Oct. 6, 1964 H. HERRMANN 3,151,912

IMPACT PLANER DEVICE FOR EXTRACTION OF MINERAL MATERIAL

Filed Jan. 9, 1962

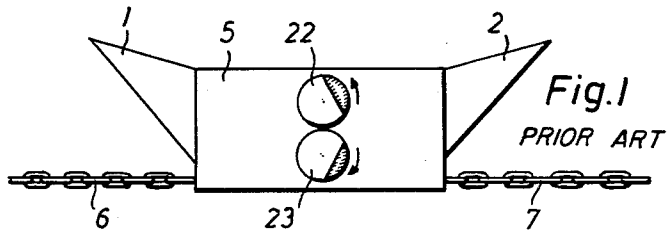


Fig.1
PRIOR ART

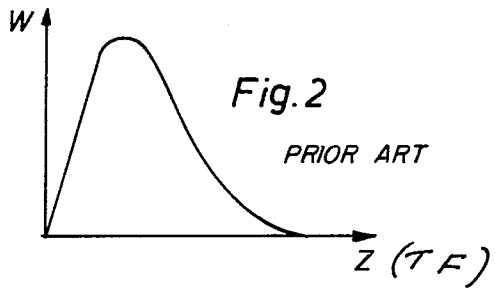
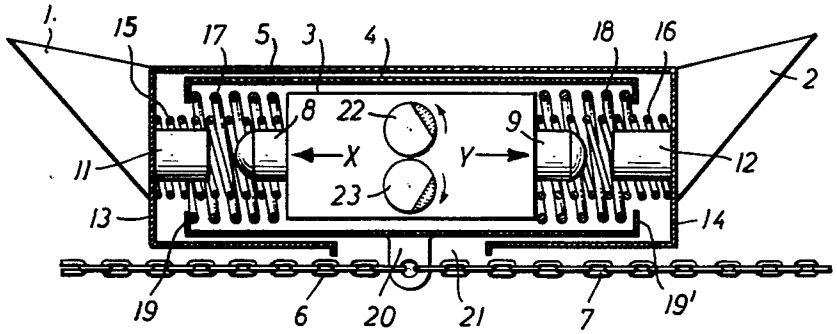


Fig.2
PRIOR ART

Fig.3



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United States Patent Office 3,151,912 Patented Oct. 6, 1964

3,151,912

IMPACT PLANER DEVICE FOR EXTRACTION OF MINERAL MATERIAL

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Filed Jan. 9, 1962, Ser. No. 165,117
Claims priority, application Germany Jan. 14, 1961
9 Claims. (Cl. 299—34)

The present invention relates to improvements in a planer device for extraction of mineral material, and more particularly to such a device used for the extraction of coal from a mine face under the influence of linear oscillations coupled with the beneficial positive pulling force of a pulling means conveying the planer longitudinally along the mine face being worked.

Devices of this general type are known wherein a pair of imbalances are provided in a housing for rotation in opposite directions in order to impart oscillations to the planer to which the imbalance housing is attached for the purpose of providing the cutters of the planer with a straight-line oscillatory movement in the direction of operation of the planer with respect to the mine face. Generally, cutters are provided at both longitudinal ends of the planer device with the oscillating means disposed therewithin so that the chipping of coal, for example, from a mine face may be carried out in both longitudinal directions, as the case may be. Depending upon the direction of operation as influenced by the pulling or traction means, the planer will be pulled in a particular longitudinal direction along the mine face, such pulling usually being carried out by means of a chain or cable connected to the planer and extending in either direction therefrom along the mine face to the conventional drive means.

