

Dec. 17, 1940.

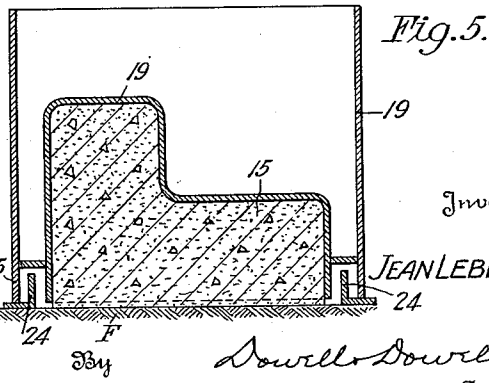
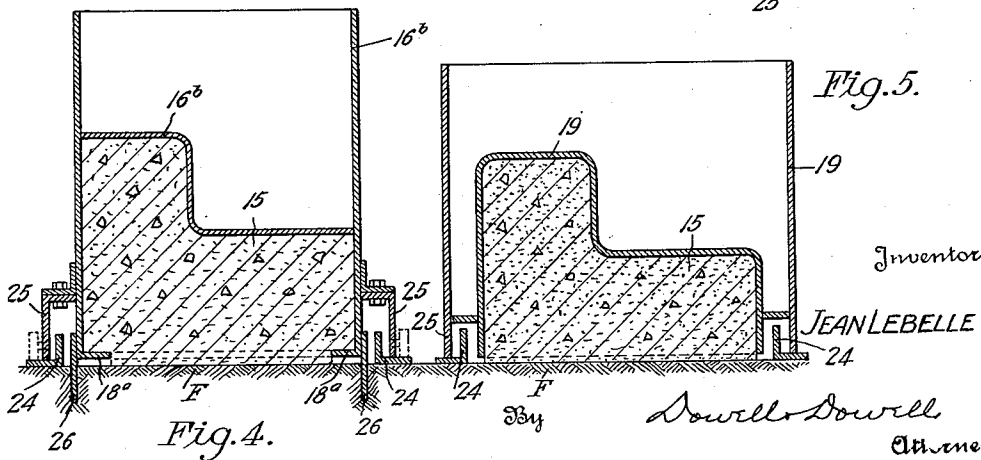
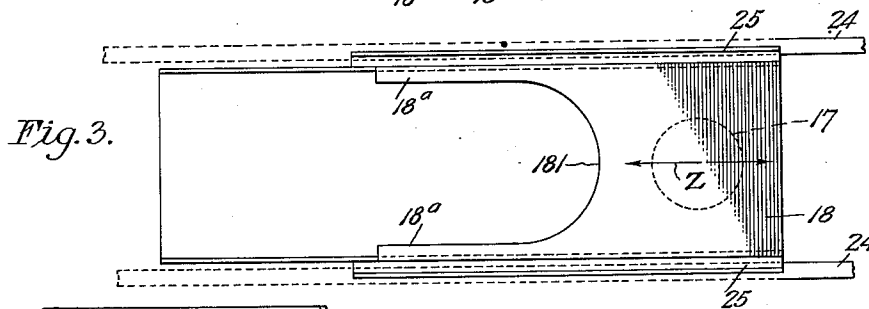
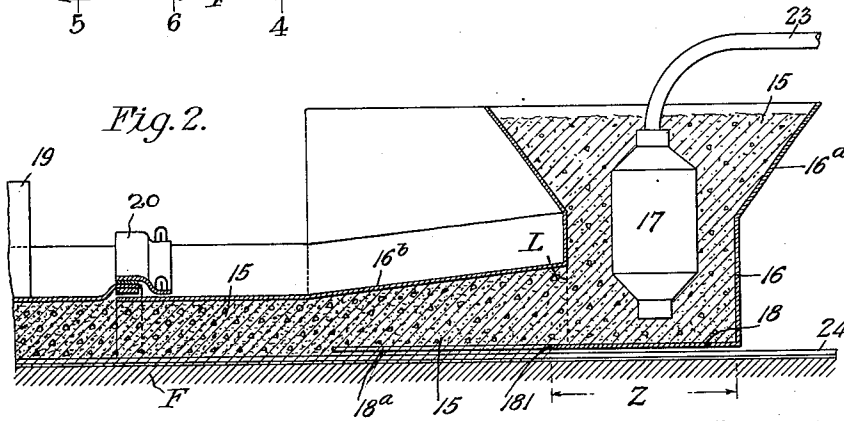
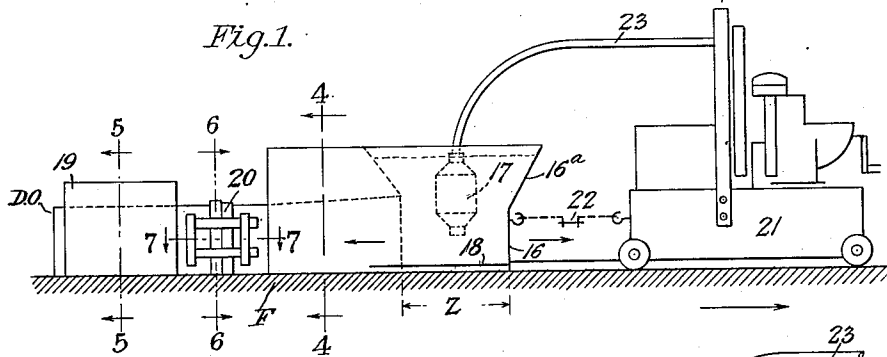
J. LEBELLE

