May 9, 1967 G. WARNER 3,318,637

MACHINE FOR TRANSVERSELY SLOTTING A STRIP OF CONCRETE PAVEMENT AT DIFFERENT ANGLES

Filed Oct. 19, 1964 2 Sheets-Sheet 1

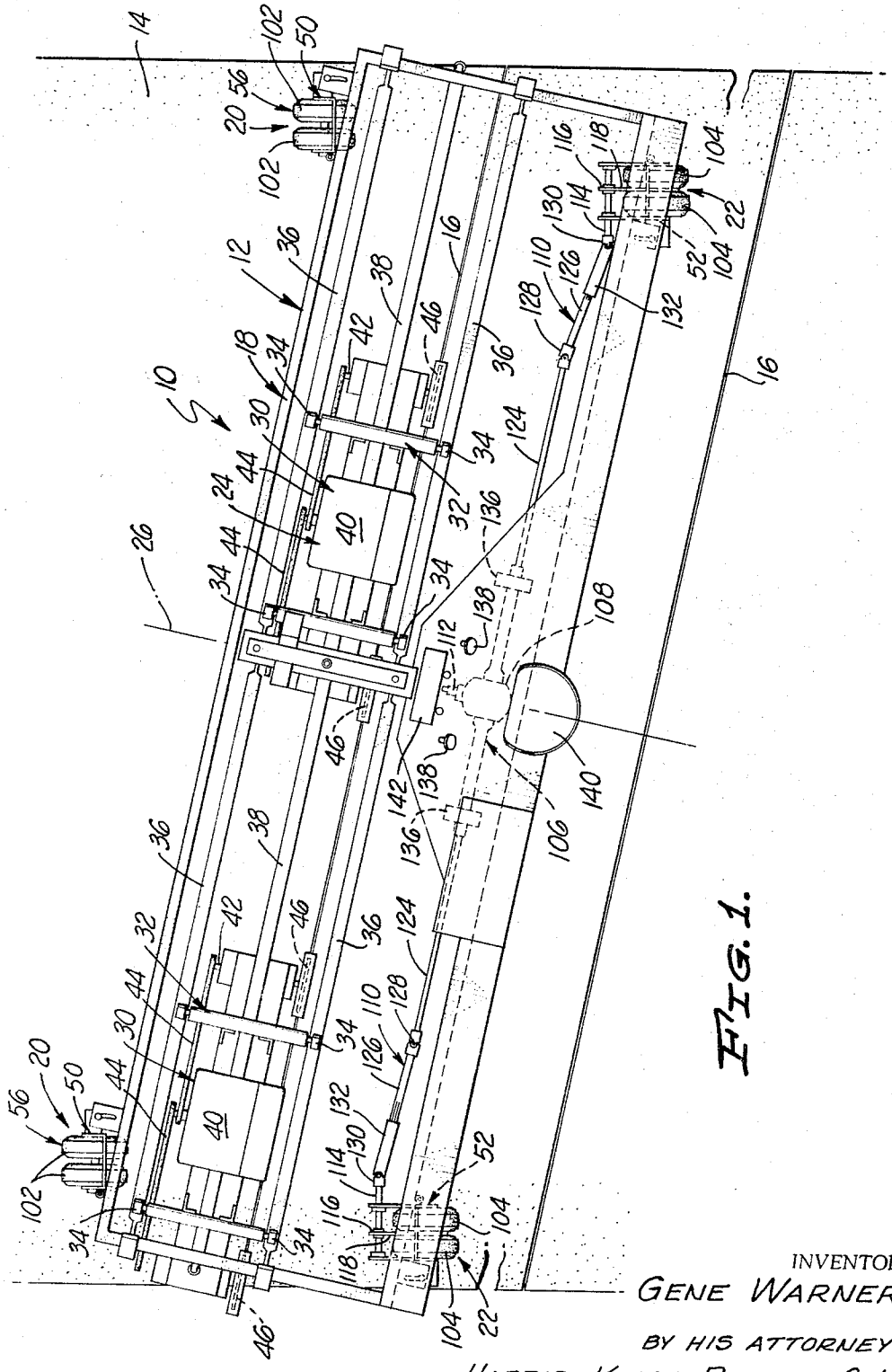


FIG. 1.