Specifically, the traction or pulling means, such as a cable, may pull the planer in a forward longitudinal direction so that the cutters thereon at the corresponding end will operate against the mine face adjacent thereto under a specific force occasioned by the pull of the cable. This pulling force of the cable stands in a certain relationship to the kinetic energy or impact energy which is imparted to the coal face per oscillation of the planer as a result of the oscillating imbalances. Prior techniques have indicated that the most favorable value for the kinetic energy or impact energy of the oscillations of the cutters onto the mine face is attained with less than the maximum tractive force or pull of the cable. Specifically, the most favorable pulling force which should be exerted through the planer upon the cutters during the oscillation of the cutters is located within the range in which the tractive or pulling force amounts to about 30% of the power stroke or force-amplitude of the oscillation imparting means in either direction.

Nevertheless, in practice, as will be realized where the planer is being conducted by the cable uphill or where the planer is stuck or wedged between the guiding frame therefor, and the coal face, substantially greater traction or pulling forces become necessary. These additional sources of resistance may occur and disappear suddenly, with the consequence that the pulling or tractive force may demand such high values that the kinetic energy of the oscillations produced in the planer is no longer available at the coal face for positively causing the chipping away of mineral. In this regard, since the pulling force of the cable is so great, the oscillation forces are completely overcome and cannot perform their effective work.

A further disadvantage of known planer constructions is that the cutters thereon may swing back and forth during the oscillations imparted thereto and consequently fail to continuously abut against the working face. As a result, a cushion of fine coal forms at the edges of the

cutters, whereby such fine coal must be cut through in each working stroke of the cutters before the tips of the cutters are exposed for engaging additional mineral in the mine face. By reason of this situation, a comparatively large portion of the kinetic energy of the oscillations is diverted from the prime purpose and needless energy is consumed rendering the over-all operation less efficient.

It is an object of the present invention to overcome the foregoing drawbacks and to provide an improved planer having linearly oscillating impact imparting means and cutting means, whereby intermediate stop means resiliently interconnect the pulling means or traction means within the impact imparting means, the intermediate stop means having a stop portion preventing excessive pulling forces from being transmitted to the cutters through the impact imparting means, yet permitting these excessive forces to be transmitted directly upon the cutters.

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

FIG. 1 represents a conventional planer device guided longitudinally along a mine face by means of pulling or traction members, the planer device having cutting means at either longitudinal end as well as oscillation imparting means therewithin.

FIG. 2 represents a graph of the kinetic energy available at the cutting means against the mine face in relation to the traction force or pulling force of the pulling means guiding the planer along its path, and

FIG. 3 represents an embodiment in accordance with the invention illustrating schematically the particular positioning of linearly oscillating impact imparting means separate from the cutting means by reason of resilient connections and an intermediate stop means directly connected to the pulling or traction member.

It has been found in accordance with the present invention that a particularly effective improvement may be provided in a planer having linearly oscillating impact imparting means and cutting means adapted to be moved by a pulling means along a mine face for engagement of the mine face by the cutting means under the force of the pulling means and extraction of material by operation of the force of the impact imparting means on the cutting means and against the mine face. The invention broadly comprises intermediate stop means resiliently interconnecting the pulling means with the impact imparting means by spring means, the impact imparting means being normally spaced from and resiliently connected with said cutting means. The intermediate stop means, impact imparting means and cutting means are displaceably arranged with respect to one another in the direction of linear oscillation of the impact imparting means, i.e. in the longitudinal direction of movement of the planer parallel to the mine face being worked, and the intermediate stop means is provided with a stop portion normally extending between the impact imparting means and cutting means for direct abutment with the cutting means upon maximum displacement of the intermediate stop means, and in turn the impact imparting means toward the cutting means under the force of the pulling means. Accordingly, the impact imparting means may impart oscillation force directly onto the cutting means while the pulling means may exert force only resiliently onto the impact imparting means through the intermediate stop means and the spring means, yet directly upon the cutting means by the direct abutment of said stop portion of the intermediate stop means with the cutting means.

Suitably, upon the maximum displacement of the intermediate stop means, the impact imparting means directly abuts the cutting means both under the resiliently applied force of the pulling means, exerted thereon through the

intermediate stop means resiliently interconnecting the pulling means within the oscillation imparting means by said spring means, and under the directly applied oscillation force of the impact imparting means itself.