2,225,015

METHOD AND MEANS FOR PRODUCING CONCRETE STRUCTURES

Filed Feb. 16, 1938

3 Sheets-Sheet 1



Inventor

JEAN LEBELLE

Douglas Dowell

Attorneys.

Dec. 17, 1940.

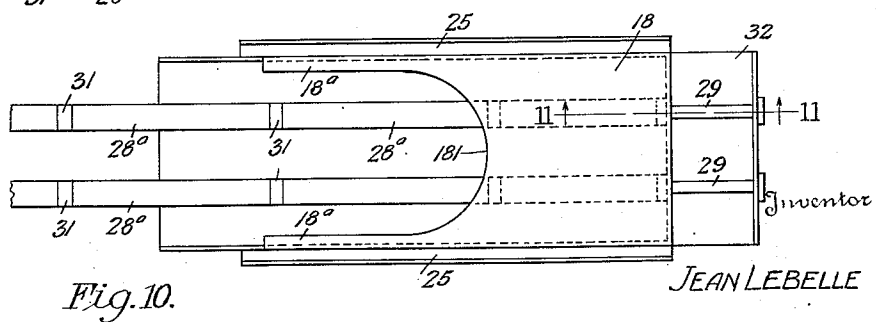
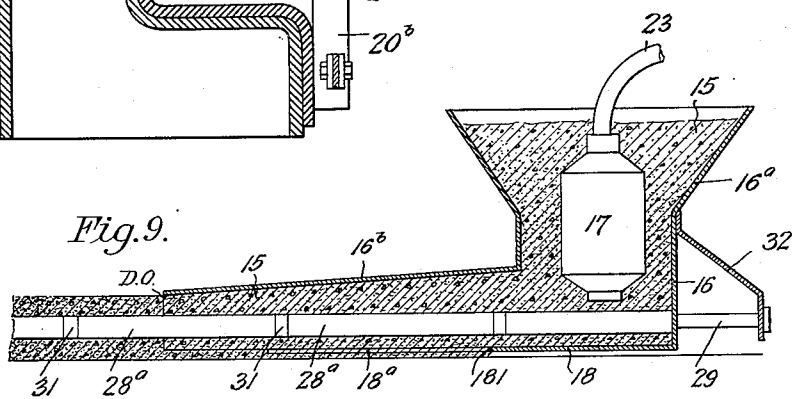
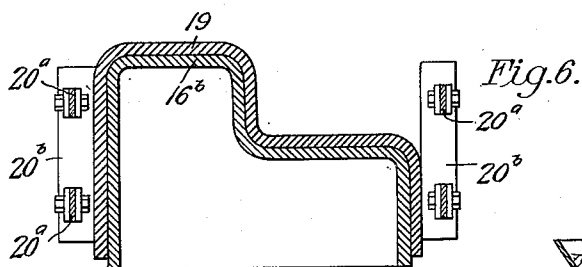
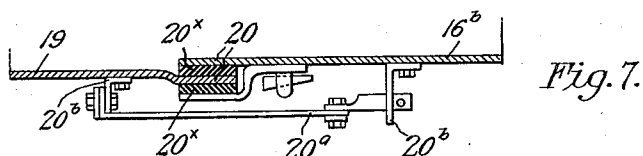
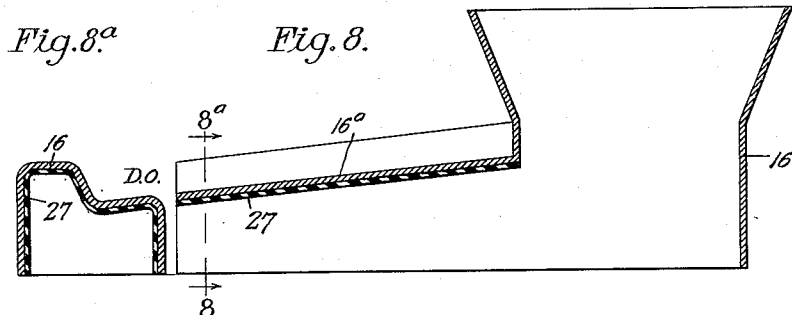
J. LEBELLE

2,225,015

METHOD AND MEANS FOR PRODUCING CONCRETE STRUCTURES

Filed Feb. 16, 1938

3 Sheets-Sheet 2



JEAN LEBELLE

By

Dwells Dwell

Attorneys.

Dec. 17, 1940.

J. LEBELLE

2,225,015

METHOD AND MEANS FOR PRODUCING CONCRETE STRUCTURES

Filed Feb. 16, 1938

3 Sheets-Sheet 3

Fig.11.

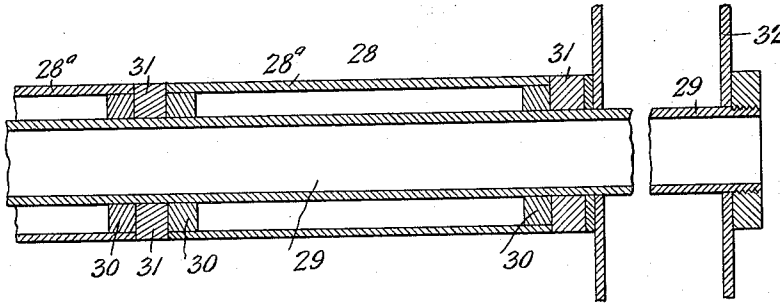


Fig. 12.

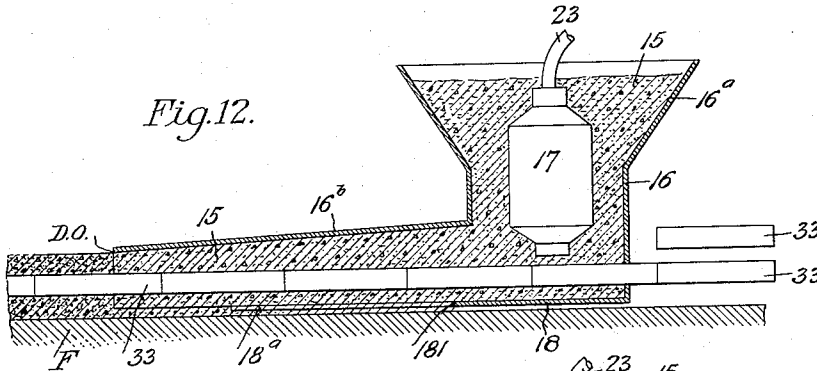


Fig. 13.

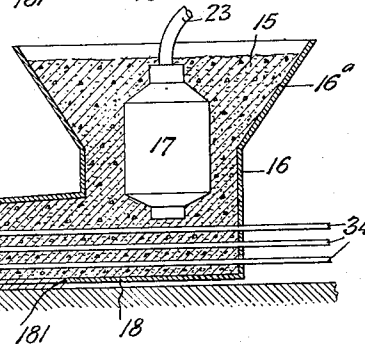
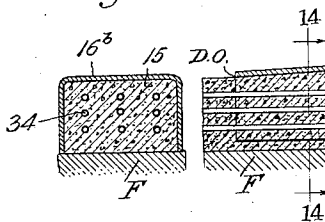


Fig.14.



Inventor

JEAN LEBELLE.

Buz

Dowell & Dowell
Attorneys.

UNITED STATES PATENT OFFICE

2,225,015

METHOD AND MEANS FOR PRODUCING
CONCRETE STRUCTURES

Jean Lebel, Paris, France, assignor to Procédés
Techniques de Construction, Paris, France, a
corporation of France

Application February 16, 1938, Serial No. 190,853
In France February 19, 1937

7 Claims. (Cl. 94—46)

This invention relates to the laying and molding of concrete or the like, having reference more particularly to the construction or production of roadways, pavements and other surfacings, curbs, gutters and other edgings or facings therefor, walls, viaducts, and sectional units such as blocks, pipes and other members used in building, including multitubular and reinforced structures.

The primary aim is to provide an improved method and means or apparatus for the production of different structures of the kind stated and in special particular those structures of the flat surface and edging type, such as road-shoulders or pavements and curbs or walls which constitute such an extensive part of modern construction work.

Among several important objects to this end it is sought to simplify and shorten the process and work of producing concrete structures according to the ordinary and generally accepted way.

One of the principal objects is to eliminate the necessary use of fixed molds or framing to form and set or to form and hold the concrete in place until it has set sufficiently hard to stand alone, unsupported.

Another principal object is to provide an improvement in which the concrete or the like is or may be laid, compacted and molded in a continuous progression upon or along its intended foundation; that is, a method and operative means in and by which the concrete is or may be imposed and simultaneously molded with proper hardening compaction in the desired form upon the intended base in a continuous progression along said base, or by a relative movement between the imposed concrete and said base.

Further objects and the more obvious advantages of the invention will be mentioned or else appear plainly from the description which follows.

It will facilitate understanding to here initially state that the invention broadly consists in supplying the concrete or the like in mixture (dry) to a feeding receptacle movable forwardly along the foundation upon which the formation is to be laid, subjecting the concrete mass in the forward or receiving part of said receptacle to a vibration producing the phenomena of fluidity or plasticity in said material rendering it compact and moldable, dampening or restraining or suppressing the vibration in the rearward or discharge part of the feeding receptacle so that the concrete will assume or resume a plastically solid consistency therein, and moving the receptacle

forwardly at a rate synchronized with the rate of the concrete's assumption of a solid consistency in the discharge end of the receptacle. As the receptacle is moved forward it leaves therebehind a body or strip of the concrete having the plastic form imparted to it by the interior or discharge end of the receptacle. This body or strip of concrete being no longer subjected to the vibration and having assumed or resumed a solid consistency, retains and hardens in that form without requiring any retaining mold or framing.

In other words, the concrete or the like is fed continuously into a receptacle having a discharge outlet of the shape which it is desired the concrete shall take cross-sectionally. In said receptacle a device is provided to vibrate the concrete mixture or mass so as to give it a fluently plastic character in the forward or receiving end, and this vibration is checked or deadened in the rearward or discharging end so as to allow the concrete to assume a solidifying consistency while plastically taking up or molding hardenably into the exact inner shape of the discharge outlet. Being so brought to a solidifying and hardening state, it emerges in preservation of said shape through said outlet in "ribbon fashion" as the receptacle is moved forward or translated relatively to the receiving base.

Various forms of means or apparatus may of course be employed to carry this method into practice and effect, depending upon conditions or circumstances and the nature, character or form of the structure to be produced. By way of example only, one practical embodiment of such an apparatus, with certain modifications thereof, is illustrated in the appended drawings in a form designed to produce a combined curb and gutter alongside a road foundation, and for better understanding of the full nature and scope of the invention, the same will now be described further with reference to the same.

In said drawings:

Fig. 1 is a side elevational representation of a complete apparatus;

Fig. 2 is a partial longitudinal section, upon larger scale, of the receptacle wherein the concrete mass is subjected to vibrational treatment;

Fig. 3 is an inverted plan or bottom view of said receptacle upon the larger scale;

Fig. 4 is an enlarged cross-section on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged cross-section on the line 5—5 of said Fig. 1;

Fig. 6 is an enlarged cross-section on the line 6—6 likewise of Fig. 1;

Fig. 7 is an enlarged plan section on the line 7—7 of Fig. 1;

Fig. 8 is a partial longitudinal section, corresponding to Fig. 2, illustrating a modification of the apparatus;

Fig. 8^a is an end cross-section taken on the line 8^a—8^a of Fig. 8;

Fig. 9 is a longitudinal section, also corresponding to Fig. 2, illustrating another modification of the apparatus;

Fig. 10 is an inverted plan or bottom view of the modification of Fig. 9;

Fig. 11 is a partial longitudinal section taken on the line 11—11 of Fig. 10;

Fig. 12 is a longitudinal section similar to Fig. 9 of a further modification of the apparatus;

Fig. 13 is a similar longitudinal section of still another modification; and

Fig. 14 is a cross-section on the line 14—14 of Fig. 13.

Referring first to Figs. 1 to 7, the prepared concrete or the like mixture 15 is supplied to a hopper-like feeding receptacle 16, having its receiving or forward end part 16^a advantageously opening upwardly into funnel shape, and its discharging (feeding) or rearward end part 16^b converging or inclining gradually to a connection or discharge opening described later.

Within said receiving or forward end part of the receptacle a high-frequency vibrator 17 immersed in the concrete subjects the same to a vibration producing the phenomena of fluidity or plasticity in said material, rendering it workable into a flowing solidifying moldable mass. Under the zone of vibration, indicated by Z, and in its front or forward part, the bottom of the receptacle is closed by a base-member or plate 18 in order to avoid the ready escape of the mortar or other ingredient of the concrete made fluid by the vibration, the remainder or rearward part of the bottom being left open so as to allow the concrete to contact and spread upon the foundation on which it is to be molded. This base-member 18 is effectually sealtight all around its fitting or union with the walls of the receptacle so as to make it leakproof in said front or forward part end also along the sides, a bay or inward cut 18¹ leaving forked leg portions 18^a being formed in its rearward end so that the concrete will gradually contact and spread out upon the foundation toward the rear end of the receptacle. Thus the receptacle's front wall portions and the concrete itself in the rearward part thereof retain the fluid within the forward part of the receptacle.

It might be well to explain here that the mortar forming one of the constituents of the concrete is an essential contributant to imparting a fluidity state thereto under the influence of the vibration and it is important to prevent the outflow of this mortar in the fluid form. It is thereby kept in the concrete up to the point where, after the vibration is sufficiently reduced and the concrete has begun to acquire a solidifying plastic consistency, the mortar no longer has any tendency to flow out.

In the rearward part 16^b of the receptacle, the vibration is reduced or deadened, resulting in part from its relative remoteness from the vibration zone. In this particular instance said rearward part is connected at its end with an extension or caisson-member 19 in which the dampening of vibration is in major part and more com-

pletely performed. Said connection indicated at 20 is a flexible connection, effected for example by an interlocked overlapping of one upon the other with interposed elastic bands 20^x as shown (see Figs. 7 and 2), at the same time ensuring a tight closure. The interlock may be attained by resilient coupling straps or bars 20^a secured between brackets 20^b on the two members (see Figs. 6 and 7). Of course the inner surfaces of the two members should be preserved substantially flush to ensure an unimpeded flow of the concrete from the one into the other.

Said extension or caisson-member 19 has its free or trailing end opening, or formed with a discharge opening indicated by DO, in the cross-sectional shape of the structure to be produced or in which the concrete is desired to be molded. In fact, the caisson-member and the rearward part of the receptacle likewise have such a cross-sectional form, in this instance being that of a combined curb and gutter (see Figs. 4 and 5). However, the upper walls or surfaces are preferably inclined gradually downward in the rearward direction in order to concentrate and compact the final mold of the concrete. This may to a certain extent be advisable also with respect to the side walls of the receptacle and caisson members, although ordinarily it will not be so. It may also be desirable in some instances to have the upper wall or surface of the caisson-member, and perhaps also the rearward part of the receptacle, adjustable vertically to regulate or vary the height of the formation to be produced, this being obviously possible, although it has not been specifically illustrated, by reference to Figs. 4 and 5.

At the forward end of the receptacle, a tractor 21 is coupled to draw or move it forward. Said coupling is indicated at 22 and is of course disconnectable. The motor of this tractor is advantageously utilized also to drive or operate the aforementioned vibrator 17 through a suitable connection therewith, such for example as a flexible transmission cable 23 herein shown.

The illustrative apparatus thus far described, and shown in rather elementary form, operates as follows:

Starting from rest, the concrete or the like supplied into the hopper-like receptacle 16 is set into vibration by the vibrator 17 in its forward end 16^a, this being continued until the concrete has been brought into a fluidic or plastically flowing state tending to fill up the rearward end 16^b of the receptacle. At the outset, before there has been any prior filling of said rearward end, it may facilitate preparatory conditioning to block off the rearward part by inserting a separate partitioning plate or panel (not shown) upon the line indicated in dotting by L in Fig. 2 and removing it again after the concrete in the forward part has reached the proper consistency to be released rearwardly. As the fluent or plastic concrete moves or flows rearwardly (with forward movement of the receptacle) in tending fill of the rearward part, it takes up the form of said part and begins to assume or resume a solidifying consistency of closely compacting ingredient particles. This filling and acquisition of a mold is promoted by the converging or downwardly inclining upper wall of said rearward part, which tends to assert a pressure addition to the vibration action. Within the rearward part, and in the caisson-member 19, the vibrations are dampened or deadened and suppressed so that the mass of flowing concrete works increasingly into

a less fluidic and plastic state. Gradually the concrete assumes the directed shape in its relative progress toward the rear of the receptacle and through the extension or caisson-member, all the while smoothing out and growing more solid-
 5 ific, until it finally emerges through the discharge opening DO in complete molding to form. Having by this time reached a solidifying consistency, it retains the molded form without need
 10 of any framing or support.

During this time the tractor 21 draws or has been drawing the receptacle and attached member forward along the foundation upon which the molded formation is to be laid. The rate of
 15 forward movement is contemporized or synchronized with the rate of the concrete's assumption of the solidifying consistency, or the rate at which it is ready to be expended out. Inversely, the rate of concrete progression through the
 20 molding process may be regulated according to the speed given to the tractor—assuming of course that the action can be accelerated by conditions, such as temperature and the character or different compositions of the concrete.
 25 The supply of the concrete mixture to the feeding receptacle is of course maintained correspondingly to the discharge.

From the foregoing explanation the fundamental operation in carrying the method of the
 30 invention into practice will be readily understood. Certain refinements and additional features of apparatus provision will, however, promote its performance and perfect the results attained.

For instance, in order to obtain a formation which is perfectly straight or of a desired predetermined curvature, guiding rails such as the angle irons 24 may be provided on which to have the apparatus move. Such rails, shown rested
 40 on the foundation and of course fixed temporarily in place, may be rendered to cooperate with side guard or supporting plates 25 on opposite sides of the feeding receptacle and its connected extension, and the latter plates might
 45 carry or rest upon wheels (not shown) moving on the rails. By this or some equivalent arrangement obviously the apparatus, including the tractor similarly adapted, will be directed or moved along a definite track laid out in advance.
 50

In further instance, the lateral spread of flow restraint of the concrete and the tightness along the bottom edge of the feeding receptacle may be augmented by applying in the foundation, or,
 55 if the foundation is soft, to the bottom longitudinal edges of the receptacle itself, vertically disposed plates 26 extending slightly into the foundation between which the receptacle body per se closely moves over the latter. In the former instance of course the body moves relatively to
 60 the plates, i. e. it slides between them, and in the latter case it carries the plates along with it, moving them forward simultaneously.

It should be mentioned here that the foundation, indicated at F, will ordinarily be a cement or other usual foundation for the superposed concrete structure, but it may be some other foundation, or the equivalent, or even the ground itself. In some cases a direct ground foundation may be preferred.
 70

Referring now to the modifications:

In the modified apparatus of Fig. 8, the extension or caisson-member 19 is omitted and the vibration and dampening are both performed in
 75 the single hopper-like receptacle 16, which may

need to be then somewhat longer. To provide for this the two side and upper wall portions of the rearward part 16^b are lined or covered, preferably somewhat thickly, with an elastic or resilient material 27 (see also Fig. 8^a), such as rubber
 5 or cork, insulating or muffling them from the vibration transmitted to the concrete. Thus the function and result of an extensional separate dampening member (19) may be obtained, although it is considered to be less effectual and
 10 satisfactory than the separately (flexibly) attached dampening member itself, which is ordinarily preferred. In this modified apparatus the end of the rearward part alternatively provides the discharge opening DO. In general, the apparatus is otherwise the same as the first described form and operates correspondingly, assuring a sufficient compactness of the mold of the concrete to enable a monolith structure thereof to be drawn out indefinitely without any
 20 support framing being necessary.

In the modification of Figs. 9 and 10, a single unit apparatus similar to Fig. 8 is illustratively shown adapted for the production of bi-tubular
 25 monoliths or blocks, and which may be similarly adapted for the production of multitubular structures or pipes. This adaptation includes mandrel cores 28 mounted longitudinally in the molding receptacle around which the concrete
 30 will form to produce longitudinal channels in the molded structure. Said cores are designed so that their rear portions will not transmit vibration to the concrete working to its final mold, or in other words so that they will dampen the vibration in the rearward part of the receptacle. This is done for instance by forming
 35 the cores in sections 28^a (see Fig. 11) concentrically disposed upon a central pipe 29, with support upon elastic rings 30 and separation by elastic washers 31 therebetween. The forward
 40 end of the pipe 29 is fixed in a bracket 32 on the forward wall of the receptacle through which it extends, while its rearward end is left free and is supported by the molding concrete itself. In other respects said apparatus is and functions
 45 substantially the same as before described.

In the modification of Fig. 12 the apparatus is very much like the preceding, except that in this instance provision is made to insert tubular or pipe sections 33 to remain permanently in the
 50 concrete mold, for either reinforcement or conduit purposes. Said sections are shown introduced through the front wall of the molding receptacle, one following another end to end, as
 55 the receptacle moves forward. A receptive hole is formed for the purpose and a receiving tube (not shown) registering with said hole guides the sections inwardly into place.

The modification of Figs. 13 and 14 illustrates a provisional arrangement by which either channels according to Fig. 9, or either tube or bar sections according to Fig. 12, may be introduced in the concrete mold in multiple number. In this last modification actually the series of longitudinal elements 34 represents small pipe sections being embedded in the concrete for reinforcement purposes as described in Fig. 12, but it will be obvious that the purpose of Fig. 9 may be similarly and equally well carried out.
 65

It will be understood, in connection with the foregoing, that the means and manner of producing the vibration of the concrete, included herein, is not in itself a feature of the present invention claimed per se. This specifically in a broader sense and applicability is covered in a
 75

prior U. S. Patent, No. 2,015,217 to Deniau dated September 24, 1935 owned by this patentee. Although an immersed vibrator has been shown and described, any other means suited to the purpose may, as well, be used. Also, although the material treated and molded has been defined generally by the term "concrete" this term is not intended to be restrictive, but rather is meant to apply in a properly broad sense, inasmuch as the invention comprehensively applies to any similar material similarly moldable into a solidifying structure or body.

However, with reference to the concrete or the like which is employed or intended to be employed in the molding, according to the method described, it should perhaps here be mentioned that said material is naturally granulous and substantially dry in the initial mix or untreated state, but acquires a fluidic and plastical state under the action of the vibration as previously stated, without any water or moisture addition to it. The material must of course have a constituent and sufficient body to bind and hold itself together as any ordinary concrete or cement mixture is intended and expected to do, and the material used is of course of this general common nature including a certain amount of cement (flour), gravel, sand and the like broadly included in the term "granulous."

With reference to possible modifications, it may be desirable in some cases to have the hopper-like feeding receptacle remain stationary and to have the foundation, in its place, move thereunder as in the form of a platform or belt. Indeed such an arrangement would be preferable in the case of an apparatus adapted to produce only blocks or short slab sections of different concrete structures. It has already been stated that the invention is designed and adaptable to the production of various different structures, and it was such modifications had in mind by this statement. Moreover, different structures to be produced will in themselves obviously necessitate different cross-sectional and other different arrangement forms of apparatus.

In conjunction with the described apparatus it is of course contemplated as already stated, that a mixture of the concrete to supply the same will be maintained continuously during its operation, either by hand or by some suitable mechanical means.

Various other modifications and different embodiments of apparatus may be employed to carry out or adapt the described method to performance. Varied requirements, working conditions and future developments will determine or suggest the apparatus best suited to the particular purpose, and improvements will likewise follow. It will therefore be understood that the appended claims are not intended to be limiting to the actual apparatus, or embodiment and modifications thereof, shown. On the contrary, they are intended to embrace and cover any other kind of apparatus or means designed to perform the same functions and to attain or accomplish the same desirable results.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. An apparatus for producing concrete in monolithic or the like forms without the use of any fixed molds or framing, comprising an elongate open-bottomed shaping chamber movable longitudinally over and along the intended foundation having a forward receiving and a

rearward discharge end, means for vibrating a concrete mix in the forward end of the chamber, means closing the chamber in the forward end below the zone of vibration, means comprising the walls of the rearward discharge end of the chamber for progressively compacting and shaping the concrete mix in its movement toward the discharge end, means connected with said rearward walls of the chamber for dampening out the vibrations of the concrete mix originated in its forward end, said means consisting of surfaces engaging the concrete mix at top and both sides, and means for moving the shaping chamber relative to the foundation onto which it deposits.

2. An apparatus for laying a body of concrete on a foundation, comprising a receptacle having a forward hopper part and a rearward shaping part with downwardly converging upper walls, said receptacle being provided with downwardly extending side walls adapted to confine the body of concrete against lateral displacement, a vibrator in said hopper part, said hopper part being provided with a rearwardly extending closure plate at the bottom thereof adapted to prevent the materials in said hopper from premature deposit on the foundation during vibration, and a vibration dampening open-bottomed extension member provided with top and side surfaces and resiliently coupled to the rear portion of the shaping part of the receptacle and adapted to dampen the vibrations within the body of the concrete and means for moving the apparatus relative to the foundation.

3. An apparatus for producing concrete forms according to claim 1, wherein the means connected with the rearward walls of the chamber for dampening out the vibrations in the concrete mix comprises a flexible sheeting material applied as liners to the inner surfaces of said rearward walls progressively compacting and shaping the mix.

4. An apparatus for laying a body of concrete on a foundation, comprising a receptacle having a forward hopper part and a rearward shaping part with downwardly converging upper wall, said receptacle being provided with downwardly extending side walls adapted to confine the body of concrete against lateral displacement, a vibrator in the hopper part of said receptacle, said hopper part being provided with a rearwardly extending closure plate at the bottom thereof adapted to prevent the materials in said hopper from premature deposit on the foundation during vibration, a vibration dampening open-bottomed extension member provided with top and side surfaces and resiliently coupled to the rear portion of the shaping part of the receptacle and adapted to dampen the vibrations within the body of the concrete, openings formed in the hopper part of the receptacle for therethrough incorporating longitudinal reinforcement or conduit members into the concrete body as the material thereof is vibrated and passed formatively through the receptacle, and means for moving the apparatus forwardly relative to the foundation on which the concrete body is laid.

5. An apparatus for producing concrete monolithic structures from substantially dry material mixtures, without the use of fixed molds or retainers, which comprises an elongate open-bottomed shaping chamber disposed over and movable in relation to the intended foundation for such structures, the said chamber having a forward hopper space providing a receiving end

and a rearward shaping space providing a discharge end, vibrating means in the forward hopper space for vibrating a mixture of concrete or the like supplied therinto, means closing the bottom of the chamber at the forward hopper end under the zone of vibration by said vibrating means, means constituting the shaping space walls of the chamber in its rearward end for progressively compacting and shaping the concrete mix moving therein from the hopper space toward the discharge end, means connected with said walls of the chamber for dampening out of the concrete mix the vibrations imparted thereto in the forward end of said chamber, said means constituting surfaces engaging the mix at top and sides, and means moving the shaping chamber forwardly in relation to the foundation onto which it deposits the concrete mix.

6. An apparatus for laying a body of concrete on a foundation, comprising an open-bottomed receptacle constituting a forward receiving hopper part and a rearward discharging and shaping part, the said rearward discharging and shaping part having at least one of its walls converging toward the discharge point and said receptacle throughout having downwardly extending side walls adapted to confine the body of concrete therein against lateral escape or displacement, a vibrator in said forward receiving hopper part of the receptacle, said hopper part being provided with a rearwardly extending closure plate at the bottom under the zone of vibration by said vibrator adapted to prevent the concrete in said part from premature deposit on the foundation during vibration, a vibration dampening open-bottomed extension member having top

and side surfaces resiliently coupled to the rear portion of the discharging and shaping part of the receptacle and adapted to dampen out the vibrations within the body of the concrete originated in the forward hopper part of the receptacle, and means for moving the complete apparatus forwardly in relation to the foundation.

7. The method of producing concrete monolithic structures without the employment of fixed molds or side retainers, which consists in supplying a substantially dry mix of the concrete to a receiving chamber, subjecting the mix to vibration in said chamber to render it moldably plastic, flowing the vibrated moldably rendered mix from said chamber into and through an open-bottomed discharge passage and in simultaneous deposit onto the intended foundation within the confines of said passage, progressively constrictingly compacting and molding the plastically rendered mix cross-sectionally into the desired mold form on said foundation as it is flowed through said passage thereonto, positively smothering or dampening out the vibrations in said constrictingly molded mix before its discharge release from said passage by subjecting it to a vibration-suppressive action upon all sides whereby said mix is brought to a solidification and set sufficient to be wholly self-sustaining, and meanwhile moving the mix and discharge passage relative to each other so as to emit the self-sustaining mass of the mix from said passage and thereby simultaneously withdrawing all mold retainer from said mass, leaving the same resting upon the foundation without any other support.

JEAN LEBELLE.