United States Patent [19]

Riley

[11] **3,791,696**

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[54] **EXPANSION JOINT CLEANING APPARATUS AND METHOD**

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[52] **U.S. Cl.** **299/10,** 299/36, 404/74

[51] **Int. Cl.** **E01c 23/09**

[58] **Field of Search** 299/10, 36, 37; 404/74

[56] **References Cited**

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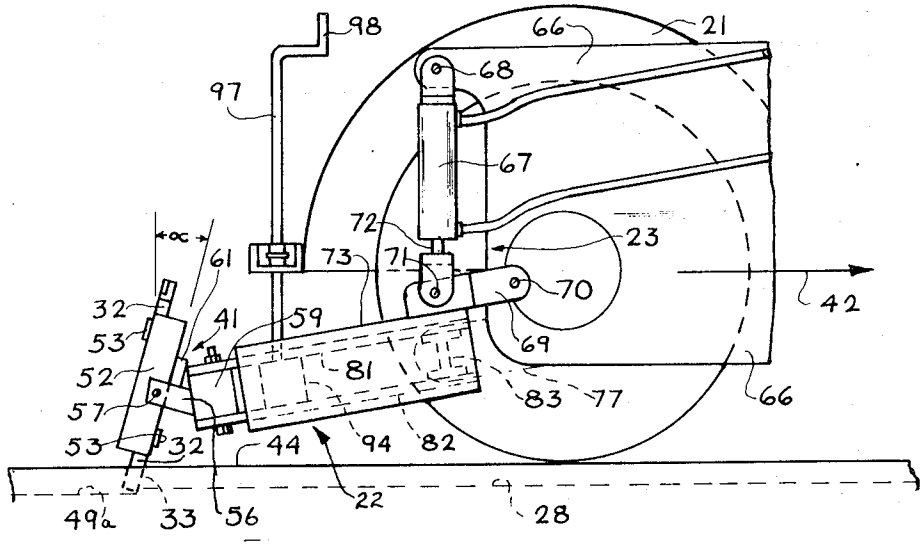
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Primary Examiner—Ernest R. Purser
Attorney, Agent, or Firm—Warren, Rubin, Brucker & Chickering

[57] **ABSTRACT**

An apparatus and method for cleaning of expansion joints between adjacent slabs of concrete and, more particularly, for removing joint sealant compositons from the expansion joints for periodic replacement thereof, are disclosed. The apparatus includes a vehicle having a tool carrying arm on which a plow-type cleaning tool is mounted. The cleaning tool has a cutting face formed from a material capable of cutting concrete and is dimensioned to create an overlap or interference fit with the side walls of the joint. The tool is mounted on the arm with the cutting face inclined toward the direction of advancement of the vehicle down the expansion joint during cleaning, and the cutting forces are applied downwardly and forwardly to effect cutting of the concrete while reducing spalling adjacent the joint. A pantograph-type linkage is employed with a tool having tapered side cutting edges to allow the tool to track or follow the expansion joint during plowing.

