Dec. 17, 1968 L. WORSON 3,416,415

METHOD AND APPARATUS FOR INSERTION OF JOINT FORMER MATERIAL IN UNCURED CONCRETE

Filed June 26, 1967 4 Sheets-Sheet 1

FIG. 1

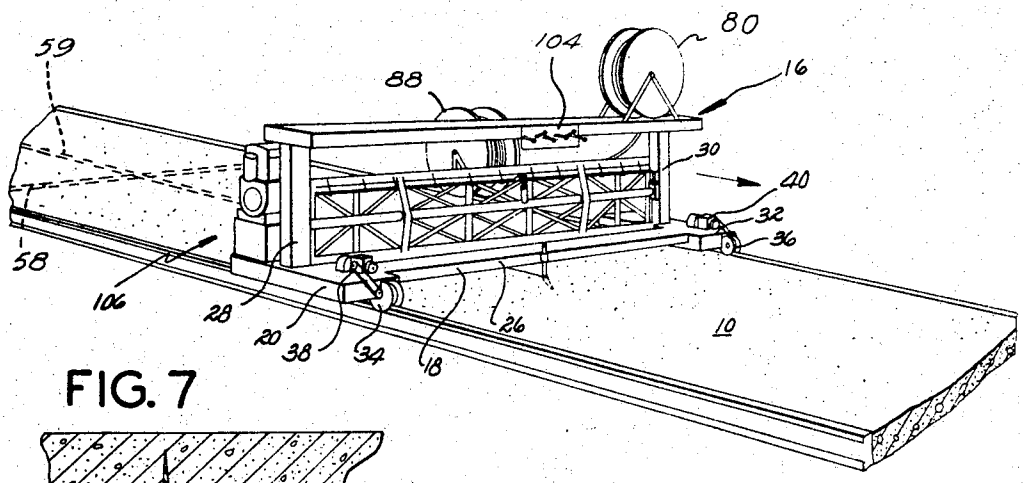


FIG. 7

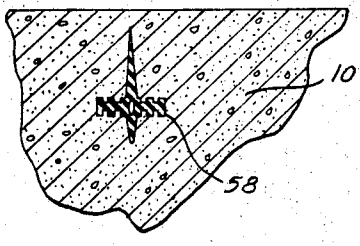
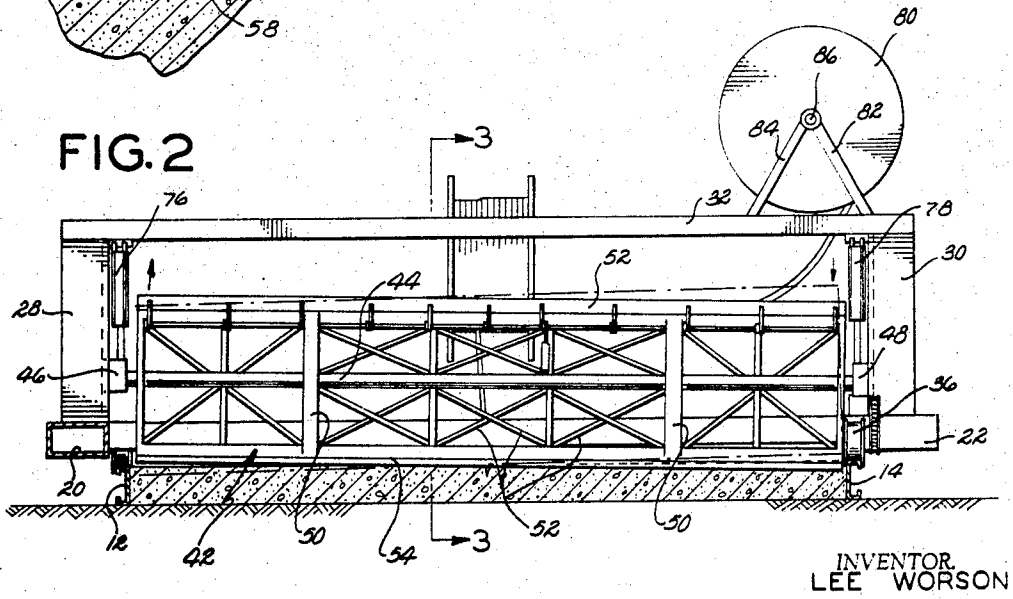