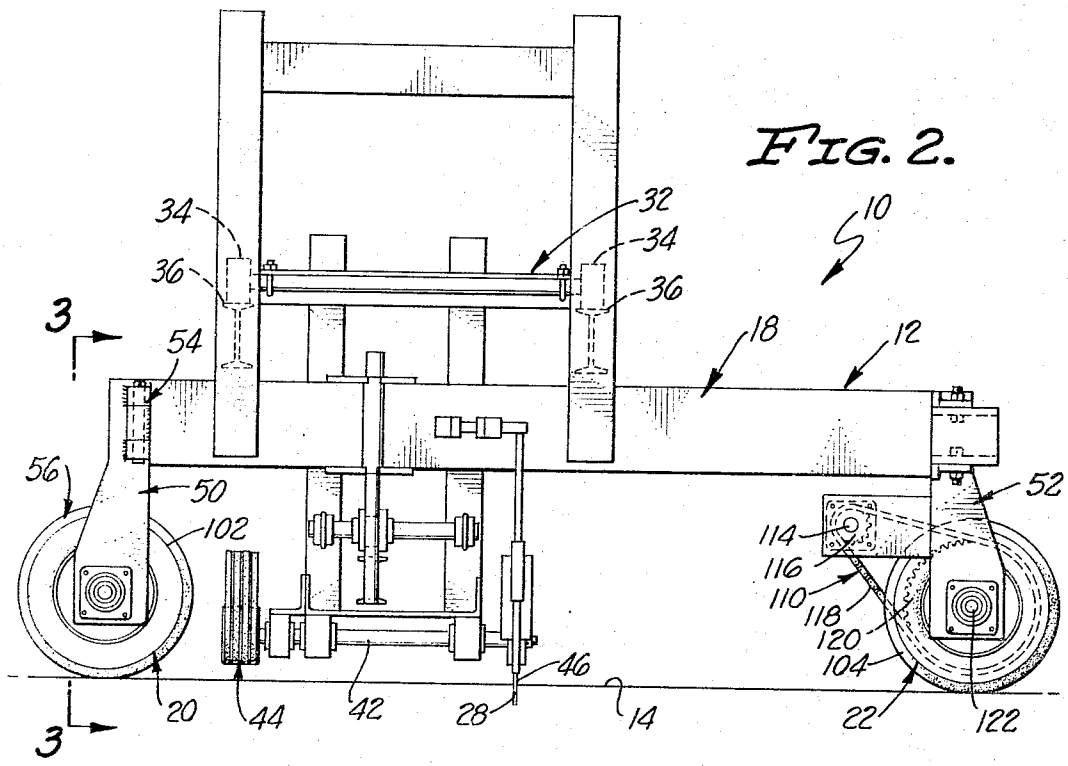
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FIG. 2.



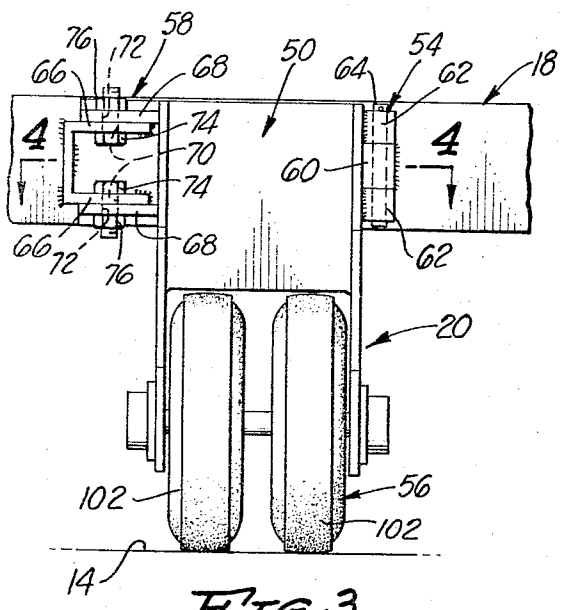


FIG. 3.

