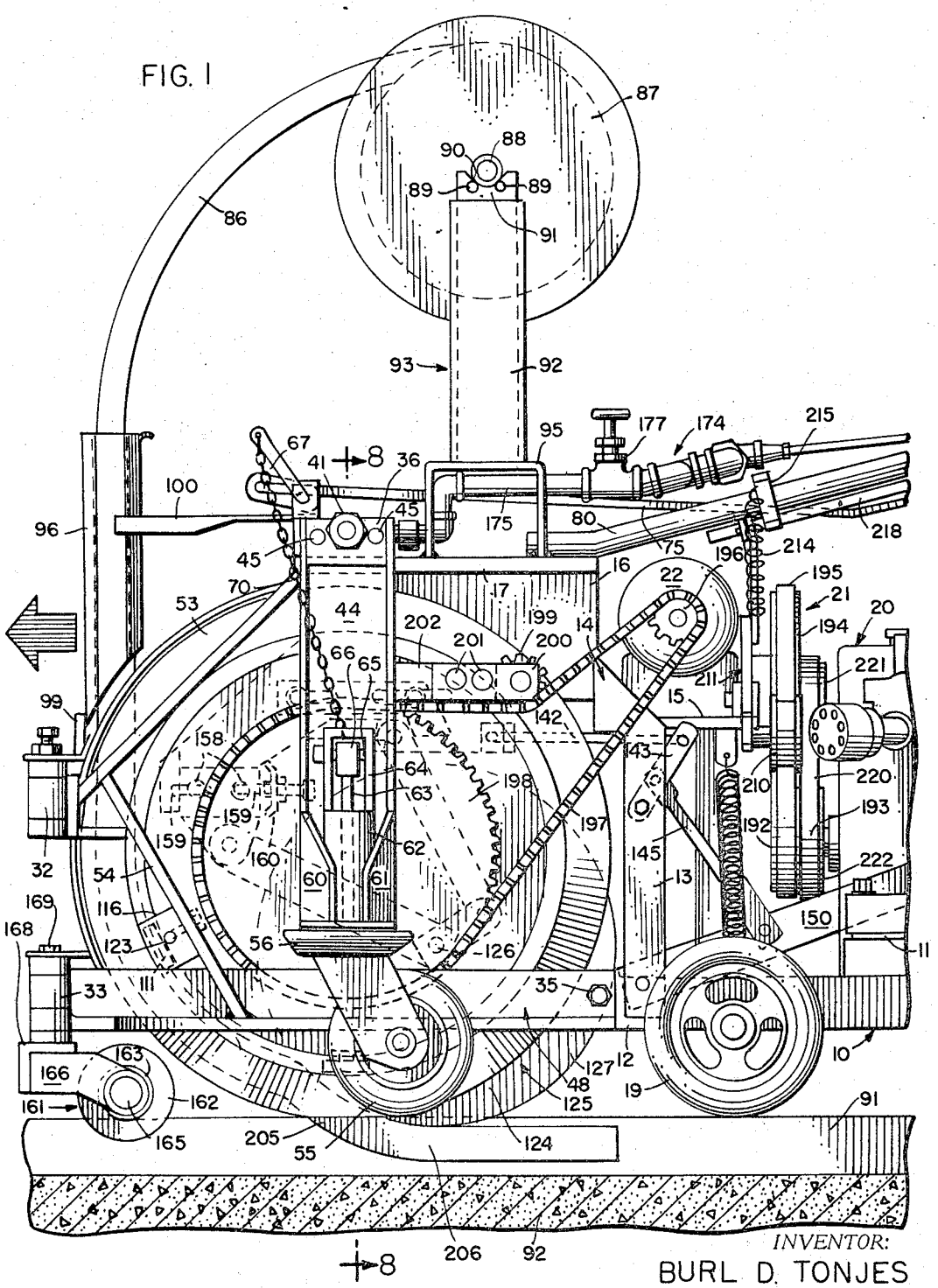
Feb. 13, 1968 B. D. TONJES 3,368,465

MACHINE FOR INSERTING ELONGATED LATERALLY COMPRESSIBLE STRIPS IN CONCRETE JOINTS, AND THE LIKE

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FIG. 1




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FIG. 2

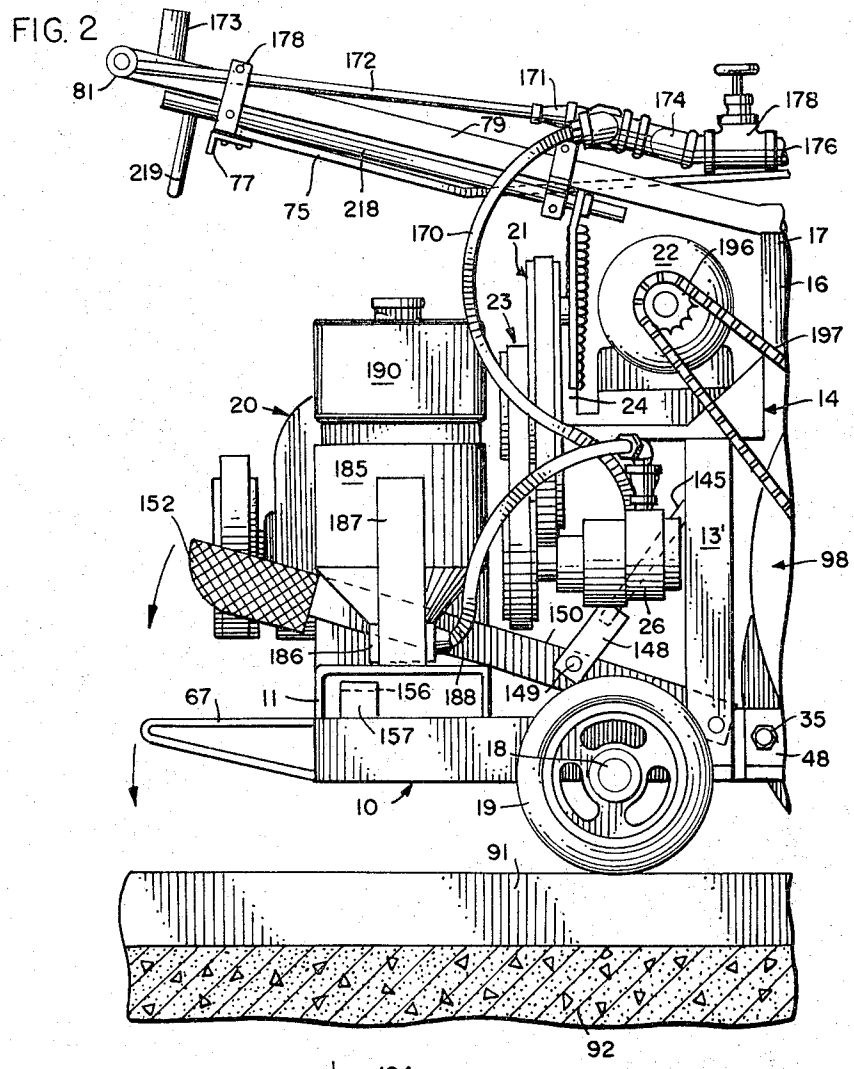



FIG. 3

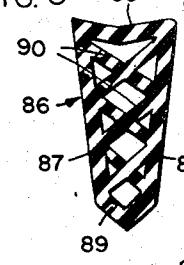



FIG. 4

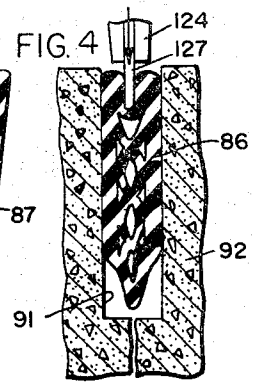
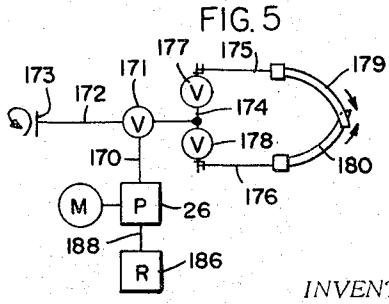



