Oct. 3, 1961 C. W. JACKSON 3,002,249

MACHINE FOR THE MANUFACTURE OF CONCRETE BUILDING UNITS

Filed March 18, 1957 4 Sheets-Sheet 1

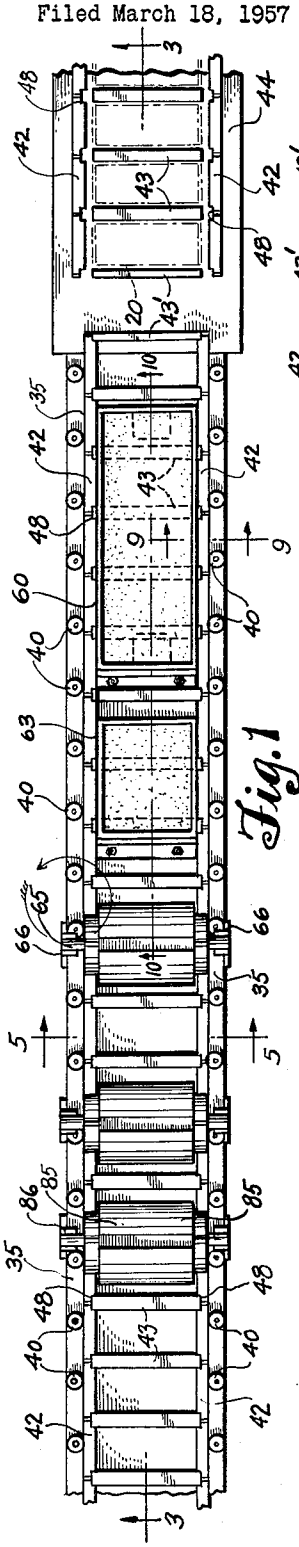


Fig. 1

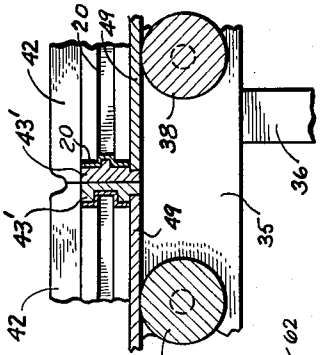


Fig. 4

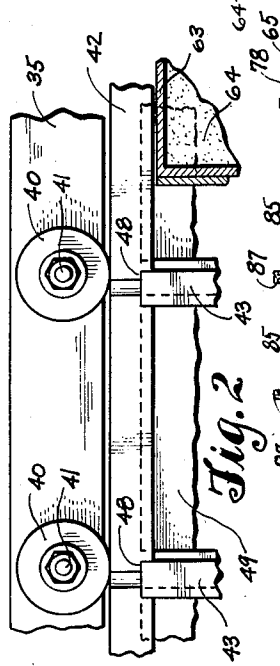


Fig. 2

Fig. 3

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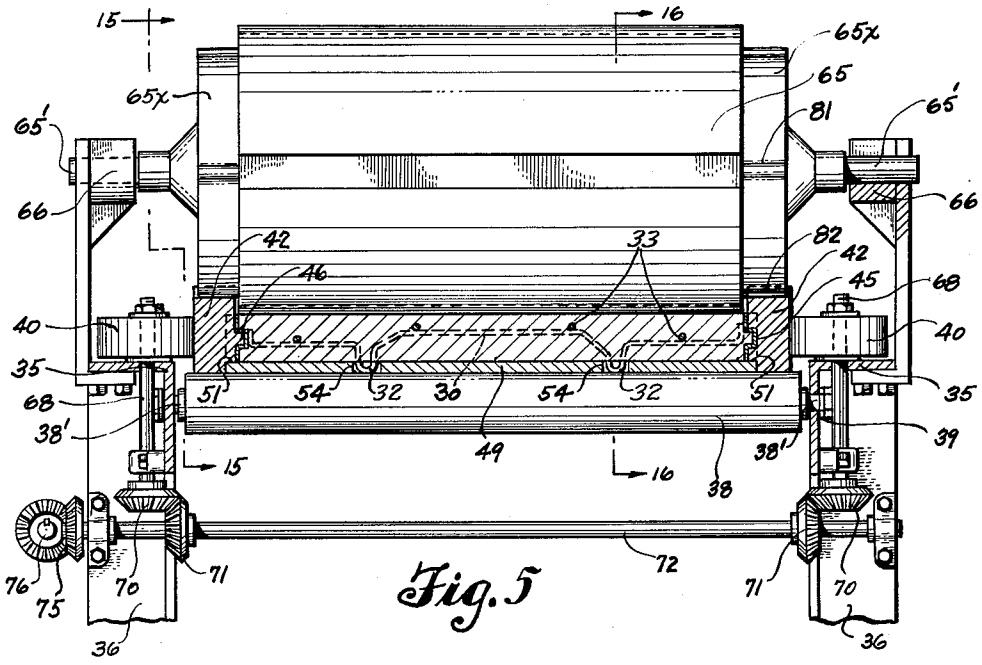