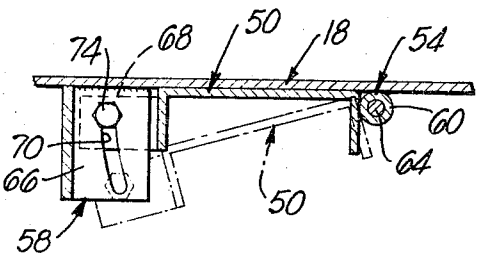


FIG. 4.

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MACHINE FOR TRANSVERSELY SLOTTING A STRIP OF CONCRETE PAVEMENT AT DIFFERENT ANGLES

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2 Claims. (Cl. 299—39)

The present invention relates in general to a machine for grooving or slotting pavement and, more particularly, to a machine for transversely slotting a strip of concrete pavement at longitudinally spaced points to provide contraction joints at such points.

It is conventional in present-day concrete airport and highway construction to pour the concrete in a long strip without transverse joints. After the concrete has set sufficiently, transverse grooves or slots are cut in the strip at longitudinally spaced points, the depth of cut being but a fraction of the thickness of the pavement. Subsequent contraction of the pavement results in controlled transverse cracking of the strip along the transverse slots, thereby providing the necessary contraction joints in a regular pattern.

When a strip of concrete pavement having transverse contraction joints is in use, vehicle wheels crossing the joints impose shock loads on the succeeding slabs, such shock loads being extremely severe in the case of heavy vehicles such as heavy trucks, large aircraft, and the like. In order to reduce such impact loads, it is necessary to form the joints at an angle, to the path of vehicles crossing the joints, which differs substantially from 90°. By proper selection of the angle of such a nonperpendicular joint, only one wheel of a pair of laterally-aligned vehicle wheels will cross the joint at a time. Consequently, the impact load produced by a vehicle crossing such a nonperpendicular joint is only half the impact load imposed with a perpendicular joint.

The basic object of the invention is to provide a machine for transversely slotting a strip of pavement having very simple means for obtaining a nonperpendicular slot orientation, or any desired slot orientation.

In general, the invention contemplates a cross slotting machine which includes a wheeled vehicle movable longitudinally of the strip of pavement and having a frame supported by longitudinally-spaced front and rear wheel assemblies, and which includes pavement slotting means, movable laterally of the frame along a transverse slotting path, for transversely slotting the strip of pavement while the vehicle is stationary.

More particularly, the invention contemplates mounting the wheel assemblies on the frame for pivotal movement relative thereto about upright axes so as to vary the angle of the transverse slotting path relative to the longitudinal path of movement of the vehicle along the strip of pavement. With this construction, any desired cross slot angle relative to the strip of pavement can be achieved merely by correspondingly adjusting the angular positions of the wheel assemblies relative to the frame and then orienting the wheel assemblies parallel to the longitudinal edges of the strip, which is an important feature of the invention.

An important object of the invention is to mount each wheel assembly on the frame by means of a simple hinge, which has several advantages. For example, simple hinged connections between the wheel assemblies and the main or vehicle frame are sturdy, may be manufactured easily and inexpensively, and provide for easy adjustment of the angular positions of the wheel assemblies.

More particularly, an object of the invention is to provide hinge means, for connecting wheel frames of the wheel assemblies to the main or vehicle frame, each of

which includes interengaged hinge elements on the main frame and the corresponding one of the wheel frames, and an upright hinge pin pivotally interconnecting such hinge elements.

Still another object of the invention is to provide locking means, for locking the wheel frames in predetermined angular positions relative to the main frame, each of which includes interengaged locking elements on the main frame and the corresponding wheel frame.

