This invention relates to concrete and other structures such as roadways, runways, walks, and the like, wherein expansion joints are provided to allow the concrete to expand, and such joints are filled or sealed with material which permits relative expansion and contraction occasioned by temperature changes, but maintains the joints sealed or sufficiently tight to exclude water from the joint and consequent weathering action.

Further, the invention relates to a machine for removing the sealing or other materials from the joints between sections of concrete or the like, and for filling the joint with new material in cold workable condition, leaving the upper surface of the filling material relatively rounded and smooth, but sufficiently low so that when maximum contraction occurs there will be no upstanding ridge or bulge which might cause the jolting of vehicles passing thereover.

Heretofore the fillings in joints between sections of walks, roadways, airfield runways and the like have been unsatisfactory for various reasons, including failure to fully protect from the weather, deterioration from temperature changes particularly from excessive heat, and creating a ridge or bulge in the roadway.

In the filling of joints of this character the material has been removed from the joints and the joints cleaned either by hand or with eroding or excavating mechanisms. This has been unsatisfactory from the viewpoint of expense, amount of time consumed, and durability and efficiency of the joint. Also, the filler has been in the nature of tar or similar substance, which first had to be heated and then applied in molten condition, thereby creating a fire hazard which sometimes resulted in the workmen being burned, produced noxious or objectional odors, and required a substantial lapse of time in order to permit the material to cool before traffic could be permitted.

It is an object of the invention to provide a relatively simple, inexpensive, machine which includes a power plant, can be self-propelled or can be pulled or propelled in some other desired manner, has a container or hopper for material to be injected into a joint to be filled, as well as joint excavating cleaning and filling mechanism easily accessible from the side of the machine and driven, along with the pump for discharging material in a cold state, from the power plant of the machine, whereby joints may be readily excavated, cleaned and filled in minimum time with material capable of withstanding temperatures of relatively high character corresponding to those produced by jet aircraft.

Another object of the invention is to provide a joint filling machine which can be readily employed for cleaning and filling joints of various sizes and configurations, in which the elements are readily adjustable, providing greater flexibility of the machine, and all resulting in reduced cost of operation and maintenance.

A further object of the invention is to provide a machine of the character described having a pilot gouger or excavator, a rotary power-driven excavating member providing traction for the machine, a power-driven rotary cleaning brush for cleaning out the joint, and an applicator behind the brush from which cold material or filling material may be injected into the joint to a level slightly below the surface with the filling material smooth so that due to its spacing beneath the surface of the joint it will not produce unevenness or a ridge causing bumping by a vehicle passing thereover, as well as a power plant mounted on the body of the machine for driving the various elements.

Other objects and the nature and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective illustrating one application of the invention;
FIG. 2 is a detail perspective of the applicator;
FIG. 3 is a perspective of the bottom of the applicator;
FIG. 4 is a transverse section through the applicator on line 4--4 of FIG. 2;
FIG. 5 is a detail perspective illustrating the relation of the pilot gouger, the traction providing cutter, the cleaning brushes, and the applicator;
FIG. 6 is a perspective of a slightly modified type of applicator;
FIG. 7, a perspective of a further modified form of applicator;
FIG. 8, a diagrammatic view illustrating a portion of the drive for the wheels of the machine;
FIG. 9, a fragmentary view on an enlarged scale and with parts in section for greater clarity showing the clutch for controlling the drive to the wheels of the machine;
FIG. 10, a fragmentary plan view showing the manner of maneuvering the wheels and the drive means therefor; and,
FIG. 11, a sectional view on the line 11--11 of FIG. 10 showing the over-running clutch provided in each wheel.

Briefly stated, the invention comprises a vehicle which may be self-propelled or provided with some other means of locomotion. Preferably it is provided with a supporting wheel at each side, and a guiding wheel at the front. A power plant such as, for example, a gasoline engine is mounted upon the forward portion of the body, and this power plant through reduction gearing serves to drive the various elements of the machine, as well as propel the machine itself.

The power plant through a dual speed transmission may be employed to drive a positive displacement pump for forcing the mastic or joint filler through a discharge tube to an applicator which may be wielded manually or disposed along the side of the machine in a definite position. The mastic may be supplied from a hopper and a tube to the positive displacement pump. The hopper is provided with a wall scraping agitator, also driven from the power plant.

