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Shoe et al.

[11] **3,824,055**

[45] **July 16, 1974**

[54] **SCREEDER**

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[21] Appl. No.: **135,325**

[52] **U.S. Cl.** **425/220**, 425/218, 425/231

[51] **Int. Cl.** **B28b 3/12**

[58] **Field of Search** 425/220, 231, 362, 374, 425/419, 423, 418, 218

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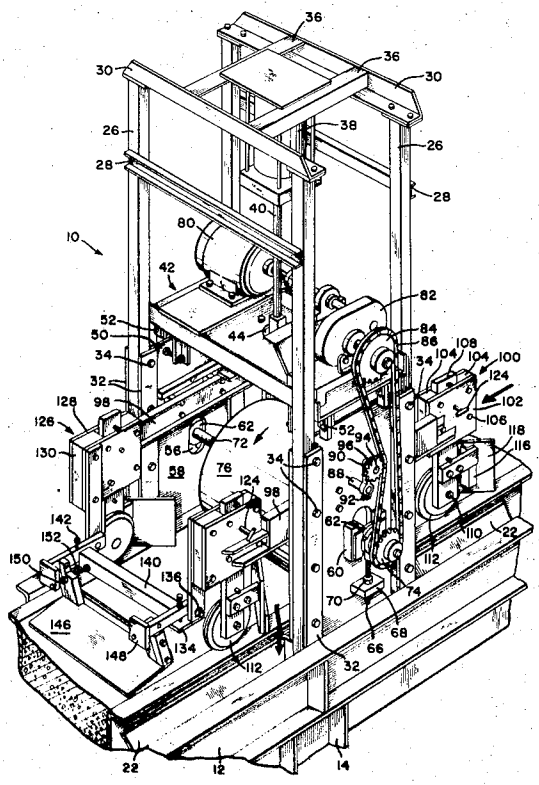
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Assistant Examiner—B. D. Tobor
Attorney, Agent, or Firm—Marechal, Biebel, French & Bugg

[57] **ABSTRACT**

Screeding apparatus for smoothing and finishing the upper surface of freshly poured concrete in the manufacture of precast concrete slabs. The screeder comprises a base frame, including a conveyor for carrying concrete filled forms through the screeder, and a vertically reciprocal screeder carriage upon which are mounted a rotatable drum, pairs of inwardly and outwardly directed scraper blades mounted downstream and upstream of the drum, rollers for engaging the upper flanges of the concrete forms passing through the screeder, wipers curved to the configuration of the drum surface and wiping the edges of the drum, and a final trowel positioned downstream of the drum and extending across the screeder to impart a final finishing and smoothing effect to the concrete as it passes through the screeder. All of the various components mounted on the screeder carriage are adjustable to permit the uncured slabs carried by the forms to be screeded level with the upper edge of the form or at depths below the upper edge of the form if somewhat thinner slabs are being manufactured.