FIG. 5




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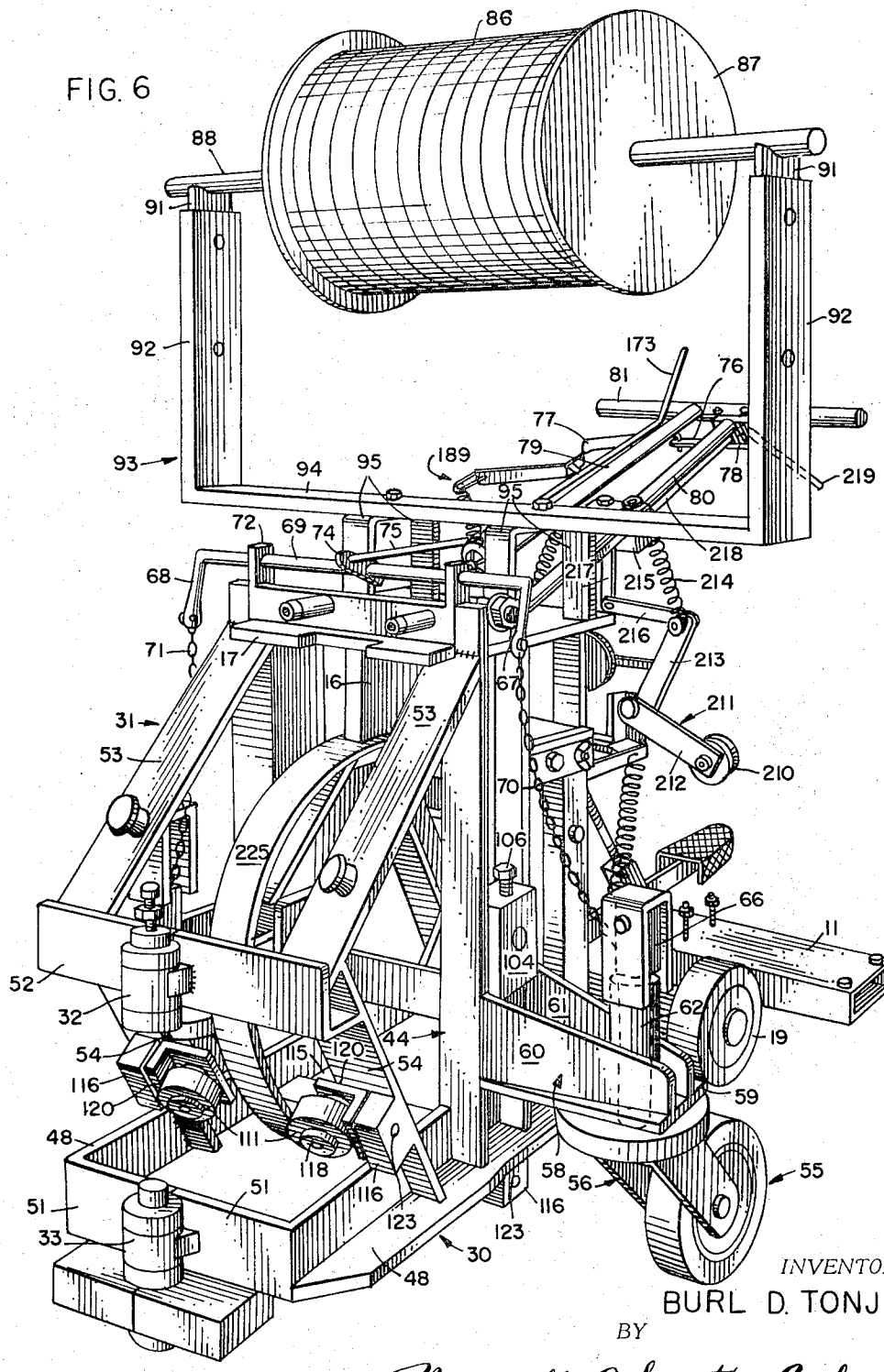
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FIG. 6




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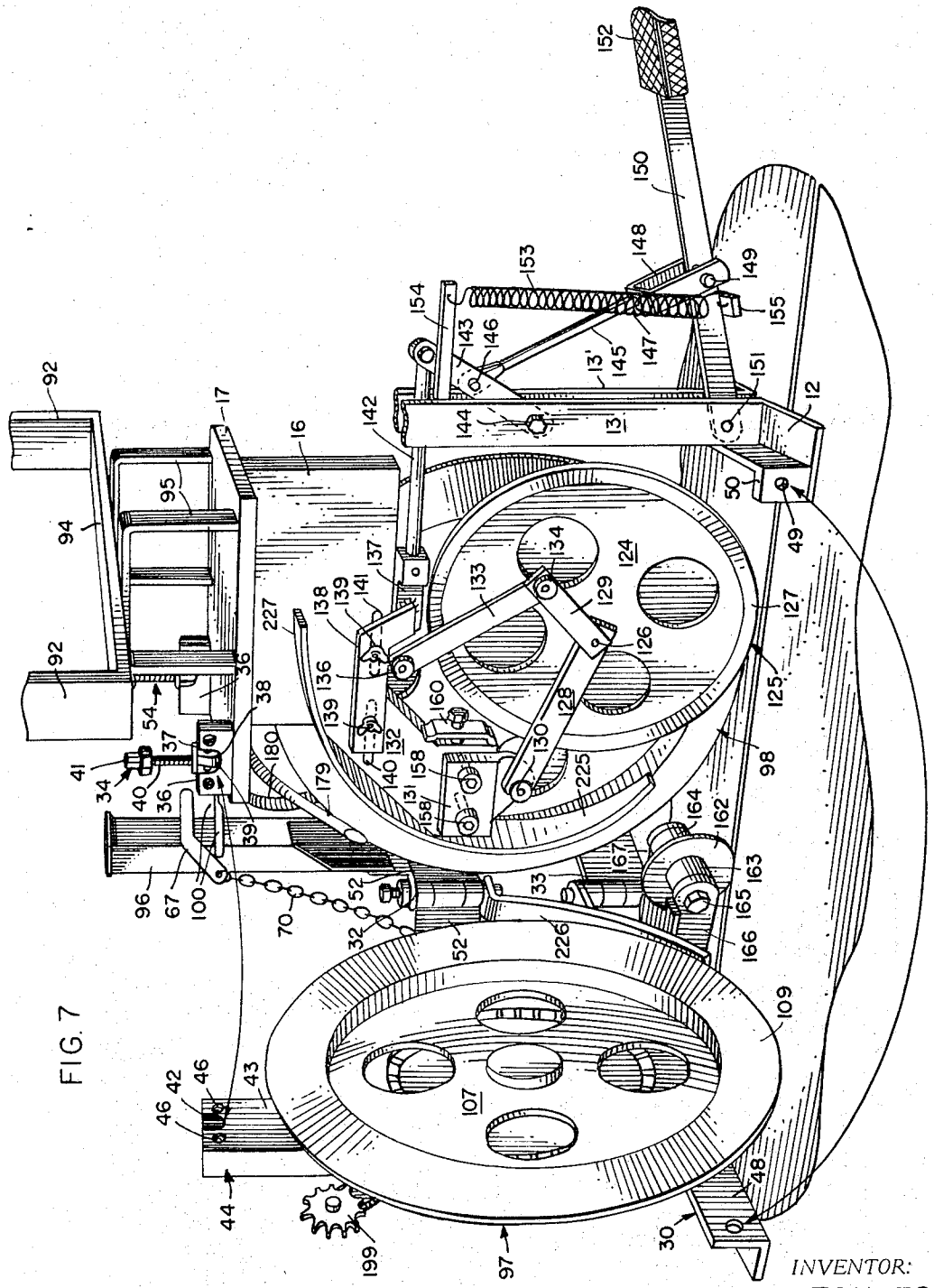