11 Claims, 5 Drawing Figures



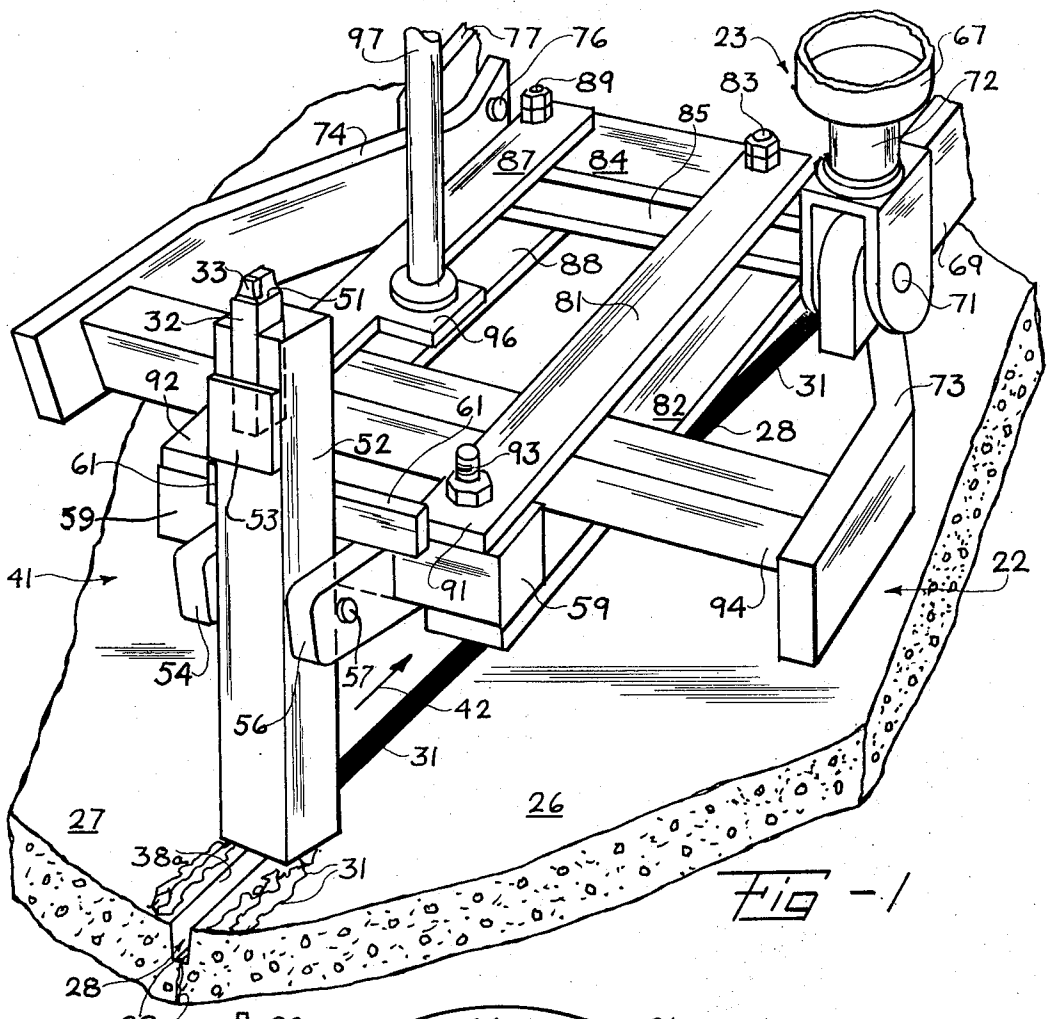

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Fig - 1

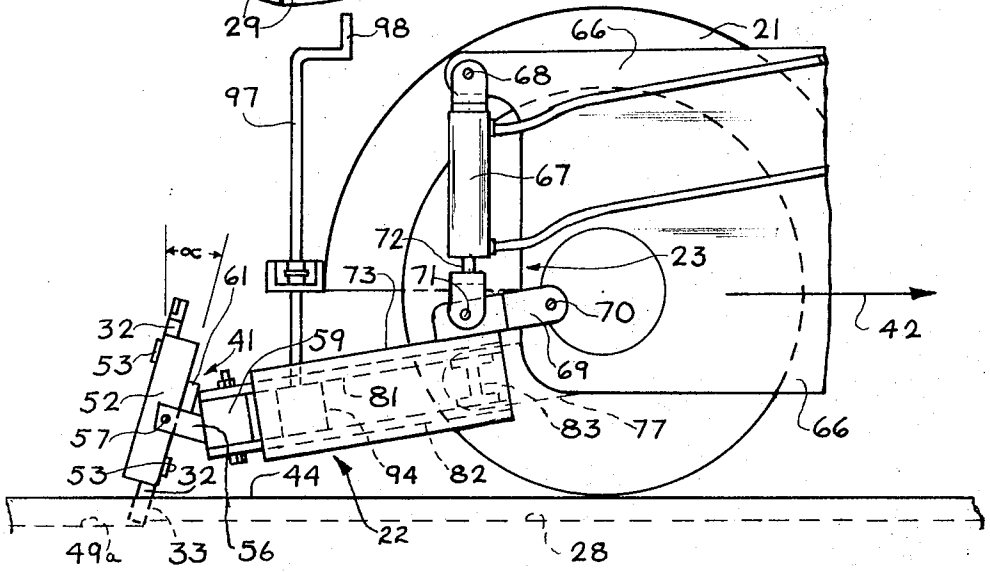

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Fig - 2

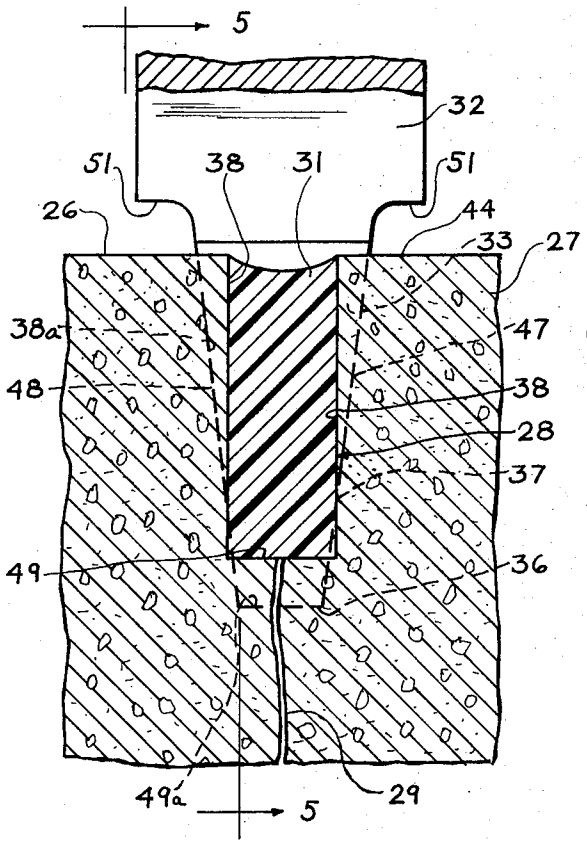


Fig - 3

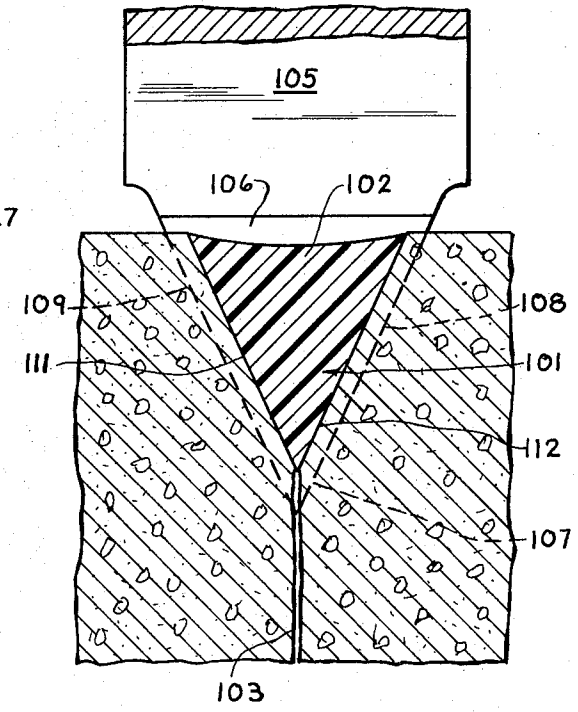


Fig - 4

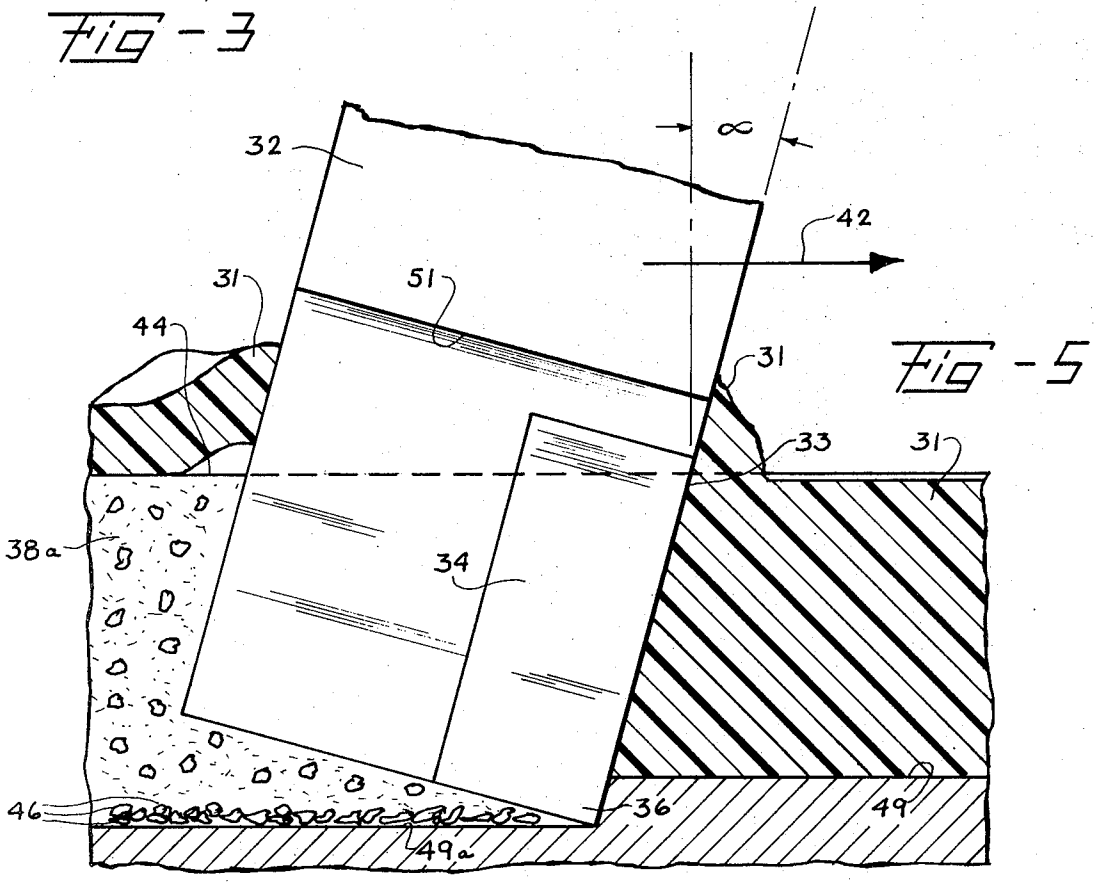


Fig - 5

EXPANSION JOINT CLEANING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

The use of sealant filled joints in concrete structures such as airfield pavements, highways, and floor slabs of buildings has become widespread. The joint is usually formed either during casting of the concrete slab or after the concrete has set. These joints are typically about ⅜ to ½ inch in width and about one to 1¼ inches in depth, and they are spaced at about 25 foot intervals. In some instances, however, the width, heighth, spacing and configuration of joints can vary substantially from the above dimensions.