23 Claims, 14 Drawing Figures



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SHEET 1 OF 5

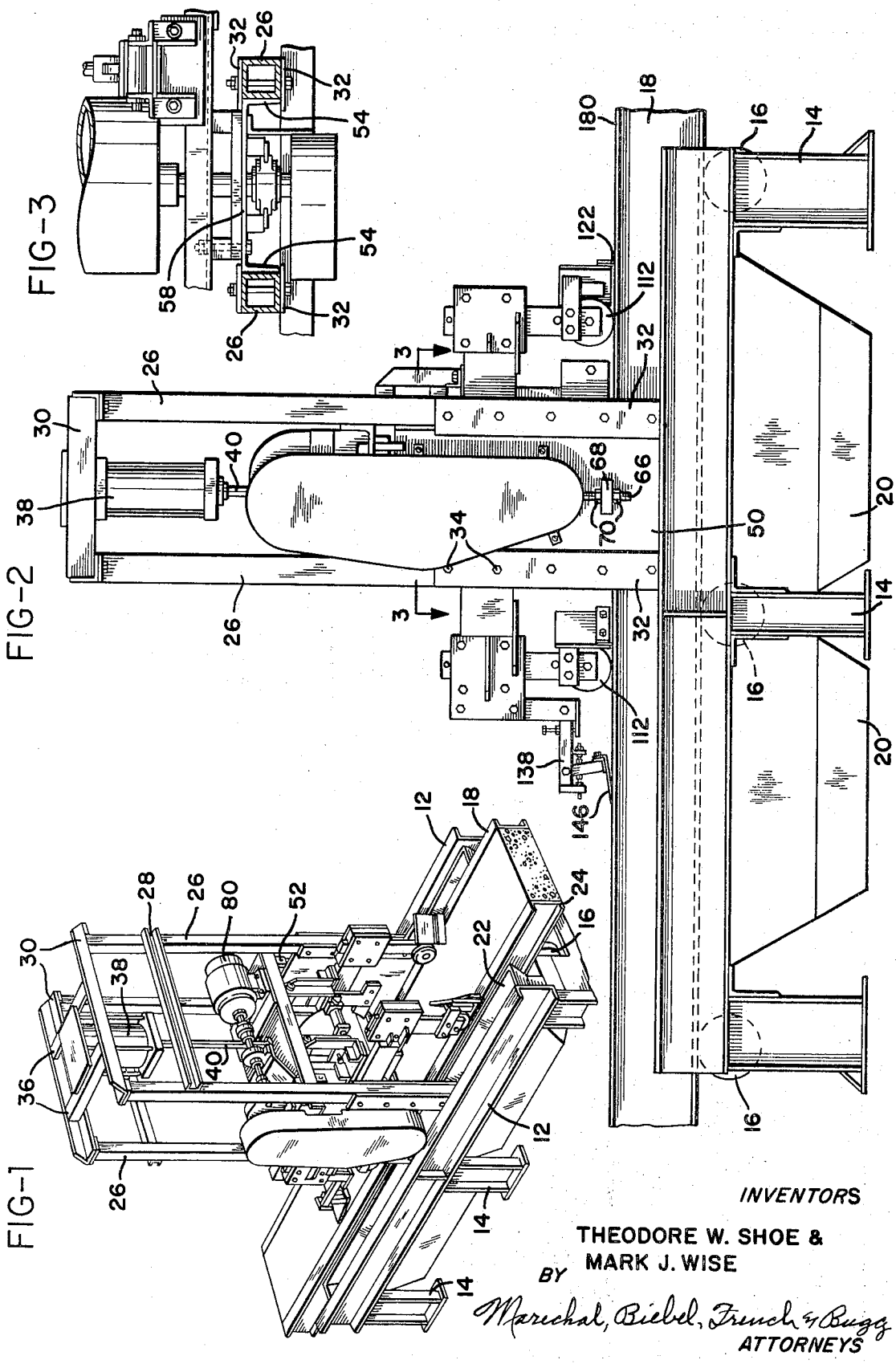
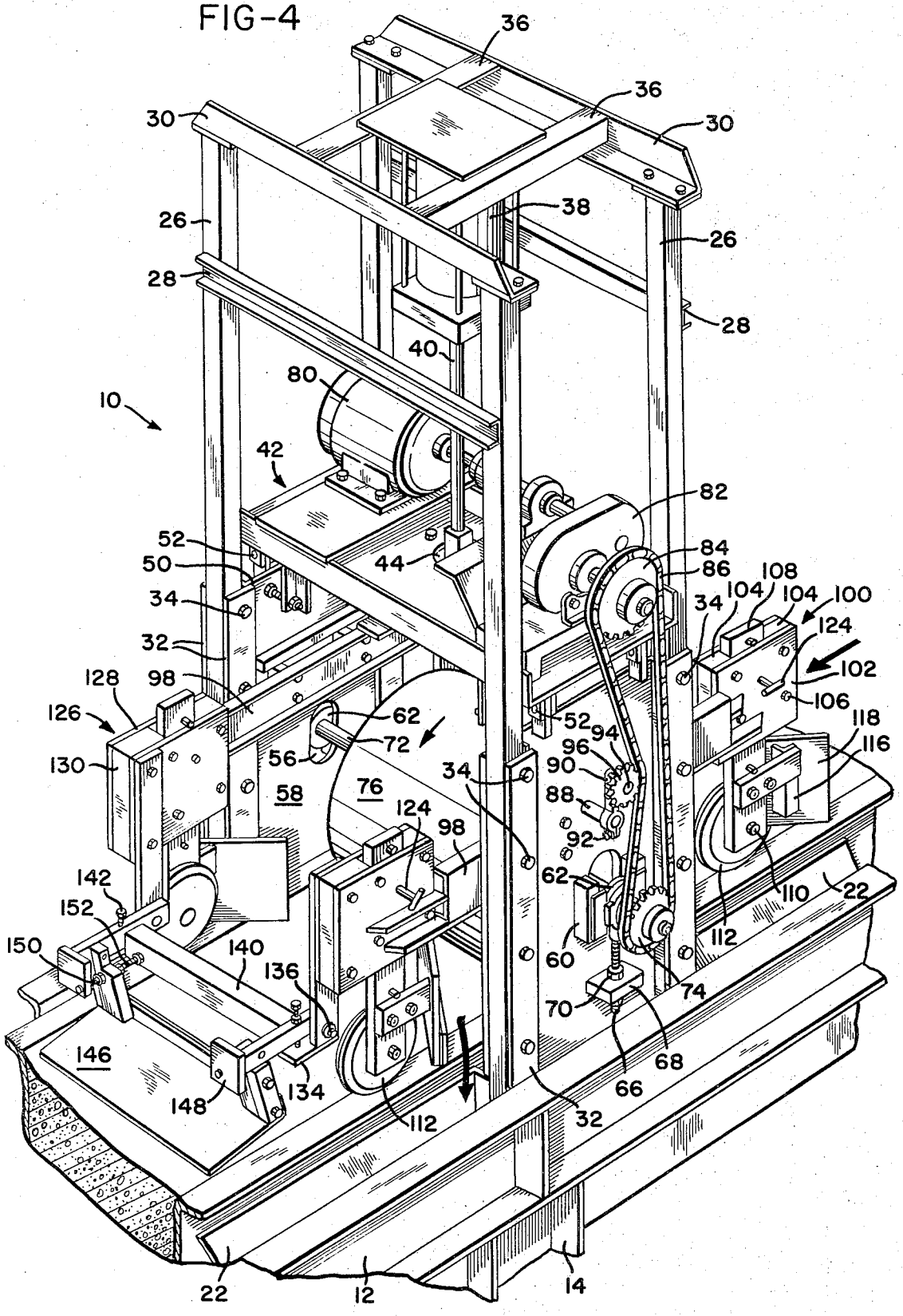


