency necessary at the particular location thereof in the bedding to enable a clean cut to be made at the interface between the mineral, such as coal, and the footwall.

It will be realized that while in the embodiment shown in FIG. 6, a pair of cooperating planer elements 22 is shown to have hollow portions 35, 36, alternatively, one such planer element may be provided with a central channel therethrough of conformation and dimension permitting the insertion of arm 4 thereat for displaceable mounting, for example by the use of pins, or the like, extending through the element and openings in the rearward portion 34 of arm 4.

With respect to the specific embodiment of FIGS. 7 and 8, the arm means is in the form of a pair of hollow tubes 4' mounted on a carrier plate 38 extending transversely and having guide abutments 39 displaceably situated thereon and having abutment surfaces 40 disposed for engaging corresponding abutment surfaces 41 disposed on steering abutments 42, which are in turn connected to the longitudinally disposed and transversely extending plate cutting head 5''. Plate cutting head 5'' is hingedly connected about a longitudinal axis 6' to the free end of carrier plate 38 which is provided with hinge ears 61 thereat for cooperative articulated connection to corresponding hinge ears 62 extending rearwardly from the forward means of head 5''. Plate cutting head 5'' contains stepped-back sub-plate portions 63 and 64 with suitable cutter bits 8'' being provided along the forward transverse edge of head 5'' for the desired operative engagement of the head with the slit being formed in the mine face. An auxiliary pivotal cutter 66 also having cutter bits 8'' thereon is disposed in a central slot 65, preferably of V-shaped cross-section defined in the transverse forward face of head 5'' and mounted thereat for pivoting about vertical axis 67 normal to axis 6'. Because of the con-

fining shape of the outwardly diverging slot 65, auxiliary pivotal cutter 66 is only able to execute limited pivotal displacement such as, for example, through an amplitude of about 4° (see FIG. 8). On the other hand, the pivotal displacement of head 5'' about the longitudinal axis 6' is such that about a 34° swing is possible to attain an angular displacement of head 5'' with respect to the hollow tubes 4' and carrier plate 38 sufficient to score an angular recess, of the type shown in FIG. 3, for example, in the adjacent wall of the slit in which the head 5'' is disposed.

The actual control of the pivotal displacement of head 5'' with respect to carrier plate 38 is made possible because of a particular control mechanism utilized, many of the parts of which are not specifically shown in the drawing but whose configuration and nature will be clear from the following explanations, as the artisan will appreciate.

The spindles 56 and 57 extend respectively through the appropriate hollow tubes 4' and at their forward end portions contain thread means (not shown) having cam means (not shown) such as in the form of a surrounding sleeve operatively engaging the thread means by reason of appropriate cam followers extended into engagement with the thread means. In this manner, axial displacement of the cam means will take place upon rotation of the appropriate spindle by reason of the gear mechanism 47, 49 and 50 operated by suitable drive means attached to extension 48. The drive means may comprise a hand-crank or automatic drive means to rotate central spindle 58 which is mounted at the rear end of carrier plate 38, so that suitably directed motion may be imparted via gears 47, 49 and 50 to spindles 56 and 57 and in turn the thread means portion thereof adjacent the axis 6'. Tubes 4' are provided with tracks 53 having transverse elongated apertures 52 therein, and guide abutments 39 (one of which is omitted in FIG. 8 to show details of construction) are similarly provided with transverse elongated apertures 55 superimposed over apertures 52 so that a corresponding projection 54 extending from the appropriate cam means at the thread means of the spindles 56 and 57, may be guided within the appropriate apertures 52 and 55. Thus, upon rotation of spindles 56 and 57, the cam means axially displaced with respect to the thread means (not shown) will cause in turn displacement of projections 54 and thus axial displacement of guide abutments 39 riding on tracks 53. Sufficient end contact between projections 54 and the appropriate end portion of apertures 55 will cause the desired axial movement of guide abutments 39 and, in turn, appropriate contact between surfaces 40 and 41. Upon displacement of guide abutments 39 (shown on the upper side of carrier plate 38), steering abutments 42 mounted on head 5'' will cause rotation of head 5'' about longitudinal axis 6', and in this connection corresponding rearward displacement of steering abutments 46 on the underside of head 5'' by contact between the adjacent abutment surfaces 45 and 44 will cause rearward axial displacement of guide abutments 43 disposed on the underside of tubes 4'. The described movement of projections 54 in the forward direction to cause outward displacement of guide abutments 39 produces a downward swinging of head 5''.