There are at least three types of joints commonly encountered, namely, weakened plane dummy joints, also known as contraction joints; keyed joints, also known as cold construction joints; and expansion joints. As used herein, the term "expansion joint" shall include all of the aforesaid types of joints.

In order to prevent the entry of water and other materials into the expansion joints, the expansion joints are preferably filled with a joint sealant material. The joint sealant materials are rubbery in nature and accommodate expansion and contraction between adjacent concrete slabs while keeping the joints free of noncompressibles and water. Typical joint sealant materials include rubberized asphalt, coal tar extended polysulfide, and polyurethane polymers, and more recently, new rubberized polyvinyl chloride joint sealants have been found to be extremely effective.

Thermal expansion and contraction, exposure to the weather, spillage of gasoline and solvents, and heavy loading of the concrete structures will cause a gradual breakdown of the sealant material in the joints. Accordingly, joint sealants must be periodically removed from the expansion joints and replaced, with the length of time that the sealant is effective depending upon the nature of the sealant and the conditions to which it is exposed. Some sealants will only last two or three years before they should be replaced while the newer polymer type, hot-poured, elastomeric sealants will last for as long as ten years.

Regardless of the kind of sealant which is used in a concrete expansion joint, it must be periodically removed from the joint, and the task of removing the joint sealant has been found to be extremely difficult and time consuming. At present, the most widely used method of removing joint sealant consists of mounting a cleaning tool on an arm which is hydraulically controlled from a tractor or other vehicle. The cleaning tool is mounted to dig down into the concrete joint and pry the sealant material up out of the joint. A variety of joint cleaning plows of this type have been devised including those set forth in U.S. Pat. Nos. 2,541,309, 2,584,993, 3,043,200 and 3,347,597. Numerous problems have been encountered in connection with the use of such plowing apparatus. First, prying the sealant out of the joint is very difficult since the sealant material is tenacious and rubbery. The strength of the sealant in adhering to the expansion joint requires extreme force to be used, and the cleaning tool often seriously chips or spalls the concrete in attempting to remove the sealant. Secondly, the action of the tool in prior plowing devices has been to scrape the sealant from the side walls and bottom of the expansion joint. The scraping action, however, generates substantial heat causing the sealant to flow past the cleaning tool and re-adhere to the sides of the joint. Thus, many passes over the expansion joint by the plow are usually required to remove the majority of the sealant. Even after plowing has been completed, moreover, the use of fiber or diamond wheels will often be required in order to remove the old sealant from the side walls of the expansion joint, and sandblasting of the joint is usually required by sealant manufacturers before they will guarantee the performance of new sealant placed in a cleaned joint. Still further, it is sometimes necessary to use a concrete saw to widen the expansion joints in order to obtain a clean surface to which new sealant may bond.

Accordingly, it is an object of the present invention to provide a concrete expansion cleaning apparatus and method which enables the complete removal of joint sealants and the like from the expansion joint without the need of using several tools and processes.

Another object of the present invention is to provide a concrete expansion joint cleaning apparatus and method which allows the joint to be more rapidly cleaned and affords an improved surface to which new joint sealant can bond.

Another object of the present invention is to provide a concrete expansion joint cleaning apparatus and method which effects substantial cost savings both at the time of the initial investment and during use.

Still a further object of the present invention is to provide an apparatus and method which is durable, easily adaptable to a variety of commonly available vehicles, can be used by relatively unskilled personnel, and minimizes the time during which the concrete structure being resealed must be out of use.

Other objects and features of advantage of the concrete expansion joint cleaning apparatus and method of the present invention will be obvious from and are set forth more fully in the detailed description contained hereinafter.

SUMMARY OF THE INVENTION

The expansion joint cleaning apparatus of the present invention is comprised, briefly, of a vehicle, a tool carrying arm, means mounting the arm to the vehicle for manipulation of the arm, a cleaning tool having a cutting face formed from material capable of cutting concrete and tool mounting means mounting said tool with the cutting face inclined toward the direction of advancement of the vehicle during cleaning of the expansion joint. The method of the present invention is comprised, briefly, of using a plow-type cleaning tool to apply a forward and downward cutting force to cut away the side walls and preferably the bottom of the concrete joint and thereby remove the sealant and expose new concrete to which new sealant can bond. It is preferable to employ a cleaning tool having a tungsten carbide steel cutting face with tapered side cutting edges and pantograph-type arm manipulating linkage, which combines with the tapered cutting edges to cause the cleaning tool to track or follow the expansion joint as it simultaneously cuts away a portion of both of the side walls and bottom thereof.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top perspective view of an expansion joint cleaning apparatus constructed in accordance with the present invention.