In accordance with a preferred embodiment of the invention, the planer includes an outer tubular member having an end wall at each end thereof, each end wall having a cutting means outwardly extending therefrom and an impact base inwardly extending therefrom. The intermediate stop means includes an inner tubular member displaceably received within the outer tubular member, the inner tubular member having a stop rim at each end thereof spaced from and positioned for abutment with the corresponding outer tubular member end wall with the corresponding impact base received therewithin. The oscillation imparting means in this connection specifically includes an elongated oscillating member having an impact head at each end thereof spaced from and in longitudinal alignment with the corresponding opposing impact base, yet within the inner tubular member.

Advantageously, the outer tubular member is provided with a central longitudinally extending aperture and the inner tubular member is centrally provided with a transversely directed outward shoulder extending through said aperture for attachment with the pulling means or traction means, e.g. cable. The distance between each impact head and corresponding impact base is substantially equal to the distance between each stop rim and corresponding outer tubular member end wall, the longitudinal distance of the central aperture being at least slightly greater than the combined distances between the stop rims and the corresponding outer tubular member end walls.

In order to drive the planer cutting means in the desired manner against the coal face, for example, the oscillating member may include a pair of oppositely rotating imbalance members operatively positioned for imparting linear oscillations in the longitudinal direction of the planer. The imbalances may be arranged in the longitudinal center of the elongated oscillating member with their axes in a plane transverse to the longitudial direction whereby upon rotation of the first imbalance member clockwise and the second imbalance member counterclockwise or vice versa oscillating force is imparted in a longitudinal back and forth direction. The resilient coil springs provided in accordance with the invention permit the oscillator to be maintained in the state of dynamic rest when in operation and in the state of rest in the longitudinal center of the planer when the oscillator is at rest. The oscillating movements of the oscillator are thus resiliently cushioned against both the planer and the intermediate stop means which is connected to the flexible traction member or pulling member, e.g. cable means. Of course, the spring force provided between the oscillator and the intermediate stop means must be greater than the spring force between the oscillator and the planer itself.

The oscillator may be any oscillator of known construction, such as one having a pair of imbalance members rotating in opposite directions coupled via a transmission linkage with a drive means such as a compressed air motor, or any other type of oscillator such as a piston-impact motor powered by compressed air.

Referring to the drawing, FIG. 1 shows the conventional type of planer device 5 having the cutter 1 on one longitudinal end and the cutter 2 on the other longitudinal end thereof with the pair of rotating imbalance members 22, 23 disposed at the longitudinal center of the device. The planer 5 is drawn under the pulling force of the pulling means or traction means 6 in one direction and by the pulling means or traction means 7 in the other direction. Thus, the pulling means, schematically shown as a chain, will force the corresponding cutter into engagement with the mine face so that the imbalance members which cause the planer to oscillate will permit the particular cutting means to chip away coal or other mineral from the mine face in the desired manner.

FIG. 2 represents a graph of the kinetic energy of the cutting means against the mine face in relation to the traction force or pulling force of the pulling means or traction means. It will be seen that a maximum peak is achieved at a comparatively lower range of the traction force available. It is within the range of this maximum kinetic energy that the device of the invention operates so as to achieve a most efficient production of coal without regard to the adverse influence formerly exerted upon the cutting operation by excessive pulling or traction forces of the cable.