FIG-4


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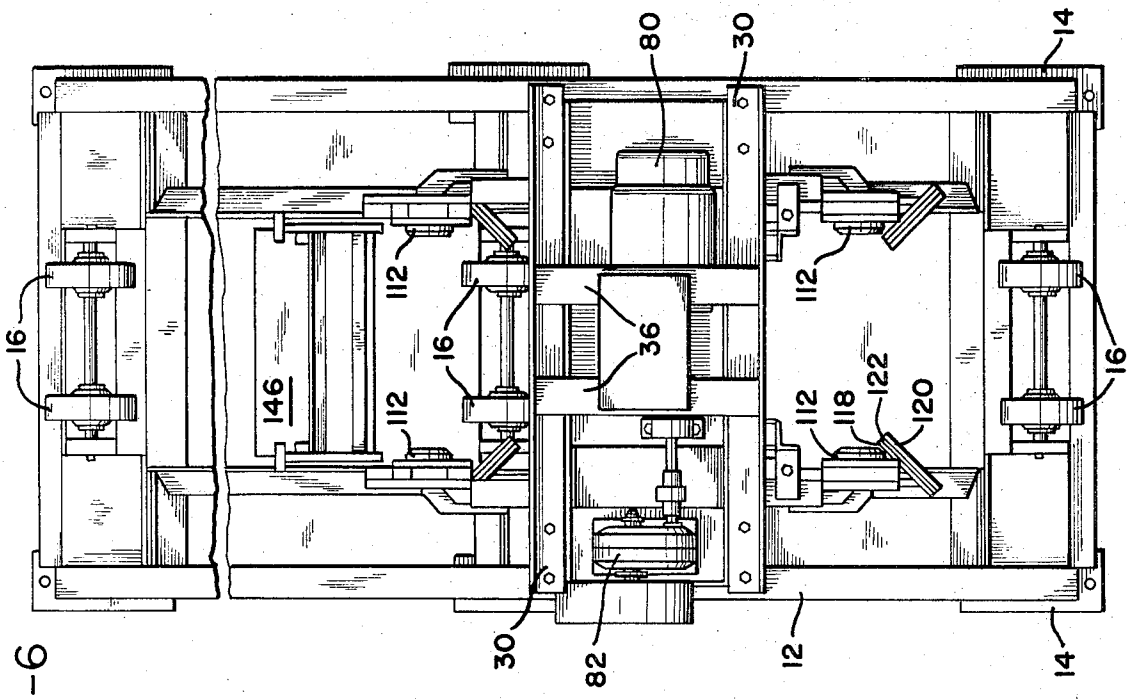