FIG. 2 is a fragmentary side elevational view of the apparatus of FIG. 1, as shown mounted on a vehicle.

FIG. 3 is an enlarged, fragmentary, front elevational view in cross-section of a concrete joint showing the cleaning tool of the present invention.

FIG. 4 is an enlarged, fragmentary, front elevational view in cross-section of an alternative form of expansion joint and cleaning tool constructed in accordance with the present invention.

FIG. 5 is an enlarged, fragmentary, side elevational view in cross-section taken along the plane of line 5—5 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, the apparatus for cleaning concrete expansion joints of the present invention can be seen to be comprised of a vehicle 21 (shown in FIG. 2 as the rear wheel of a tractor) to which a tool carrying arm, generally designated 22, is mounted by means 23 for manipulation of the arm and the application of substantial downward forces to the arm. It should be initially noted that the tool carrying arm may also be mounted from the front or side of vehicle 21. As thus far described, the expansion joint cleaning apparatus of the present invention is similar to joint plowing apparatus which have been previously employed in attempting to remove sealants from concrete joints.

A typical concrete expansion joint is shown in FIG. 1 in which adjacent slabs 26 and 27 of concrete have been formed or sawed to provide a groove or slot 28 which acts as the expansion joint. The groove or slot is typically about ⅜ to ½ inch in width and 1 to 1½ inch in depth, and as will be seen, the joint 28 does not extend through the entire thickness of the concrete slabs. Depending upon the thickness of the concrete, however, the width and depth of the joint can be selected so that a crack 29 forms between the adjacent slabs to complete the separation between the slabs and allow for thermal expansion and contraction. To prevent non-compressibles from entering into joint 28 and causing damage to the concrete upon thermal expansion or contraction, and similarly to prevent the entry and freezing of water in the joint, sealant material 31 is disposed and bonds with the side walls of the joint. The sealant material does not inhibit the expansion and contraction and yet maintains the joint free of damaging materials.

In order to effect removal of joint sealant from the expansion joint and simultaneously prepare the expansion joint for receipt of new sealant material, the apparatus of the present invention includes a cleaning tool 32 (best seen in FIGS. 2, 3, and 5) having a cutting face 33 formed from a material capable of cutting concrete. As shown in FIG. 5, cutting face 33 is preferably provided by an inset 34 of a material capable of cutting concrete. It is preferred to form inset 34 of tungsten carbide, which is commonly employed in tools for machining steel. A tungsten carbide cutting element having a low percentage (between about 6 percent and about 3 percent) of cobalt binder is preferred. Such tungsten carbides are usually designated as Industry Standard C-2, with the most preferred grade being K-68 grade tungsten carbide having 6 percent cobalt binder.

As best may be seen in FIG. 3, the cleaning tool of the present invention is further formed with a lower portion, in this case distal end 36, dimensioned for insertion into the expansion joint and an upper portion 37 dimensioned to have a greater width than the width of joint 28. As so formed, the cleaning tool overlaps or forms an interference fit with the side walls 38 of the expansion joint.

In order to effect removal of the sealant by the cutting process of the present invention without excessive chipping and spilling of the concrete adjacent the joint, tool mounting means, generally designated 41, mounts tool 32 on arm 22 with cutting face 33 inclined toward the direction of advancement of vehicle 21 during cleaning of the joint, as indicated by arrow 42. Thus, the concrete cutting face of the cleaning tool is oriented by tool mounting means 41 to apply a forwardly and downwardly oriented cutting force on the side walls of the concrete defining the joint and on the upper surface of the concrete slabs adjacent the joint. Since concrete has relatively high strength and compression and relatively low strength and tension, the downward cutting force of the tungsten carbide steel cleaning tool results in a relatively clean severing of the side walls of the concrete joint without chipping or spalling of top surface 44 of the slabs, and the new side wall 38*a* is completely free of residue sealant and will readily accept new sealant. The only additional step after plowing with the cleaning apparatus of the present invention which is required is blowing the debris 46 from the side walls and bottom of the joint.

Unlike prior art plowing devices, which scrape the side walls and slope the cutting tool away from the direction of travel of the vehicle to attempt to pry the sealant up out of the expansion joint, it has been found that applying a forward and downward force with a concrete cutting tool will simultaneously remove all of the joint sealant material in the expansion joints and expose clean side walls to which new sealant can readily bond. While it may appear that the rubbery joint sealant material would be compressed downwardly into the joint and more firmly than ever lodged therein by the downward component of force of the forwardly inclined cleaning tool, the contrary has been found to be the case, and it is believed that shearing of the side walls to which the sealant is bound frees the sealant to be forced upwardly and out of the expansion joint with the sheared or cut-away side walls of the concrete.