On the other hand, where it is desired to swing head 5'' upwardly about the axis 6', then the opposite manipulation must be undertaken with reversal of the rotation of spindles 56 and 57. Steering abutments 46, abutment surfaces 45 and 44, and guide abutments 43 operate in the same manner as steering abutments 42, abutment surfaces 40 and 41 and guide abutments 39, these parts being substantially of the same shape and configuration to permit ease in replacing and/or substituting such parts for one another. Also, since the parts in question are more or less the same on the upper surface and under surface of carrier plate 38 and head 5'', the disposition of the cutting arm means and cutting head means may be reversed so that either side may be considered the upper side and underside.

The desired angular displacement of head 5'' about axis 6' will be attained in each instance since guide abutments 39 and 43 operate in the same way to urge against steering abutments 46 and 42, as the case may be. In this regard, the sleeve or other cam means in engagement with the thread means at the forward ends of spindles 56 and 57 contain similar projections 54 downwardly directed so as to extend through corresponding apertures in suitable tracks for guide abutments 43. However, it will be realized that the displacement of the particular projections 54 on the underside of carrier plate 38 will be in the opposite direction to the displacement of the guide abutments 39, as the artisan will appreciate. This is carried out by the suitable gear arrangement 47, 49 and 50 used, corresponding configuration of the thread means on the forward ends of the spindles 56 and 57, and corresponding mounting relationship between such thread means at the appropriate portion of the cam means on the upperside and underside of such thread means, whereby to permit suitable axial displacement of the projections which extend through the appropriate elongated apertures at the upper and underside of hollow tubes 4'. In order to provide for reinforced guidance of head 5'' with respect to carrier plate 38, the end walls 51 are provided which are operatively engaged by the axis 6' in the form of a pivot pin in the embodiment shown. Extending through the rearward portion of carrier plate 38 are the mounting openings 60 which may receive therethrough suitable bolts for fixedly attaching carrier plate 38 to the guide means in question, such as a planer element 22 of the type shown in FIG. 6. The bolt means (not shown) may be removably attached to permit axial displacement of hollow tubes 4' and carrier plate 38 by merely placing the appropriate bolts in a different axially disposed opening 60. Of course, other means may be utilized to displaceably mount carrier plate 38 on the planer in question, as the artisan will appreciate, and it is not believed that specific depiction thereof is necessary herein.

It will be realized that while manual adjustment of the angular disposition of the particular cutting head with respect to the cutting arm means may take place, for example in connection with the construction shown in FIGS. 4 and 5, and that while remote mechanical control of the angular disposition of the cutting head with respect to the cutting arm means may take place as shown in FIGS. 7 and 8, for example, any other suitable cutting means may be employed for this purpose so long as the change from the plane of the axis of the cutting arm means which the cutting head undergoes is a fixed change, i.e., with the head being fixed at the angular position.

Remote control automation devices may be used as well to determine any angular displacement of the cutting head with respect to the arm means, and while such means are not shown, their nature and purpose are believed to be clear to the artisan. Radio impulses or other actuating impulses may be utilized in accordance with the invention, for example to control servo-motors, and the like, which actually cause the angular displacement of the cutting head. For the most part, however, manual adjustment by hand crank at part 37 (see FIG. 6) or part 48 (see FIGS. 7 and 8) may be used, as this will be completely sufficient for the purposes and reduce to a minimum the trouble and expense involved. In the case of the embodiment of FIGS. 7 and 8, for example, suitable cranking of part 48 will cause the spindles 56 and 57 to be oppositely rotated, whereby the desired displacement of head 5'' upwardly or downwardly will take place depending on the direction of rotation of spindle 58.

Advantageously, in accordance with the present invention, the cutting head is designed with blades which may be spread apart by means of a sliding wedge or rotatable eccentric member in order to determine the width of the pre-cut slot to guide the planer. Also, the upper and

lower external surfaces of the cutting head adjacent the pivotal connection thereof to the arm means are formed of material having increased wear resistance to guard against premature wear. Considering that the upper and lower external surfaces of the cutting head are generally convexedly formed in the area of the pivot connection, this increased wear resistance is supplemented by the very nature of the configuration of the parts used.

In accordance with a preferred embodiment of the invention, the longest extended length of the cutting arm is dimensioned about three times longer than the corresponding dimension of the cutting head. Also, the length of the cutting head itself is preferably three times that of the largest width of separation of the cutting blades which determine the width of the pre-cut slot to be made in the mine face. On the other hand, the operative width or cross-section of the head is less than that of the outward spread of the cutting tools thereon and the operative width or cross-section of the arm in turn is less than that of said head.