Fig. 5

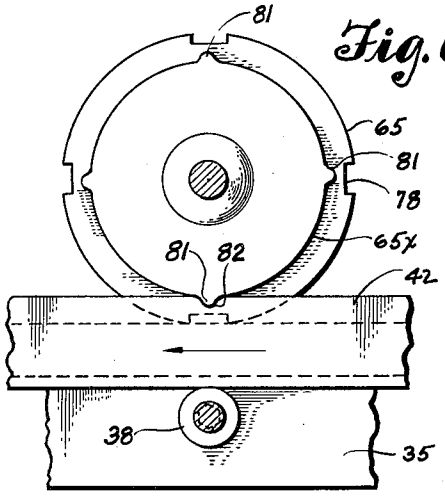


Fig. 6

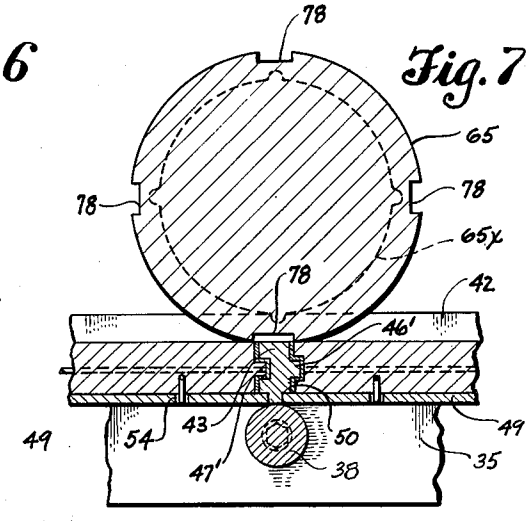


Fig. 7

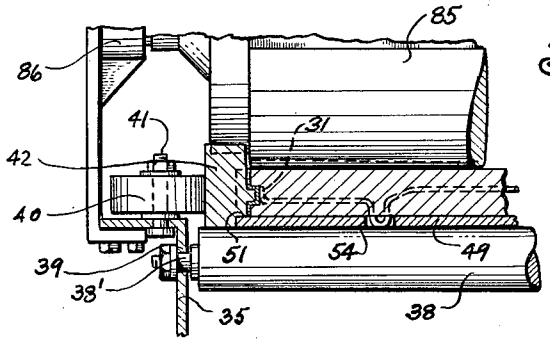


Fig. 8

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Fig. 9

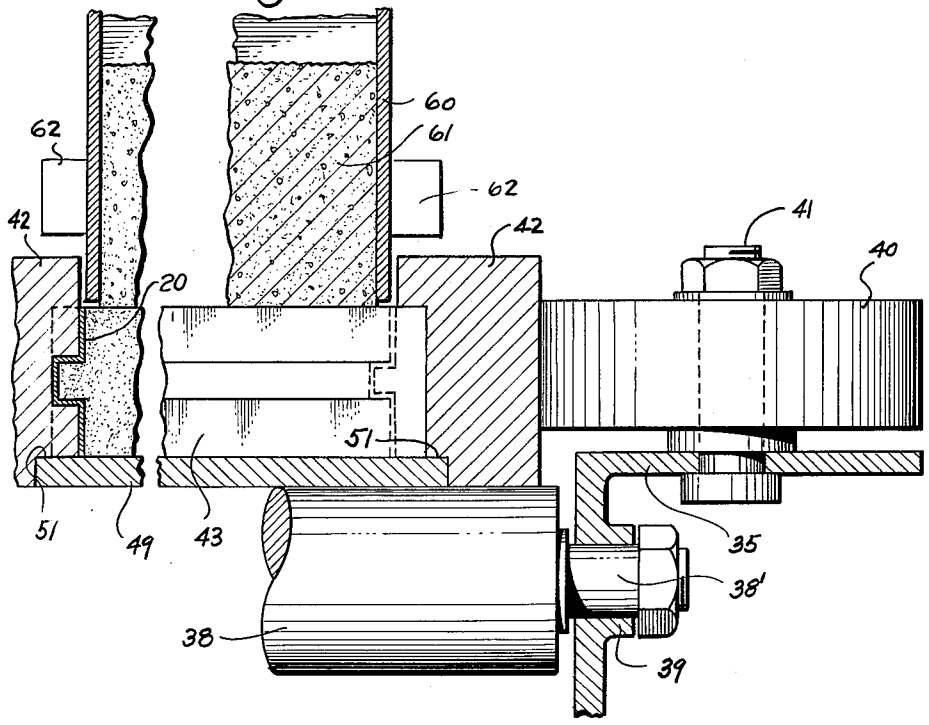