As will be more fully set forth hereinafter, tool carrying arm 22 is preferably formed with a pantograph-type linkage which allows the cleaning tool to track or follow joint 28 notwithstanding slight deviations in the alignment of the tractor or vehicle 21 with the expansion joint. Additionally, it is preferable that the upper and lower portions of the cutting face are defined by spaced apart convergently tapering side cutting edges 47 and 48 having a width at end 36 less than the width of joint 28 and a width at portion 37 greater than the width of the joint. Still further, distal end 36 of the tool is preferably oriented with a cutting edge substantially parallel to the bottom of the joint, and the cutting face 33 of the tool has a substantially trapezoidal front cross-sectional area of greater width and heighth dimension than the joint, as best may be seen in FIG. 3. As so formed, the tool can initially be inserted into the joint to start the cut and a downward force applied through arm raising and lowering means 23 until the

tool begins cutting the concrete side walls and the distal end of the tool reaches the bottom 49 of the joint. It is further preferable that the tool be urged downwardly by means 23 until distal end 36 is below and overlapping the bottom 49 of the joint to cut a new bottom surface 49a which is also clean of sealant.

In order to insure cutting with the tungsten carbide steel cutting face, the cutting edges 47, 48 and 36 are preferably formed at substantially right angles to face 33, although it is even further preferred that the cutting tool taper from the front face to the rear so that the angles at the cutting edges are somewhat less than 90°. It should be noted further that cutting of the bottom surface 49 of the expansion joint is not as critical as obtaining clean side walls for the joint. If the sealant bonds to the side walls properly, foreign matter will not be able to enter the concrete joint, and it is often necessary to place a string or rope at the bottom of the joint in order to prevent the liquid joint sealant from running out through crack 29 before it solidifies.

The tapered side walls 47 and 48 of the cleaning tool tend to cause the tool to center itself in the concrete joint and carve substantially equal portions off the side walls of the joint, as long as the arm is free to move laterally by reason of the pantograph linkage.

To help control the vertical depth to which the tool is urged by raising and lowering means 23, it is preferable that the tool be formed with horizontally extending shoulders 51 on each side of the tool at a distance spaced from distal end 36 slightly greater than the vertical depth of joint 28. Thus, shoulders 51 will prevent the tool from being inserted too far into the joint by the operator.

The angle of forward inclination or rake employed to achieve the cutting action of the expansion joint cleaning method of the present invention can be varied in accordance with the conditions encountered. It has been found that the angle between a plane perpendicular to the top surface 44 of the concrete slabs and the cutting face, as shown in FIGS. 2 and 5 as angle alpha (α), should be at least 15 degrees and is preferably between about 20 and about 45 degrees. It has been found that the effect of increasing alpha (α) or the inclination of the tool face beyond about 60 degrees tends to cause the tool to be forced upwardly out of expansion joint 28 with a force sufficient to cause the tool face to ineffectively ride the top edge of the joint without providing effective cleaning or cutting. Conversely, reducing angle alpha (α) to near vertical tends to increase chipping and spalling of the concrete to an undesirable degree.

In order to hold the tool at the desired inclination, a preferred tool mounting means 41 includes an elongated member 52 having a tool 32 mounted at each end thereof, for example, by welding plate 53 over a channel in member 52 in which tool 32 is disposed. Positioned on either side of member 52 are a pair of arms 54 and 56, and member 52 is mounted therebetween by pin 57 which extends between the arms. Member 52 is free to pivot about pin 57 to any desired angle. Arms 54 and 56 are fixedly secured to transverse member 59 by fasteners, welding or the like. In order to limit the pivoting of member 52 about pin 57 and control the orientation of the cutting face of the tool, a bar member 61 is dropped between members 59 and 52. The width of the bar member can be selected to vary the angle alpha (α) at which the tool face is forwardly inclined or raked. Thus, if a thin bar 61 is employed alpha (α) increases, and if a thick bar member is employed alpha (α) decreases. The weight of bar member 61 and the substantial forces on the cleaning tool cause the bar member to be maintained in a position wedged between the blocks and the tool carrying member 52. The mounting of two tools in elongated tool carrying member 52 allows the operator to remove pin 57 and reverse the ends of tool carrying member 52 to allow a new tool to be used in addition to providing a means for controlling the angle of inclination of the tool.

Since the apparatus and method of the present invention comprise cutting away side walls of the expansion joint in order to remove the joint sealant and prepare the walls to receive new sealant, it has been found extremely desirable and advantageous to mount arm 22 to vehicle 21 by a mounting means which will allow the arm to track or follow the expansion joint without crowding or digging in preferentially to one side of the joint. To effect such a tracking of the expansion joint with the cleaning tool, it has been found preferable to employ a pantograph-type of linkage as part of the mounting means and raising and lowering means 23 for arm 22. As can be seen in FIG. 2, a plate 66, which is part of the frame of vehicle 21, has a hydraulic cylinder 67 mounted thereto by pin 68 and an arm 69, which is pivoted at pins 70 and 71, to allow extension of piston 72 therefrom. Fixedly mounted to arm 69, as by welding or the like, is an arm 73, and a second arm 74 is pinned at 76 to a frame element 77 on the opposite side of the vehicle, as may be seen in FIG. 1. Thus, the pair of arms 73 and 74 provide a frame which is pivotally mounted to the vehicle for articulation about a horizontal axis to effect raising and lowering of arms 73 and 74.