The joint treating mechanism is disposed along the side of the machine and includes a practical, adjustable pilot gouger, a rotary excavator and traction member, and a brush ahead of the applicator. The gouger and rotary excavator are mounted on a vertically adjustable arm so that they may be disposed at the proper height.

A series of chains provide the driving force for the rotary excavator and the brush. The machine may have handlebars or hand grips at one end of the same such as, for example, at the rear, adjacent which may be disposed controls for the power plant.

With continued reference to the drawings, the invention comprises a wheeled vehicle having a frame supported for movement over a surface by means of wheels disposed one on each side of the vehicle, and with a front or caster wheel rotatably supported in a fork. The fork is revolvable in the lower end of a rod vertically adjustable in ears detachably fixed to the frame 10 by means of removable pins 16. These removable pins may be received in sockets in the rod 14.

The machine may be provided with a handle at-
tached to one of its ends as, for example, to the rear end of the frame of the vehicle as shown, and by means of which an operator may connect and guide the vehicle. The machine may be provided with a power plant such as, for example, a gasoline engine 18, by means of which the elements of the machine may be driven. The power plant may include a gear box 19 housing a two-speed drive for a shaft 20, having mounted thereon a sprocket wheel 20 which drives a larger sprocket 21 by means of a chain 32 and such larger sprocket operates a gear-type or other positive displacement pump 23 for feeding the joint filling material.

Upon the shaft 20 is mounted a grooved pulley 24 which drives a second pulley 26, by means of a V-belt 25. The pulley 26 through suitable gearing connections may operate an agitator (not shown) in a substantially conical hopper 27 for maintaining the filling material in condition to be fed through a tube 28 to the pump 23.

Power is supplied to the two-speed transmission from the power plant by means for reduction gearing (not shown) and a sprocket wheel 29 mounted on the shaft 30 which drives the chain 31.

The gear box or transmission 19 controls the gear ratio and thereby the speed of rotation of the shaft 20 under the influence of an operating lever 32 connected by a cable 33 such as a Bowden wire or the like, to a gear-shaft or control lever 34 on the handle 17. This makes it possible to control the power plan by means of a cable 35 connected to control means (not shown) on the handle 17.

Projecting upwardly from the frame 10 and fixed thereto is a post or column 36 provided with openings 37 at suitably spaced intervals. The upper end of the column 36 may be maintained in position by a brace 38 connected to other portions of the frame. An L-shaped bracket 39 is provided and has an enlargement at one end with an opening 40 for receiving the column 36 and permitting vertical adjustment of the bracket relative thereto. The bracket 39 may be secured in fixed relation to the column 36 by means of a pin or set screw 41 passing through a threaded opening in the bracket and into one of the openings 37 for allowing vertical adjustment.

At the lower end of the bracket 39 a shaft 42 is rotatably maintained in a bearing extending through the bracket along the axis substantially parallel to the axis of the wheels 11 and a rotary cutter 43 having cutting teeth 44 is removably maintained on the shaft 42 for operation therewith for performing a cutting operation and serving to drive the vehicle forward.

The portion of the shaft 42 extending toward the frame is provided with a sprocket 45 fixed to such shaft and connected by means of chain 46 to a sprocket 57 fixed to the shaft 30. It will be evident that shaft 30 is mounted for rotation in suitable bearings 48 and 49.

An arm 50 extends forwardly from the lower end of the bracket 39, and adjustably receives a post 50' which carries a pilot gauge 50" held in place by a suitable set screw. The pilot gauge 50' serves to remove excess filling material in the joint to be excavated and filled. A second arm 51 extends rearwardly from the lower end of the bracket 39 and is connected by means of a universal joint 51' to a third arm 52 connected by means of a universal joint 53 to a fourth arm 54 so that there may be a lateral swinging between said arms without relative rotation thereof. A suitable bearing 55 is located on arm 52 intermediate the ends thereof and rotatably supports a shaft 55' which carries removable brushes 56 and 57. The shaft 55' is rotated by means of a chain 58 engaging a sprocket 58' on shaft 55' and another sprocket 58" on shaft 42 whereby the brushes 56 and 57 are rotated in the same direction as the rotary cutter 43 as indicated by the arrow.