In accordance with an alternative embodiment of the present invention, the head may be formed with nozzles rather than cutting blades or tools thereon, whereby sharply delimited high pressure water jets may issue from such nozzles in the direction of the mine face. The use of water jets from such nozzles will serve to accomplish an erosion of material from the slot being formed and at the same time prevent the troublesome development of dust. This alternative may find particular application in mine faces composed of material lending itself to hydraulic pressure rather than scoring by mechanical cutting with the use of tools. While the water jet nozzle embodiment is not shown in the drawings, the same would be provided by simple modification, for example, of the embodiment shown in FIGS. 7 and 8 whereby the cutting tool 8'' would be replaced by nozzles thereat and suitable conduits provided in head 5'' and carrier plate 38 to convey the hydraulic pressure. The actual flow lines for conveying such pressure and their arrangement between hingedly connected parts would be well known to the artisan in any case.

In accordance with a particular practical embodiment of the invention, the cutting head is provided in the form of a rudder-like swingable plate having pre-cutting blades or bits or cutting tools thereon, with a V-shaped space in the central outwardly directed portion thereof for containing an auxiliary pivotal cutter blade mounted for limited pivoting about an axis perpendicular to the axis of the hinged connection between the cutting head and the cutting arm assembly. Advantageously, with the use of the hollow tube embodiment of the arm means and cutting means shown in FIGS. 7 and 8, the mounting of the arm may be reversed so that either side may be the upper side or the lower side.

By the use of hydraulic and/or mechanical and/or remote control equipment (not shown), the head may be angularly adjusted with respect to the arm, advantageously, by automatic control as a function of changes in the elevation or disposition at the interface between the mineral to be extracted, such as coal, and the footwall therebelow. A transducer, for instance, may be used in connection with the automatic control and/or a hydraulically driven regulator. The adjusting equipment is advantageously operable by way of a servo mechanism capable of remote control, as the artisan will appreciate.

Thus, a planer arangement may now be provided having a series of separate planer elements stacked one above the next by simple and rapid fastener means and with a passage transversely therethrough to accommodate the insertion of the cutting arm means of the invention. The cutting arm means of the invention is preferably situated at about a level halfway up the mine seam in question and extendable approximately parallel to the footwall being worked. The planer additonally may have bottom cutting tools to assist in the change of direction

of the planer as well as obliquely extending roof cutting tools, such as those shown in the embodiment of FIG. 6, whereby over-all more efficient mineral extraction will be attained.

Advantageously, therefore, in accordance with the present invention, a mining planer adapted to be moved longitudinally back and forth along a mine face for the extraction of mineral therefrom may now be provided including upright base means having a base forward face carrying base cutting means extending outwardly therefrom for extractively engaging the adjacent portion of such mine face, and a transversely situated preliminary cutter arm means mounted at one end thereof on said base means with the other end of said arm means extending outwardly beyond said base forward face and said base cutting means toward the adjacent mine face and carying on said other end an angularly adjustable cutting tool mounted for limited angular fixed position adjustment about a pivot point on said other end, whereby upon said back and forth movement of such planer said cutting tool will engage the mine face to excavate a slit therein having a direction corresponding to the longitudinal movement of said planer and a configuration corresponding to the angle of fixed position adjustment of said cutting tool.

The cutting tool is generally mounted for displacement about a longitudinal axis substantially parallel to said base forward face and substantially normal to the medium transverse vertical plane of said base means, and said cutting arm means is transversely axially displaceably mounted on said base means.

The cutting means may include, in accordance with a specific preferred embodiment, a pair of parallel arms interconnected to form a first hinge member and the cutting tool may include a longitudinally extending cutting plate forming a second hinge member, said first and second hinge members being hingedly interconnected about the axis of said pivot point to provide said limited angular fixed position adjustment of said cutting plate, said cutting plate having cutter bits thereon at the end portion thereof remote from the hinged interconnection of said members and extending in a direction toward the adjacent mine face, and said first hinge member having attachment means thereon at the end portion thereof remote from said hinged interconnection for displaceably mounting said first hinge member on said base means.