In FIG. 3, a planer device in accordance with the invention is shown schematically including an outer tubular member 5 having the cutting means 1 at one longitudinal end thereof and the cutting means 2 at the other longitudinal end. An inner tubular member 4 is provided coaxially within outer member 5 while the oscillator 3 is disposed coaxially within inner member 4. At the side opposite the coal face, outer member 5 is provided with a central aperture 21 of adequate length through which the shoulder 20 centrally attached to inner member 4 extends for attachment with pulling chain 6 and pulling chain 7. Oscillator 3 is provided with the impact heads 8, 9 at each end, respectively, spaced from corresponding impact bases 11 and 12 inwardly directed from the side walls 13 and 14 of outer member 5. Intermediate stop member 4 is provided at each end with a stop rim 19 and 19' respectively, for abutment with the corresponding end wall 13, 14, upon maximum displacement of inner member 4 with respect to outer member 5. Large diameter coil springs 17, 18 are situated between the inner side of stop rims 19, 19' and the outer sides of oscillator 3 for maintaining a resilient connection between the pulling chain 6, 7 and oscillator 3 by reason of the intermediate stop means 4 and said springs. On the other hand, smaller diameter springs 15, 16 are provided coaxially within larger diameter springs 17, 18, respectively, for engaging the outer sides of oscillator 3 and the inner sides of end walls 13, 14, as the case may be. Suitably, springs 15 and 16 are disposed over the corresponding impact head of oscillator 3 and impact base of outer member 5.

By reason of the maintenance of springs 17 and 18 of equal force and the maintenance of springs 15 and 16 of equal force, oscillator 3 is maintained in the longitudinal center of outer member 5 while inner member 4 is maintained in said longitudinal center as well whereby the device is normally placed in equilibrium with a common center of gravity coinciding with the longitudinal center. Imbalance members 22 and 23 are situated in a plane passing through the longitudinal center and rotate in opposite directions as noted by the arrows. Upon the rotation of imbalance members 22 and 23, either in the direction shown by the arrows or in the opposite direction, so long as these members rotate oppositely with respect to one another, oscillating force will be imparted correspondingly in the longitudinal back and forth direction of the arrows X and Y. Assuming that oscillations are to be used for imparting a force against the cutter 2 in the direction Y, only a certain oscillation power will be imparted to the cutter 2 by way of impact between impact head 9 and impact base 12. Since impact head 9 is spaced from impact base 12, the full force of the oscillating energy will not be exerted. Upon the addition of the traction force of chain 7 in the direction of the arrow Y, this force will be transmitted through shoulder 20 to inner member 4 causing inner member 4 to compress spring 17 in turn displacing oscillator 3 toward cutting means 2. Upon maximum displacement of the shoulder 20 within the aperture 21, stop rim 19' of inner member 4 will abut against end wall 14 of outer member 5. At this point, impact head 9 will be placed against base 12 for exerting the full energy of impact of the

oscillator 3 onto the cutting means 2. Upon such maximum displacement, springs 17 and 18 will counteract one another, the net result being that oscillator 3 is now positioned with impact head 9 immediately against impact base 12. Under these conditions, oscillator 3 will be suitably resiliently suspended within inner member 4 by reason of springs 17 and 18, only being opposed by the force of spring 16 now compressed due to the movement in the direction Y of the oscillator.

Naturally, the full force of the cable 7 will be exerted through shoulder 20 and stop rim 19' of inner member 4 onto the cutting means 2 for maximum exertion against the coal face. However, this force will not be detrimental to the normal oscillating power of oscillator 3 since at maximum displacement in the direction Y, oscillator 3 is freely suspended between springs 17 and 18 and need only overcome the resilient counter force of spring 16 in order to impart its full power to the cutting means 2. A completely resilient suspension of oscillator 3 is thus provided in accordance with the invention which permits the full force of the pulling means or cable to be exerted onto the cutting means yet permits the full kinetic energy of oscillation to be applied against the cutting means as well without regard to changes of an abrupt nature, or otherwise, of the traction force of the chain in the particular direction contemplated.

Of course, the operation will be correspondingly carried out in the direction X where the traction force or pulling force is exerted by chain 6 rather than chain 7.

It should be emphasized that the force of the particular spring permits the oscillator to be maintained when at rest in the longitudinal center position of the planer or outer member 5 whereas when oscillations are to cause impacting imparted in one direction, the oscillator 3 will act in that direction whether displaced by reason of the force of the cable means or not. Of course, any form of oscillation producer may be used in accordance with the invention such as a piston impact motor rather than the imbalance mass method specifically shown in FIG. 3.