FIG. 2



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FIG. 3

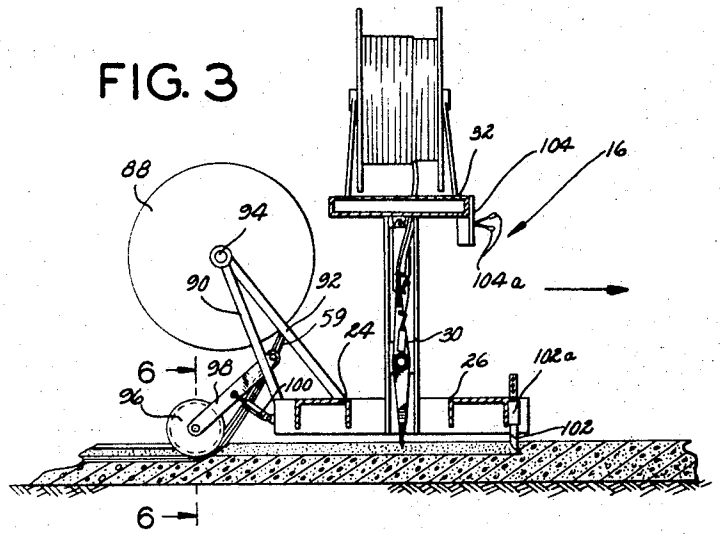


FIG. 4

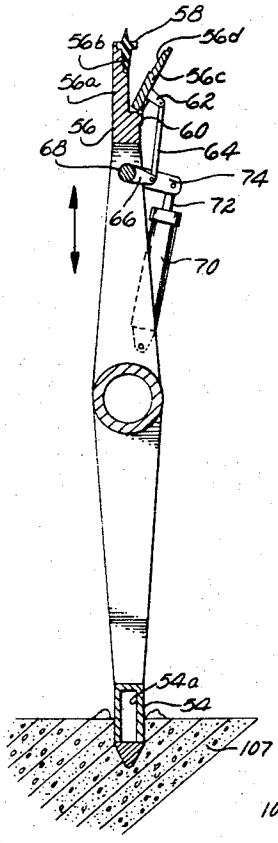


FIG. 5

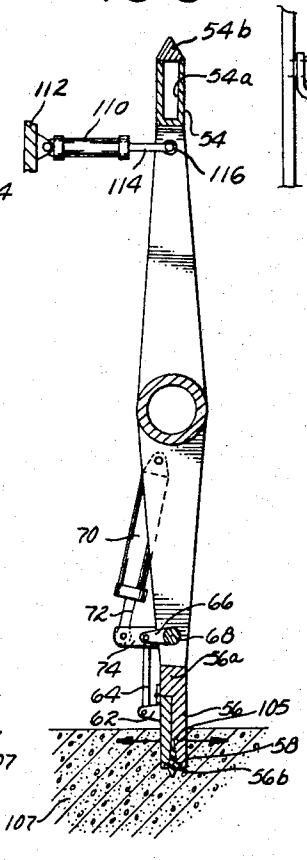
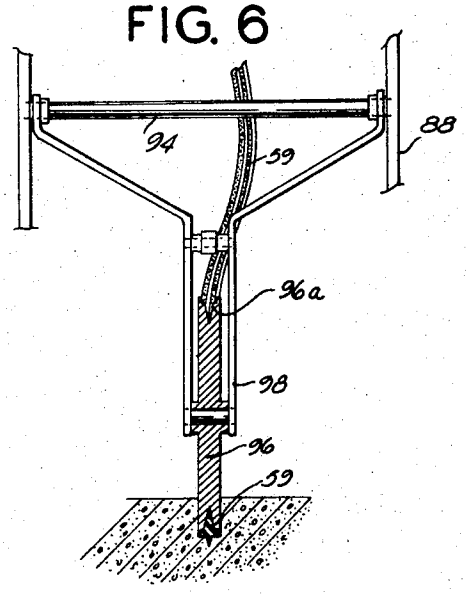


FIG. 6



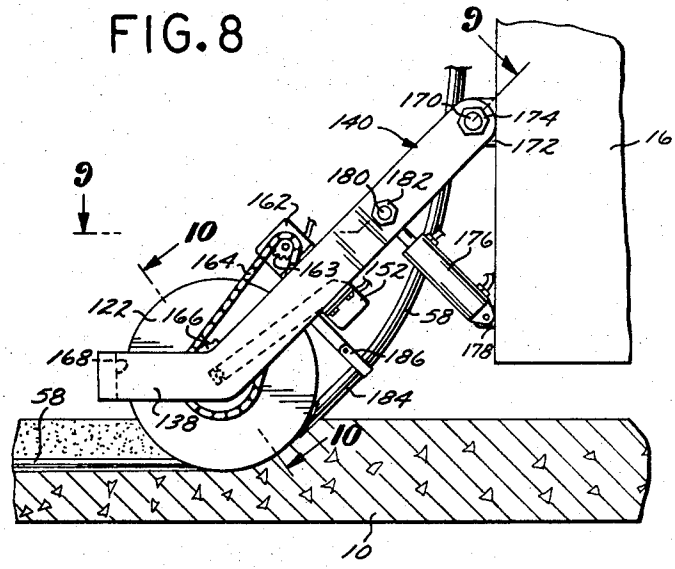
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FIG. 8



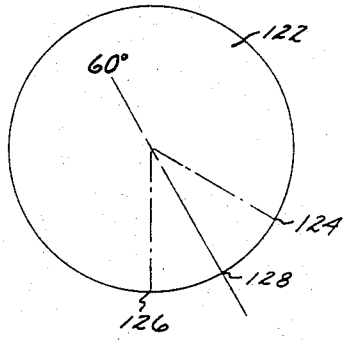


FIG. 13

FIG. 9

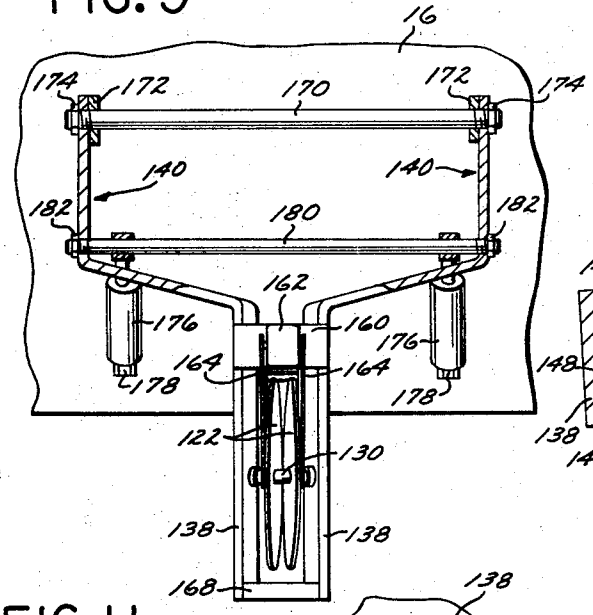


FIG. 10

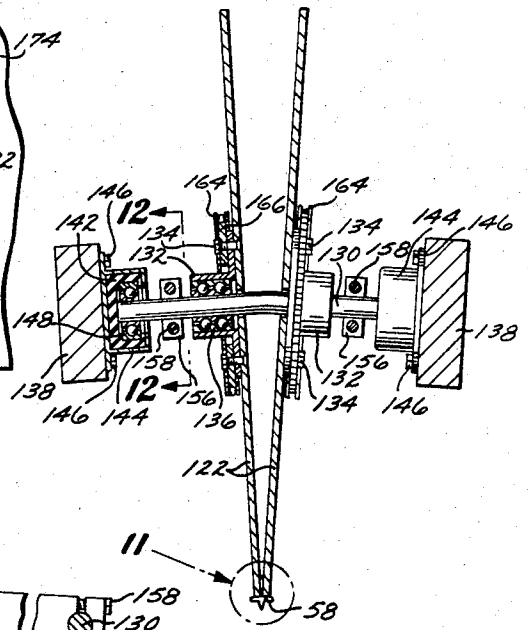
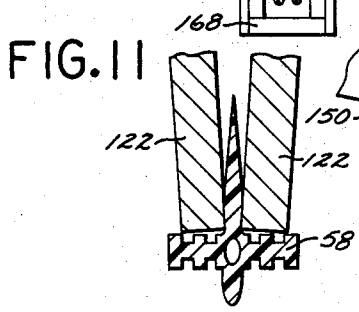