The pantograph linkage of the present invention is comprised of a first pair of vertically spaced parallel elements 81 and 82 pivotally mounted by pin 83 to bar members 84 and 85. Bar members 84 and 85 are fixedly secured to arms 73 and 74 for raising and lowering as a part of the frame to which the pantograph is mounted. A second pair of vertically spaced parallel elements 87 and 88 are pivotally mounted by pin 89 for articulation about a vertical axis at a spaced distance from pivotal mounting 83. Member 59 extends between and connects the distal ends 91 and 92 of the pairs of elements, and each pair of elements is pivotally secured to the connecting member 59 by a pin 93 or the like so that the pairs of pantograph elements are parallel. As so mounted, the pantograph elements will maintain tool 32 aligned in an orientation parallel to the direction of travel of the vehicle even if the vehicle is laterally displaced in its alignment with joint 28 by reason of driver errors or variances in the alignment of the joint.

In order to apply the downward force necessary to recut and form the concrete joint while removing the sealant, transverse element or bar 94 is formed and dimensioned to pass through vertically spaced pantograph linkage members 81 and 82 and members 87 and 88. Thus, raising and lowering of arms 73 and 74 by hydraulic cylinder 67 will cause bar 94 to urge the upper and lower surfaces of the pantograph members and apply a lifting or lowering force to the tool. Bar member 94 is further dimensioned for lateral sliding engagement of the pantograph members thereover so that it does not interfere with tracking of the pantograph ele-

ment while maintaining a downward cutting force on the cleaning tool. It is preferable, therefore, to lubricate the upper and lower surfaces of connecting bar **94** to insure that the pantograph elements will slide laterally over the same with relative ease.

As shown in FIGS. **1** and **2**, pantograph linkage element **87** is further formed with an ear **96** to which a manipulating rod **97** is attached. The operator may use the handle **98** on rod **97** to slide the pantograph linkage transversely until cleaning tool **32** is aligned with the expansion joint prior to lowering the cleaning tool into the expansion joint.

The expansion joint cleaning apparatus of the present invention can be readily attached to a number of different kinds of vehicles. Moreover, the pantograph linkage can conveniently be secured to the vehicle from a side thereof or in front of the vehicle, as well as from the rear. It can be advantageously employed, for example, with a tractor or tug which is commonly available at airstrips by mounting the arm and arm raising and lowering mechanism as shown in FIGS. **1** and **2** to the tractor. A tractor or tug weighing 6000 pounds and having an 80 horsepower engine with one operator has been found to be particularly advantageous. Such tractors with the apparatus of the present invention can be used to prepare joints for resealing at a rate of between about 2,000 feet per hour and about 3,000 feet per hour. It should be noted that prior art plowing devices in combination with necessary additional support equipment require a combination of five to ten men to produce at the above 2,000 feet to 3,000 feet per hour rate.

To effect most efficiently the removal of the sealant and cutting or redressing the joint side walls, without excessive chipping and spalling, it has been found more than one "pass" may be desirable. Initially the cutting tool face is preferably forwardly inclined a minimum angle (α) of 15° with angle alpha (α) increased to about 60° maximum for the final "pass."

To enlarge or reshape an existing joint to a more desirable cross section, i.e., widening an existing ¼ inch wide joint to ½ inch (a minimum Government Standard), the first pass would preferably be made with a cutting tool having a configuration as shown in FIG. **4** and inclined at an angle (α) of about 20° followed by a cutting tool formed as shown in FIG. **3** and inclined at about 45°, resulting in a final joint configuration as shown in FIG. **3**.

In addition, the term "vehicle" as used herein may include movable structures, such as power bridges and the like, which are commonly employed in highway construction and presently used to carry diamond concrete saws and other equipment. In power bridge applications the apparatus of the present invention could be mounted to be movable across the pavement spanned by the power bridge or longitudinally in the direction of movement of the power bridge down the pavement, and the pantograph linkage is again particularly advantageous in causing the cleaning tool to track the expansion joint.

It should be noted further that, while the cleaning tool of the present invention is particularly advantageously employed in cleaning expansion joints between adjacent concrete slabs, expansion joints are sometimes placed between a concrete slab and an asphalt slab, and the apparatus and method of the present invention can be employed with equal advantage in such applications.

Referring now to FIG. **4**, an alternative form of expansion joint and cleaning tool is illustrated. The expansion joint **101** is generally triangular in shape and includes crack **103** to complete the joint. Disposed in joint **101** is sealant material **102** in a manner as above described. The cleaning tool **105** is here formed with a triangular front cutting face **106** and has an end **107** which is initially easily inserted into the expansion joint. As the cutting tool is lowered into the expansion joint, the side walls of the tool **108** and **109** are dimensioned to begin engaging the side walls **111** and **112** of the expansion joint. With the end of the tool inserted beyond the bottom of the expansion joint, the cutting edges of the tool will be seen to overlap or be in interference fit with the side walls of the joint. Thus, with the tool inclined forwardly and the cutting face formed to cut concrete, the cutting face of the triangular tool will again remove sealant **102** by cutting away a portion of the side walls of the concrete slab to thereby expose clean sealant-free surfaces for resealing of the expansion joint. Obviously, still further joint constructions may be encountered from time to time and corresponding plowing tools employed to cut or shear away the side walls in order to effect removal of the sealant.