A further object is to provide a construction wherein the hinge means and the locking means connected to each wheel frame are spaced apart in the direction of the axis of rotation of a wheel on such wheel frame and are located on opposite sides of such wheel.

Preferably the frame of the wheeled vehicle is supported by front and rear pairs of laterally or transversely spaced wheel assemblies, the front and rear pairs being spaced apart longitudinally of the vehicle. An object in this connection is to provide the wheel assemblies of one of the pairs, preferably the rear wheel assemblies, with driving wheels, and to provide means for driving such wheels to advance the vehicle longitudinally of the strip of pavement from one cross slotting location to the next.

Another object of the invention is to provide means for rotating the driving wheels which includes a differential on the frame in a laterally intermediate position, and which includes driving connections between the differential and the driving wheels, such driving connections including universal and slip joints to permit pivoting of the corresponding wheel assemblies relative to the frame.

Another object is to provide means for braking the wheels of one pair of wheel aseemblies, preferably the driving wheels, to lock the vehicle in position at each cross slotting location. A related object is to provide separately-actuable braking means for the wheels of the two brake-equipped wheel assemblies to permit steering of the vehicle along the strip of pavement. Still another object in this connection is to provide a machine wherein the two braking means act on the driving connections between the differential and the wheels of the driving wheel assemblies.

An important advantage of the particular means of the present invention for varying the angle of the transverse slotting path relative to the longitudinal path of movement of the vehicle is that it permits the use of a frame having a longitudinal dimension which is small compared to its lateral dimension. Thus, when the machine is loaded on a trailer, for example, with its longitudinal dimension perpendicular to the longitudinal axis of the trailer, the over-all width of the resulting load is minimized so that the machine can be transported long distances without exceeding maximum width limits. Also, if it is desired to transport the machine of the invention a relatively short distance under its own power, the wheel assemblies can readily be oriented parallel to the longitudinal axis of the frame to make driving the machine more convenient to the operator. Further, with the wheel assemblies oriented parallel to the longitudinal axis of the frame, the lateral dimension of the frame is minimized to permit passage through spaces which would not be wide enough to permit passage if the wheel assemblies were oriented at angles to the longitudinal axis of the frame.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the art to which the invention relates in the light of this disclosure, may be achieved with the examplary embodiment of the invention described in detail hereinafter and illustrated in the accompanying drawings, in which:

FIG. 1 is a plan view of a machine of the invention for

transversely slotting a strip of pavement, the machine being shown adjusted to cut a nonperpendicular slot in a strip of pavement;

FIG. 2 is a side elevational view showing the left hand side of the machine of FIG. 1, except that the machine is adjusted to make a perpendicular cut in the strip of pavement;

FIG. 3 is an enlarged, fragmentary front elevational view, taken as indicated by the arrowed line 3—3 of FIG. 2; and

FIG. 4 is a sectional view taken along the arrowed line 4—4 of FIG. 3 of the drawings.

Referring particularly to FIG. 1 of the drawings, the cross slotting machine of the invention is designated generally by the numeral **10** and comprises a wheeled vehicle **12** supported by and movable longitudinally along a strip of concrete pavement **14**, the function of the machine being to cut longitudinally spaced, transverse slots **16** in the pavement strip at an angle relative to the longitudinal edges of the strip differing substantially from 90°. The wheeled vehicle **12** comprises a main or vehicle frame **18** supported by laterally-spaced front wheel assemblies **20** and laterally-spaced rear wheel assemblies **22**, the latter being spaced longitudinally from the front wheel assemblies. The machine **10** further includes pavement slotting means **24** for cutting successive nonperpendicular transverse slots **16** at successive longitudinal positions of the machine along the pavement strip **14**. The slotting means **24** is carried by the frame **18** of the wheeled vehicle **12** longitudinally intermediate the front and rear wheel assemblies **20** and **22**, and is movable laterally of the frame, in a manner to be described, in the course of cutting each transverse slot **16** while the vehicle **12** remains stationary.