FIG. 11



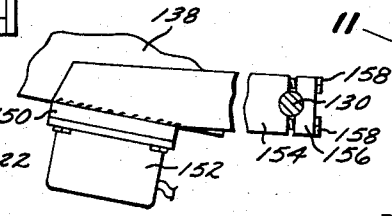


FIG. 12

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FIG. 14

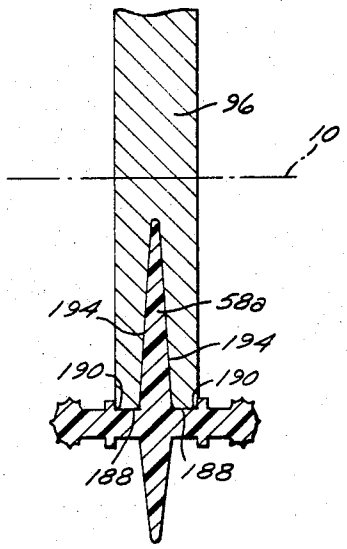


FIG. 15

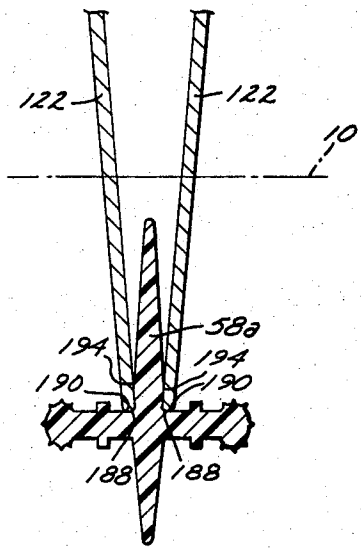
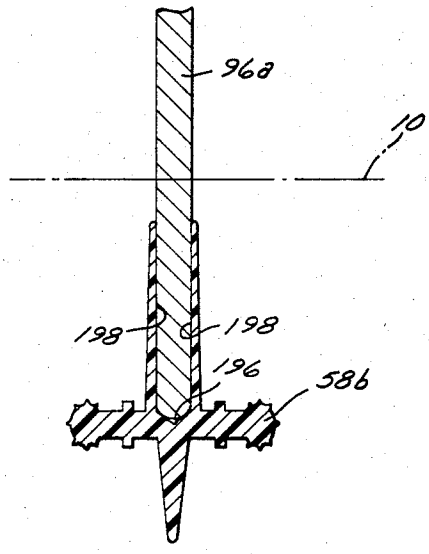


FIG. 16



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United States Patent Office 3,416,415 Patented Dec. 17, 1968

3,416,415

METHOD AND APPARATUS FOR INSERTION OF JOINT FORMER MATERIAL IN UNCURED CONCRETE

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Continuation-in-part of application Ser. No. 533,960, Mar. 14, 1966. This application June 26, 1967, Ser. No. 652,394

14 Claims. (Cl. 94—22)

ABSTRACT OF THE DISCLOSURE

A method and apparatus operative to continuously insert or embed in uncured concrete an elongated strip of joint former material and characterized by progressive engagement of vertically and transversely oriented portions of such material by rotating wheel means to thereby align and thrust downwardly such material in the uncured concrete.

Cross reference to related applications

This application is a continuation-in-part of my abandoned co-pending patent application Ser. No. 533,960, filed Mar. 14, 1966, and entitled "Method and Apparatus For Forming Joints In Concrete," which in turn is a continuation-in-part of my co-pending patent application Ser. No. 258,003, filed Dec. 8, 1961, now Patent No. 3,270,636 and also entitled "Method and Apparatus For Forming Joints In Concrete."

Background of the invention

Field of the invention.—The present invention relates to a method of forming joints in concrete and to the apparatus for forming such joints, but more particularly it pertains to methods and apparatus for embedding flexible sealing and expansible joint forming means in uncured concrete.

Description of the prior art.—In the construction of large concrete surfaces, as for instance roadways, airport runways and the like, it is necessary to provide joints in the concrete for systematic control of expansion and contraction of the concrete with changes in temperature. If provision is not made for such systematic control, random cracks will occur throughout the entire surface of the concrete during its final curing. Often such non-uniform cracks become enlarged due to wear and further expansion and contraction of the concrete and result in structural failure of a large section of the concrete.

In addition to controlling the occurrence of cracks in the concrete, it is necessary that sealing means be provided in the resulting joints or cracks to prevent moisture from washing away the bed beneath the road and to prevent the creation of excessive pressures within the concrete due to changes in temperature of such moisture. Accordingly, as set forth in my United States Letters Patent No. 3,023,681, issued Mar. 6, 1962, for Combined Weakened Plane Joint Former and Water Stop, elongated flexible sealing and joint forming strips are embedded in the concrete before it is cured. However, due to the necessary flexibility of such a strip, it is difficult to properly introduce and orient the strip in the concrete in a position in which the upper vertical portion of the strip is located so as to properly form and accurately locate the ensuing crack or joint, and in which the horizontal portion of the strip is located so as to be able to block or stop passage of water downwardly past the strip. The thickness or heavy consistency of the concrete also makes such introduction and orientation difficult. The relatively

large rocks or stones in the gravel which forms a part of the concrete get in the way of the strip, and the heavy consistency of the concrete impedes forward passage of the joint material inserting apparatus.

Prior art joint material inserting apparatus of the type adapted to continuously insert the material, either longitudinally from behind a conventional continuous paving machine, or transversely from a trolley or car moving above the expanse of uncured concrete, generally employs an inserting tube. The tube is suitably carried by associated support apparatus for projection beneath the surface of the concrete, and is characterized by a hollow interior or passage having a cross-section approximating that of the joint former material. In effect, the material is extruded from the tube as the associated support apparatus moves or is transported over the freshly laid concrete. This type of apparatus works quite well in certain situations, but in particular applications it is not entirely satisfactory. The apparatus is not adapted to vary the drag of the tube on the joint material as it is exuded, and on transition from a flat expanse of concrete to a sloping expanse, for example, the tube apparatus tends to pull the already inserted material out of the concrete in the transition zone as the tube apparatus moves past the zone.

Summary

Consequently it is an object of this invention to provide a method and apparatus for embedding elongated flexible joint forming material in uncured concrete through progressive engagement of the material by rotating wheel means. Since the rate of rotation of the wheel means can be varied, the material can be inserted at a rate greater than, the same as, or less than the rate of travel of the apparatus across the concrete, so that the tension in the inserted material will be as required.

Another object of this invention is to provide a method and apparatus as characterized above in which the wheel means simultaneously provides a path through the aggregate of the concrete, and forcibly inserts the joint forming material into the concrete along such predetermined path.

Another object of this invention is to provide a method and apparatus for inserting a flexible joint former strip in uncured concrete by application of localized downward pressure upon a transverse section of the strip, and progressively along the length of the strip, to embed the strip at the proper depth in the concrete, and also by stabilizing engagement of a vertical section of the strip to properly orient the strip to achieve its dual function of forming a joint and sealing the joint from water passage past the strip.