In this embodiment the cutting plate may be provided with an outwardly diverging slot on the end portion thereof remote from the hinged interconnection and auxiliary pivotal cutter limitedly pivotally disposed in the slot and mounted on the cutting plate about a vertical axis of limited auxiliary pivot normal to the axis of the pivot point of the hinged interconnection. Specifically, the parallel arms in such embodiment may be in the form of hollow tubes each containing a spindle member rotatably positioned therewithin, such spindle members being provided with drive means for rotation thereof, each said spindle member having a threaded portion defined thereon at the end thereof adjacent said hinged interconnection, cam means operatively engaging said threaded portion for resultant axial displacement within the corresponding tube, each said tube having axially elongated aperture means defined therein through which corresponding projections provided on the appropriate cam means protrude, axially displaceable guide means mounted on said tubes and operatively engaged by said projections, and abutment means on said cutting plate positioned for operative abutment with said guide means for changing the angle of disposition of said cutting plate with respect to said hollow tubes about said hinged interconnection, in dependence upon the rotatable disposition of the spindle members and in turn the axial disposition of said cam means and guide means.

Most advantageously, the present invention contemplates a method for controlled guidance of a mining

planer having a forward upright face carrying forward planer cutting means thereon for longitudinal back and forth movement of such planer along an adjacent mine face for operative engagement of said planer cutting means with said mine face for extraction of mineral therefrom, and having a preliminary cutting arm, at a level substantially intermediate the height of said planer and extending transversely outwardly therefrom in a direction toward the mine face, and carrying an angularly adjustable cutting tool at the outward end thereof adjacent the mine face, which comprises moving said planer longitudinally back and forth with said cutting tool disposed along the axis of said arm and in engagement with the mine face until a preliminary slit of predetermined length and transverse depth is scored relatively horizontally in said mine face, changing the angular position of said cutting tool with respect to the axis of the arm, continuing the longitudinal movement of said planer to score an angular recess with respect to the relative horizontal disposition of said slit at the inner portion of said slit, further moving said planer with said cutting tool guided in said angular recess, whereby said arm and planer are in turn guided correspondingly at a changed angle with respect to the mine face and transverse axis of said slit, respectively, and carrying out further extraction of mineral from said mine face with said forward planer cutting means in engagement with the mine face during further back and forth movement thereof at said changed angle with respect to the mine face in dependence upon the angular change of position assumed by said planer in consequence of the disposition of said angular recess with respect to the relative horizontal slit and the guidance provided for said planer by said arm and cutting tool operatively confined within said slit and recess respectively.

It will be appreciated that the instant specification and drawings are set forth by way of illustration and not limitation, and that various modifications and changes may be made without departing from the spirit and scope of the present invention which is to be limited only by the scope of the appended claims.

What is claimed is:

1. Mining planer adapted to be moved longitudinally back and forth along a mine face for the extraction of mineral therefrom including upright base means having a base forward face carrying base cutting means extending outwardly therefrom for extractively engaging the adjacent portion of such mine face, and a transversely situated preliminary cutter arm means mounted at one end thereof on said base means with the other end of said arm means extending outwardly beyond said base forward face and said base cutting means toward the adjacent mine face and carrying on said other end an angularly adjustable cutting tool mounted for limited angular fixed position adjustment about a pivot point on said other end, whereby upon said back and forth movement of such planer said cutting tool will engage the mine face to excavate a slit therein having a direction corresponding to the longitudinal movement of said planer and a configuration corresponding to the angle of fixed position adjustment of said cutting tool.

2. Planer according to claim 1 wherein said cutting tool is mounted for displacement about a longitudinal axis substantially parallel to said base forward face and substantially normal to the median transverse vertical plane of said base means, and said cutting arm means is transversely axially displaceably mounted on said base means.

3. Planer according to claim 2 wherein said cutting arm means is mounted on said base means at about mid-height thereof and has an operative length transversely toward the mine face corresponding to at least thrice the corresponding operative length of the base cutting means extending from said base forward face, and wherein the operative dimension of said cutting tool is wider than that of said cutting arm means.

4. Planer according to claim 2 wherein said cutting tool is provided with wear-reinforcement side portions adjacent said pivot point to offset pronounced wear thereat in any fixed angular adjustment position of said cutting tool.

5. Planer according to claim 2 wherein said cutting tool is provided with a pair of outwardly diverging blades having a normal spaced apart relation to one another, and a displaceable lug means is provided in operative guiding contact therebetween to change the spaced apart relation of said blades and in turn the magnitude of mine face extractive engagement thereof.