FIG. 7

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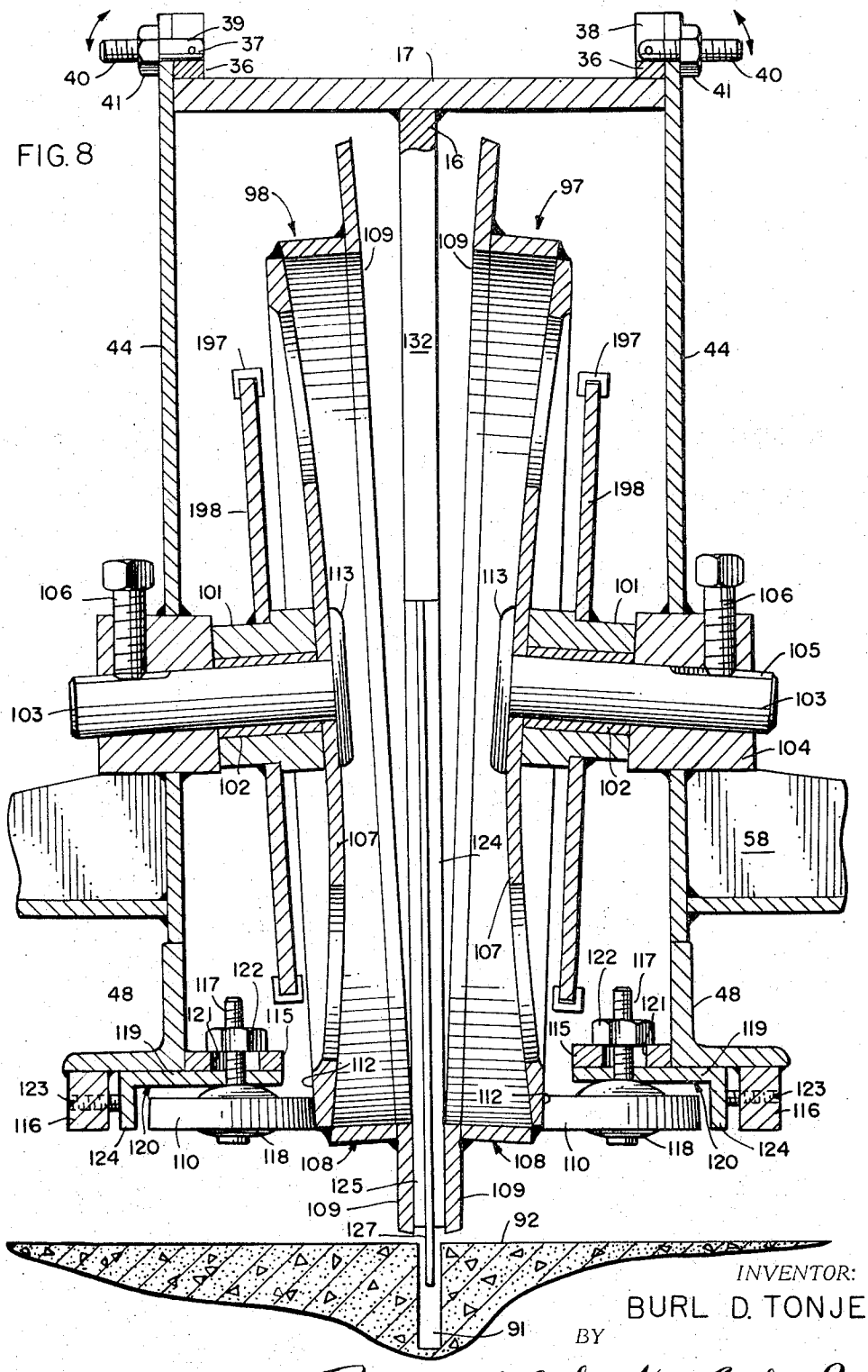
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FIG. 8




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FIG. 9

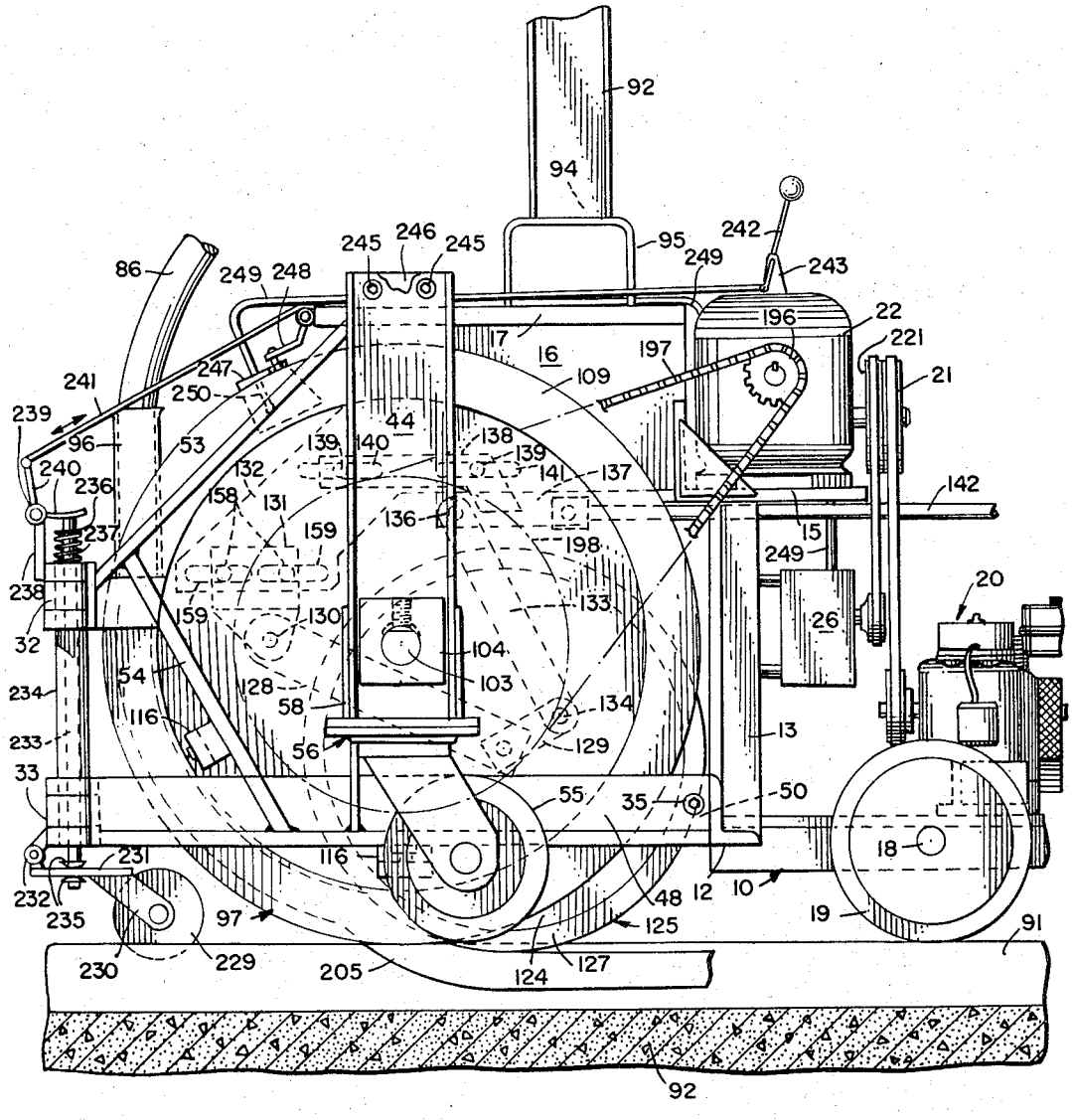
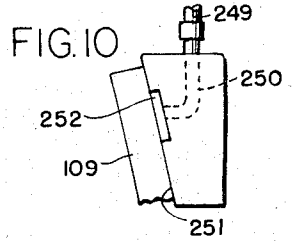



FIG. 10




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Patented Feb. 13, 1968



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# MACHINE FOR INSERTING ELONGATED LATERALLY COMPRESSIBLE STRIPS IN CONCRETE JOINTS, AND THE LIKE

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Filed Jan. 3, 1966, Ser. No. 518,444
19 Claims. (Cl. 94—39)

## ABSTRACT OF THE DISCLOSURE

Machine for inserting laterally compressible strips in concrete joints embodying (a) power driven, canted compression discs; (b) rearwardly eccentrically mounted narrow discharge wheel, preferably with a thin edge, between discs with up and down and forward and rearward adjustability; (c) pressure rollers operating against periphery of outer faces of compression discs; (d) hinged frame; (e) lubricant applying means; (f) front guide member or wheel; (g) strip feed guide means on front portion of frame adjacent canted discs; and (h) wheel adjustability for raising canted discs to roll the machine over surfaces when not in strip-inserting operation.

This invention in general relates to machines for inserting elongated, laterally compressible strips in slots or grooves, especially in expansion and contraction joints and the like in concrete roadways, concrete airstrips, concrete floors and the like. More particularly, the invention pertains to portable machines adapted to move along the slots or grooves while laterally compressing and inserting into such slots or grooves resilient, laterally compressible, elastomer strips therein and to processes embodying the folding of the flexible, upper wall of said seals about the edge of a discharge wheel to eject the laterally compressed strip into the joint and related improvements.

In recent years, there have been developed for use as expansion and contraction joint seals tubular-like elastomer strips which are inserted into the joints to seal them against instrusion by water, dirt and the like. The sides of the joint seal strips are in tight, sealing contact with the side walls of the slots forming the joints.

This invention pertains to machines and processes in which strips of the aforesaid character are fed from a spool or other source, laterally compressed between rotating, converging discs to a width narrower than the slot or groove forming the joint, and ejected in the compressed state from said discs by a thin edged discharge wheel rotating eccentrically between the converging discs. Upon such ejection, the strip expands outwardly against the side walls of the joint.

The machines of the invention embody many new innovations as will be hereinafter described with relation to the specific embodiments illustrated in the drawings. Among such innovations may be listed the following features:

(a) Canted, strip-compression discs embodying a rim portion between which the strip is laterally compressed and pressure rollers or idler wheels rotating against said discs to keep the discs and their bearings from bending, warping or otherwise distorting under the high force of compression reqiured to compress the laterally compressible strip;

(b) Lubricant application to opposite sides of the laterally compressible strip and/or the surfaces of the converging discs between which said strip is compressed to make possible the ejection of the laterally compressed strip by the eccentrically mounted, discharge wheel;



(c) A hinged, frame structure facilitating the quick opening of the strip-compression portion of the machine for repair and/or adjustment;

(d) Mechanism for horizontally or vertically adjusting the position of the discharge wheel;

(e) Provision of a front guide wheel or member adapted to ride in the joint for guiding travel of the machine along the joint and mechanism for elevating the strip-compression discs by raising the front portion of the frame;

(f) Front support wheels on the machine and mechanism associated therewith whereby the front support wheels may be raised or lowered relative to the machine frame to accomplish the raising and/or lowering of the front end of the machine;

(g) Mechanical means for raising the discharge wheel from its lower, operative position between the canted, compression discs to inoperative position to allow the machine to be rolled on its support wheels without damage to the discharge wheel;

(h) The combination of canted, strip-compression discs having a thin-edged discharge wheel eccentrically positioned therebetween near the area of closest convergence of said discs, whereby the discs compress a hollow elastomer strip with a tight, inward fold in its upper wall and the thin edge of the discharge wheel enters the right fold in the upper wall to engage the sides of the thin edge with the sides of the fold with sufficient friction to cause said strip to be ejected in its laterally compressed state from the compression discs; and

(i) The provision of strip-guide shoes between the canted discs at the strip-feed zone to prevent fouling of the feed of the strip into the canted discs.

Among the new innovations in processes for inserting said strips in concrete joints and the like may be listed the following features:

(a) The step of lubricating the sides of the seal and/or the compression disc faces in contact therewith in a manner whereby the laterally-compressed strip does not slip in orbit with the discs, yet will slip enough to be ejected by the discharge wheel;

(b) The lateral compression of the aforedescribed hollow, elastomer strip between the rotating compression discs in a manner whereby the elastomer top will of the strip is folded tightly inwardly and the ejection thereof in the laterally compressed state via peneration of the right fold by the thin edge portion of the eccentric discharge wheel; and

(c) In the most preferred form, the insertion of the laterally compressed strip in the joint with a longitudinal compression force in the strip, which is provided by power drive of the compression discs, and rearward pushing action thereof against the inserted strip on the short strip portion being ejected by the discharge wheel.

It is accordingly a primary object of this invention to provide machines and processes of the aforesaid character embodying one or more of the aforesaid features. Another object of the invention is to provide machines for laterally compressing and inserting into a slot or groove an elongated, laterally compressible strip which is fed to the machine during the strip-inserting operation. A still further object of the invention is to provide improvements in mechanisms for laterally compressing and inserting laterally compressible strips into slots or grooves. A particular object of the invention is to provide improvements in processes for inserting elongated, tube-like elastomer strips in a laterally compressed state into expansion and contraction joints in concrete.

The foregoing and numerous other important objects, advantages, features, and inherent functions of the inven-

tion will be apparent as the same are more fully understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a side elevation of a preferred embodiment of the machine with the rear portion thereof shown in fragment;

FIG. 2 is a side elevation of the rear portion of the opposite side of said embodiment;

FIG. 3 is a transverse cross-section through a webbed, elongated, elastomer strip which may be inserted into slots or grooves by the illustrated embodiment;

FIG. 4 is a transverse section of a joint in concrete and illustrates the strip of FIG. 2 being inserted therein;

FIG. 5 is a schematic view of the lubricant application system of the embodiment;

FIG. 6 is a perspective, front view of the frame elements of the machine;

FIG. 7 is a side, perspective view of a fragment of the machine and shows one side of the hinged frame swung to open position;

FIG. 8 is a cross-section taken on section plane 8—8 of FIG. 1;

FIG. 9 is a side elevation of another embodiment; and

FIG. 10 is a side elevation of a lubricant applicator block and a segment of the rim to which the lubricant is applied.

Referring to the drawings, the embodiment of FIGS. 1–8 is described in subsections comprising a frame and wheels, the compressible strip feed unit, the compressible strip discharge wheel, the front guide wheel, and the lubricant system.

*Frame and wheels*

The illustrated machine comprises a rear underframe **10** supporting a rear, cross frame channel **11**. A front angle iron **12** extends across the forward edge of the rear underframe **10** and is rigidly connected therewith. A pair of contiguous, spaced angle iron supports **13**, **13'** are rigidly mounted on the front angle iron **12**. The supports **13**, **13'** rigidly support a frame subassembly **14** having a platform **15** and also rigidly support a center plate **16** projecting forwardly and lying substantially in the vertical, longitudinal plane through the machine. The center plate **16** has rigidly joined to its upper edge a horizontal support plate **17**.

The rear underframe **10** has an axle **18** on which is rotatably supported the rubber-tired, rear wheels **19** of the machine. An internal combustion engine **20** is mounted on the frame channel **11** and is connected by a belt and pulley drive **21** to a reduction gear of a conventional reduction gear box **22**. The shaft **24** for the reduction gear is connected by a belt and pulley takeoff drive **23** to a lubricating pump **26** (FIG. 2) mounted on the angle iron supports **13**, **13'**.

The front part of the frame comprises, besides the center plate **16**, a pair of side frame subassemblies **30** and **31** pivotally joined by front hinges **32** and **33**, whereby each frame subassembly **30** or **31** is individually pivotable about a vertical axis through the hinges **32** and **33**. FIG. 7 shows frame subassembly **30** in outwardly pivoted position.

Frame subassemblies **30** and **31** respectively are held rigid with the center plate **16** and support plate **17** by bolts **34** and bolts **35**. Bolts **34** each have a pivot head **39** pivotally supported in saddle **36** (rigidly mounted on top plate **17**) by means of a pivot pin **37** extending across the U-recess **38**. Bolts **34** each have a threaded shank **40** on which is threaded nut **41**.

In lock position, each shank **40** lies in a U-recess **42** in the upper edge of the rear wall **43** of the vertical, U-channel **44** of the respective frame subassembly **30** and **31**. The front faces of saddles **36** have two studs **45** which enter apertures **46** in the rear face **43** of U-channel **44** to provide proper alignment when the frame subassemblies are in lock position. Nuts **41** are drawn tight against the front face of rear wall **43**.

To unlock the frame subassemblies, nuts **41** are loosened sufficiently to allow bolts **36** to be pivoted out of U-recess **42**, e.g., to upstanding position as shown in FIG. 7.

Bolts **35** are conventional bolts respectively extending through a hole in the rearward edge of the bottom, L-channel **48** with the bolt shank threaded in tapped hole in block or plate **50**, the latter in turn being rigidly attached to the rear frame channel **12**.

The respective frame subassemblies **30** and **31** can be best seen in FIGS. 1 and 6. Each comprises the aforesaid vertical, U-channel **44** having its lower end rigidly welded to bottom, L-channel **48**. The latter, in turn, is connected to lower hinge **33** by a front plate **51**. The upper hinge **32** is connected to each frame subassembly **30** and **31** by a front L-channel **52**, which is rigidly joined to U-channel **44** by a pair of converging frame bars **53** and **54**.