Another object of this invention is to provide apparatus as characterized above which is simple and inexpensive to manufacture and rugged and dependable in operation.

The novel features of which I consider characteristic of my invention are set forth with particularity in the appended claims. The method and apparatus, both as to organization and mode of operation, and additional objects and advantages thereof, will best be understood from the following description of specific embodiments, when read in connection with the accompanying drawings, in which:

FIGURE 1 is a perspective view of apparatus according to the present invention shown in operating position relative to a large area of concrete;

FIGURE 2 is a front elevational view of the apparatus of FIGURE 1;

FIGURE 3 is a sectional view taken substantially along line 3—3 of FIGURE 2 of the drawings;

FIGURE 4 is a fragmentary sectional view through the insertion tool of the apparatus of FIGURE 1;

FIGURE 5 is a fragmentary sectional view similar to FIGURE 4 showing a combined waterstop and weakened plane joint former inserted into the concrete;

FIGURE 6 is a fragmentary sectional view taken substantially along line **6—6** of FIGURE 3 of the drawings;

FIGURE 7 is a fragmentary sectional view of a combined waterstop and weakened plane joint former that has been embedded in concrete by means of the method and apparatus of the present invention;

FIGURE 8 is a side elevational view, similar to FIGURE 3, but illustrating another form of apparatus for continuously inserting a joint former into fresh concrete or like material;

FIGURE 9 is a view taken along line **9—9** of FIGURE 8;

FIGURE 10 is an enlarged view taken along line **10—10** of FIGURE 8;

FIGURE 11 is an enlarged cross-sectional view of the portion indicated by the number **11** in FIGURE 10;

FIGURE 12 is an enlarged view taken along the line **12—12** of FIGURE 10;

FIGURE 13 is a diagrammatic view of the inserting wheel of FIGURE 8 and illustrating the portion of its rotation during which the gripping forces upon the joint former are developed; and

FIGURES 14 through 16 are partial transverse cross-sectional views of three types of inserting wheels, and the manner of their cooperation with joint former material during an insertion operation.

Like reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to FIGURE 1 of the drawings, the embodiment chosen for illustration of the present invention is shown in operating position immediately above a section of uncured concrete **10**. Such concrete may be part of a roadway, airport runway, flood control or irrigation canal, or substantially any other structure having large areas of concrete.

In building the forms for receiving and defining the shape of the concrete, it may be desirable to employ means such as side form rails **12** and **14** which can also serve as a track along which the subject apparatus can be propelled as will hereinafter be explained. However, the particular means of locomotion for the subject apparatus does not form a limiting part of this invention, it merely being necessary that any desired means for moving the apparatus relative to the concrete, as will hereinafter appear in detail, be provided for successful practice of this invention.

With the forms for the concrete suitably positioned, the concrete **10** can be poured in any desired manner. Before the concrete has cured, the subject apparatus identified generally with the numeral **16** should be positioned for relative movement with respect to the longitudinal strip of freshly-poured concrete.

Apparatus **16** is formed of various types of steel structural members. The body or frame thereof includes a base or platform **18** which is composed of a pair of longitudinally extending box or U-shaped end members **20** and **22** which are joined together by a pair of elongated inverted U-shaped channel members **24** and **26**. As will hereinafter become more readily apparent, the subject apparatus must be extremely rugged and dependable in operation thus necessitating the use of relatively strong steel members welded into a unitary structure. At either end of platform **18** is positioned a vertical support **28** and **30** respectively, each of which may take any desired form in accordance with the support function to be performed. Attached to the upper end portions of support members **28** and **30** is a box section channel member **32** which is positioned transversely on apparatus **16**.

To support the entire apparatus while permitting movement thereof, there are provided suitable wheels, as shown at **34** and **36**, attached to the box members **20** and **22** in any appropriate manner. Any desired number of wheels may be employed, to adequately support the apparatus. As shown most clearly in FIGURES 1 and 2, the wheels shown in the disclosed embodiment are formed to straddle the C-shaped rails **12** and **14** to insure that the apparatus remains in the proper position with respect to the concrete **10**.

Any suitable means, as for instance motors **38** and **40**, may be employed for rotating wheels **34** and **36** respectively, there being suitable chain or belt drive means for transmitting power therebetween. The energy for operating motors **38** and **40** may be supplied from any suitable source as for instance a gasoline engine-driven generator carried on the apparatus.

An insertion tool identified generally with the numeral **42** is mounted on the apparatus laterally or transversely of the direction of the latter. Tool **42** is formed with a shaft **44** the opposite ends of which are rotatably mounted in suitable brackets or bearing members **46** and **48**, which are slidable vertically in the support members **28** and **30** respectively. Due to this arrangement, support members **28** and **30** should be formed with channels for receiving the bearing members and permitting vertical movement thereof while preventing rotation or horizontal relative movement.

The shaft **44** carries a predetermined number of transverse vertical arm members as at **50** and a predetermined number of angularly disposed structural members as at **52**. The resulting structure is substantially coplanar, parallel to the axis of rotation of shaft **44**. Along the opposite side edges of insertion tool **42** are a pair of tool members **54** and **56**, shown most clearly in FIGURES 4 and 5 of the drawings.

Tool member **54** extends the entire length of insertion tool **42** and is disposed transversely of the direction of movement of the apparatus **16**. As shown most clearly in FIGURES 4 and 5 of the drawings, tool member **54** does not have any moving parts and may, if desired, be formed with a hollow as shown at **54*a***. For purposes to be hereinafter explained in detail, tool member **54** is preferably provided with an elongated tip or edge as at **54*b***.

Insertion tool **56** is formed with an abutment member **56*a*** which extends the entire length of tool **42** for receiving an elongated combined waterstop and joint forming strip **58** which is characterized by oppositely disposed and substantially horizontally oriented lateral portions which present one or more transverse sections for engagement by the tool **56**, or by the analogous components of other insertion apparatus described herein. The strip **58** also includes an upwardly extending and substantially vertically oriented portion intermediate the lateral portions and presenting a vertical section for engagement by the insertion apparatus, as will be seen. To facilitate this, abutment member **56*a*** is shaped throughout its length with a surface **56*b*** which corresponds to one side of strip **58**.