I claim:

1. In an apparatus for the cleaning of expansion joints between adjacent slabs of concrete including the removal of fillers and joint sealant compositions positioned in said joints, said apparatus including a vehicle, a tool carrying arm, means mounting said arm to said vehicle for manipulation of said arm and application of a substantial downward force to said arm, the improvement comprising:

a. a cleaning tool having a cutting face formed from material capable of cutting concrete, said cutting face being formed for insertion of a lower portion thereof into said joint; and

b. tool mounting means mounting said tool on said arm with said cutting face inclined toward the direction of advancement of said vehicle during cleaning in an amount sufficient to apply a forwardly and downwardly oriented cutting force which will effect cutting of the concrete adjacent said joint substantially without spalling the same.

2. An expansion joint cleaning apparatus as defined in claim **1** wherein,

said upper and lower portions of said cutting face are defined by spaced apart convergently tapering side cutting edges being spaced at a width at the distal end of said tool for insertion into said joint and spaced at a width mediate the heighth of said face causing an overlap of said cutting edges with opposed side walls defining said joint whereby both side walls of said joint may be simultaneously cut by said tool.

3. An expansion joint cleaning apparatus as defined in claim **1** wherein,

said face is formed by tungsten carbide steel and includes substantially right angle cutting edges on opposite sides thereof.

4. An expansion joint cleaning apparatus as defined in claim **1** wherein,

said tool mounting means is formed to mount said face at an angle of at least about 15° from a plane normal to the top surfaces of said slabs.

5. An expansion joint cleaning apparatus as defined in claim 1 wherein,

said tool mounting means is formed for selective adjustment of the angle at which said face is inclined toward the direction of advancement of said vehicle.

6. An expansion joint cleaning apparatus as defined in claim 1 wherein,

said arm and said means mounting said arm to said vehicle are formed as a pantograph linkage to allow said arm to move laterally with respect to said joint as said vehicle advances down said joint while maintaining said tool aligned parallel to the direction of travel of said vehicle.

7. An expansion joint cleaning apparatus as defined in claim 6 wherein,

said means for raising and lowering said arm includes an element transverse to said pantograph linkage and said element is formed to apply a downward force to said pantograph linkage while guiding said linkage for transverse movement.

8. An expansion joint cleaning apparatus as defined in claim 7, wherein,

said pantograph linkage and raising and lowering means are comprised of:

a. a frame pivotally mounted to said vehicle for articulation about a horizontal axis;

b. a first pair of vertically spaced parallel elements pivotally mounted adjacent a first end thereof to said frame for articulation about a vertical axis;

c. a second pair of vertically spaced parallel elements pivotally mounted adjacent a first end thereof to said frame at a spaced distance from said first pair of elements for articulation about a vertical axis;

d. a connecting member pivotally connected to said first and said second pairs of elements adjacent the distal ends thereof at an equal distance from said frame and a distance apart causing said first and second pairs of elements to be substantially parallel; and

e. said element transverse to said pantograph linkage is mounted to said frame and extends between said first and second vertically spaced pairs of elements mediately of said frame and said connecting member, said element transverse to said pantograph linkage being dimensioned for sliding lateral movement of said first and second pairs of elements thereover.

9. A method of cleaning fillers, sealants and debris from an expansion joint between adjacent slabs of concrete with a vehicle having means for manipulating a plow-type cleaning tool comprising the steps of:

a. selecting a cleaning tool having a cutting face formed of a material capable of cutting concrete and mounting said cleaning tool in said means;

b. positioning said cutting face in engagement with and overlapping a portion of at least one of a pair of opposed side walls defining said joint by manipulating said vehicle and said tool, and positioning said cutting face to be inclined toward the direction of advancement of said vehicle during cleaning of said joint sufficiently to substantially prevent spalling of said joint; and

c. applying a downward force to said cleaning tool while advancing said vehicle down said joint in inclined orientation to effect a downward and forward cutting force through said cutting face to cut away a portion of the side wall of said joint and remove material in said joint.

10. The method of cleaning expansion joints as defined in claim 9 wherein,

said cutting face is inclined from a plane normal to said slabs toward the direction of travel of said vehicle during cleaning at least about 15° and not more than about 60°.

11. The method of cleaning expansion joints as defined in claim 10, and

positioning said cutting face at a forward inclination of about 15°;

advancing said tool down a length of said joint;

repositioning said cutting face at a forward inclination of about 60°; and

advancing said tool a second time down said length of said joint.

* * * * *