Advantageously, by positioning the springs in the manner contemplated a comparatively small length of the planer may be attained although if desired, the spring positions may be modified, such as for example by arranging the springs 15, 16 between the outer surfaces of stop rims 19, 19' of inner member 4 and end walls 13, 14 of the planer or outer member 5. Springs 15, 16 would then represent an extension of springs 17, 18 in longitudinal direction. The spring forces and distances between the impact heads and impact bases contemplated by the invention are such that where the pulling force of cable 6 or 7 is not employed, linear oscillation will be produced by the oscillator 3 in the vicinity of the center point of the planer device without contact between the impact heads and impact bases, whereas upon adding the pulling force of cable 6 or cable 7, the intermediate stop means 4 will be displaced in turn displacing the oscillator 3 so that the oscillations in the displaced position will be carried out about a point removed from the center point a distance corresponding to that of the displacement of the intermediate stop means or inner member 4.

It should be noted that in the position of greatest possible displacement, the spring 17, where displacement is in the Y direction, and spring 18, where displacement is in the X direction, will be placed under a compression force amounting to about 30% of the force amplitude, or power of the oscillator with the result that the particular impact head will strike the corresponding impact base with the greatest possible kinetic energy or force coming into play. This maximum kinetic energy is uninfluenced even though the tractive force or pulling force of the cable increases even more, the kinetic energy always being maintained at its greatest value by reason of the presence of the intermediate stop means. The cutting means will merely abut the coal face with greater forces measured by the greater traction or pulling forces exerted by the cable so that the cutting edge of the cutting means no longer swings back and forth as objectionably occurred heretofore but continuously abuts the coal face. Such continuous abutment decreases the former lost efficiency of the cutting edges by reason of the cushion of fine coal particles formed thereon in the discontinuous abutment practiced with prior techniques, whereby any fine coal particles become crushed by the excessive traction forces of the cable and all of the kinetic energy of the oscillator or impact device is rendered fully available for the chipping of the coal in the desired manner.

What is claimed is:

1. In a longitudinally extending planer having cutting means at each end thereof and longitudinally directed linearly oscillating impact imparting means intermediate said cutting means, said planer being adapted to be moved longitudinally by a pulling means in both directions along a mine face for engagement of the mine face by the cutting means in each direction of movement, respectively, under the corresponding directional force of the pulling means and extraction of material by operation of the corresponding directional force of the impact imparting means on the respective cutting means and against the mine face, the improvement which comprises intermediate stop means, spring means operatively interposed between said stop means and said impact imparting means, said stop means being connected to the pulling means and resiliently interconnecting the pulling means with the impact imparting means by said spring means, said impact imparting means having ends normally longitudinally spaced from the corresponding cutting means and said impact imparting means being resiliently connected to said cutting means, said intermediate stop means, impact imparting means and cutting means being displaceable with respect to one another in the direction of linear impact of the impact imparting means, said intermediate stop means having a stop portion respectively extending normally between each end of said impact imparting means and the corresponding cutting means for direct abutment between each stop portion and the corresponding cutting means upon maximum displacement of said intermediate stop means and in turn said impact imparting means toward the corresponding cutting means under the force of the pulling means in the corresponding direction, whereby, upon such maximum displacement of said intermediate stop means and in turn said impact imparting means toward a corresponding cutting means under the force of the pulling means until the corresponding stop portion of the intermediate stop means is in direct abutment with said corresponding cutting means, said impact imparting means imparts its impact force directly onto the corresponding cutting means while said pulling means exerts force only resiliently onto said impact imparting means through said intermediate stop means and said spring means yet directly upon the corresponding cutting means by the direct abutment of said stop portion of the intermediate stop means with said cutting means.