As will be described in more detail hereinafter, the wheel assemblies **20** and **22** are pivotable relative to the frame **18** about upright axes to vary the angle between the longitudinal centerline **26** of the frame and the longitudinal edges of the pavement strip **14**. Thus, when the wheel assemblies **20** and **22** are so oriented that they are parallel to the longitudinal edges of the pavement strip **14**, but are not parallel to the longitudinal centerline **26** of the frame, as shown in FIG. 1, the slotting means **24** cuts the transverse slots **16** at a corresponding angle to the longitudinal edges of the pavement strip. If desired, a transverse slot **28**, FIG. 2, which is perpendicular to the longitudinal edges of the pavement strip **14** may be produced by pivoting the wheel assemblies **20** and **22** relative to the frame **18** until they are oriented parallel to the longitudinal centerline **26** of the frame, and by reorienting the machine **10** until the wheel assemblies are again oriented parallel to the longitudinal edges of the pavement strip.

In the particular construction illustrated, the wheel assemblies **20** and **22** are shown as being so oriented relative to the frame **18** as to cause the slotting means **24** to slant the slots **16** from right to left in the direction of travel of the machine **10**. In the event that a left to right slant in the direction of travel is desired, this may be achieved readily by locating the hinge axis of each wheel assembly on the opposite side of such assembly from the location shown.

Considering the machine **10** in more detail now, the frame **18** is shown as rectangular and as having a longitudinal dimension, in the direction of its longitudinal centerline **26**, which is relatively small as compared to its lateral dimension or width, the magnitude of the latter being determined by the width of the pavement strip **14**. Except as hereinafter pointed out, the frame **18** may be of any suitable construction so that a detailed description is not necessary.

Considering the pavement slotting means **24**, it comprises two laterally spaced slotting units **30** interconnected to move laterally of the frame **18** in unison in cutting

one of the transverse slots **16**. Each slotting unit **30** is similar to the laterally movable slotting unit of the cross slotting machine of Patent No. 2,791,412, issued May 7, 1957 to Cecil W. Hatcher, attention being directed thereto for a more complete disclosure. Briefly, each slotting unit **30** comprises a carriage **32** supported by rollers **34** movable along tracks **36** extending laterally of and mounted on the frame **18**. Each carriage **32** is guided in its lateral movement relative to the frame **18** by a guide rail **38** on the frame.

Each slotting unit **30** includes a motor, preferably an internal combustion engine **40**, mounted on the corresponding carriage **32**. Also mounted on each carriage **32** are laterally spaced arbors **42** the axes of which are parallel to the longitudinal centerline **26** of the frame **18**. The two arbors **42** on each carriage **32** are driven by the corresponding engine **40** through belts **44**, respectively. The four arbors **42** of the two slotting units **30** respectively carry four rotary slotting elements **46** arranged in tandem so that they all cooperate to cut a single transverse slot **16** as the carriages **32** are moved laterally along the tracks **36**. It will be understood that the rotary slotting elements **46** on each carriage **32** cut slightly more than one-half the length of each transverse slot **16**, there being sufficient overlap of the movements of the slotting units **30** along their transverse slotting path to insure a cut extending completely across the pavement strip **14**.

The manner in which the carriages **32** are moved laterally along the tracks **36**, the manner in which the rotary slotting elements **46** are moved into and out of cutting engagement with the pavement strip **14**, and the like, are all generally disclosed in the aforementioned Hatcher patent. Consequently, a further description herein is not required.

The front and rear wheel assemblies **20** and **22** respectively include front and rear wheel frames **50** and **52** mounted on the main frame **18** for pivotal movement relative thereto about upright axes. All of the wheel frames **50** and **52** are mounted on the main frame **18** in essentially the same manner so that only the mounting means for one of the front wheel frames **50** will be considered.