A latching member **56*c*** is pivotally fixed to abutment member **56*a*** by means of spaced hinges as shown at **60** and is formed with a surface **56*d*** which conforms to the other side of the strip **58**. A plurality of spaced lugs **62** are fastened to latching member **56*c***. Each lug **62** is connected to one end of an actuating lever **64**, the opposite end of which is fastened to a bell crank **66** firmly fastened to a rotatable rod **68**. Rod **68** as shown most clearly in FIGURES 2, 4 and 5, is mounted within suitable openings in the transverse structural members **50** of insertion tool **42**. For rotation of rod **68**, there is provided one or more hydraulic operating cylinders **70** secured to the transverse structural members **50**. Each hydraulic cylinder **70** is provided with a piston (not shown) and piston rod **72** which is rotatably connected to a pivot arm **74**. Each arm **74** is non-rotatably fastened to rod **68**, to transmit the operation of the respective cylinder **70** to rod **68**.

At the opposite ends of tool **42** there is provided hydraulic rocking cylinders **76** and **78**. Such cylinders are

firmly anchored to transverse support member **32** and are provided with piston rods which are connected to the respective bearing members **46** and **48**. As will be readily apparent to those persons skilled in the art, this arrangement enables either or both of the opposite ends of shaft **44** to be moved in a vertical direction in accordance with the particular function to be performed as will hereinafter be explained in detail.

Mounted on support member **32** is a spool or drum **80** on which is wound a suitable length of strip material **58** for providing the transverse joints in the concrete **10**. Such spool **80** is rotatably supported by means of bracket members **82** and **84** carrying a shaft **86**.

A similar spool **88** is mounted on the rear of the apparatus for supplying strip material **59** identical to the strip material **58** to be positioned longitudinally in the concrete **10**. Spool **88** is rotatably mounted by means of bracket members **90** and **92** which are fastened to inverted channel member **24** and which carry a shaft **94**.

A rotatable insertion wheel **96** carried by a lever mechanism **98** projects from the rear of the apparatus. Lever mechanism **98** is pivotally fastened relative to the bracket members which support spool **88**. A hydraulic actuating cylinder **100** is interposed between channel member **24** and lever mechanism **98** for controlling the position of wheel **96** with respect to the section of concrete **10**.

Mounted on the front of the apparatus is path forming means comprising an adjustable tool **102** which slidably fits within a sleeve **102***a* welded to channel member **26**. Any appropriate means may be employed for permitting adjustment of the height of tool **102** relative to concrete **10**, as for instance a shaft or thumb screw which can be inserted into suitable openings in tool **102** for engagement with the upper edge of sleeve **102***a*.

A control panel **104** for mounting suitable control levers as at **104***a* is fixed to the forward edge of member **32**. An operator stands on the platform **18** as provided by channel member **26** for manipulation of the control members mounted on panel **104**.

A source of power for operating the apparatus is mounted on platform **18** as shown at **106**. Although such power source may take substantially any desired and appropriate form in accordance with the type of actuating devices employed in the apparatus, FIGURE 1 shows a gasoline engine drivingly connected to both a hydraulic pump and an electric generator. The hydraulic pump, of course, affords the necessary hydraulic pressure for operation of the various aforedescribed hydraulic cylinders, whereas the electric generator affords the electric power for operation of the drive motors **38** and **40**.

The method of embedding the strips **58** and **59** in the concrete is substantially as follows:

By suitably controlling the energization of the electric motors connected to the drive wheels, the apparatus can be caused to move on rails **12** and **14** longitudinally of the concrete **10**. As the apparatus moves, tool **102**, which previously has been adjusted to the proper vertical position, forms a longitudinal path through the aggregate of the concrete **10**. That is, due to the viscosity of the fine ingredients of the concrete, as for instance the cement, sand, water and the like, a path cannot be formed therein which will remain for any appreciable length of time. However, the larger and heavier ingredients of concrete, such as gravel, which is commonly termed aggregate, can be pushed to one side or the other as the desired path is being formed. As such, a path can be formed through the heavier materials to greatly facilitate the subsequent insertion of the joint forming means.

As the apparatus **16** continues to move, such motion causes the flexible strip **59** from spool **88** to be inserted longitudinally into the concrete **10**. That is, such strip **59** is caused to unwind from the spool **88** and to pass under the insertion wheel **96**. As shown in FIGURE 6 of the drawings, wheel **96** is formed with a suitably configured outer periphery for receiving the strip **59**. Due to this feature, the wheel **96** does not deform the strip **59** but rather applies pressure thereto at the predetermined strongest sections. The depth of insertion of the longitudinal strip **59** is determined by the operation of hydraulic cylinder **100**, the latter being controlled by suitable control levers mounted on panel **104**.

The insertion wheel **96** is aligned with the path forming tool **102** so that the strip **59** from spool **88** is inserted to the proper depth along the path formed thereby. Thus the strip material is inserted without engaging relatively hard immovable objects such as the aggregate of the concrete **10**.

At predetermined intervals during the travel of apparatus **16** relative to concrete **10**, the entire apparatus is brought to rest for purposes of inserting lateral strips **58**. After the apparatus is stopped, the insertion tool **42** is rotated within bearing members **46** and **48** until the path forming tool member **54** is disposed downwardly. While in this position, the operator, by suitable manipulation of the appropriate controls on panel **104** causes the entire tool **42** to be moved downwardly so as to cause tool member **54** to provide a transverse path in the aggregate of the concrete **10**. Such action of tool **42** can be accomplished by simultaneously actuating hydraulic cylinders **76** and **78** to cause the entire length of tool member **54** to be inserted instantaneously in the concrete. In the alternative, the hydraulic cylinders **76** and **78** may be operated separately so as to cause first one end of tool member **54** to be inserted into the concrete and thereafter the other end to be inserted. Ultimately, however, the entire tool member **54** is pressed downwardly into the concrete so as to form a predetermined transverse path through the aggregate thereof.

While the tool **42** is so positioned as shown in FIGURE 4, the strip **58** from spool **80** can be out to the proper length and positioned in the tool member **56**. To accomplish this, tool member **56** is opened by suitable actuation of hydraulic cylinder **70**. That is, such cylinder is suitably energized to cause latching member **56***c* to pivot in a clockwise direction as shown in FIGURE 4. The section of the strip **58** is then positioned in the abutment member **56***a* and the latching member **56***c* is returned to closed position. The latter operation, of course, is effected by suitable actuation of hydraulic cylinder **70** by the operator at control panel **104**.

After the strip **58** is mounted in the insertion tool member **56**, the entire insertion tool **42** is rotated within journal members **46** and **48** until the tool member **56** is disposed downwardly as shown in FIGURE 5 of the drawings.