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FIG-6

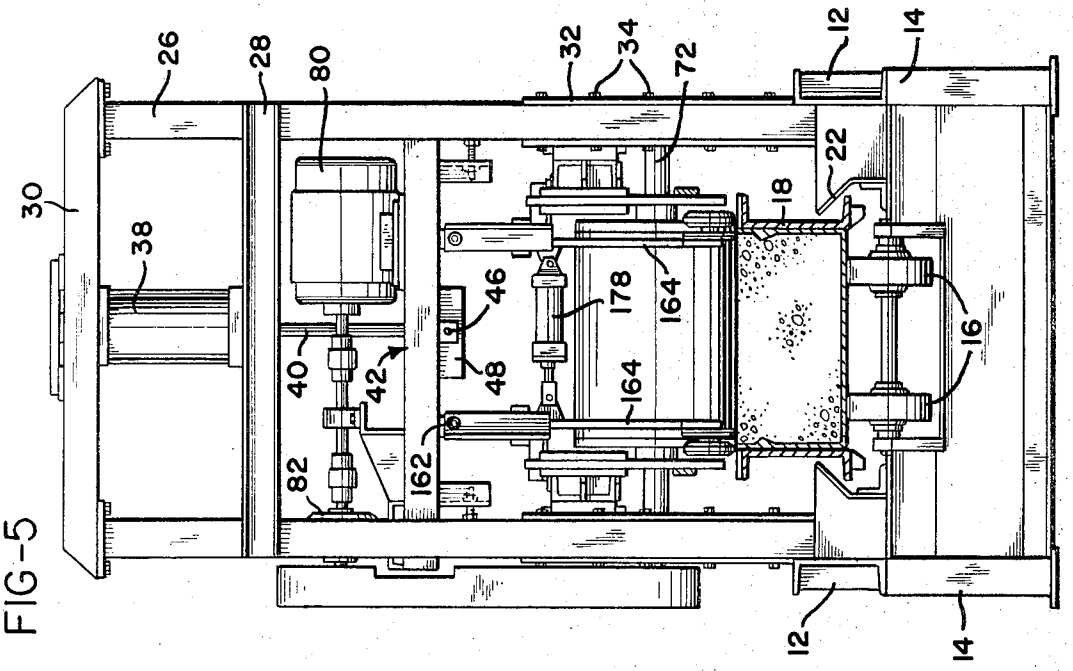

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FIG-5

FIG-7

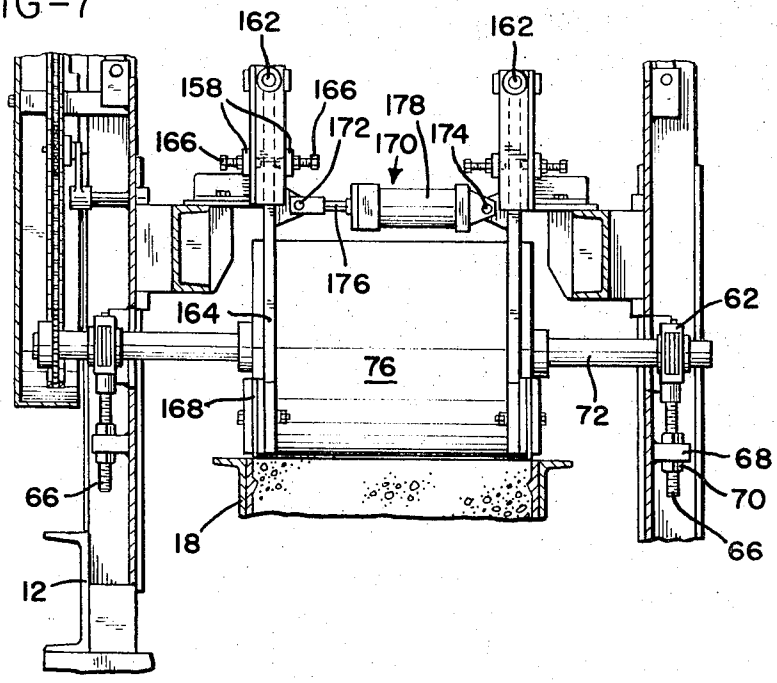


FIG-8

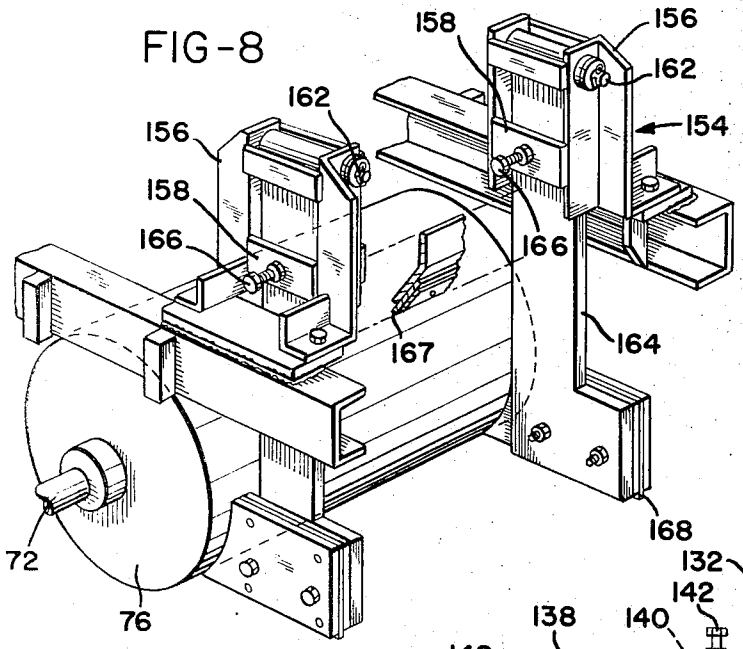


FIG-9

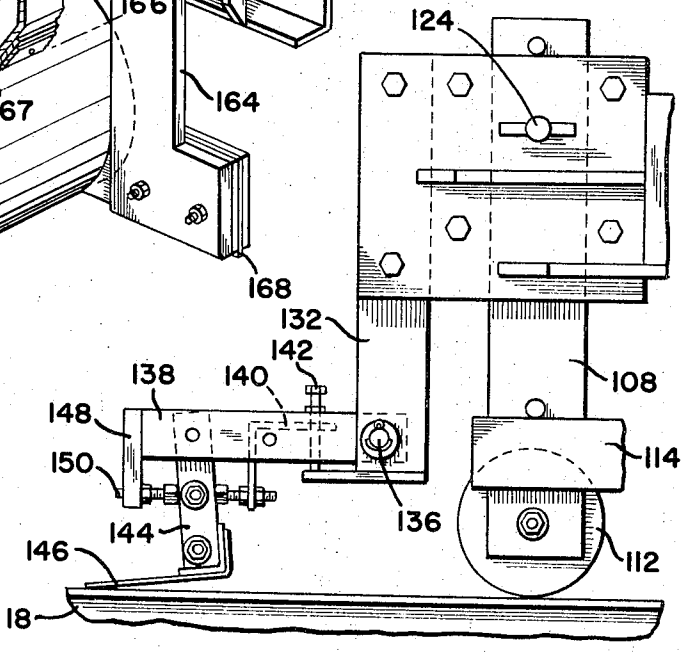


FIG-10

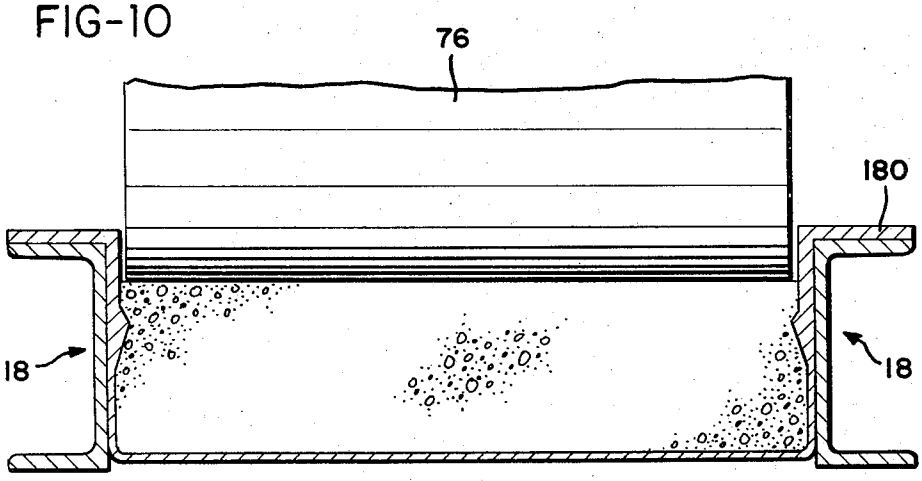


FIG-11

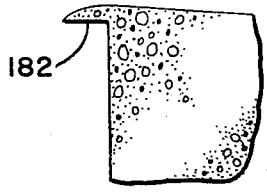


FIG-12

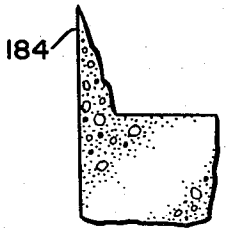


FIG-13

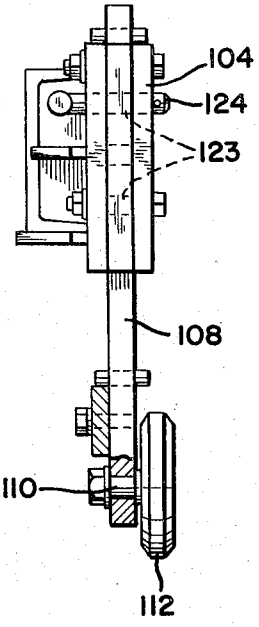
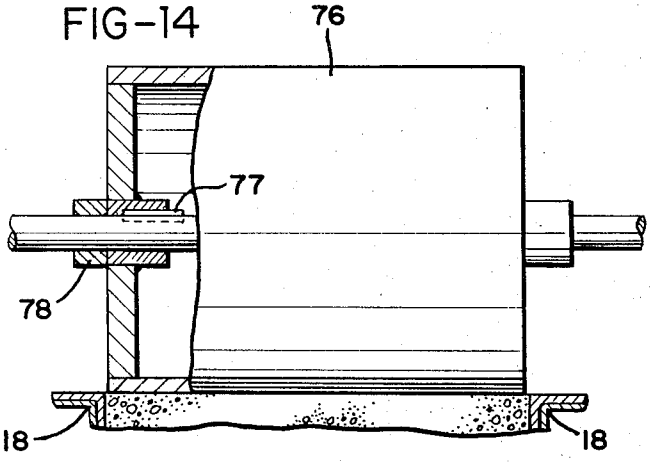


FIG-14



SCREEDER

BACKGROUND OF THE INVENTION

In manufacturing precast concrete structural components it is desirable to provide the components with a smooth exterior finish. This is particularly true in the manufacture of such things as floor slabs, since the uniformity and smoothness of the slab surfaces will dictate the amount of on site preparation required in order to provide an acceptable subsurface for the application of various flooring materials. Obviously, the less on site operations required the less expensive the construction costs.

In one widely used method of manufacturing precast concrete slabs, prestressing cables and void forming inflatable tubes are first placed in the concrete form and a fairly stiff mix of concrete deposited in the form, encapsulating the inflatable tubes and prestressing cables. The concrete filled form is then vibrated, the upper surface screeded to remove excess concrete and smooth the upper surface of the concrete, and the concrete filled forms then placed in a kiln for curing at carefully controlled temperatures and humidity. Thereafter, the forms are stripped from the slabs and the slabs cut to customer specifications.

All of these operations are carried out in a carefully planned sequence to provide an efficient manufacturing operation that will produce the maximum number of finished slabs with a given amount of manufacturing equipment. In the past, one bottle neck in this otherwise highly systematic manufacturing process has been the finishing or screeding operation. Originally, each form was manually screeded by workmen using angle irons or other suitable, flat surfaced members. This operation was then automated to the extent that the angle irons were provided with means for mechanically reciprocating them transversely of the forms to smooth and finish the upper surface of the concrete.

Aside from the fact that even this degree of automation did not improve the speed of the screeding operation to the extent desired, it will be apparent that this type of screeder lacks the flexibility necessary to screed different depths of concrete within the form. Therefore, if the manufacturer desired to produce slabs of different thickness it was necessary to have forms of different depths. Since the cost of the forms is a significant factor in the manufacture of precast slabs, it is of course desirable to keep the number of forms necessary to an absolute minimum.

SUMMARY OF THE INVENTION

The present invention provides fully automatic screeding apparatus which is capable of screeding concrete slabs of various thickness regardless of the depth of the form being used. The screeding apparatus includes a base frame which supports a series of receiving and collecting troughs, a conveyor for carrying filled concrete forms through the screeding apparatus, and a screed carriage which is vertically reciprocating and carries the concrete finishing and smoothing components.