Referring particularly to FIGS. 3 and 4 of the drawings, the front wheel frame **50** is connected to the main frame **18** by a hinge means **54** which permits pivotal movement of the wheel frame relative to the main frame about an upright axis to vary the angular position of a wheel means **56** relative to the main frame so as to vary the angle of the transverse slotting path of the slotting means **24** relative to the longitudinal edges of the pavement strip **14**. The wheel frame **50** is also connected to the main frame **18** by a locking means **58** for locking the wheel frame **50** in a predetermined angular position. The hinge and locking means **54** and **58** are spaced apart along the axis of rotation of the wheel means **56** and are located on opposite sides, respectively, of such wheel means.

Considering the hinge means **54** in more detail, it includes interengaged hinge elements **60** and **62** on the main and wheel frames **18** and **50**, respectively, and includes an upright hinge pin **64** pivotally connecting the hinge elements **62** to the hinge elements **60**.

Considering the locking means **58**, it includes two locking elements **66** on the main frame **18** embraced by and respectively slidably engaged by two locking elements **68** on the wheel frame **50**. The locking elements **66** have arcuate slots **70** therein concentric with the axis of the hinge pin **64**, while the locking elements **68** have registering holes **72** therethrough. Bolts **74** having nuts **76** thereon extend through the respective slots and holes **70** and **72**.

As will be apparent, the angular orientation of the wheel assembly **20** in question relative to the main frame **18** may be varied readily by loosening the nuts **76**, ad-

justing the angular position of the corresponding wheel frame **50** about the axis of the corresponding hinge pin **64**, and then retightening the nuts **76**.

It will be noted that the load imposed on the front wheel assembly **50** under consideration is transmitted thereto through the hinge elements **60** and **62** and the locking elements **66** and **68**. The result is a very sturdy mounting of the front wheel assembly **20** in question on the main frame **18**, but one which nevertheless permits easy angular adjustment of the position of this wheel assembly relative to the main frame. Furthermore, this simple hinged mounting for the front wheel assembly under consideration is relatively easy and inexpensive to manufacture.

The two front wheel assemblies **20** are identical and are identically mounted on the main frame **18**. The two rear assemblies **22** are similar to the front wheel assemblies **20**, and are mounted on the main frame **18** in a similar manner. Consequently, further descriptions in this respect are unnecessary.

It will be understood that all of the front and rear wheel assemblies **20** and **22** must be adjusted to the same angular orientation relative to the longitudinal centerline **26** of the frame **18**. The transverse slot **16** cut by the slotting means **24** then has the same angular orientation relative to a perpendicular to the edges of the pavement strip **14**. Preferably, an angular orientation for the front and rear wheel assemblies **20** and **22** which will produce the nonperpendicular slots **16** is used, rather than an angle which will produce a perpendicular slot such as the slot **28**. However, a slot perpendicular to the longitudinal edges of the pavement strip **14** may be used if desired or required.

In the particular construction illustrated, each front wheel assembly **20** includes dual front wheels **102** constituting the wheel means **56**, and each rear wheel assembly **24** includes dual rear wheels **104**. However, it will be understood that the number of wheels in each wheel assembly may be increased or decreased if desired.

The wheels of one of the pairs of wheel assemblies **20** and **22**, and preferably the wheels **104** of the rear wheel assemblies **22**, are driving wheels for moving the vehicle **12** along the pavement strip **14** from one joint location to the next after cutting a transverse slot **16** at the preceding joint location. An exemplary driving means for the rear wheels **104** is designated generally by the numeral **106**.