The front wheels **55** comprise rubber tire wheels which can swing about on casters **56**. The respective casters **56** are mounted near an end of outrigger arm **58** comprising bottom plate **59** and spaced, side plates **60** and **61** rigidly joined together and to U-channel **44**.

Each bottom plate **59** rigidly supports a vertical tube **62**, which serves as a bearing for the vertical shaft **63** of caster **56**. Shaft **63** is rotatable in tube **62** and freely axially slidable therein. Casters **56** are settable in two different, vertical positions relative to their respective frame subassemblies **30** and **31**. The up-position is shown in FIG. 1. The down-position is shown in FIG. 6. The up-position is used when the machine is laying elastomer strip in the concrete joint. The down-position is used to tilt the machine in a manner raising the front end of the machine so that the machine can be rolled on the four wheels **19** and **55** from one joint to the next or the like.

The tubes **62** each have a U-bar **64** rigidly mounted on their respective upper ends. A pin **65** extends between the side legs of each U-bar **64**. The pin pivotally supports a block **66** within U-bar **64**. The casters are placed in down-position (FIG. 6) by tilting the machine so as to raise its front end. A U-shaped step plate **67** attached to the rear frame **10** is provided for this purpose (FIG. 2). When the machine is so tilted, casters **56** drop down by virtue of the free axial slidability of respective shafts **63** in respective tubes **62**. Blocks **66** are permitted to swing by gravity to vertically downwardly hanging position as shown in FIG. 7. In such position, the respective upper ends of shafts **63** abut the respective lower ends of blocks **66**, thereby holding casters **56** in down-position and keeping the machine tilted upwardly from rear to front.

The blocks **66** are pivoted about 90° toward the center of the frame to allow the casters to move to up-position (FIG. 1). This is done by rotating the arms **67** and **68** on pivot rod **69** in an upward direction to pivot blocks **66** via chain links **70** and **71**. Pivot rod **69** is pivotally supported at the front edge of top plate **17** by plate bearings **72**, which are mounted on cross-bar **73**, the latter being secured to plate **17**.

Pivot rod **69** has an arm **74** attached thereto at the center portion. Arm **74** is connected by rod **75** to a pivotable lever **76** having a handle **77** at its free end and being pivotally mounted at its other end to the underside of block **78**. The latter is mounted on the handle rod **80** of handle rod pair **79** and **80**, which rods are rigidly attached at the forward ends thereof to the top plate **17** and to the handle bar **81** at the rearward ends thereof. The pivotal movement of lever **76** is transmitted through rod **75**, pivot rod **69**, and chains **70** and **71** to pivot the blocks **66**.

*Compressible strip feed unit*

A type of laterally compressible strip for use in sealing roadway joints is illustrated in FIGS. 3 and 4. The

strip 86 is an extruded elastomer strip having downwardly tapered side walls 87, a top wall 88, and a V-shaped bottom wall 89. These elongated walls are interconnected by a network of diagonally oriented, collapsible, elongated webs 90 having therebetween triangular and diamond-shaped elongated hollow spaces when the strip is in the normal, uncompressed state as shown in FIG. 3. The webs 90 collapse when the strip 86 is laterally compressed as is shown in FIG. 4, which illustrates the strip in the slot or groove 91 of a roadway joint in poured concrete 92.

The strip 86 is coiled on a spool 87, which is supported by rod 88. Each end of rod 88 is rotatably supported on a pair of wheels in the upper recess 90 of respective bars 91. The latter are secured to vertical legs 92 of the U-bracket 93, the base leg 94 of which is removably mounted on mounting brackets on the top plate 17. The strip 86 is fed from the spool 87 through a vertical tube 96 mounted immediately above the forward, outer edges of the canted discs 97 and 98 by L-bracket 99 and a pair of brace arms 100.

These canted discs are rotatably journalled on the respective, vertical, U-channels 44. Referring particularly to FIG. 8, each disc 97 and 98 has a hub 101 containing sleeve bearing 102. The hub and sleeve bearing are rotatably mounted on a stub axle 103, which is rigidly mounted in a mounting block 104. Each mounting and thrust block 104 is rigidly mounted in a respective, vertical channel 44. The outer end of each stub axle 103 has a flat portion 105, against which bears the inner end of set screw 106 in mounting block 104.

The inner end of each fo the hubs 101 is rigidly connected to a symmetric central disc plate 107 having a peripheral flange 108. The axes of axles 103 are at a small, acute angle to the horizontal, whereby the disc pair comprising the canted discs 97 and 98 converge most closely at the bottom portions of said discs and diverge the greatest distance at the top portions thereof (FIG. 8).

The members of the canted discs 97 and 98 which apply the lateral compression to the strip 86 are the rims 109. As shown particularly in FIG. 8, the rims 109 are oriented so that their strip-contacting faces are substantially parallel and lie substantially in the vertical plane as each portion of the rim is at the bottom point of revolution. This orientation of the rims 109 affords the best arrangement for ejection of the strips at the bottom point of revolution of the rims.

The forces required to laterally compress strips of the nature of strip 86 between the rims 109 are substantial. Therefore, each disc has two pressure rollers 110 and 111 bearing against the outer edge 112 of the central disc plate 107. Rollers 110 and 111 may press against rims 109, if desired. The rollers 110 and 111 resist the spread thrust against compression discs 97 and 98, which occurs when strip 86 is compressed therebetween. Rings 113 are rigidly secured on the inner ends of stub axles 103 to prevent the compression discs from falling off these ends of the stub axles.

Each pressure roller 110 is mounted on the underside of the respective frame channel 48. Each pressure roller 111 is mounted on the respective frame bar 54. The details of the roller mounting for rollers 110 are shown in FIG. 8. The same type of mounting is used for mounting the rollers 111 on the respective frame bars 54.

Referring to FIG. 8, rollers 110 are mounted on plates 115, which are rigidly welded to the inner sides of frame channels 48. A block 116 is welded to the underside of each frame channel 48. The respective threaded shafts 117 of rollers 110 extend from hubs 118 of the rollers 110 through legs 119 of L-bars 120 and through slots 121 in plates 115. The rollers 110 and L-bars 120 are held on the undersides of respective plates 115 and channels 48 by nuts 122. A set screw 123 is threaded in each block 116, the inner end of which bears against the leg 124 of the respective L-bar 120. The set screws 123 hold the rollers in the desired position under the lateral thrust forces which occur in lateral compression of the strip.

The rollers 111 are mounted on the frame bars 54 by the same structures. Accordingly, like numerals designate like parts.

*Strip discharge wheel*

A strip discharge wheel 125, which accomplishes the ejection of the strip 86 from the bottom portions of the canted discs 97 and 98, is mounted for rotation about an axis eccentric to the axes of discs 97 and 98 on the shaft 126. The shaft 126 is displaced rearwardly with respect to the stub axles of discs 97 and 98.

As the strip is fed continuously into front portions of discs 97 and 98 through tube 96 and is carried by said discs to the bottom portions thereof, the opposing faces of the respective rims 109 converge and laterally compress the strip. The discs 97 and 98 are arranged so that the respective, opposite segments of the faces of the rims 109 converge to the narrowest spacing substantially at the lower portions of the discs and diverge to a widest spacing at the upper portions thereof (see FIG. 8). Thus, the strip 86 is laterally compressed to its narrowest width at the bottom portion of the discs. At this point the laterally compressed strip is ejected from the essentially parallel faces of compression discs by the discharge wheel 125. The sides of the main disc body 124 of discharge wheel 125 are in close fit with the essentially parallel compression faces of rims 109, whereby extrusion of the compressed rubber strip into the spaces therebetween is precluded.

As can be noted, particularly from FIG. 8, the lower edges of the discs 97 and 98 do not enter the slot or groove 91. Because of the strength requirements for the rims 109 of discs 97 and 98, in order to achieve the strip compression function, the compression discs 97 and 98 do not enter the slot or groove 91, but rather are spaced slightly above the surface of the roadway 92 contiguous to the upper edges of the slot or groove 91.

As the strip 86 is compressed, its upper wall 88 folds inwardly into a tight fold in a manner shown in FIG. 4. The thin edge 127 of discharge wheel 125 enters the fold, and the sides of the thin edge 127 frictionally engage the folded sides of the top wall 88 of the strip 86. This frictional engagement causes the strip 86 to be urged from the compression discs and to be ejected from the discs and pressed into slot or groove 91 substantially as shown in FIG. 4.

In this machine, therefore, the thin edge 127 of discharge wheel 125 is substantially narrower than the laterally compressed width of the strip 86 which it ejects and is also substantially narrower than the closest spacing between the rims 109 of the canted discs 97 and 98. The bottom portion of the discharge wheel 125 is below and rearwardly of the bottom edges of discs 97 and 98.

As can be best seen in FIG. 8, the main disc body 124 of discharge wheel 125 is wider than the axially-centered, thin edge 127. The sides of the radially outer portions of main disc body 124 rotate in close fit relative to the inner faces of rims 109. This close fit has proved advantageous for keeping portions of the elastomer strip 86 from extruding between said sides and faces under the intensive compression forces which occur when strip 86 is laterally compressed.

The discharge wheel 125 and its shaft 126 are mounted on a linkage which allows the wheel 125 to be raised and lowered between operable and inoperable positions. This raising and lowering is provided so that the thin edge 127 can be raised above the lower edges of the wheels of the machine so that it will not interfere with or be damaged by movement of the machine during non-operating periods, e.g., in moving the machine from one roadway joint to another. Furthermore, this linkage embodies mechanisms for adjusting the depth of penetration of the slot or groove 91 by the thin edge 127 of the discharge

wheel to control the depth of insertion of strip 86 when the discharge wheel is in operative position.

The aforesaid linkage and associated mechanism can be seen in FIGS. 1 and 7. It comprises a pair of angularly disposed and rigidly interconnected arms 128 and 129 on opposite sides of the discharge wheel 125. The outer ends of arms 128 are pivotally mounted on pin 130, which is supported by bracket structure 131 on the forwardly and downwardly sloping tongue 132 of the center plate 16. The arms 129 respectively are pivotally connected to pivot arms 133 on opposite sides of the wheel 125 by a respective pin 134. The upper ends of arms 133 are pivotally connected by pin 136 to a block 137. The block 137 has two, parallel guide plates 138 rigidly attached to opposite sides of the block 137 and with the horizontal portions thereof slidably resting against opposite sides of the center plate 16. The guide plates 138 are connected by bolts or pins 139 extending through horizontal elongated slots 140 and 141 through the center plate 16. The slots 140 and 141 and pins 139 form a sliding guide for the guide plates 138 and the block 137 supported thereby. The block 137 is moved back and forth by an actuator rod 142, which is connected to the block 137.

The rod 142 is pivotally connected at its other end to an end of pivot arm 143. The other end of pivot arm 143 is pivotally mounted on pin 144 between the frame supports 13, 13'. A link rod 145 is pivoted at one end by pin 146 on the mid-portion of pivot arm 143. At its other end, it is coupled by a threaded coupling 147 to the cross-leg of a U-yoke 148. The side legs of U-yoke 148 are pivoted by pin 149 on the mid-portion of foot-treadle arm 150, the forward end of which is pivoted by pin 151 between frame supports 13, 13'. The rear end of arm 150 has a foot tread plate 152.

A coil spring 153 is connected at its upper end to a bar 154, which is rigidly supported on frame supports 13, 13', and at its lower end to bar 155 on the foot-treadle arm 150, thereby urging the treadle arm to up-position. It is held in down-position by hooking the arm 150 under the downwardly hooked end 156 of catch plate 157 (FIG. 2), which is mounted below arm 150 on the rear frame structure between channel frame sections 11.

When treadle arm 150 is in up-position, discharge wheel 125 is in the non-operative, up-position. When it is pushed to down position and held therein by hooking arm 150 under hooked end 156 of catch plate 157, the plates 138 have moved rearwardly and thereby have caused the linkages of arms 128, 129, and 133 to move wheel 125 down into operative position. The depth to which edge 127 penetrates the slot or groove 91 can be adjusted by shortening or lengthening the total length of rod 145 and U-yoke 148 by means of threaded connection 147.

The brackets 131 are held on tongue 132 by two bolts 158 extending respectively through horizontal slots 159 in the tongue. This permits back and forth adjustment of brackets 131, whereby the discharge wheel 125 can also be shifted back and forth relative to canted discs 97 and 98 to effect adjustments in the strip discharge. Since strip 86 exerts a rearward thrust against the discharge wheel, it is preferred to provide on the rear side of tongue 132 a set screw or bolt assembly 160 to block rearward slippage of the brackets 131 after they have been tightened by bolts 158.

*Front guide wheel*

The machine is guided as it moves along the slot or groove 91 by a front guide wheel 161, which comprises a narrow wheel 162 which is narrower than the width of the slot or groove 91 and rollers 163 and 164 of smaller diameter. The front guide wheel 161 is rotatably mounted on axle 165 which is supported on arms 166 and 167 extending downwardly and rearwardly from the wheel mounting bracket 168. The latter is mounted on the lower end of hinge pin 169 of lower hinge 33.

The narrow wheel rides in the slot or groove 91. It need not have an exact fit because the machine needs only general directional guiding. The weight of the front of the machine is carried by the rollers 163 and 164, which roll on the upper surface of concrete 92 on opposite sides of the slot or groove.

*Lubricant system*

As aforestated, the pressures exerted against the sides of the strip 86 by the rims 109 of the canted, strip-compression discs 97 and 98 are very great. Hence, there is a great friction force between the side walls 87 of the compressed strip and the contacting faces of the rims 109. This makes it difficult, and sometimes impossible, to eject the strip 86 by the discharge wheel 125. It has been found on occasion that even when the strip 86 is ejected without lubrication, the strip 86 does not seat properly in the groove or slot 91.

Therefore, the lubricant system of the invention is a practical necessity. This lubricant system comprises a lubricant line 170 leading from lubricant pump 26 to shut-off petcock 171. The latter is operated by a rod 172 which extends back to handle 81 where it can be rotated by rod handle 173 (FIG. 6).

Lubricant pumped through the petcock 171 divides in pipe manifold 174 into two pipe branches 175 and 176, each having a manually operable, flow control valve 177 and 178, respectively. Each pipe branch terminates in thin wall tubing 179 and 180, each of which has an end 181 cut at an angle (FIG. 7) so that each end 181 rides substantially flat against the respective, inner, strip-compression face of rim 109 of compression discs 97 and 98. The lubricant system is illustrated schematically in FIG. 5.

Alternatively, the application of the lubricant strip or ribbon to the faces of rims 109 may be done by applicator blocks of the type of blocks 247, as hereinafter described in the embodiment of FIG. 9. and illustrated in FIG. 10.

The illustrated lubricant system applies lubricant to provide enough lubricity to allow strip 86 to be ejected from discs 97 and 98 relatively easily. For purposes of the invention, the lubricant can be applied to the sides 87 of strip 86 and/or to the inner faces of rims 109. Preferably it is applied as a narrow strip of lubricant film near the outer edge of rims 109 so that some area of the contacting portions of rims 109 and the sides 87 are not lubricated. This gives enough friction to assure that strip 86 will not slip as it is drawn around by the discs 97 and 98. The quantity of lubricant applied to each rim 109 can be adjusted by the respective valves 177 and 178.

The lubricant film is wiped cleanly off the faces of rims 109 as the strip is ejected. The lubricant preferably is a relatively viscous, non-greasy fluid which leaves upon drying a non-greasy residue having a high coefficient of friction.

The lubricant is supplied from a reservoir 185 having a well 186. Lubricant is drawn from the well 186 into pump 26 via the flexible tube 188. The reservoir 185 is supported on the frame channel 11 by a pair of vertical support arms 187. A can of lubricant (not shown) may be inverted thereon with a suitable gasket or other connection to the can whereby the lubricant will be drawn out of the can by the pump suction. An assembly 189 of a bracket arm and a coil spring half-loop (FIG. 6) may be used to hold the inverted can on the reservoir.

*Propulsion*

The machine is powered by a gasoline engine 20 having a gasoline tank 190. The drive shaft 193 of the engine drives drive pulley 192, which in turn drives pulley 194 via V-belt 195. Pulley 194 drives the gear reducer 22, which has small drive sprockets 196 on opposite sides thereof. The latter drive the chains 197 and the large sprockets 198, which are fixedly mounted on the respective hubs 101 of strip-compression discs 97 and 98. Chains 197 are deflected by the respective idler sprockets 199,

which are journalled on arm 200. The latter is bolted by bolts 201 to arm 202, which is rigidly welded to vertical frame channel 44. The idler sprocket 199 may be disengaged by removing one bolt 201 when it is desired to remove the chain 197, e.g., when opening the frame as shown in FIG. 7.

It will be noted that only the strip-compression discs 97 and 98 are driven in the embodiment as illustrated. Support wheels 19, 55 and 161 are not driven. The invention contemplates, however, the coupling of the power drive to one or more support wheels for advancing the machine at a rate equal to or slightly greater than the lineal rate of feed of strip 86 into the slot or groove 91. In the latter case, the strip 86 may be stretched slightly in the longitudinal direction as it is forced into the slot or groove 91.

As aforesaid, however, the preferred method of inserting the strip involves backing the machine to one end of the slot or groove with discharge wheel 125 at or just behind said end. The power is applied to the strip-compression discs, and the strip 86 is fed and pressed into the end portion of the slot or groove 91. From there on, the machine advances under its own power by virtue of the aforedescribed pushing of the rearwardly advancing, discharged strip portion 205 (FIG. 1) "pushing" against the inserted, tightly seated portion 206 of strip 86. Such method eliminates longitudinal stretch of the elastomer strip.

The drive belt 195 is tensioned in driving engagement with pulleys 192 and 194 by tensioner pulley 210, which is mounted on one leg 212 of pivotable, L-arm 211. The other leg 213 is coupled by tension spring 214 to a split bar coupling 215 mounted on handle arm 80, which spring urges pulley 210 to non-tensioning position. The leg 213 is also coupled to link arms 216 and 217, the latter being rigidly joined to rod 218, which is rotatable in the split bar couplings 78 and 215. When handle 219 of rod 218 is drawn up against handle 81, the rod 218 activates link arms 216 and 217 and L-arm 211 to swing pulley 210 into tensioning engagement with belt 195 and thereby activate the power drive of discs 97 and 98.

Pump 26 is driven by belt 220 and its pulleys 221 and 222 (FIG. 1). Pulley 221 is coupled to the same shaft as pulley 194, whereby the pump is motivated only when the strip-compression discs 97 and 98 are being driven. This arrangement automatically stops and starts feed of lubricant concurrently with the stopping and starting of rotation of the discs 97 and 98. Pump 26 preferably is a low pressure, constant volume pump driven directly by pulley 222 or via a slip clutch, if desired.

*Strip feed guide shoes*

In its preferred form, the elastomer strip 86 is guided during the initial portion of its travel in the strip-compression discs 97 and 98 to keep the strip from "snaking," i.e., bending and fouling between the upper portions of discs 97 and 98. For this purpose, the machine has opposing, longitudinally curved guide shoes 225 and 226. Guide shoe 225 is a tapered, longitudinally circularly curved tongue having forks 227 on opposite sides of frame plate 16, which are welded thereto. The tapered edges of guide shoe 225 fit just behind the inner side flanges 108.

The guide shoe 226 is coupled to the lower end of upper hinge 32. It is a longitudinally circularly curved, tapered tongue having its tapered edges closely following the outer edges of rims 109 from the vicinity of upper hinge 32 to the approximate point where discharge wheel 125 begins to force the laterally compressed strip 86 from rims 109. The widths of guide shoes 225 and 226 are narrow enough to permit movement of the compression discs 97 and 98 to the narrowest, desired spacing.

*Embodiment of FIGURE 9*

This embodiment operates on the same principles as those for the embodiment of FIGS. 1–8. It illustrates practice of the generic invention by a somewhat different mechanical structure. Where applicable, like numerals in FIG. 9 illustrate like parts previously described for FIGS. 1–8.

The structures in FIG. 9 which differ in detail from the embodiment of FIG. 8 include the following:

(a) The casters 55 are not vertically movable relative to the outrigger arms 58. The movement of the machine between concrete joints is achieved, instead, by raising the discharge wheel 125 and the front guide wheel 229 and rolling the machine on wheels 19 and casters 55. If desired, a front support wheel (not shown) may be provided, which front support wheel can be lowered to elevate the front of the machine and to roll the machine on rear wheels 19 and the lowered front wheel after raising discharge wheel 125 and front guide wheel 229.

(b) The machine is guided as it moves along the slot or groove 91 by a front guide wheel 229 which is narrower than the width of the slot or groove 91. The front guide wheel 229 is rotatably mounted on arms 230 extending downwardly and rearwardly of rear portion of the wheel mounting plate 231. The front edge of the plate 231 is connected by hinge 232 to the lower, front hinge 33, and the arm 231 and the wheel 229 thereon may be swung about a horizontal pivot axis. A vertical rod 233 extends through the tube 234, which extends through hinges 32 and 33 and acts as the hinge pin therefor. Rod 233 is connected at its lower end by nuts or other suitable fasteners 235 to the plate 231 in a manner whereby the rod 233 will not bind the pivotal movement of plate 231. The upper end of rod 233 projects above upper hinge 32 and has near its upper end a fixed ring 236. A coil spring 237 is mounted about the upper end of rod 233 and presses outwardly against ring 236 and the upper surface of hinge 32. The spring 236 acts through rod 233 to urge the wheel mounting plate 231 and the wheel mounted thereon to upwardly retracted position.

The wheel 229 is lowered by an actuator mechanism including a vertical support arm 238 rigidly attached to upper hinge 32. A support pin 239 pivotally supports L-arm 240, one leg which bears against the upper end of rod 233. The other leg of the L-arm 240 is connected to a cable 241, the other end of which is connected to the pivot arm 242 of the front guide wheel locking control 243, the latter being mounted at any suitable place on the machine frame. When the pivot arm 242 is pushed forwardly, the L-arm 240 pushes rod 233 downwardly and lowers wheel 229. When the pivot arm 242 is pivoted rearwardly, the pressure on the upper end of rod 233 by L-arm 240 is released, whereby the spring 237 urges the rod 233 upwardly to pivot plate 231 and wheel 229 upwardly from the position shown in FIG. 9.

The wheel 229 need not bottom in slot or groove 91. It need only penetrate the slot or groove to the depth substantially as shown in FIG. 9 whereby the sides of the wheel slide along the side walls of slot or groove 91 to guide the machine.

(c) The hinge front frame subassemblies in FIG. 9 are essentially the same as frame subassemblies 30 and 31. Each frame subassembly is bolted in fixed position by removable bolts as previously described. In FIG. 9, however, the attachment of the upper end of vertical frame channels 44 is done by two bolts 245 which are threaded into tapped blocks 246, the latter being welded to the top plate 17 immediately behind the upper ends of the respective frame channels 44.

(d) The lubricant applicators in FIGS. 9 and 10 comprise, for each compression disc 97 and 98, a molded plastic applicator block 247 having an applicator face pressing against the inner face of respective rims 109. These blocks 247 are mounted between the discs 97 and 98 by a hinge arm 248 attached to the front portion of the horizontal plate 17. The lubricant applicator blocks 247 apply a thin film of appropriate lubricant to rims

109 of discs 97 and 98 as the latter rotate at points thereon prior to contact of rims 109 with the strip 86 being fed therebetween.

The rim-contacting face 251 of each applicator block has a groove 252 extending from front to rear, into which groove the relatively viscous lubricant from pump 26 is fed via flexible tubing 249 and communicating passage 250 in the applicator block.

(e) Actuator rod 142 for raising and lowering discharge wheel 125 is merely a push-pull rod having any suitable means at the rear portion thereof to lock it in at least one forward position and at least one rearward position.

It will be appreciated from the previous description that the machines and processes of the invention herein have many advantages. In addition to those previously described, it will be appreciated that the machines are transportable readily from job-to-job by small trucks or even by light plane. The casters 55 are located on the machine frame so that they contact the concrete surface just behind the place at which the discharge wheel 125 begins to force the strip 86 into slot or groove 91 when the machine is travelling forwardly (FIGS. 1 and 9). To start that strip in the end of a slot or groove 91, the machine is backed along the slot or groove to the end with discharge wheel 125 right at the end. In backing, casters 55 swing around 180° from the positions illustrated, whereby they remain on the concrete surface and support the machine. Feed of strip 86 is begun, but the machine will not advance until the initial portion of the strip 86 is forced into the end of the slot or groove 91. At this point, with the initial portion of strip 86 seated in the end of the slot or groove, the machine begins to advance by virtue of the forward thrust imparted through the strip, as previously described. The same technique is used in butt-splicing of ends of strips in the same slot or groove. The embodiments utilizing only the aforesaid thrust from the inserted strip have an advantage in butt-splicing in that the end of the strip being inserted is thrust rearwardly against the abutting end of the previously inserted strip.

The discharge wheel 125 may be one in which the peripheral edge is the same width as body portion 124 (without the narrow edge 127). In such case, the periphery may be smooth, serrated or sinuous. With such discharge wheels, the strip 86 is pushed out of the strip-compression discs 97 and 98 by pressure of the peripheral edge against the upper surface of the laterally compressed strip.

A discharge wheel with a narrow edge or rim 127 is much preferred, however, because it centers the laterally-compressed strip and holds it centered as it is forced from discs 97 and 98 into slot or groove 91, aids in achieving proper inward fold of the top wall 88 of the strip 86, provides a relatively large surface area for frictional engagement of the folded top wall 88 and the discharge wheel to facilitate ejection from discs 97 and 98, and securely grips the strip in proper shape of the latter before the laterally compressed strip begins its ejection from discs 97 and 98.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the forms herein disclosed being preferred embodiments for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. A portable machine for inserting an elongated, laterally compressible strip in an elongated concrete joint, which comprises, in combination, a frame, a pair of opposed, canted, strip-compressing discs, axle means rotatably mounting said strip-compressing discs on said frame with said discs canted in spaced, downwardly converging relationship, power drive means for rotatably driving said discs into the bottom area thereof, the axis of rotation of said discharge wheel being rearwardly eccentric relative to said axle means, and support wheels on said frame for rolling said machine along said joint as the strip is progressively ejected by said discharge wheel and forced into said joint with the lower edges of said discs closely adjacent to and above the concrete on opposite sides of said joint.

2. A portable machine for inserting an elongated, laterally compressible strip in an elongated concrete joint, which comprises, in combination, a frame, a pair of opposed, canted, strip-compressing discs, axle means rotatably mounting said strip-compressing discs on said frame with said discs canted in spaced, downwardly converging relationship, power drive means for rotatably driving said discs, a narrow discharge wheel rotatably mounted between said discs for ejecting downwardly therefrom a laterally compressed strip as it is carried by said rotating discs into the bottom area thereof, the axis of rotation of said discharge wheel being rearwardly eccentric relative to said axle means, support wheels on said frame for rolling said machine along said joint as the strip is progressively ejected by said discharge wheel and forced into said joint, and a pressure roller mounted on said frame contiguous to the bottom of each strip-compressing disc, each roller rolling against the outer face of its respective disc near the periphery thereof to resist warping or bending of said discs during lateral compression of said strip.

3. A portable machine as claimed in claim 1, said discs each comprising a disc body having on its peripheral edge a flange directed toward the opposite disc and a radially outwardly extending rim on each flange, the opposing faces of said rims constituting the strip-compressing faces of said discs, and said rims being substantially parallel in the bottom area of said discs.

4. A portable machine as claimed in claim 3, and a pressure roller mounted on said frame contiguous to the bottom of each strip-compressing disc, each roller rolling against the outer face of its respective disc near the periphery of said disc body to resist warping or bending of said discs during lateral compression of said strip.

5. A portable machine as claimed in claim 1, and means to apply lubricant on the strip-compressing faces of said discs.

6. A portable machine as claimed in claim 5, said means to apply said lubricant comprising a pump for pumping liquid lubricant while said discs are rotating, lubricant applying means for applying pumped, liquid lubricant on said strip-compressing faces prior to contact thereof with said strip, and conduit means for conveying pumped lubricant from said pump to said lubricant applying means.

7. A portable machine for inserting an elongated, laterally compressible strip in an elongated concrete joint, which comprises, in combination, a frame, a pair of opposed, canted, strip-compressing discs, axle means rotatably mounting said strip-compressing discs on said frame with said discs canted in spaced, downwardly converging relationship, power drive means for rotatably driving said discs, a narrow discharge wheel rotatably mounted between said discs for ejecting downwardly therefrom a laterally compressed strip as it is carried by said rotating discs into the bottom area thereof, the axis of rotation of said discharge wheel being rearwardly eccentric relative to said axle means, support wheels on said frame for rolling said machine along said joint as the strip is progressively ejected by said discharge wheel and forced into said joint, said frame including opposite side frame sections, said axle means comprising stub axles mounting each strip-compressing disc on a side frame section, hinge means mounting at least one of said side frame sections

on the frame of said machine whereby said side frame section with its stub axle and strip-compressing disc can be swung open on said hinge means, and coupling means releasably coupling the swingable portion of said side frame section to said frame.

8. A portable machine as claimed in claim 1, a machine frame member between said strip-compression discs, movable arm means supporting said discharge wheel on said last-mentioned frame member for movement of said discharge wheel between an upper, inoperative position and a lower, operative position, the lower edge of said discharge wheel projecting below the contiguous edges of said strip-compressing discs when said strip-ejector disc is in said operative position and being raised thereabove in said inoperative position, and manually operable activating means accessible externally of said strip-compressing discs for moving said arm means to raise or lower said discharge wheel.

9. A machine as claimed in claim 8, and means for holding said arm means on said machine frame member in different horizontal positions thereon whereby said discharge wheel can be shifted forwardly or rearwardly relative to said strip-compressing discs.

10. A machine as claimed in claim 1, and means for selectively adjusting the vertical, operative position of said discharge wheel relative to said strip-compressing discs to adjust the depth of insertion of said strip.

11. A machine as claimed in claim 1, and a guide member on the lower front part of the machine frame, said guide member extending downwardly into said concrete joint during operation of said machine.

12. A machine as claimed in claim 11, said guide member comprising a guide wheel which is narrow enough to fit into said joint.

13. A machine as claimed in claim 1, strip feed guide means on the front portion of the machine frame for feeding said strip between said discs at the front portion of said discs, and guide shoes comprising tapered, longitudinally arcuate tongues rigidly mounted on said machine frame between the front portions of said discs for guiding the orbital travel of said strip with the strip-compressing faces of said discs.

14. A machine as claimed in claim 1, and means on said frame for raising said strip-compressing discs from their operative position to allow said machine to be rolled with the lower edges of said discs in elevated position.

15. A machine as claimed in claim 14, wherein said last-mentioned means operates by lowering at least one wheel on the front portion of said frame and thereby elevates said discs.

16. A machine as claimed in claim 1, said support wheels including a pair of caster wheels swivelly supported on respective side frame members at positions wherein the caster wheels contact the concrete surface on opposite sides of said joint at points forward of the lower edge of said strip-compressing discs when said caster wheels are swivelled toward the front of the machine.

17. A machine as claimed in claim 16, and means operatively associated with said caster wheels for lowering and locking said caster wheels in a lower position relative to said frame members to tilt the forward end of said machine upwardly and thereby elevate the lower edges of said strip-compression disc for rolling of said machine on its wheels.

18. A portable machine as claimed in claim 1, said discharge wheel having a body portion with a peripheral edge in relatively close fit with the strip-compressing faces of said discs in the strip-ejection zone, and a thin, annular edge around said peripheral edge of said discharge wheel, said thin edge adapted to enter the inwardly folded, top wall of the laterally compressed strip and provide frictional engagement between the sides of said thin, annular edge and the inwardly folded, top wall to eject the latter from said discs.

19. A portable machine for inserting an elongated laterally compressible strip in an elongated, concrete joint which comprises, in combination, a frame, said frame being supported by wheels for movement of said machine along said joint while inserting said strip therein, all of which wheels being non-driving, free-rolling wheels, strip-compressing means having opposed, strip-compressing faces with the lower edges thereof closely adjacent to and above the concrete on opposite sides of said joint, said strip-compressing means adapted to convey the laterally compressed strip rearwardly slightly above said joint, strip-ejection means operatively associated with said strip-compressing means for ejecting said compressed strip from said faces downwardly into said joint as said strip is conveyed rearwardly, and power drive means on said frame and operatively connected to said strip-compressing means for conveying rearwardly the strip compressed between said faces to advance said machine along said joint solely by the force resulting from the rearward thrust of said strip against the portion of said strip tightly seated in said joint.

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