An extensible strut comprising a cylinder 59 and having a pivotable connection 62 to ears mounted on arm 52 controls the relative vertical position of the brush with respect to the cutter 43. This extensible strut may include a spring for normally biasing the rod 61 toward its operative position or it may include a fluid cylinder for controlling the relative positions of the parts thereof. The pivotable connections 60 and 62 allow limited lateral movement of the arm 52 so that the brush 56 may be angularly offset with respect to the plane of the cutter 43.

In order to dispense the filling material into the joint, an applicator is provided having a discharge nozzle 63 formed in one end of an elbow 64 which has a pivotal connection 65 with the fourth arm 54. The pivotal connection 65 in conjunction with the universal joint 53 allows lateral movement of the applicator to permit the machine to turn a corner.

The nozzle 63 is maintained at a predetermined depth in the joint by a plate 66 mounted by its leading end on the elbow 64. The plate 66 is adapted to span the joint and rest on the upper surfaces of the pavement. An ear or lug 67 is provided on the plate 66 at the trailing end and at one side thereof and to which lug a piston rod 68 is pivotally connected while its cooperating cylinder 69 is pivotally connected to an L-shaped bracket 70 having an aperture 70' in an elongate column 71 supported at one end receiving a column 71' supporting the base of the frame. The bracket 69 is adjustably vertical and may be held in fixed adjusted position by a pin or set screw 72 passing through an opening in the bracket and into one of a series of openings 73 in the column 71. It will be apparent that a downward pressure from the cylinder 68, which may be either mechanical or a fluid type, will seat the plate 66 in intimate contact with the surface of the pavement or structure adjacent the joint being filled and will prevent the filling material from exuding above the surface.

A flexible tube 74 is connected at one end by means of a nipple 75 to the elbow 64 of the nozzle and the other end of the flexible tube 74 is connected to an outlet nipple 76 of a shut-off valve 77 which is in communication with the outlet of the gear pump 23 by a pipe 77A. A suitable by-pass 78, which may have a pressure relief valve therein, is arranged between the outlet and inlet of the gear pump to prevent damage in the event the shut-off valve is completely closed or some unexpected obstruction occurs.

Referring more particularly to FIGS. 2 to 4 inclusive, it will be observed that the plate 66 is provided with a rib 79 (FIG. 3), extending longitudinally thereof substantially in line with the axis of the arm 52. The rib 79 extends into the groove or crack between the sections of concrete or the like. The nozzle 63 projects downwardly from the plate 66 approximately the depth of the crack to be filled and its lowermost portion is open and an elongated notch or opening 80 is provided on the rear side of the nozzle, being open at said joint and extending upwardly to adjacent the plate 66. At the forward side of the nozzle another opening or notch 81, of materially less height than notch 80, is provided to permit observation of the nozzle during the time that filling material is discharged therefrom as well as to permit the discharge of filling material in operation of the nozzle it will be evident that the filling material is forced thereto by means of the pump 23 and the amount of filling material discharged is accurately controlled by the speed of operation of the pump, the rate of movement of the machine along the ground, the shape of the nozzle and the controlling effect of the rib 79. Plate 66 and the plate 70 whereby the groove or crack may be accurately filled to the desired height, the bypass 78 prevents excessive discharge from the nozzle.

The nozzle 63 shown in FIG. 3 is somewhat more elongated in the direction of movement to allow a greater amount of controlled confinement of the filling material
so that such material may exude or be discharged from a substantially greater area.

In FIG. 2 a wand 83 of a hollow relatively rigid tube is connected to nipple 75 to permit manual operation of the nozzle 63 and the plate 66. The supply hose 74 may be high pressure and flexible for permitting the manual operation of the nozzle 63 and plate 66 by means of the hollow wand or handle 83 whereby joints which have been excavated may be filled further.

In FIG. 6 a further modification of an applicator nozzle and a controlling rib are shown and may comprise a triangular nozzle tip 64 which may be formed by cutting a tube at an angle to the axis thereof and using a continuation of such tube to provide an elbow 65 having a connection 66 for joining the nozzle to a source of filling material under pressure. Plate 87 may be of generally convex contour on its underside for projecting into a joint or groove for preventing the filling material from overfilling the groove and for maintaining the desired contour of the upper surface on the filling material in the groove.