The driving means **106** is shown as including a differential **108**, containing conventional differential gearing, mounted on the frame **18** and having driving connections **110** to the respective dual rear wheels **104**. The differential **108** may be driven by a hydraulic motor **112** supplied with hydraulic fluid under pressure by a hydraulic pump, not shown, driven by one of the engines **40**. (It will be noted that the rotary slotting elements **46** are not in cutting operation during forward movement of the wheeled vehicle **12**. Consequently, the output of one of the engines **40** may be used to produce the desired forward movement of the vehicle **12**.) Each driving connection **110** includes a shaft **114** carried by the corresponding rear wheel frame **52** and carrying a sprocket **116** driving a chain **118** trained around a sprocket **120** on an axle **122** carrying the corresponding dual rear wheels **104**. The shafts **114** of the respective rear wheel assemblies **22** are connected to opposite sides of the differential **108** through shafts **124** and **126**, universal joints **128** and **130**, and slip joints **132**. Such combinations of universal and slip joints permit the hereinbefore-discussed pivoting of the rear wheel assemblies **22** relative to the frame **18**.

The driving connections **110** between the differential **108** and the two sets of rear wheels **104** incorporate braking devices **136**, which may be hydraulically operated in a manner not specifically shown, but well known in the art. The respective braking devices **136** are controlled by foot pedals **138** accessible from a driver's seat **140**, from which a control console **142** for operating various other components of the machine **10** is also accessible. By applying the braking devices **136** simultaneously while making one of the transverse cuts **16**, the machine **10** may be held absolutely stationary to insure an accurate cut and to prevent damage to the rotary slotting elements **46**. During forward movement of the machine **10** from one slotting location to the next, any steering of the machine which may be required may be accomplished by actuating one or the other of the braking devices **136**.

It is thought that the over-all of the pavement slotting machine **10** of the invention will be clear from the foregoing. Consequently, a further description is not necessary.

Although an exemplary embodiment of the invention has been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention as defined by the claims which follow:

1. In a machine for transversely slotting a strip of pavement, the combination of:

(a) a wheeled vehicle movable longitudinally of the strip of pavement and including a main frame supported by longitudinally-spaced front and rear wheel assemblies;

(b) pavement slotting means, carried by said main frame between said front and rear wheel assemblies and movable laterally of said main frame along a transverse slotting path, for transversely slotting the strip of pvement;

(c) said wheel assemblies including wheel frames respectively having wheels rotatably mounted thereon;

(d) hinge means respectively connecting said wheel frames to said main frame for pivotal movement relative thereto about upright axes to vary the angle of said transverse slotting path relative to the path of said vehicle;

(e) each of said hinge means including at least three interleaved, vertically aligned, hinge elements on said main frame and the corresponding one of said wheel frames, and including an upright hinge pin pivotally interconnecting said hinge elements thereof, alternate ones of said interleaved hinge elements of each of said hinge means being on said main frame and the corresponding wheel frame, respectively;

(f) locking means respectively connecting said wheel frames to said main frame for locking said wheel frames in predetermined angular positions relative to said main frame; and

(g) each of said locking means being remote from the corresponding hinge means and including interengaged locking elements on said main frame and the corresponding wheel frame.

2. In a machine for transversely slotting a strip of pavement, the combination of:

(a) a wheeled vehicle movable longitudinally of the strip of pavement and including a main frame supported by longitudinally-spaced front and rear wheel assemblies;

(b) pavement slotting means, carried by said chain frame between said front and rear wheel assembiles and movable laterally of said main frame along a transverse slotting path, for transversely slotting the strip of pavement;

(c) said wheel assemblies including wheel frames respectively having wheels rotatably mounted thereon;

(d) hinge means respectively connecting said wheel frames to said main frame for pivotal movement relative thereto about upright axes to vary the angle of said transverse slotting path relative to the path of said vehicle;

(e) each of said hinge means including interengaged hinge elements on said main frame and the corresponding one of said wheel frames, and including

an upright hinge pin pivotally interconnecting said hinge elements thereof;

(f) locking means respectively connecting said wheel frames to said main frame for locking said wheel frames in predetermined angular positions relative to said main frame;

(g) each of said locking means including interengaged locking elements on said main frame and the corresponding wheel frame; and

(h) the hinge means and the locking means connected to each of said wheel frames being spaced apart in the direction of the axis of rotation of the wheel on said wheel frame and being located on opposite sides of said wheel.

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