Thereafter, the hydraulic cylinders **76** and **78** are alternately actuated so as to cause the entire insertion tool **42** and the strip **58** attached thereto to rock end-for-end upon the pivots afforded by the connections between the tool extremities and the brackets **46** and **48**, respectively, which slide vertically in the support members **28** and **30**. As this action continues, the tool **42** is caused to progressively "creep" downwardly until the strip **58** is at the proper position within the concrete. The aforedescribed rocking and "creeping" action is necessary to prevent collapse and deformation of the strip **58**. Such strip is generally made of plastic or other suitable elastomeric materials to insure that it will yieldably engage the sections of concrete to provide the necessary seal therebetween. Also, such end-for-end rocking motion causes the strip to "knife" its way through the concrete to further insure that said strip will maintain its intended size and shape. This action will be recognized by persons skilled in the art as being substantially identical with the action of insertion wheel **96** in progressively exerting pressure along the length of the longitudinal strip **58**.

Due to the previously formed path through the aggregate of the concrete as formed by tool member **54**, the flexible strip **58** is ultimately forcibly inserted into the concrete to the desired position. Then by suitable actuation of the appropriate control lever, the hydraulic

cylinder **70** releases the strip **58**. In this regard, latching member **56***c* of tool **56** need not be actuated to its extreme open position but rather need only be moved a small distance to permit strip **58** to remain within the concrete **10** as tool member **56** is removed. After this has been accomplished, and the entire insertion tool **42** is in its retracted position the apparatus **16** is moved forward to continue laying the longitudinal strip **59** until the next position for a lateral strip **58** is reached.

It should be noted that under certain conditions it is desirable that the tool **56** be given a fore-and-aft rocking motion as it effects insertion of the lateral strip **58**. This motion will help enlarge the strip-receiving groove **105** formed in the uncured concrete **107**. Thus, as indicated in FIGURE 5, a hydraulic cylinder **110** is removably interposed between a fixed element **112** of the apparatus **16** and the upper portion of each of the arms **50**. With continued reference to this figure, one end of the cylinder **110** is pivotally connected to the fixed element **112** while the piston rod **114** associated with cylinder **110** is detachably connected to the upper portion of arm **50** as by a removable pin **116**. The cylinder **110** is operated in a conventional manner to effect reciprocation of piston rod **114**. This serves to effect a fore-and-aft rocking of the insertion tool **56**, as indicated by the directional arrows in FIGURE 5. Such fore-and-aft rocking may be independent of or concurrent with the end-for-end rocking of the entire insertion tool **42**.

Although not mandatory for successful practice of the present invention, it may be found desirable to provide suitable notches or cutouts in the vertical webs of the strips **58** and **59** at their intersection.

Referring now to FIGS. 8 through 12, there is illustrated another form of insertion wheel **120**, which is broadly similar to the wheel **96** previously described, but which is characterized by a more positive gripping of the strip material **58**.

The wheel **120** includes a pair of transversely spaced apart and generally vertically oriented circular disks **122**. The disks **122** converge toward each other adjacent their bottoms so that the spacing between them gradually decreases in a downward direction. As best seen in FIGS. 10 and 13, the maximum spacing between the disks **122** occurs adjacent their upper portions, and the minimum spacing occurs adjacent their lower portions. As will be more particularly described hereinafter, the strip material **58** is brought into position between the lower portions of the disks **122**, the engagement continuing through the arc of approximately 60 degrees which is indicated in dash-dot outline in FIG. 13. That is, initial engagement occurs at the radius **124** and continues through to the radius **126**, at which point the strip material **58** is released. The disks **122** are closest to each other at a radius **128**, which is approximately 30 degrees of arc upwardly from the bottom of the disks **122**. At this radius **128** the strip material **58** is most firmly gripped by the disks **122**.

The pairs of disks **122** are centrally bored for free rotation about a shaft **130** which is deformed so that its opposite extremities are axially offset, the longitudinal axes of the longitudinally offset extremities of the shaft **130** intersecting approximately midway between the adjacent opposed inner surfaces of the disks **122**. With this arrangement, each disk **122** rotates in a plane which is slightly canted or inclined with respect to a vertical plane. Each disk is mounted to the annular flange of a hub **122** by a plurality of uniformly circumferentially spaced nut and bolt assemblies **134**. Each hub **134** mounts the outer race of a ball bearing **136**, the inner race of the bearing **136** being mounted to the shaft **130**.

The ends of the the shaft **130** are resiliently mounted to a pair of horizontal arm extensions **138** which are spaced apart in confronting relation and constitute extensions of a pair of mounting arms **140**. The resilient mounting at each end of the shaft **130** is provided by a rubber or elastomeric element **142** which is enclosed within a mounting bracket **144** secured to the adjacent arm extension **138** by a plurality of suitable bolts **146**.

Each rubber element **142** is centrally apertured to mount the outer race of a ball bearing **148**, the inner race of the bearing being secured to the associated end of the shaft **130**. This arrangement permits free rotation of the disks **122**, and yet affords a resilient or cushioned mounting of the ends of the shaft **130** whereby the disks **122** may be vibrated, as will be more particularly described below.

A transverse strap or plate **150** is welded to the lower edges of the arm extensions **138** and, as best illustrated in FIG. 12, mounts a pair of usual and conventional electrically operated vibrators **152**, a vibrator **152** being secured to the underside of each extremity of the plate **150** adjacent one of the arm extensions **138**. The forward extremities of a pair of vibrator arms **154** are welded or otherwise rigidly secured to the bases of the vibrators **152**, respectively, and the rearward extremity of each arm **154** includes an arcuate cavity which fits and receives the curved surface of the shaft **130**. A complemental cavity is formed in each of a pair of caps **156** located on the opposite side of the shaft **130**, the caps **156** being secured tot he arm **154** by threaded bolts **158**. This securely clamps the arms **154** to the shaft **130** on opposite sides of the disks **122** whereby the disks **122** are vibrated upon operation of the vibrators **152**.

Immediately above the plate **150**, a transverse strap or plate **160** is welded to the upper edges of the adjacent arm extensions **138**, and monuts a usual and conventional hydraulically operated motor **162**. The motor output shaft extends from the opposite sides of the motor **162** and each mounts a drive sprocket **163** about which a pair of drive chains **164** are trained.

The drive chains **164** extend rearwardly and are trained about driven sprocket **166** which are secured to the disks **132**, respectively. More particularly, each drive sprocket **166** abuts against the outer surface of the annular flange of the associated hub **132** and is secured in this position by the nut and bolt assemblies **134**.

Upon operation of the motor **162**, the disks **122** are rotated in a clock-wise direction, as viewed in FIGS. 8 and 13. Fluid under pressure required for the operation of the motor **162** is provided by any usual and conventional hydraulic apparatus carried by the apparatus **16**, as will be apparent to those skilled in the art. The vibrators **152** are energized from any suitable source, such as a motor-generator carried by the apparatus **16**.