6. Planer according to claim 2 wherein said cutting arm means includes a pair of parallel arms interconnected to form a first hinge member and said cutting tool includes a longitudinally extending cutting plate forming a second hinge member, said first and second hinge members being hingedly interconnected about the axis of said pivot point to provide said limited angular fixed position adjustment of said cutting plate, said cutting plate having cutter bits thereon at the end portion thereof remote from the hinged interconnection of said members and extending in a direction toward the adjacent mine face, and said first hinge member having attachment means thereon at the end portion thereof remote from said hinged interconnection for displaceably mounting said first hinge member on said base means.

7. Planer according to claim 6 wherein said cutting plate is provided on said end portion thereof remote from said hinged interconnection with an outwardly diverging slot and an auxiliary pivotal cutter is limitedly pivotedly disposed in said slot and mounted on said cutting plate about a vertical axis of auxiliary limited pivot normal to said axis of the pivot point of said hinged interconnection.

8. Planer according to claim 7 wherein said cutting plate is formed in stepped-back sub-plate portion disposition with respect to said end portion thereof remote from said hinged interconnection, each said sub-plate portion carrying cutter bits thereon in corresponding stepped-back disposition.

9. Planer according to claim 7 wherein said parallel arms are in the form of hollow tubes each containing a spindle member rotatably positioned therewithin, such spindle members being provided with drive means for rotation thereof, each said spindle member having a threaded portion defined thereon at the end thereof adjacent said hinged interconnection, cam means operatively engaging said threaded portion for resultant axial displacement within the corresponding tube, each said tube having axially elongated aperture means defined therein through which corresponding projections provided on the appropriate cam means protrude, axially displaceable guide means mounted on said tubes and operatively engaged by said projections, and abutment means on said cutting plate positioned for operative abutment with said guide means for changing the angle of disposition of said cutting plate with respect to said hollow tubes about said hinged interconnection, in dependence upon the rotatable disposition of the spindle members and in turn the axial disposition of said cam means and guide means.

10. Method for controlled guidance of a mining planer having a forward upright face carrying forward planer cutting means thereon for longitudinal back and forth movement of such planer along an adjacent mine face for operative engagement of said planer cutting means with said mine face for extraction of mineral therefrom, which comprises providing on said planer at a level substantially intermediate the height of said planer, and extending transversely outwardly therefrom in a direction toward said mine face, a preliminary cutting arm having an angularly adjustable cutting tool at the outward end thereof adjacent the mine face, moving said planer back

and forth with said cutting tool disposed along the axis of said arm and in engagement with the mine face until a preliminary slit of predetermined length and transverse depth is scored relatively horizontally in said mine face, changing the angular position of said cutting tool with respect to the axis of said arm and continuing such back and forth movement to score an angular guidance recess with respect to the relative horizontal disposition of said slit at the inner portion of said slit, whereby said arm and planer are in turn guided correspondingly at a changed angle with respect to the mine face and transverse axis of said slit, respectively, and carrying out further extraction of mineral from said mine face with said forward planer cutting means in engagement with the mine face during further back and forth movement thereof at said changed angle with respect to the mine face in dependence upon the angular change of position assumed by said planer in consequence of the disposition of said angular recess with respect to the relative horizontal slit and the guidance provided for said planer by said arm and cutting tool operatively confined within said slit and recess respectively.

11. Method for controlled guidance of a mining planer having a forward upright face carrying forward planer cutting means thereon for longitudinal back and forth movement of such planer along an adjacent mine face for operative engagement of said planer cutting means with said mine face for extraction of mineral therefrom, and having a preliminary cutting arm, at a level substantially intermediate the height of said planer and extending transversely outwardly therefrom in a direction toward the mine face, and carrying an angularly adjustable cutting tool at the outward end thereof adjacent the mine face, which comprises moving said planer longitudinally back

and forth with said cutting tool disposed along the axis of said arm and in engagement with the mine face until a preliminary slit of predetermined length and transverse depth is scored relatively horizontally in said mine face, changing the angular position of said cutting tool with respect to the axis of said arm, continuing the longitudinal movement of said planer to score an angular recess with respect to the relative horizontal disposition of said slit at the inner portion of said slit, further moving said planer with said cutting tool guided in said angular recess, whereby said arm and planer are in turn guided correspondingly at a changed angle with respect to the mine face and transverse axis of said slit, respectively, and carrying out further extraction of mineral from said mine face with said forward planer cutting means in engagement with the mine face during further back and forth movement thereof at said changed angle with respect to the mine face in dependence upon the angular change of position assumed by said planer in consequence of the disposition of said angular recess with respect to the relative horizontal slit and the guidance provided for said planer by said arm and cutting tool operatively confined within said slit and recess respectively.

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