The modification shown in FIG. 7 includes a nozzle 88 projecting downwardly from a concave-convex plate 89 and with an elbow 90 projecting upwardly for providing a connection by means of threads 75 to a flexible tube or a tubular wand as above described. The construction of FIG. 7 is particularly useful where joints of varying sizes are to be filled since the generally continuous convex surface 91 of the plate 89 may engage the edges of the groove or joint regardless of the width thereof and the filling material will be depressed below the surface of the concrete slab or other structure.

Referring particularly to FIG. 5, the cutter 43 is shown in the operation of removing the objectionable groove filling material from a joint in a concrete slab 92 and such cutter is rotated in the direction shown by the arrows in FIGS. 1 and 5 to provide an automatic feed for the entire machine while removing the old filling material from the groove or while increasing the size of existing grooves or making new grooves. The brush 56 extends into the groove 93 while the brush 57 engages the surface of the slabs 92 for removing any surface obstructions therefrom so that the plate 66 may be maintained in contact with such slabs and the rib 79 may project into the groove.

The cutter 43, brush 56, and plate 66 are maintained in the groove even though the groove be of irregular shape. The universal connections at 51 and 53 permit such adjustments to occur automatically. Furthermore, the nozzle 63 projects into the groove and the joint filling material is discharged therefrom through the bottom end as well as through the trailing opening or notch 80 while the rib 79 prevents the filling material from projecting above the surface of the filling material as shown at 94 in FIG. 5.

There is provided a new and useful machine for filling joints or grooves in new construction as well as replacing objectionable joint filling material which extends above the surface of the adjacent slabs in existing structures. The machine may be used for forming additional expansion joints in existing construction to prevent buckling and the amount of expansion space necessary between adjacent slabs may be predetermined and different sizes of cutters may be used as required. The completed joint avoids the objectionable bump which may be observed on roads where heated fillings materials are poured into the joint with large portions thereof on the upper surface. The present invention overcomes these objections and provides a satisfactory solution to a long existing problem.

In airplane runways particularly, the high temperature from the jet type power plants produces such excessive heat that the existing types of joint filling materials do not resist such heat and remain in place.

Since it is highly desirable that means be provided for positively driving the ground engaging wheels 11 to propel the apparatus over the ground, the wheels 11, as best shown in FIG. 10, are rotatably mounted on an axle 95 which in turn is supported by tubular shafts 96 and 97 which may be secured to the frame 10 of the apparatus by U-bolts or other suitable fastening means 98.

As best shown in FIGS. 10 and 11, the ground engaging wheels 11 are each provided with a hub 99 having a plurality of internal ratchet teeth 100, each tooth presenting an abutment 101 which abutments are connected by cam surfaces 102. As stated above, the wheels 11 are rotatably on the axle 95, and in order to transmit driving power from such axle to the wheel, there is provided in each end of the axle 95 a slidable pawl 103, the ends of which are beveled in opposite directions as shown at 104, pawl 103 and teeth 100 constituting an over-running clutch.

Mounted upon the axle 95 for driving the same is a pulley 107 engaging a V-belt 106 which in turn engages a pulley 107 mounted upon the power shaft 20 extending from the transmission 19.

The pulley 107 constitutes a clutch for selectively transmitting power to the wheels 11, and pulley 107 comprises a portion 108 fixed to the shaft 20, and a complementary portion 109 slidably mounted on the shaft 20 for movement toward and from the portion 108. Portions 108 and 109 are provided with complementary tapered surfaces 111 and 111 which serve to engage the belt 106 to drive the same, this driving engagement being accomplished by movement of the portion 109 toward the portion 110.

In order to move portion 109 toward and away from portion 110 there is provided a bell crank lever 112 pivoted to the chassis 10, one arm 114 of the bell crank lever 112 being provided with a yoke 115, the arms of which engage in a groove 116 in the portion 109 of pulley 107. The other arm 117 of bell crank lever 112 connects to a control cable 118 which is enclosed in a housing 119 leading to a control handle 120 mounted on the handle bar 17 in a position convenient to the operator. Actuation of the control handle 120 will serve to move the portion 109 of pulley 107 toward or from the portion 108 to engage or disengage the belt 106, thereby controlling the transmission of power from the motor 18 to the wheels 11.

As is well known when a vehicle turns a corner, the outer wheel must travel at a higher rate of speed than the inner wheel, and the pawl and ratchet mechanism above described in connection with FIGS. 10 and 11 serves to compensate for this movement of the outer wheel in that engagement of the teeth 100 with the abutments 101 of the teeth 100 on the inner wheel will continue to drive this wheel and the action of the operator in turning the apparatus will cause the outer wheel to move at a faster rate and thus cause the beveled surface 104 of the pawl 103 to engage one of the cam surface 102 thereby sliding the pawl 103 through shaft 95 into the space provided by an opposite tooth 100. This constitutes an over-running clutch action and as long as the speed of rotation of one wheel exceeds the speed of rotation of axle 95 the over-running action will continue, but upon movement of the apparatus in a straight line, both of the pawls 108 will engage an abutment 101 and both wheels 11 will serve to drive the apparatus over the ground.

The above described mechanism represents a relatively simple and inexpensive drive for an apparatus of this type and permits complete control thereof by the operator to start or stop movement of the apparatus over the ground and also permits turning thereof in any desired path of movement.

It will be obvious to those skilled in the art that various changes may be made in the invention, without departing from the spirit and scope thereof, and the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.
What is claimed is:

1. A machine for cleaning and filling joints comprising a frame, ground-engaging supporting wheels for movably supporting said frame on a surface, power means on said frame, a vertically adjustable bracket projecting from said frame and having a substantially horizontal bearing, a shaft rotatably mounted in said bearing, a cutter mounted on said shaft, a vertically adjustable pilot gauge mounted on said bracket, arm means projecting rearwardly from said bracket, a nozzle pivotally connected to the rear end of said arm means and projecting downwardly therefrom, a ground-engaging plate extending rearwardly from said nozzle and having a downwardly projecting rib in alignment with said nozzle on the lower side of said plate, a rotatable brush mounted in a bearing of said arm means, means connecting said cutter and said brush to said power source for operating the cutter and brush in a direction to feed the machine forwardly, and means for supplying joint filling material under pressure to said nozzle whereby the machine will excavate the joint to uniform dimensions and fill the same in a manner that substantially all of the filling material will be below the upper portion of the joint.

2. A machine for cleaning and filling joints comprising a frame, ground-engaging supporting wheels for movably supporting said frame on a surface, power means on said frame, a vertically adjustable bracket projecting from said frame and having a substantially horizontal bearing, a shaft rotatably mounted in said bearing, a cutter mounted on said shaft, arm means projecting rearwardly from said bracket, a nozzle pivotally connected to the rear end of said arm means and projecting downwardly therefrom, a ground-engaging plate extending rearwardly from said nozzle and having a downwardly projecting rib in alignment with said nozzle on the lower side of said plate, a rotatable brush mounted in a bearing of said arm means, means connecting said cutter and said brush to said power source for operating the cutter and brush in a direction to feed the machine forwardly, and means for supplying joint filling material under pressure to said nozzle whereby the machine will excavate the joint to uniform dimensions and fill the same in a manner that substantially all of the filling material will be below the upper portion of the joint.

3. An attachment for a wheeled vehicle comprising a first bracket for adjustable connection to the vehicle and having a bearing at its free end extending transversely to the direction of movement of the vehicle, a rotatable cutter mounted in said bearing for engagement with a supporting surface for excavating a groove therein, an arm extending rearwardly from said first bracket and having a bearing thereon, a rotating brush mounted in said bearing of said arm, a nozzle connected to said arm and having a discharge portion opening downwardly and rearwardly and closed at the front and sides, said nozzle projecting downwardly for penetration into an excavated and cleaned groove for filling the same, means connecting said brush and cutter to a source of power on said vehicle, and means for supplying filling material from said vehicle to said nozzle.

4. Means for filling a joint comprising a plate having a rib projecting from one side thereof, a nozzle projecting from the same side of the plate and in substantial alignment with said rib, said nozzle having a discharge portion opening downwardly and rearwardly in the direction of said rib and closed at the front and sides, the said nozzle being of a width to extend into a joint to be filled and accommodating the plastic material under pressure whereby the said nozzle and plate may be moved together for filling a joint and said rib serving to limit the height of the filling material in the joint.

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