The rearwardly projecting ends of the arm extensions **138** are secured together by an end plate **168**, while the opposite extremities of the arm extensions **138** diverge outwardly and then extend forwardly, that is, in the direction of travel of the apparatus **16**, to define the remainder of the mounting arms **140**. The forward ends of the arms **140** are pivotally mounted to the apparatus **16** by a shaft **170** whose ends are disposed through the arms and through a pair of mounting brackets **172** which are rigidly secured to the apparatus **16**. The shaft **170** is secured in position by a pair of nuts **174** which are mounted upon the threaded ends of the shaft **170**.

The disks **122** are pivotable about the axis of the shaft **170** by operation of a pair of double acting hydraulic cylinder **176**. The cylinders **176** are pivotally mounted at their forward ends to a pair of brackets **178**, respectively, which are secured to the apparatus **16**, and are pivotally mounted at their piston rod ends to a transverse shaft **180**. The shaft **180** extends between the arms **140** and is secured thereto by a pair of nuts **182** mounted upon the threaded ends of the shaft **180**.

As will be apparent to those skilled in the art, extension and retraction of the piston rods of the cylinders **176** is effected by application of hydraulic fluid to the cylinders **176**, under the control of usual and conventional valves (not shown), to thereby raise and lower the disks **122** as desired.

The spacing between the peripheries of the disks **122** at the point indicated by the radius line **124** in FIG. 13 is sufficient to permit the strip material **58** to pass between the disks **122**. Thereafter, as the disks **122** are rotated in a counterclockwise direction, the peripheries of the disks squeeze the upper vertical extension of the strip material **58** to firmly carry it rearwardly and place it within the fresh concrete **10**. These squeezing of the strip material **58** is therefore positive in nature, which is particularly important in those situations where the strip material is being laid in a transverse joint having both a horizontal portion and an upwardly sloping portion. An example of such a joint is the transverse joint in the horizontal floor and sloping side wall of an irrigation canal. In the absence of positive feeding, it will be seen that during the laying of the strip material **58** in the sloping portion of the concrete, the strip material already laid in the horizontal portion of the concrete tends to be pulled out of its embedded position. However, such pulling out of the strip material is prevented by the positive feeding action of the apparatus illustrated in FIGURE 8.

The strip material is fed to the disks **122** from a usual supply or feed drum (not shown), extending downwardly as illustrated. The strip material is guided into position for engagement by the disks **122** by a guide element **184** which is held in position adjacent the disks **122** by a loop or strap **186** secured at its opposite ends to the arm extensions **138**. The guide **184** is preferably made up of metal and formed with an internal cross-section approximating the cross-section of the strip material **58** so that the strip material **57** is easily slidable through the guide **184** and is properly oriented for engagement by the disks **122** when the material leaves the guide immediately adjacent the disks **122**. The firm and positive engagement by the disks **122**, accompanied by the vibration previously mentioned, is then effective to embed the strip material with good compaction of the fresh concrete about the strip material. The depth of embedment is controlled by actuation of the cylinders **176**.

Referring now to FIGS. 14 through 16, there are illustrated three methods and apparatuses for inserting an elongated flexible joint forming material or strip in uncured concrete, either transversely or longitudinally, the surface of the concrete being indicated generally by the numeral **10**.

The strip **58*a*** is substantially similar to the strip **58** except that the proportions of the parts are slightly different, and the configuration of the horizontal portions is slightly different. These slight differences between the strips **58** and **58*a*** are not important to the present invention, the strip **58** being illustrated merely to show a different embodiment of joint former strip material which is in present use.

The showing in FIG. 14 is similar to that of FIG. 6, in that the wheel **96** is employed to hold and embed the strip. Likewise, the showing in FIG. 15 is similar to that of FIG. 11 in that the wheel means or pair of disks **122** are employed to hold and embed the strip. Both showings are included in side-by-side relation to emphasize the unique function provided by the wheel **96** and the disks **122**.

More particularly, the edge periphery of the wheel **96** and the disks **122**, designated at **188**, is seen to engage a pair of horizontal or transverse sections or portions **190** of the strip **58*a*** located on either side of the upper vertical web or portion **192** of the strip **58*a***. The transverse sections **190** are defined by the upper surfaces of the substantially horizontal, transversely oriented pair of opposed lateral webs or portions of the strip **58*a***, while the sides of the vertically oriented upper web or portion of the strip **58*a*** define a pair of vertical portions or sections **194**.

The sections **194** are engageable by the radially directed inner surfaces of the peripheral groove or joint strip receiving hollow in the wheel **96**. The sections **194** are similarly engageable by the inner, confronting surfaces of the disks **122** adjacent the peripheries thereof.

With the arrangement just described, the engagement of the transverse sections **190** enables the wheel **96** or the disks **122**, as the case may be, to press down upon the strip **58*a*** and embed it in the uncured concrete. Where the transverse sections are located depends upon the nature of the joint strip, the transverse section only being required to be one which can be engaged and pressed downwardly to embed the joint strip. FIG. 16 illustrates a different joint strip **58*b*** which is characterized by a pair of spaced apart, upwardly extending, and substantially vertically oriented webs or portions, instead of the single web or portion of the strip **58*a***.

Although the strip **58*b*** could be pressed downwardly and embedded by a properly proportioned wheel **96** or pair of disks **122** adapted to straddle the pair of upwardly extending vertical portions, the transverse section **196** defined between and at the base of the vertical portions can also be utilized for depressing the strip **58*b*** into the concrete. In this case a wheel **96*a*** is utilized which projects between the joint strip vertical portions, with its opposite faces in engagement with the confronting vertical surfaces or surfaces **198** thereof, and its periphery in engagement with the transverse section **196**.

From the foregoing it will be apparent that the number and location of transverse sections engaged by the rotating wheel means can be varied to suit the requirements of the job and the particular joint strip.

In this regard, the engagement of the vertical sections of the joint strip by the corresponding or complemental surfaces of the rotating wheel means can be similarly varied to suit the requirements of the moment. Such engagement between the vertical sections **190** and the previously described complemental portions of the wheel **96** or the disks **122** is a stabilizing engagement which constrains the strip **58*a*** against lateral tipping. Consequently, the vertical and horizontal portions of the strip **58*a*** will be able to perform its joint forming and water stop functions, respectively.

In similar fashion, the engagement of the wheel **96*a*** with the vertical sections **198** of the strip **58*b*** in FIG. 16 is a stabilizing engagement, constraining the strip **58*b*** against lateral tipping and disorientation.