2. Improvement according to claim 1 wherein said impact imparting means is normally positioned in the longitudinal center of the planer between said cutting means and upon such maximum displacement directly abuts the corresponding cutting means both under the resiliently applied force of the pulling means, exerted thereon through the intermediate stop means resiliently interconnecting said pulling means with said oscillation imparting means by said spring means, and under the directly applied impact force of the oscillation imparting means.

3. Improvement according to claim 2 wherein said planer includes an outer tubular member having an end wall at each end thereof, each end wall correspondingly having said cutting means outwardly extending therefrom and an impact base inwardly extending therefrom, said intermediate stop means includes an inner tubular member

displaceably received within said outer tubular member, said inner tubular member having a stop rim at each end thereof spaced from and for abutment with the corresponding outer tubular member end wall with the corresponding impact base received therewithin, and said impact imparting member includes an elongated oscillating member having an impact head at each end thereof spaced from and in longitudinal alignment with the corresponding opposing impact base.

4. Improvement according to claim 3 wherein said outer tubular member is provided with a central longitudinally extending aperture and said inner tubular member is centrally provided with a transversely directed outward shoulder extending through said aperture for attachment with the pulling means.

5. Improvement according to claim 4 wherein the distance between each impact head and corresponding impact base is substantially equal to the distance between each stop rim and corresponding outer tubular member end wall, and wherein the longitudinal distance of said central aperture is at least slightly greater than the combined distances between said stop rims and the corresponding outer tubular member end wall.

6. Improvement according to claim 5 wherein said spring means include a large diameter coil spring operatively disposed between each end of the elongated oscillating member and the corresponding stop rim of said inner tubular member, and wherein a small diameter coil spring is operatively disposed between each end of the elongated oscillating member and the corresponding outer tubular member end wall, said small springs being correspondingly disposed concentrically within said large springs, said large springs having an equal spring force and said small springs having an equal spring force, the spring force of said large springs being greater than that of said small springs, said springs normally maintaining said inner tubular member in the longitudinal center of said outer tubular member, said elongated oscillating member in the longitudinal center of said inner tubular member, and said outward shoulder in the longitudinal center of said central aperture.

7. Improvement according to claim 6 wherein said elongated oscillating member includes a pair of oppositely rotating imbalance members operatively positioned for imparting linear oscillations in the longitudinal direction of the planer.

8. Improvement according to claim 7 wherein said imbalance members are arranged in the longitudinal center of said elongated oscillating member with their axes in a plane transverse to the longitudinal direction whereby upon rotation of the first imbalance member clockwise and the second counterclockwise, oscillating force is imparted in a longitudinal back and forth direction.

9. In a planer having linearly oscillating impact imparting means and cutting means adapted to be moved by a pulling means along a mine face for engagement of the mine face by the cutting means under the force of the pulling means and extraction of material by operation of the force of the impact imparting means on the cutting means and against the mine face, the improvement which comprises intermediate stop means, spring means operatively interposed between said stop means and said impact imparting means, said stop means being connected to the pulling means and resiliently interconnecting the pulling means with the impact imparting means by said spring means, said impact imparting means being normally spaced from and resiliently connected with said cutting means, said intermediate stop means, impact imparting means and cutting means being displaceable with respect to one another in the direction of linear oscillation of the impact imparting means, said intermediate stop means having a stop portion normally extending between said impact imparting means and cutting means for direct abutment with said cutting means upon maximum displacement of said intermediate stop means and in turn said impact imparting means toward said cutting means under the force of the pulling means, whereby upon such maximum displacement of said intermediate stop means and in turn said impact imparting means toward said cutting means, under the force of the pulling means until said stop portion of the intermediate stop means is in direct abutment with said cutting means, said impact imparting means directly abuts said cutting means and imparts its impact force directly onto said cutting means while said pulling means exerts force only resiliently onto said impact imparting means through said intermediate stop means and said spring means yet directly upon said cutting means by the direct abutment of said stop portion of the intermediate stop means with said cutting means.

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