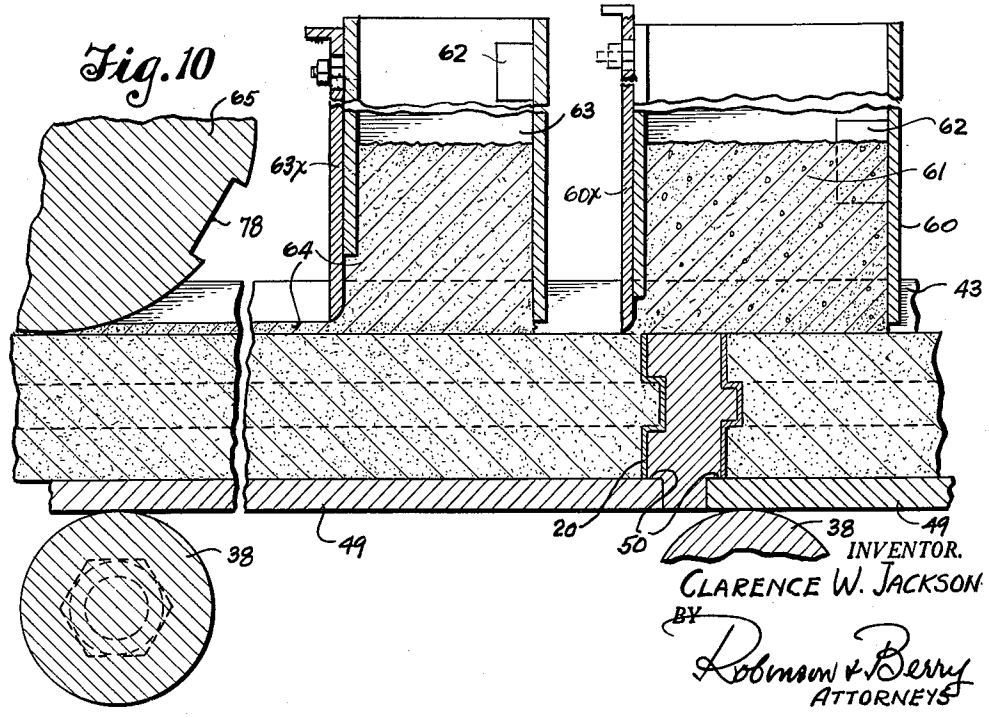


Fig. 10



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MACHINE FOR THE MANUFACTURE OF CONCRETE BUILDING UNITS

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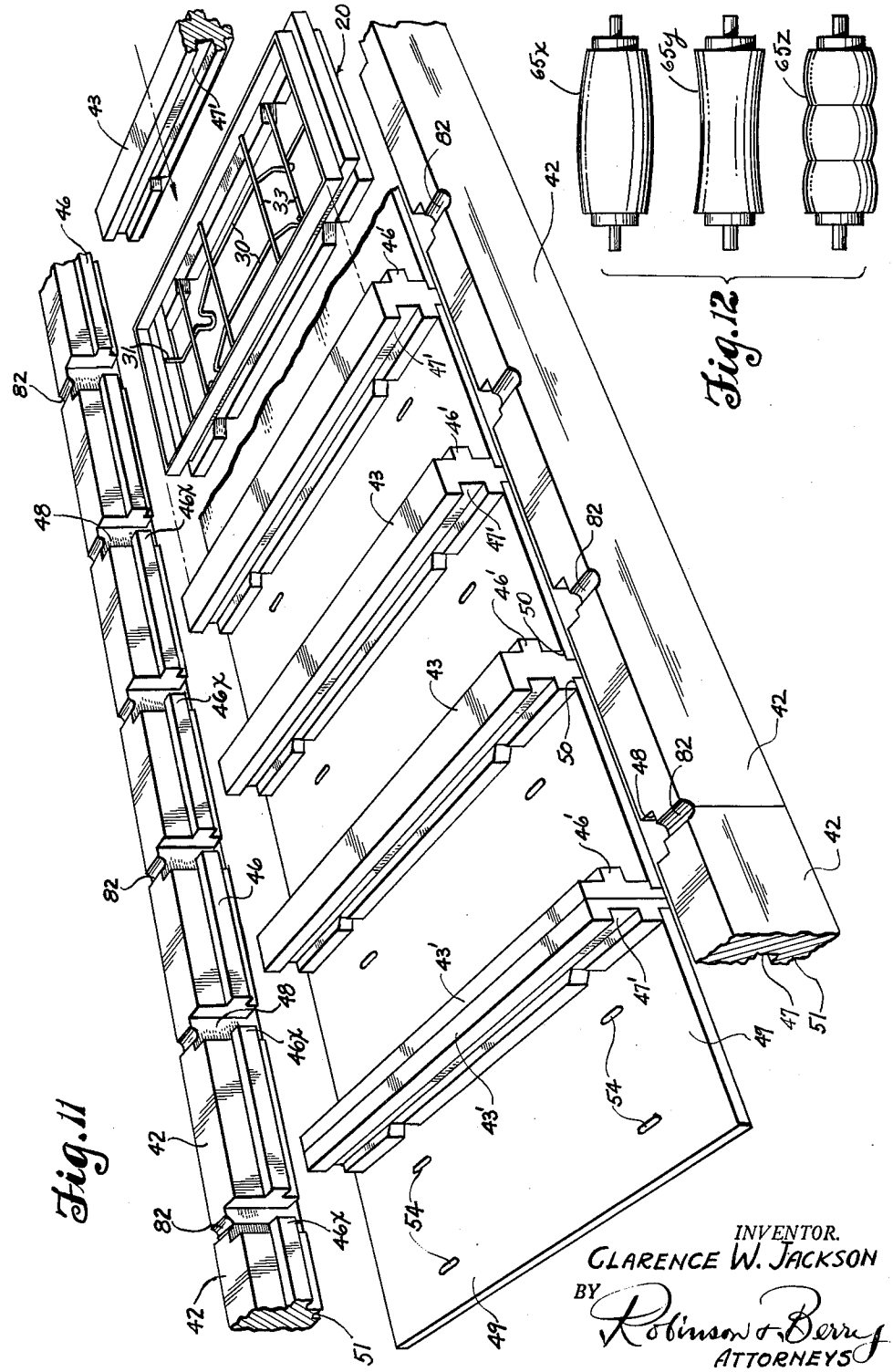


Fig. 11

Fig. 12

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United States Patent Office

3,002,249
Patented Oct. 3, 1961

3,002,249

MACHINE FOR THE MANUFACTURE OF CONCRETE BUILDING UNITS

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Filed Mar. 18, 1957, Ser. No. 646,734
3 Claims. (Cl. 25—99)

This invention relates primarily to a means for the expeditious and economical manufacture of what will herein be referred to as concrete building units; the word "concrete" in this instance being used to designate the usual or a special mixture of cement, sand, gravel and water, and/or other aggregate, plastic or moldable hard setting material which can be used in a manner like concrete to form building units of the present type.

More specifically stated, the present invention has to do with the manufacture of concrete units which may be like, or of the general character of the units illustrated and described in my abandoned application filed on Dec. 3, 1956, under Serial No. 625,861; the particular building units therein disclosed being of rectangular or square slab form, of predetermined modular dimensions and each being adapted to be assembled with others of like kind to form a wall with closed, interfitted and interlocked weather tight joints through which a weight sustaining continuity is provided without use of mortar or other joint sealing materials.

One of the principal objects of the invention is to provide a machine, or apparatus for carrying out a method of manufacture and which machine makes possible the desired high rate of production of units with exact precision in their predetermined dimensions.

Still another object of this invention resides in the provision of a practical and economical mechanical apparatus for the desired high speed manufacture of the present units.

Still another object of the present invention is to provide an apparatus for the high speed manufacture of concrete units of modular dimensions, and to establish those dimensions with such exactness of precision that, in the building of a wall, the units may be laid up in courses, end to end and edge to edge, in closed, interfitted and interlocked horizontal and vertical joints that require no joint sealing mortar.

Still further objects of the present invention reside in the various details of construction and combination of parts embodied in the apparatus; in the details of the concrete units per se, and in the specific sequence of steps as followed in carrying out the present method of high speed, precision manufacture of the units.

In accomplishing the above mentioned and other objects of the invention, I have provided a unit manufacturing apparatus embodying improved details of construction and have designed specific forms of building units to be manufactured thereby; the preferred form of apparatus and the preferred desgin of units being illustrated in the accompanying drawings, wherein:

FIG. 1 is a plan, or top view of an apparatus designed for the rapid manufacture of concrete units embodied by this invention in exact precision of dimensions.

FIG. 2 is an enlarged plan view of that portion of the apparatus enclosed by the circularly directed arrow in FIG. 1.

FIG. 3 is a vertical section of the apparatus, taken on the line 3—3 in FIG. 1.

FIG. 4 is an enlarged vertical sectional view of a part of the apparatus, particularly showing the face to face, engaged relationship of end rails of adjacent compound forms as advancing through the machine.

FIG. 5 is an enlarged, vertical cross-section of the present apparatus taken on the line 5—5 in FIG. 1.

FIG. 6 is an end view of a compacting roll and a side view of a part of one of the compound forms as passing under the roll.

FIG. 7 is a vertical section taken on line 7—7 in FIG. 5.

FIG. 8 is an enlarged vertical section taken on line 8—8 in FIG. 3, showing a part of one of the shaper rolls and its mounting.

FIG. 9 is an enlarged transverse sectional detail, taken on line 9—9 in FIG. 1.

FIG. 10 is an enlarged sectional detail taken through the hoppers on line 10—10 in FIG. 1.

FIG. 11 is an exploded view of one of the compound forms within which the individual unit frames are contained for filling with concrete as advanced through the mechanism.

FIG. 12 illustrates some of the various forms which may be given the compacting and shaper rolls when units with special surface contours or shapes are desired.

Referring more in detail to the drawings:

The specific building unit to be manufactured in accordance with the steps of the present method and by use of the apparatus or means of this invention, is of rectangular form and of such limited thickness with respect to its other dimensions that it can be considered to be of "slab" form. As presently manufactured, the unit is sixteen inches long, eight inches wide and one and one-half inches thick; these dimensions being here mentioned only for the purpose of imparting a better understanding of the type or character of the unit, and are not to be considered in any way as dimensional limitations. The unit is made of concrete, as previously defined, and the specification for the concrete used in its manufacture would ordinarily be according to local building codes, requirements or desires of the builder and are not herein definitely established. However, it is desired here to emphasize that the thought behind the present invention, as embodied both in the mechanism for and in the method of manufacture, is to make possible the manufacture of units at a high rate of production and with exact precision in all dimensions. To this end it becomes necessary to not only design an apparatus, including the frames and forms in which the units are molded, with extreme exactness in predetermined dimensions, but also to take into consideration all the physical properties of the aggregate materials as well as the atmospheric conditions in which manufacturing is to be carried out.

The present concrete unit has flat, parallel inside and outside surfaces; it is square cornered and its bounding edges are formed with tongues and grooves, as illustrated, to provide for an interfitted and interlocked edge to edge relationship of units when laid up in horizontal courses. However, it is to be understood that, insofar as either the method or apparatus of this invention is concerned, each applies equally to the making of units with plane edges or with edge formations of various other kinds.

One of the features of the present concrete unit resides in its being molded or formed within a frame, form or edge binding of sheet metal, plastic or other suitable material, made exactly to predetermined dimensions for the desired modular unit, which is adapted to be easily removed from the unit to ready it for use but which, until that time, serves to strengthen, and protect the unit against edge chipping, handling damage or cracking. Furthermore, such frames serve to retain the units in form for easy handling especially while green, and immediately after their removal from the compound molds in which the units are made.

Each unit comprises a solid, rectangular, molded concrete body with flat, smooth, parallel opposite faces; the body in the present instance being provided to its full length along its top edge and centrally between the planes of its "inside" and "outside" surfaces, with an integral, square cornered tongue. Likewise, the body is formed along one of its vertical end edges with a square formed tongue. Also, each unit is formed in and along its bottom horizontal edge and in its other vertical end edge, respectively, with similarly dimensioned grooves.

Each of the units in the form above described, is originally enclosed by the protective, edge binding or frame **20** previously mentioned.

In FIG. 5, I have shown the unit as containing reinforcing rods **30** of a predetermined form and embedded in the unit, lengthwise thereof, and symmetrically spaced from its opposite longitudinal edges. These rods have angularly turned opposite end portions, **31—31**, tack welded for easy release, to the opposite end members of the frame **20**, thus to hold the rods properly placed therein preparatory to the frame being filled with concrete. It is shown also that each of the rods **30** is bent intermediate its ends to form two downwardly projecting U-shaped loops **32** which will extend slightly from the inside surface of the finished unit. It is also shown in FIG. 5 that the unit contains a plurality of transverse, spaced reinforcing rods **33**; these being spot welded to the longitudinal rods **30**, thus to hold them in proper position prior to and while the frames are being filled with concrete.

It is to be understood that although I have illustrated a machine for the mechanical manufacture of the present units, manufacture could be quite satisfactorily carried on manually, that is, by hand filling the frames with concrete tamping it to proper compactness therein, smoothing off the surfaces and allowing the concrete to set in the frames **20**; these being removed from the units preferably at the time of their being put to use. However, the economic practicability of the use of the present concrete units resides, in part, in their rapid manufacture. Hand manufacture would not ordinarily be commercially feasible, and it is for this reason that the present apparatus, providing for high speed production, has been devised.

An apparatus or machine designed for the high speed manufacture of the present types of units is shown in FIG. 1. It comprises an elongated base or frame structure of table-like form made up of longitudinal, laterally spaced opposite side beams **35—35**, extended to its full length and supported at the same convenient working level by legs **36** arranged at suitable intervals therealong. It is to be understood that this table structure can be given the necessary rigidity by suitable cross and longitudinal bracing. The table top, for the greater part, is made up of a succession of rather closely spaced, transverse rollers **38**, all of the same diameter and all supported at the same horizontal level; these rollers being formed with trunnions **38'** at their opposite ends, rotatably contained in bearings **39** fixed in or to the longitudinal beams **35—35**, as seen in FIG. 5.

Mounted on the top surfaces of the beams **35—35**, in alignment and at rather closely spaced intervals therealong, are form guide rollers **40** and between these two parallel rows of rollers, the compound frame enclosing forms, presently to be described, are adapted to be successively advanced end to end, for the filling of their contained frames with concrete thus to form the individual units. The rollers **40**, as shown in FIG. 1, are all of the same diameter, and most of them are mounted to rotate freely on vertical stud spindles **41**, best shown in FIGS. 2 and 9, that are fixed to the beams **35—35**. The others are rotatably driven, as will presently be explained, for the advancement of the compound forms through the machine.

The lateral spacing of the two rows of aligned guide rollers **40**, as applied to the two laterally spaced beams **35—35**, is a predetermined measurement, exactly equal to the outside width of the compound forms. The compound forms, each containing a plurality of frames **20**, are supported for advancement and the filling of the frames, upon the cross-rolls **38**, and are guided by and between the rows of rollers **40**.

The compound forms as provided for the reception of the present rectangular frames **20**, are presently of such length as to accommodate ten frames, but it is to be understood that they may be made to accommodate a greater or a lesser number, according to desires. Each of the compound forms is made up of a plurality of easily assembled and disassembled parts, best shown in FIG. 20. Each form comprises parallel, opposite side rails **42—42** of the same length. Eleven cross-bars **43** are assembled with these side rails, at equal spacing thus to define ten compartments. Within each compartment thus formed one of the metal frames **20** is contained and securely held. The present operation contemplates the assembling of the frames **20** with the compound forms at one end of the machine; the advancing of the frame containing forms, end to end, into the machine at that end, the filling of the frames as they successively pass the aggregate and surface finishing material containing hoppers, then the compacting of the aggregate in the frames and, as the forms reach the discharge end of the machine, the disassembling of the forms, and the carrying of the filled frames on their pallets, to a place where the units are left to cure.

Referring now more particularly to FIG. 11, it is to be observed that one of the longitudinal rails **42** of the compound form is formed in its inside surface and to its full length with a channel **47**, and the opposite rail **42** is formed likewise with an intermittent longitudinal rib **46** extended to its full length.

The cross-bars **43** are all of the same length and each, except those at the opposite ends of each form, is formed lengthwise thereof on one side with a rib **46'** and in its opposite side with a channel **47'**. When cross bars and side rails are assembled and interfitted, ribs and channels of bars register with the ribs and channels of the rails **42—42**. At their opposite ends, all cross-bars **43** are square cut and, in the assembly of parts, are seated in recesses **48** formed vertically through the inside surfaces of the rails **42—42** at exact, predetermined intervals as shown in FIG. 11. It is further to be observed in this view, that the successive portions of tongue **46** are extended slightly, as at **46x**, so as to enter the bar grooves **47'**. Also, it will be understood that the end portions of the cross-bar tongues **46'** likewise will enter the rail groove **47**. The compartments that are formed by the assembly of the opposite side rails **42—42** and cross-bars **43, 43'**, are adapted to snugly contain the frames **20** therein.

It is to be noted in FIG. 11 that the cross-bar **43'** used at the opposite ends of the compound forms, are provided by longitudinally splitting one of the regular cross-bars **43**, thus they are only of half width, as will be understood by reference to FIG. 13; such "half bars" are designated by numeral **43'**.

For a convenient assembly of frames **20** in the compound forms, I have provided an assembly table **44** at the receiving end of the machine. This comprises a flat table surface preferably at the same level as the rollers **38**.

Preparatory to the assembling of metal frames **20** within a compound form, they are placed transversely of the table **44** and in a row aligned with the machine, each resting upon a rectangular pallet **49** of substantially the same length and width; it being understood that these pallets are precision formed of metal as are all the other parts of the form so that there is a precision fit of the frames therewith in the final assembly of parts. The cross-bars **43** are placed between adjacent frames, and the split half-bars **43'** are located at the opposite ends

of the form. Then the longitudinal rails 42—42 are brought into position to receive the ends of the cross bars 43 within the rail recesses 48. As these parts 42—42 and 43—43' are thus assembled and interfitted, the rectangular pallets 49 are received between them and in seats 50 formed in the lower edges of the cross-bars, and at their ends in seats 51 formed in the lower, inner edges of the opposite side rails 42—42. All pallets are exactly of the same size, and when firmly seated at their edges in the seats provided in the cross-bars and rails, they serve to square up the assembly of parts and give the desired rigidity to the form. It is to be understood also that in the assembling of these compartment defining parts with the metal frames 20, the tongue and groove defining portions of the frames and forms are caused to be snugly interfitted. This adds rigidity to the assembly and maintains the proper relationship of the assembled parts as advanced between the two rows of rollers 40 for filling of the frames. Also, the metal frames rest with their lower edges seated firmly against the individual supporting pallets 49 as noted in FIG. 4. All frames are exactly equal in height and each defines the width, length and depth of the unit to be formed therein. In the advancing of the compound forms through the machines, the forms are held against spreading between the rows of guide rollers 40—40 and thus their rigidity is assured.

When the frames 20 contain reinforcing rods of the form disclosed, it is necessary that the supporting pallets be provided with slots therethrough for passage of the anchor loop forming portions of the rods. Such slots have been designated in FIG. 5 by numeral 54.

For filling the metal frames 20 with concrete as confined in the compound molds, I provide a hopper 60 supported by and above the frame structure of the machine at a location near its entrance end. This hopper is of box like form, with vertical opposite side walls, and vertical end walls.

It is shown in FIG. 9 that the lower edges of the sidewalls extend down between the rails 42—42, just within the vertical planes of the ends of the frames, and close to the level of their top edges. It is to be observed in this view also that the rails 42—42 are of greater height than the cross-bars 43, and thus the extending of the hopper walls down within the rails is possible without their contacting with the cross-bars as the forms are advanced. A prepared aggregate 61 is contained in the hopper and it is adapted to feed downwardly therefrom into the frames as they are successively advanced thereunder; feeding being effected under the influence of any suitable form of mechanically operated vibrating devices located at suitable places on the frame structure or on the hopper, for example, as indicated at 62 in FIGS. 9 and 10.

It is further to be understood that the arrangement and character of the vibrating means, and the manner of their control is dependent on the materials of the aggregate.

Also supported on the frame structure, beyond the hopper 60, as noted in FIGS. 1 and 3, is a second and smaller hopper 63, beneath which the compound forms are advanced after receiving the filling material from the hopper 60. From the hopper 63 a thin surfacing layer of fine finishing material 64, is fed automatically onto the top surfaces of the concrete units to a predetermined thickness. The level to which the filling material is fed into the frames is controlled by vertically adjustable gates 60*x* and 63*x* attached respectively to the ends walls of the two hoppers as best shown on FIG. 3. In each case the lower edge of the gate establishes the top level of the material fed to the frames.

Beyond the hopper 63 are one or more transverse rolls 65 which operate as the filled frames pass thereunder to roll on and compact the aggregate and its over-layer of finishing material to smooth down the top surfaces of the units to a predetermined and uniform level. In the present instance only one roll 65 has been shown. These rolls have trunnions 65' at their ends contained as in FIG. 5, for a slight vertical movement, in retaining bearings 66 that are mounted on the side rails 35—35 of the main frame structure. It is the intent that the frames 20 be filled from the hoppers to such extent, and that the weight of the rolls 65 shall be effective, as they roll on the aggregate, to compact it and bring the top surfaces of all units flush with the top edges of their containing frames.

Various means may be employed for the mechanical advancement of the compound forms with their assembly of frames 20 through the filling mechanism, or, if it is so desired, these forms could be advanced manually. However, in the present instance it is preferred that their advancement be effected by driving certain of the guide rollers 40 by and between which the compound frames are guided. For this purpose selected rolls 40 at opposite sides of the main frame and at a suitable intervals therealong are fixed on the upper ends of vertical shafts 68, and these paired shafts are joined to rotate in proper direction and in unison. It is shown in FIG. 5 that bevel gears 70 are fixed to the lower ends of paired vertical shafts 68 and bevel gears 71 on a driven cross-shaft 72 mesh therewith. Driven rollers, as above arranged, are located at necessary intervals along the table to insure the advancement of the compound forms without interruption when placed end to end and the several cross-shafts 72 are driven in unison, each by a geared connection as at 75, with a line shaft 76. Drive rollers 40 may be equipped with suitable friction tires for this purpose.

In order that the cross-bars 43, as applied in the compound forms may pass freely under the compressing rolls 65 without the rolls causing any impact therewith, such as would result in the event that layers of finishing material should remain on the top surfaces of the bars, the rolls are formed from end to end with longitudinal surface channels 78, located therein at a circumferential spacing that is equal to the lineal spacing between bars 43 as contained in the compound forms. The proper indexing of each roll 65 to cause the channels 78 to register with the cross-bars with clearance as they pass beneath the rolls, is effected as follows: Each roll 65 is formed at its opposite ends with diametrically reduced hubs 65*x* of the same diameter. These hubs extend across and may roll on the top surfaces of the longitudinal side rails 42—42 of the advancing forms as they pass thereunder. Each roll 65 is held against travel along the table by reason of its end trunnions being confined in the bearings 66, and the rollers or shapers will roll upon the concrete or aggregate as contained in the frames 20 to compact it. The hubs 65*x* are formed at regular intervals circumferentially thereof with transverse ribs or teeth 81, here shown to be of U-shape, that are adapted to register in complemental notches 82 formed in the top surfaces of the form rails 42—42, thus to maintain the proper registering relationship between the channels 78 of rolls 65 and cross-bars 43 of the forms.

Immediately following the aggregate compacting rolls 65, one or more troweling rolls 85 are mounted transversely of the frame by bearings 86 fixed to the rails 35—35. These rolls are in constant contact with moistening wicks 87 and roll on the top surfaces of the concrete in the filled frames. These rolls are channeled as are rolls 65 and are equipped in like manner with means whereby their proper registration is maintained with the forms as advanced thereunder.

As the frame enclosing compound forms are received at the discharge end of the machine, they pass from between the laterally spaced rows of guide rolls 40 onto a dis-assembly table, not shown. The side rails 42—42 are pulled apart thus to free the cross-bars therefrom, permitting the filled frames 20 to be separated and conveyed on their individual pallets 49 to storage for drying or curing.

The dis-assembled rails and cross-bars are subsequently returned to the assembly table at the receiving end of the

machine, and made ready for re-use. Here they are assembled with pallets and new frames, and the form then advanced into the machine and the filling process is repeated.

In my abandoned application, previously mentioned, a disclosure was made of concrete units of the present character, formed with corrugated surfaces for ornamental or functional purposes. It is desired to here note that such units with corrugated, convex, concave, grooved, ribbed or other surface forms may be made merely by the use of feed gates for the material hoppers, and use of compacting and shaper rolls having contours which will give to the concrete units, the selected surface formation; it being understood, of course, that the side rails and cross-bars constituting the compound forms and frames **20** if used, also would be made in such manner as to accommodate the requirements.

In FIG. 12 three different forms of rolls have been illustrated. Roll **65***x* is designed for use when a unit with a concaved outer surface is desired; roll **65***y* is designed for use where units with convex outer surface is desired and rool **65***z* is for the making of units with corrugated surface. These shapes apply in each instance to all the compacting and shaper or troweling rolls.

When such rolls are used, the feed gates **60***x* and **63***x* would have their lower edges curved accordingly. Likewise, the top surfaces of the cross-bars of the compound forms would conform to the selected surface curvature as would also the surfaces of the compacting or shaper rolls.

It is also to be understood that insofar as the manufacture of concrete units of the types disclosed is concerned, the machine can be easily and readily adapted to make the various surface formations mentioned, and also units can be made with or without use of the protective metal frames **20** but would necessarily require a certain curing period in the compound forms.

It is further anticipated that the present operation of advancing the unit frames along an established path of travel and beneath stationary rolls for the compacting and surface shaping operations, could also be accomplished in a satisfactory manner, by mounting the frames **20** and compound forms in a stationary horizontal position and then causing the hoppers and rollers to be advanced thereacross to accomplish the form filling and then the compacting and shaping operations. However, this latter procedure probably would be more expensive and less practical.

What I claim is:

1. A machine for the manufacture of concrete building units of slab form comprising a conveyor table, means establishing opposite side limits of a straight path of travel of uniform width along the table top, an aggregate storage and feeding hopper supported above and across said path of travel, a compound form disposed on said table for guided endwise advancement in said path of travel along said table, said compound form comprising an easily separable assembly of parts including opposite side rails, a plurality of transverse divisional members extending between the side rails defining a succession of identical compartments in said compound form, and a pallet fitted in the bottom of each compartment, means for advancing the compound form along the guideway for the filling of its compartments from the hopper in passing beneath it, and an aggregate compacting roller mounted above and transversely of said path of travel; said roller having a cylindrical body portion for rolling and compacting contact with the aggregate in the compartments of the form as it is advanced beneath the roller and having diametrically reduced opposite end cylindrical hubs of equal diameter disposed for rolling support on the top surfaces of the opposite side rails of the advancing compound form, and said hubs having teeth formed on their cylindrical surfaces at equal distances of angular spacing; said opposite side rails of the compound forms being provided with notches in their top surfaces, in such lineal spacing as to receive said teeth in interfitting mesh therein as the form advances, thus to synchronize the rotation of the roller with the advancement of the compound form.

2. A machine according to claim 1, wherein the means defining the opposite side limits of said straight path of travel comprises, a succession of form guiding rollers of the same diameter, and spaced at predetermined intervals to cooperatively engage in rolling contact with the corresponding side rails of the compound form in its advancement along said path of travel.

3. The machine of claim 2, wherein means is provided for rotatably driving some of said path defining and form guiding rollers at each side of the path for their positive advancement of the compound form along the path of travel.

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