Complmental wheel means and joint strips of many different configurations will occur to those skilled in the art, the invention, however, being directed to a method and apparatus achieving strip embedment by engagement of wheel means with one or more strip sections which are preferably horizontally or transversely oriented, the wheel means preferably also engaging a substantially vertical section to preserve lateral stability during embedment. However, such lateral stability could be provided by the insertion apparatus independently of the strip wheel means, if desired. Thus, the invention provides a novel method and apparatus for inserting elongated flexible joint forming material into uncured concrete by progressive engagement of the material by rotating wheel means. This provides a means for thrusting the material downwardly and, in the embodiments described, for also simultaneously aligning and orienting the material to properly perform its intended functions. The embodiments are adapted to insert either longitudinal or transverse joint material, either behind a paving machine or from a rig movable over an expanse of uncured concrete, and in conjunction with either a towed or a self-propelled support structure.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A method of continuously inserting in uncured concrete an elongated strip of joint former material characterized by oppositely disposed lateral portions and an upwardly extending substantially vertical portion, wherein said material includes a substantially horizontally ori-

ented surface accessible from above said material and a substantially vertically oriented surface accessible from a side of said material, said method comprising the steps of:

progressively engaging and pressing downwardly upon said horizontally oriented surface along successive sections of the length of said strip to progressively insert said strip in said concrete; and

simultaneously progressively engaging and constraining said vertically oriented surface against lateral movement along the length of said strip to properly orient and stabilize the inserted said strip.

2. The method according to claim **1** and including the step of varying the rate of progressive engagement of said horizontally and vertically oriented surfaces relative to the rate of embedment of said strip in said concrete.

3. Apparatus for continuously inserting in uncured concrete an elongated strip of joint former material characterized by oppositely disposed lateral portions and an upwardly extending vertical portion, wherein said material includes a substantially horizontally oriented surface accessible from above said material and a substantially vertically oriented surface accessible from a side of said material, said apparatus comprising:

a frame for carrying a supply of said joint former material;

embedding means on said frame comprising rotatable wheel means having an outer peripheral edge portion to engage said substantially horizontally oriented surface of said joint former material and having a radially oriented face portion adapted to simultaneously engage said vertically oriented surface of said joint former material whereby said joint former material is pressed by said wheel means downwardly into said uncured concrete and said vertical portion is properly oriented for proper orientation of said joint former material in said uncured concrete;

and means projecting said wheel means for rotation partially beneath the surface of said uncured concrete to form a path through said uncured concrete and simultaneously progressively embed said joint former material in said uncured concrete along said path.

4. Apparatus according to claim **3** and including vibration means for vibrating said wheel means.

5. Apparatus according to claim **3** wherein the opposite sides of said vertical portion of said joint former material each defines a separate said substantially vertically oriented surface, and the upper surfaces of said horizontal portions of said joint former material each defines a separate said substantially horizontally oriented surface, and wherein said wheel means comprises a wheel having a groove in its periphery adapted to complementally receive said vertical portion of said joint former material with the radially directed walls defining said groove engaging both said vertically oriented surfaces, and with the portions of said periphery on opposite sides of said groove engaging both said horizontally oriented surfaces.

6. Apparatus according to claim **3** wherein the opposite sides of said vertical portion of said joint former material each defines a separate said substantially vertically oriented surface and the upper surfaces of said horizontal portions of said joint former material each defines a separate said substantially horizontally oriented surface, and wherein said wheel means comprises a pair of disks adapted to receive said vertical portion of said joint former material therebetween with confronting portions of the disk surfaces engaging both said vertically oriented surfaces, and with the edge peripheries of said disks engaging said horizontally oriented surfaces, respectively.

7. Apparatus according to claim **3** wherein said joint former material includes a pair of said vertical portions spaced apart to define a groove whose confronting walls define a pair of said substantially vertically oriented surfaces, and wherein the base of said groove defines said substantially horizontally oriented surface, and wherein said wheel means comprises a wheel adapted to project into said groove with its opposite faces engaging said vertically oriented surfaces, and with its edge periphery engaging said horizontally oriented surface.

8. Apparatus for embedding elongated joint forming means in uncured concrete, wherein said means includes oppositely disposed lateral portions and an upwardly extending vertical portion, said apparatus comprising:

a frame for carrying a supply of said joint forming means;

embedding means on said frame comprising rotatable disk means having an outer periphery adapted to engage the upper surfaces of said lateral portions of said joint forming means, with said vertical portion extending radially inwardly of said outer periphery, whereby said lateral portions are pressed by said disk means downwardly into said uncured concrete and said vertical portion is properly oriented for proper orientation of said joint forming means in said uncured concrete;

and means projecting said disk means for rotation partially beneath the surface of said uncured concrete to form a path through said uncured concrete and simultaneously progressively embed said joint forming means in said uncured concrete along said path.

9. Apparatus according to claim **8** and including vibration means for vibrating said disk means.

10. Apparatus according to claim **8** and including an elongated guide carried by said frame and having an internal passage characterized by a cross-section approximating the cross-section of said joint forming means and slidably receiving said joint forming means, said guide terminating immediately adjacent said disk means.

11. Apparatus for embedding elongated joint forming means in uncured concrete, wherein said means includes oppositely disposed lateral portions and an upwardly extending vertical portion, said apparatus comprising:

a frame for carrying a supply of said joint forming means;

embedding means on said frame comprising a pair of disks adapted to roll through said concrete;

means carried by said frame and mounting said disks for rotation about axes oppositely inclined relative to a horizontal axis and orienting the inner surfaces of said disks in downwardly convergent relation to locate the lower peripheries thereof in closer proximity than the upper peripheries thereof, the proximity of said lower peripheries adapting said disks for engaging the upper surfaces of said lateral portions and the adjacent side portions of said vertical portion of said joint forming means, with said vertical portion extending radially inwardly of and between said disks, thereby to carry said joint forming means and forcibly press said lateral portions thereof downwardly into proper orientation in said concrete and thereafter release said joint forming means upon rotation of said disks;

and means coupled to said disks and operative for rotating said disks.

12. Apparatus according to claim **11** and including means for vibrating said disks.

13. Apparatus according to claim **11** and including means for raising and lowering said disks.

14. Apparatus according to claim **11** wherein said means carried by said frame for mounting said disks includes a mounting shaft having opposite, axially offset extremities, each of which rotatably mounts one of said disks.

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94—39, 51; 29—235

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,416,415 December 17, 1968

Lee Worson

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 30, "258,003" should read -- 158,003 --. Column 7, line 54, "bottom" should read -- bottoms --. Column 8, line 30, "monuts" should read -- mounts --. Column 9, line 8, "These" should read -- The --.

Signed and sealed this 17th day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents