June 1, 1943. W. R. HUME 2,320,728

APPARATUS FOR MOLDING CONCRETE SLABS

Filed Feb. 13, 1940 3 Sheets-Sheet 1

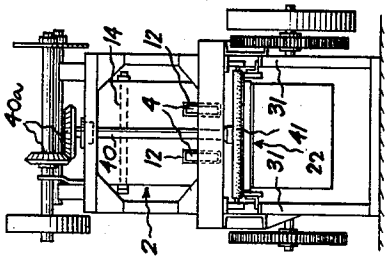


Fig. 2.

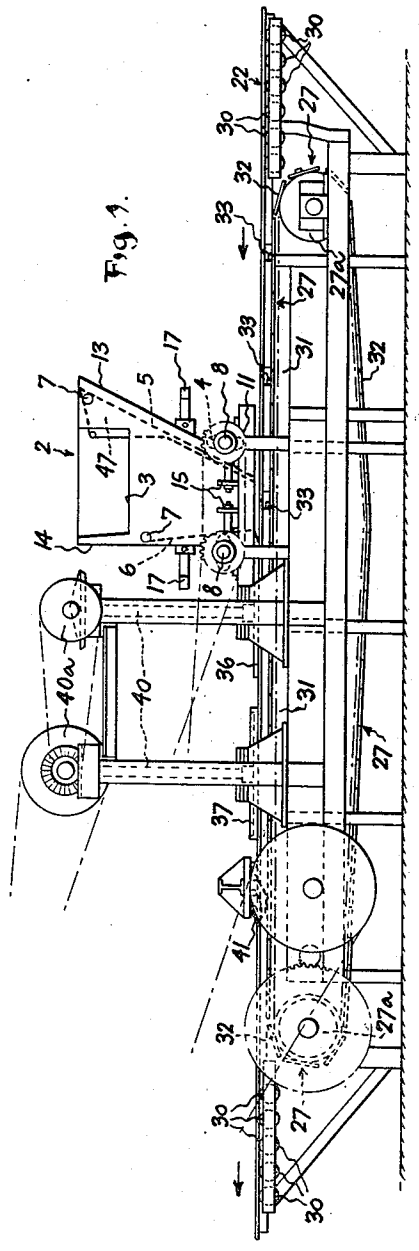


Fig. 1.

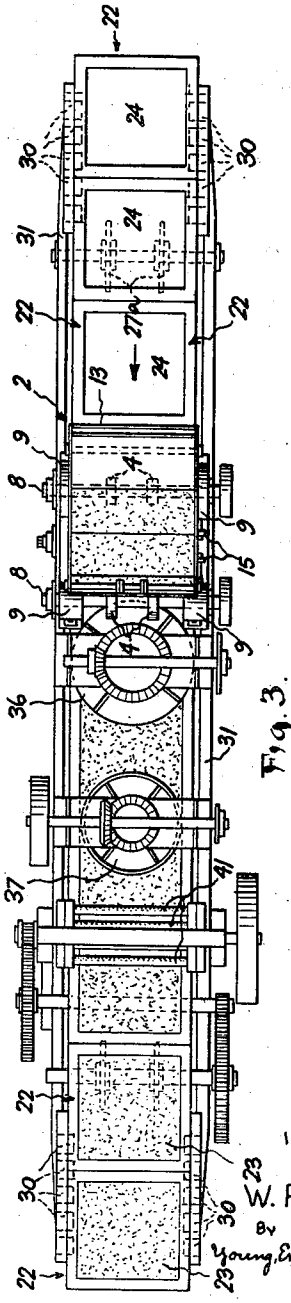


Fig. 3.

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APPARATUS FOR MOLDING CONCRETE SLABS

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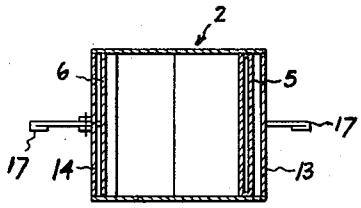


Fig. 5

Fig. 4.

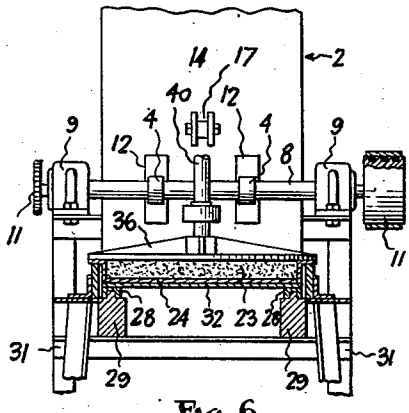


Fig. 6.

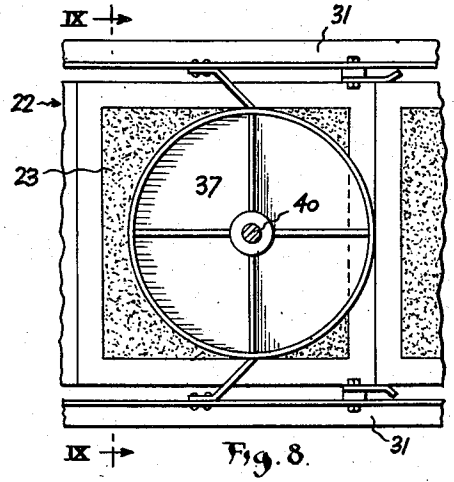


Fig. 8.

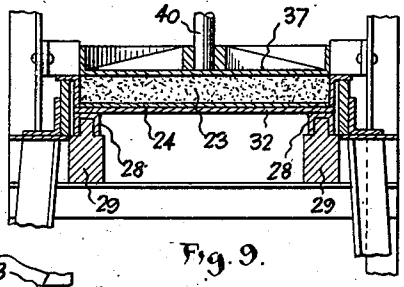


Fig. 9.

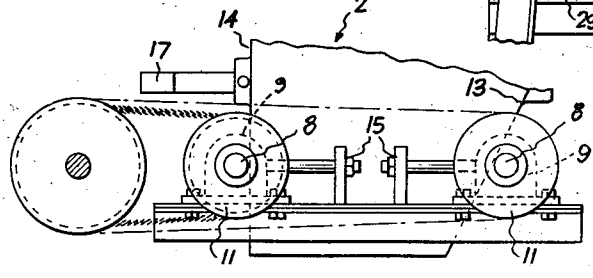


Fig. 7.

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APPARATUS FOR MOLDING CONCRETE SLABS

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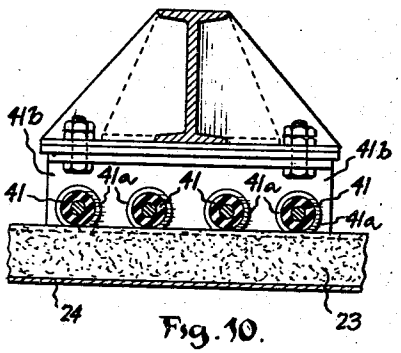


Fig. 10.

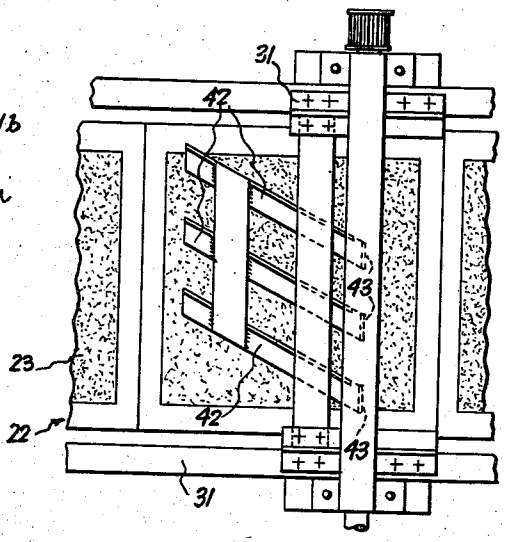


Fig. 11.

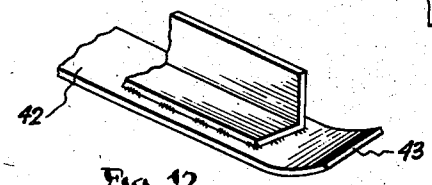


Fig. 12.

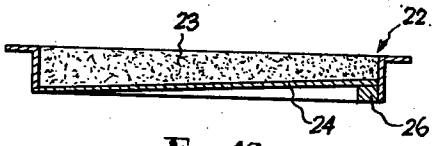


Fig. 13.

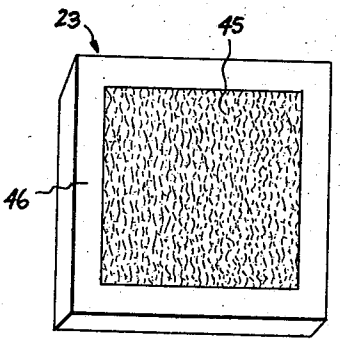


Fig. 14.

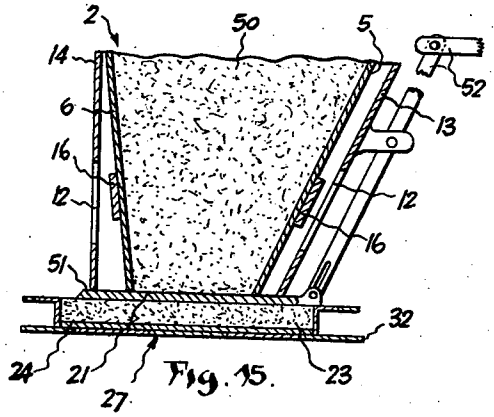


Fig. 15.

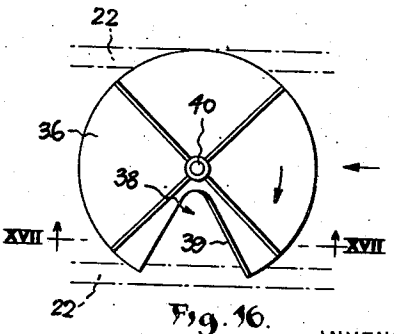


Fig. 16.

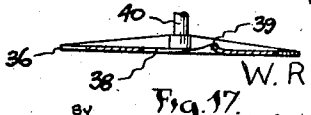


Fig. 17.

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2,320,728

UNITED STATES PATENT OFFICE

2,320,728

APPARATUS FOR MOLDING CONCRETE SLABS

Walter Reginald Hume, Melbourne, Victoria, Australia

Application February 13, 1940, Serial No. 318,764
In Australia February 24, 1939

9 Claims. (Cl. 25—42)

This invention relates to the molding of concrete slabs, blocks, tiles and the like, and refers more particularly to the molding of such articles from a relatively dry concrete mixture, usually termed a "semi-dry" mix. The invention is not, however, limited to the use of such a mixture but is applicable generally to the manufacture of concrete slabs and the like.

The use of such a semi-dry concrete mixture, wherein the water content is reduced to a minimum, has decided advantages in that it obviates, to a great extent, the formation of voids, due to the evaporation of the excess water in the molded article and the leakage or flow of the excess water, which is liable to cause localised accumulations of the cement binding agent, with the result that the product is not uniformly homogeneous, strong and well finished.

Hitherto, it has been the usual practice to mold such slabs and the like from the semi-dry concrete mix by manually placing the latter within the mold, which is then subjected to a vibratory action which is designed to distribute the low content of moisture through the material and convert the latter into a more pasty or plastic state within the mold.

Considerable difficulty has been experienced in thus effectively molding the semi-dry material by vibration within the mold, particularly when relatively shallow molds, such as those used for concrete slabs or the like, are employed. With this known method, it has been found that the whole of the concrete in the mold is usually not converted into the desired pasty or plastic state necessary to produce a uniformly homogeneous product. Thus, parts of the material, forming the slab or the like, remain relatively dry, owing to the incomplete distribution of the moisture therethrough and these relatively dry sections constitute a serious defect in the product.

Furthermore, the manufacture of slabs or the like by the foregoing process of vibrating a semi-dry material within the mold is slow and laborious owing to the necessity of manually charging each mold with the material and of vibrating it for a relatively long period with the object of effecting the desired distribution of the moisture and conversion of the material into the requisite plastic and homogeneous condition.

The primary object of the present invention is to overcome or minimise the abovementioned disadvantages by the provision of a new or improved process and apparatus whereby the semi-dry concrete mixture is vibrated or agitated and converted into the desired pastry or plastic condition within a suitable feed hopper or chamber prior to its introduction into the mold. By this process and apparatus, the relatively dry material may be effectively vibrated or agitated and converted to the desired plastic and homogeneous state during its passage through the feed hopper or the like so that it is already in the desired plastic condition when it enters the molds into which it may be expeditiously delivered in successive charges of the desired predetermined quantity as the molds are successively brought beneath the bottom or discharge opening of the hopper or the like, as hereinafter described.

In addition to insuring a more homogeneous and generally improved product, the invention also greatly facilitates the manufacture of slabs or the like owing to the fact that it is not necessary to manually fill or charge each mold and then subject the mold to the usual vibratory action. The feed hopper or the like may be of relatively large capacity so that the gravitational effect of the weight of the material therein, assisted by the vibratory or agitating action, causes the material to be automatically transferred or fed from the hopper or the like into the molds as they are successively brought beneath the open lower end or discharge opening of the hopper.

The invention also embodies an improved method and means whereby a rotary trowelling action is applied to the surface of the concrete material after it has been introduced into the mold, this trowelling action being adapted to effectively smooth or finish off the surface of the slab and compact the material within the mold as hereinafter described.

Referring to the drawings which form part of this specification:

Figure 1 is a side elevation of apparatus in accordance with the invention.

Figure 2 is an end view looking at the left-hand or delivery end of the machine.

Figure 3 is a plan of Figure 1.

Figure 4 is an enlarged side sectional elevation of the feed hopper and associated parts including a first rotary trowelling disc arranged immediately in advance of the hopper.

Figure 5 is a cross section on a reduced scale on the line V—V of Figure 4.

Figure 6 is a cross-sectional view on line VI—VI of Figure 4 on a somewhat reduced scale.

Figure 7 is a side view showing the lower portion of the hopper and the driving mechanism for

the cams or knockers which vibrate or agitate the material in the hopper.

Figure 8 is a plan view showing a second rotary trowelling disc arranged above the mold.

Figure 9 is a section on the line IX—IX of Figure 8.

Figure 10 is an enlarged cross-sectional detail view showing a group of rollers arranged to act upon the surface of the material in the molds as they are carried forwardly by the conveyor.

Figure 11 is a view of a modification embodying stationary trowelling plates for acting upon the surface of the material in the molds on the conveyor.

Figure 12 is a perspective view of portion of one of the trowelling plates seen in Figure 11.

Figure 13 is a longitudinal section of a mold having an inclined bottom plate or palette for the molding of slabs of tapered section.

Figure 14 is a perspective view of a slab showing a roughened ornamental surface surrounded by smooth marginal portions.

Figure 15 is a detail view of a modification wherein a shear blade is adapted to move between the bottom of the hopper and the molds to cut off the successive charges of cementitious material.

Figures 16 and 17 are respectively, a plan and a cross section on the line XVII—XVII, of a modified rotary trowelling plate or disc having a segmental gap therein.

In accordance with the invention, a feed hopper or receptacle 2 of the desired size and shape, according to the desired size or capacity of the hopper and the shape of the articles to be molded, is provided. The shape, in plan or cross section, of the hopper or its discharge opening, will correspond substantially with that of the mold; for instance, in the molding of rectangular concrete slabs the cross-sectional shape and area of the hopper or its discharge opening will correspond with the rectangular shape and surface area of the mold. Similarly, in the molding of circular, elliptical or other shapes, the cross-sectional shape of the hopper or its discharge opening will conform to the size and shape of the surface of the article to be molded.

The concrete mixture which is preferably of a "semi-dry" or relatively dry consistency such, for instance, as that referred to in prior United States Letters Patent No. 2,023,381, may be introduced into the feed hopper 2 or the like from a suitable source such as a concrete mixer, the discharge chute of which may be arranged above the open top of the feed hopper which is thus filled to the desired extent with the semi-dry material. Alternatively, the feed hopper or receptacle may be charged by hand labor, the concrete being shovelled into the hopper through the side opening 3 in its wall.

Any suitable means may be provided for imparting the desired vibratory or agitating action to the hopper, for instance, eccentrically mounted shafts or weights, tapping or percussive appliances, or other suitable devices may act upon the hopper to impart the desired vibratory motion thereto. Alternatively, the vibratory or agitating motion may be imparted directly to the concrete within the feed hopper or the like by arranging a suitable vibrator or agitator within or upon the top of the concrete mixture.

As shown in the drawings, the vibratory or agitating action may be effectively applied to the material in the hopper 2 by means of rotating cams or knockers 4 engaging knocker plates 5 and 6 which are pivoted or hinged as at 7 and form front and rear inner walls of the hopper chamber.

The cams or knockers 4 which are mounted on cross shafts 8 supported in bearings 9 and driven by suitable driving gear 11, make contact with the hinged knocker plates 5, 6, through openings 12 in outer front and rear walls 13, 14, of the hopper. Suitable means, indicated at 15 may be provided to permit of adjustment of the knocker shaft bearings towards and from each other and consequently adjust the cams or knockers in relation to the hinged knocker plates.

The knocker plates 5 and 6 may be provided with wearing faces 16 to engage the knockers 4 and means, such as hand levers 17, pivoted on the outer walls 13, 14 of the hopper, and passing through openings 18 therein may be provided to permit of the plates 5 and 6 being adjusted in relation to the cams or knockers 4. The levers may be suitably retained in the desired attitude on their pivots. By this means the intensity of the impacts imparted to the knocker plates and the material within the hopper may be varied according to requirements such as the particular consistency or moisture content of the cementitious material employed. Thus, the intensity of the impacts may be adjusted to produce vibrations of relatively slight amplitude in the case of concrete of comparatively "wet" consistency and to produce more forcible agitation, setting up a jolting or concussional action when the concrete has a lower moisture content.

Whilst it is contained in the feed hopper or chamber, the material is thus subjected to vibration or agitation so that it is converted into the desired pasty or plastic condition as it is shaken down through the hopper. It will thus be evident that when the material reaches the discharge opening 21 at the bottom of the hopper, it has assumed the desired plastic consistency, so that when it is transferred into the mold 22, it will at once take the shape thereof, and without further agitation, will form a slab or the like 23 which is of substantially uniform homogeneity throughout the area of the mold.

The molds 22 are preferably formed of open topped angle iron frames within which are removable bottom plates or pallet 24 upon which the slabs may be removed from the mold frames after the molding operation. If desired, the bottom plates or pallets 24 may be slightly inclined in relation to the upper edge of the mold, for instance, by providing ledges or distance pieces 26 within the mold frames to support the pallets in an inclined position as seen in Figure 13 so that the molded slabs are of tapered or progressively reduced thickness from end to end. Such slabs may be advantageously employed in the construction of roofs and other parts of buildings and the like by arranging the thick and thin ends of adjoining slabs in abutting relationship so that the thicker ends at the outer faces of the slabs project slightly beyond or overhang the adjoining thinner ends. This facilitates the insertion of jointing or grouting material, such as cement mortar, between the abutting or adjoining edges of the slabs and causes rain water to be shed or pass over the joints from the projecting thick ends onto the thinner end portions of adjoining slabs.

The molds are mounted upon an endless conveyor 27 which may comprise endless chains composed of grooves links 28 adapted to run upon parallel longitudinal bearers or tracks 29 car-

ried by the machine frame 31. Secured to these endless chains or the like are supporting plates 32 for the molds and these plates may be fitted with cross pieces or stops 33 which engage behind the molds 22 and positively carry the latter forwardly with the conveyor. The conveyor 27 may be driven through suitable driving gear indicated at 27a.

At opposite ends of the bearers or tracks 29 on the machine frame 31 and at opposite sides thereof are short idle supporting rollers 30 upon which the side flanges of the molds may rest whilst they are being fed onto and removed from the conveyor 27.

The aforesaid rotary trowelling action in accordance with the invention may be imparted to the upper surface of the concrete in the mold by means of one or more (preferably two) rotary trowels or discs 36, 37, which are arranged in a substantially horizontal plane immediately above the open topped molds which are fed forwardly beneath the trowelling disc or discs. The underneath surfaces of these discs are disposed close to and approximately flush with the upper edges of the mold frames so as to exert the desired trowelling action upon the cementitious material therein.

One of the rotary trowelling discs 36 may be arranged to rotate against the upper surface of the concrete in the molds as the latter move away from the discharge opening 21 at the bottom of the hopper, where a stationary and preferably downwardly and forwardly inclined smoothing plate or straight edge 25 is preferably arranged at the front of the discharge opening 21 as seen in Figure 4.

The trowelling disc 36 is preferably plain or continuous as seen in Figure 3 but if desired it may be provided with one or more gaps or openings 38 of segmental form (see Figures 16 and 17) so that as the disc rotates, the rear or trailing edge 39 of this opening removes surplus portions of the concrete from the surface of the slab whilst, at the same time, a slight degree of suction may be set up, causing a quantity of air and moisture to be withdrawn from the concrete through the upper surface of the slab. This action also causes some of the finer particles of the cementitious material to rise to the surface and ensures an effective compacting and smoothing of the upper face of the slab or the like.

The said rear or trailing edge 39 of the opening 38 in the rotary trowelling disc 36 may be slightly upturned or bevelled so as to facilitate and improve the trowelling action. In addition, the underneath surface of the rotary trowel or disc may be slightly rounded or bevelled around its periphery.

As previously mentioned, said opening or gap in the rotary trowel or disc 36 may be eliminated so that, as seen in Figure 3 the disc consists of a plain or uninterrupted revolving plate, the underneath surface of which rotates against the upper surface of the concrete within the mold and effects the desired smoothing and compaction thereof.

The rotary trowel or disc 36 is preferably used in conjunction with a second rotary trowelling disc 37 arranged in advance of the first disc 36 and adapted to act upon the upper surface of the concrete after the charged molds have passed under the first rotary trowel. The second disc 37 is preferably rotated at a considerably higher speed (for instance in the ratio of two to one), than that of the first disc. The latter disc preferably extends over the side flanges of the open topped molds and the second disc 37 may be of smaller diameter approximately equal to the width of the molding space between the mold walls, as shown.

The rotary trowels 36 and 37 may be mounted on the lower ends of vertical shafts 40 which are driven by suitable driving gear 40a.

Thus the first rotary trowel may initially operate upon the upper surface of the concrete in the molds as they leave the vibratory or agitating feed hopper, whilst the second trowelling disc may be used to subsequently smooth and finish off the upper surface of the slabs after they have left the first rotary trowel. The second rotary trowel may, if desired, have its underneath surface disposed slightly above the upper edge of the mold walls and at a slightly higher level than the underneath surface of the second or finishing trowel which thus serves to compress the material at the top of the mold, thereby ensuring a dense and uniform surface finish.

After the concrete within the mold has been thus subjected to the aforesaid rotary trowelling action by one or more of the trowelling discs or plates, the upper surface of the concrete may be subjected to the action of one or more rollers 41 extending across the machine frame immediately above the molds 22 as seen in Figures 1 and 10. The material may be thus further compacted and smoothed by the rollers 41 as the slabs are carried beneath the latter. The rollers 41 may be surfaced with rubber or the like and mounted in ball bearings 41a (Figure 10) carried in stationary brackets 41b at opposite sides of the machine frame.

In lieu of, or in conjunction with, the rollers 41, stationary trowelling or smoothing plates 42 (Figure 11) may be arranged upon the machine frame 31 as to extend diagonally across the upper edges of the molds and press against the upper surfaces of the slabs as the latter are carried forwardly by the conveyor 27. The ends of these plates 42 nearest the feed hopper are preferably slightly upturned as indicated at 43. After the molds with the slabs therein have been removed from the idle supporting rollers 30 at the delivery end of the machine, the upper surfaces of the slabs may be subjected to the action of a hand operated roller whereby a roughened ornamental surface pattern may be applied to the plastic or "tacky" upper face of the slab so as to provide an effective non-slip surface which obviates the risk of persons slipping on a pathway or the like composed of the slabs, particularly in wet weather. This roughened ornamental surface is indicated at 45 in Figure 14.

The marginal portions of the slab are preferably smoothed off as indicated at 46 around the roughened surface 45 by means of a hand operated straight edge thus providing a neat finished appearance.

Provision is preferably made for delivering, when so desired, a liquid concrete mixture of a smooth sandy nature and having a relatively rich cement content, onto the palette 24 which forms the bottom of the mold prior to the introduction of the main body of concrete into the mold from the feed hopper. For this purpose, a chamber or compartment 47 may be associated with the feed hopper in such a manner that the liquid mixture which is to form the smooth underneath surface of the slab, is delivered onto the pallet as the mold enters beneath the feed hopper. This compartment 47 may be formed between the

hinged knocker plate 5 at the rear of the mold and an adjacent partition 48 which separates the compartment 47 from the main chamber of the feed hopper. The top of the compartment 47 may be fitted with a hinged lid 49. Thus, the liquid surfacing mixture spreads over the pallet 24 before the main body of concrete indicated at 50, passes from the hopper into the mold. By this means, a smooth or special surface may be imparted to the underneath side of the slab by the liquid surfacing mixture in cases where such a surface is required. In this respect, it will be evident that the liquid surfacing material in the compartment 47 may be colored to produce a corresponding colored surface on the slab.

According to a modification as illustrated in Figure 15, suitable means such as one or more shear blades 51 or the like may be arranged at or near the bottom of the hopper 2 so as to cut off the desired charge of plastic concrete as it leaves the hopper and passes through the discharge opening 21 into the mold, the shear blade or the like being adapted to thus also close the discharge opening, until the next mold is in position to receive another charge of the plastic material. The said shear blade 51 or the like may be of a slidable or rotary nature, for instance, a slidable shear blade may be adapted to reciprocate or move intermittently between the hopper and the mold by means of suitable operating gear indicated at 52, or a rotary shear blade may be adapted to pass between the hopper and the mold and thus cut off the successive charges of plastic concrete and close the bottom of the hopper whilst the next mold is moving into position thereunder. The shear blade may be operated in synchronism with the endless conveyor carrying the molds so that the latter are successively brought beneath the discharge opening of the feed hopper at the proper period to receive the charge.

Preferably, however, the successive charges of plastic concrete are parted or removed from the bulk supply 50 within the feed hopper or receptacle by moving the molds in close succession beneath the hopper by means of the endless conveyor as aforesaid.

After the molds have been passed beneath the feed hopper or the like and filled with the predetermined charges of plastic concrete which is then subjected to the rotary trowelling action and, if desired, to the action of the rollers and/or stationary trowelling plates as aforesaid, they may be removed from the machine with the slabs therein for curing or setting and for any desired finishing treatment such as the aforesaid hand rolling to produce a roughened ornamental surface, prior to the removal of the slabs, or the like from the molds.

The invention ensures a homogeneous, strong and generally improved product and owing to the manner in which the material is vibrated or agitated, during its passage through the feed hopper, and is fed from the latter into the molds by the gravitational pressure and agitation of the material in the hopper, after which the material in the molds is preferably subjected to the action of the rotary trowels and if desired, to the subsequent rolling and finishing operations, the manufacture of the articles is greatly facilitated and improved and a continuous output may be obtained from the machine with a minimum of hand labour.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a wall in the form of a knocker plate hinged at its upper end and hanging freely therefrom, and means for imparting forcible impacts to said knocker plate adjacent the lower edge thereof in order to convert a non-plastic semi-dry mixture contained therein into a plastic and substantially homogeneous condition by the time it reaches the bottom of the feed hopper.

2. In apparatus for molding concrete slabs and the like, the combination of a feed hopper having a wall in the form of a hinged knocker plate, and means for imparting forcible impacts to said hinged plate.

3. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a pair of opposite walls each in the form of a knocker plate hinged at its upper end and hanging freely therefrom, and means for imparting forcible impacts to said knocker plates adjacent the lower edges thereof in order to convert a non-plastic semi-dry mixture contained therein into a plastic and substantially homogeneous condition by the time it reaches the bottom of the feed hopper.

4. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a pair of opposite walls each in the form of a knocker plate hinged at its upper end and hanging freely therefrom, and means for imparting forcible impacts to said knocker plates adjacent the lower edges thereof alternatively to one plate in one direction and to the other plate in the opposite direction.

5. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a pair of opposite walls each in the form of a knocker plate hinged at its upper end and hanging freely therefrom, means for imparting forcible impacts to said knocker plates adjacent the lower edges thereof in order to convert a non-plastic semi-dry mixture contained therein into a plastic and substantially homogeneous condition by the time it reaches the bottom of the feed hopper, and means for adjusting the intensity of such impacts, comprising hinged levers associated with said knocker plates to move the latter in relation to the impacting means.

6. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a wall in the form of a knocker plate hinged at its upper end and hanging freely therefrom, means for imparting forcible impacts to said knocker plate adjacent the lower edge thereof in order to convert a non-plastic semi-dry mixture contained therein into a plastic and substantially homogeneous condition by the time it reaches the bottom of the feed hopper, and means for conveying a series of open topped molds successively beneath a discharge opening at the bottom of said hopper, said feed hopper having a compartment for a liquid cementitious material, said compartment being located adjacent the rear of the hopper and adapted to deliver the liquid cementitious material into the molds where the latter successively enter beneath the discharge opening at the bottom of the hopper.

7. In apparatus for molding slabs from a semi-dry or non-plastic cementitious material, a feed hopper having a pair of opposite walls each in the form of a knocker plate hinged at its upper end and hanging freely therefrom, means for

imparting forcible impacts to said knocker plates adjacent the lower edges thereof in order to convert a non-plastic semi-dry mixture contained therein into a plastic and substantially homogeneous condition by the time it reaches the bottom of the feed hopper, means for conveying a series of open topped molds successively beneath a discharge opening at the bottom of said hopper, and a partition interposed between said knocker plates to divide the hopper into a main compartment for non-plastic cementitious material and an auxiliary compartment for cementitious material of liquid consistency, said latter compartment being positioned to deposit its contents into a mold beneath the same prior to deposition of material from the main compartment.

8. An apparatus of the character described comprising a feed hopper provided with inner and outer walls, an opposed pair of said inner walls being formed as hinged knocker plates and knockers for alternately impacting one plate in one direction and the other plate in the opposite direction.

9. An apparatus of the character described comprising a feed hopper provided with inner and outer walls, an opposed pair of said inner walls being formed as hinged knocker plates and knockers for alternately impacting one plate in one direction and the other plate in the opposite direction, and means for adjusting the intensity of such impacts.

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