The carriage rotatably mounts a drum which is slightly shorter in length than the width of the forms being used so that the drum can screed either at a level even with the upper edges of the form or down inside the form if less than full depth slabs are being produced. A pair of wipers are pivotally mounted and engage the drum surface adjacent each of its ends. When the drum is being used to screed full depth slabs, the wipers are positioned in slightly overlapping relationship to the edges of the drum, thereby preventing the formation of fins of concrete projecting horizontally from the upper edges of the finished slab. When less than full depth slabs are being produced the wipers are positioned inwardly in contact with the ends of the drum surface and the inner surfaces of the concrete forms to prevent the formation of vertically extending fins of concrete on the finished slabs.

The screed carriage is also provided with four wheels, two positioned upstream and two positioned downstream of the drum, which ride the flanges of the forms and prevent the drum from touching the form flanges. This reduces both drum and form wear and prevents the vibration which might otherwise occur as the result of flange-drum contact. Aside from damage to equipment that might result from such vibration, it will be seen that vibration of the concrete carried by the forms may allow the void forming, inflatable tubes to move from their proper positions. The four wheels are, of course, vertically adjustable with respect to the height of the drum to permit the drum to be positioned at various heights with respect to the bottom of the forms passing through the screeding apparatus.

Additionally, the drum is shiftable along its axle so that if some deviation from a perfectly straight side wall on the forms occurs the drum can shift slightly to accommodate this deviation and prevent binding between the ends of the drum and the form inner surfaces. The carriage is raised and lowered by a fluid actuated piston and cylinder mounted at the top of the screed apparatus base frame with the screed carriage pivotally attached to the lower end of the piston rod.

The screed carriage itself includes an upper platform and downwardly depending side members pivotally attached to the platform to provide an articulated assembly. This permits the carriage to shift if, as the rollers ride along the flanges of the forms passing through the screeding apparatus, one of the flanges is positioned higher than the other. As a result slabs of uniform thickness are produced despite the fact that the flanges of the form do not lie in a common horizontal plane.

The drive motor for the drum is positioned on the upper platform of the screed carriage and since the motor and the lift cylinder are well above the concrete forms there is little danger of their operation being hampered by contamination by the concrete.

The screed carriage also carries a pair of outwardly directed scrapers which engage the flanges of the forms just upstream of the front wheels and a pair of inwardly directed scraper blades which ride the flanges of the forms just upstream of the rear wheels. The scrapers thus clean the flanges of the form to provide a true surface for the wheels of the screed carriage to ride.

Downstream of the rear set of wheels a final trowel is positioned which extends across the form and is fully adjustable, both vertically and angularly with respect to the surface of the concrete, to impart a final finishing and smoothing to the concrete carried by the forms.

The catch troughs, which are mounted in the base frame beneath the conveyors, include inwardly projecting extensions which shield the bottom flanges of the forms and catch excess concrete removed by the screeding apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the upstream end of the screed apparatus;

FIG. 2 is a vertical elevational view of the drive side of the apparatus;

FIG. 3 is a view taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged perspective view showing the downstream end of the screeding apparatus;

FIG. 5 is an end elevational view of the screeding apparatus from the upstream end thereof showing a concrete filled form in cross-section;

FIG. 6 is a plan view of the screeding apparatus of the present invention;

FIG. 7 is an enlarged view of a portion of the structure of FIG. 5, partly in section;

FIG. 8 is an enlarged perspective view of a portion of the drum and wipers;

FIG. 9 is an elevational view of a portion of the screeding apparatus showing one of the rear wheels and the final trowel;

FIG. 10 is a cross sectional view through a concrete filled form having the screeding drum in a lowered position;

FIGS. 11 and 12 show corners of concrete slabs;

FIG. 13 is an end view of one of the form engaging wheels and supporting structure; and

FIG. 14 is a view, partly in section, through the screeder drum.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. 1–6 of the drawings, it will be seen that screeding apparatus **10** in accordance with the present invention includes a base frame having horizontally extending frame members **12** and vertically extending frame members **14.** A series of rollers **16** (FIGS. **2, 5** and **6**) form a conveyor for carrying concrete forms, as at **18,** through the screeding apparatus **10** and a pair of collecting and receiving troughs **20** are positioned beneath the conveyor with inwardly directed extensions **22** overhanging and shielding the lower flanges **24** of the forms **18.**

Box beams **26** are fixed to and extend upwardly from the frame members **12** and are suitably interconnected and braced adjacent their upper ends by cross members **28** and **30.** Adjacent their lower ends the beams **26** are provided with elongated plates **32** attached thereto by a series of bolts or the like **34** to define four, vertically extending trackways. Cross beams **36** extend between the upper cross members **30** and support a hydraulically or pneumatically operated cylinder **38** having a piston rod **40** extending downwardly therefrom.

A screed carriage upper platform, referenced in its entirety by the numeral **42,** is provided with a central opening **44,** see particularly FIG. **4** of the drawings, through which extends the piston rod **40,** pivotally attached as at **46** to a cross member **48** (see FIG. **5** of the drawings) attached to the under surface of the platform **42** and spanning the opening **44.** A pair of channel members **50** are pivotally attached to the platform **42** as at **52** and depend downwardly from the platform **42** with their flanges **54** received in the vertically extending trackways defined by the box beams **26** and the cover plates **32,** as best seen in FIG. **3** of the drawings.

Elongated openings **56** are formed in the webs **58** of the channel members **50** and bearing blocks **60** are mounted on either side of the openings **56** to slidably receive bearings **62.** An additional block **68** is affixed by welding or the like to the web **58** of the channel **50** and receives a screw threaded rod **66** adjustable vertically with respect to the block **68** by means of the adjusting nuts **70** (see also FIG. **7**).

The bearings **62** journal a shaft **72** upon which are mounted a sprocket **74** adjacent one end thereof and, intermediate the channels **50,** a drum **76** which, as seen in FIG. **14,** is slidable along and keyed to the shaft **72,** as at **77,** and retained in one position along the shaft during certain operations by means of the locking collar **78.** A drive motor **80** is mounted on the platform **42** and, through a suitable coupling device **82,** drives a drive sprocket **84.**

A drive chain **86** is trained about the sprocket **84** and the sprocket **74** to impart driving motions to the shaft **72** and hence, the drum **76.** A tensioning device is also mounted on the web **58** of the drive side channel **50** and includes a stub shaft **88** afixed to the web **58** by welding or the like. An arm **90** is attached to the stub shaft **88** by a split ring **92** and the arm **90** carries a short shaft **94** upon which is rotatably mounted the tensioning sprocket **96.**

Channel members **98** are attached to the inner surfaces of the webs of the channels **50** and project, in both upstream and downstream directions, past the vertically extending box beams **26.** At their upstream ends the channels **98** carry adjusting mechanism **100,** including side plates **102** fixed in spaced apart relationship by spacer blocks **104** and bolts or the like **106.** A flat, vertically extending bar **108** is slidably received between the two plates **102** and carries, adjacent its lower end, a shaft **110** rotatably mounting a front wheel **112.**

Also attached to the bars **108** are horizontally extending bars **114** which carry angle members **116** at their forward ends to which, in turn, are attached plate members **118.** The plate members **118** serve as backing plates and cooperate with additional plates **120** (see also FIGS. **1** and **6**) to sandwich a resilient strip **122** therebetween. Each of the bars **108,** as seen in FIG. **13,** are provided with a series of openings **123** therethrough spaced apart vertically certain predetermined distances and a connecting pin **124** extends through the plates **102** and an opening **123** to vertically position the wheel **112** at the desired height with respect to the rest of the screed carriage.

As noted above, the channels **98** extend past the beams **26** in both upstream and downstream directions. At their downstream ends the channels **98** carry adjusting and support mechanism **126** substantially identical to the supporting and adjusting mechanism **100,** with the exception that the side plates **102** are replaced with larger side plates **128,** and the downstream spacer bars **130** are somewhat wider than its counterparts in the upstream mechanisms **100.**

Additionally, it will be noted that the plates **118** at the downstream end of the channels are inwardly rather than outwardly directed. Aside from these differences the structure **126** is identical to the structure **100** and like parts are identified by like reference numberals. As best seen in FIGS. **1** and **9,** the extra width of the plates **128** is required to provide support for a

pair of depending bars **132,** across the lower ends of which are attached a flat plate **134.**

A shaft **136** is also received in the lower ends of the members **132** and a pair of arms **138** are loosely mounted on the shaft **136** and extend downstream therefrom. An angle number **140** also extends between the arms **138** and is affixed thereto by welding or the like. A bolt **142** is threadably received through one web of the angle member **140** and bears against the upper surface of the plate **134.** A second pair of arms **144** are pivotally attached to and depend downwardly from the arms **138** and carry a trowel **146** adjacent their lower end.

Each of the arms **138** also carry downwardly depending blocks **148** through which are threadably received bolts **150.** Angle iron **140** also threadably receives a bolt member, as at **152,** with each of the bolts **150** and **152** bearing on opposite sides of the downwardly depending arms **144.** The channels **98,** as best seen in FIG. **8** of the drawings, also carry wiper arm support structure, referenced in its entirety by the numeral **154.**

Each of the support structures **154** include vertically extending angle members **156** to which are affixed inner and outer cross members **158.** The angle members **156** also carry short shafts **162** which pivotally mount vertically depending wiper arms **164** on the support structure **154.** Bolts **166** are threadably received through the cross members **158** and bear on opposite sides of the depending arms **164.** It will also be noted from FIG. **8** that a wiper or doctor blade **167** bears against the surface of the drum **76** upstream of the axis thereof. Blade **167** prevents concrete from being carried back around the drum and into the concrete form.

At their lower ends members **164** carry strips of resilient material **168** which are curved on their downstream faces to conform with that portion of the surface of the drum **76** which they engage. A hydraulic or pneumatic piston and cylinder **170,** which is omitted from FIG. **8** for purposes of clarity but which is shown in FIG. **7** of the drawings, extends between the arms **164** and is pivotally attached thereto as at **172** and **174.** Thus, movement of the piston rod **176** into and out of the cylinder **178** will permit the arms **164** to pivot between the limits set by the threaded stop members **166.**

With the above construction it will be seen that a form **18** filled with concrete is conveyed through the screeding apparatus **10** by means of the rollers **16** in the direction indicated by the arrow in FIG. **4** of the drawings. As the form moves through the screeding apparatus the upper flanges **180** of the form are cleaned by the upstream scraper blades **122** to provide a smooth clear surface for the upstream rollers **112** to ride on.

The relative vertical positions of the rollers, scrapers and trowel with respect to the lower surface of the drum **76** are adjusted by means of the pins **124** and the various openings **123** in which the pins are received. Thus, with the pins **124** received within the upper most ones of the vertically spaced openings **123,** the lower surfaces of the rollers **112,** scrapers **122,** trowel **146** and drum **76** will be substantially co-planar.

Thus, with the four rollers **112** riding on the upper flanges **180** of the forms **18** the drum **76** will be positioned substantially as shown in FIGS. **5, 7** and **14** of the drawings. As the concrete filled forms **18** move past the upstream wheels **112** any concrete lying on the upper flanges **180** is scraped therefrom by the scraper blades **122** back into the forms **18.**

Continued movement of the form carries it beneath the rotating drum **76,** which smooths the surface of the concrete and removes any excess therefrom. The wipers **68** are positioned in slightly overlaping relationship to the ends of the drum **76** to wipe a portion of the flanges **180** and a portion of the drum **76** and thereby prevent the formation of horizontally extending fins **182** shown in FIG. **11** of the drawings. The wipers, in conjunction with the upstream scrapers, also provide another important function. Thus, concrete directed inwardly by the upstream scrapers is retained between the wipers against the upstream surface of the drum. The wipers, therefore serve as end dams to hold a supply of concrete which will compensate for low spots. This of course renders less critical the placement of the right amount of concrete in the forms.

As the form continues through the screeding apparatus the downstream scrapers **122** clean the flanges **180** and direct any excess concrete lying thereon onto the inwardly projecting portions **22** of the downstream receiving trough **20,** as indicated by the arrow in FIG. **4** of the drawings. The downstream wheels **112,** therefore, are also provided with a clean surface to ride on as the form passes through the screeding apparatus.

Lastly, the form **18** encounters the trowel **146,** which imparts a final smoothing and finishing to the concrete carried by the form. The vertical position of trowel **146** with respect to the upper edge of the form is controlled by threading the bolt **142** through the horizontal leg of the angle **140** with the lower end of the bolt **142** bearing on the plate **134.** The angular position of the trowel **146** with respect to the surface of the concrete may also be varied by threading the bolts **150** and **152** through the depending plates **148** and the vertically extending leg of the angle **140,** respectively.

As noted above, the entire screed carriage is movable along the trackways defined by the surfaces of the box beams **26** and the plates **32** attached thereto and the pressure with which the drum **76** bears against the concrete carried by the form **18** is controlled by the cylinder **38,** which in turn is controlled by suitable circuitry, not shown. Additionally, it will be seen that the bearings **63** for the drum shaft **72** are vertically adjustable in the channels **50** by means of the threaded member **66** as will be apparent from inspection of FIGS. **4** and **7** of the drawings.

It will further be noted that the channels **50** are pivotally attached to the upper platform **42** of the screed carriage and that the upper platform **42** is pivotally attached to the lower end of the piston rod **40.** This provides an articulated structure which permits the opposite sides of the screed carriage to shift if the form passing through the screeding apparatus is tilted so that one flange is higher than the other. Thus, upon an occurence of this sort, the screeding apparatus will still provide a finished slab of uniform depth transversely thereof.

As noted previously, it will often be desirable to produce slabs of thicknesses less than that of the full depth of forms **18.** If this is the case, it is merely necessary to reposition the pins **124** in the appropriate openings in the bars **108.** This will have the effect of lowering the lower surface of the drum **76** below the lower surfaces of the rollers **112** and the scrapers **122.** The wipers **168,**

since they are mounted directly on the channels **98** will also be lowered with the drum **76.**

With this configuration, the drum **76,** being less in axial length than the width of the forms passing through the screeding apparatus, will be positioned down in the form as shown somewhat schematically in FIG. **10** of the drawings. Before positioning the drum **76** in this manner the wiper arms **164** are pivoted inwardly by means of the piston and cylinder **170** so that the outer surfaces of the wipers **168** clear the inner faces of the forms. The cylinder **70** is then pressurized, forcing the wipers outwardly to bear against inner surfaces of the form while still contacting a portion of the surface of the roller **76** adjacent each end thereof. This prevents the formation of a fin, as shown in FIG. **12** at **184,** from forming along each of the upper edges of the finished slab.

The trowel **146,** is of course, pivoted around the shaft **136,** clockwise as seen in FIG. **9** of the drawings, to an inoperative position. Additionally, when screeding "low" or with the drum **76** within the form as shown in FIG. **10** of the drawings, it will usually be desired to loosen the locking collars **78** to permit the drum **76** to slide axially along the shaft **72.** Thus, if the side walls of the form **18** are not perfectly straight the drum **76** can accommodate this deviation by shifting along its axle **72.**

The maximum speed of rotation of the drum **76** will be determined by a variety of factors such as the stiffness of the concrete mix, the rate of speed of the form passing through the screeding apparatus, etc. To accommodate variations in these factors the speed of the drum **76** can be readily varied by changing the diameter of the sprockets utilized, with the tensioning sprocket **96** maintaining the chain **86** taut despite changes in sprocket size.

From the above it will be apparent that the present invention provides screeding apparatus which automatically provides a smooth, true, uniform surface to concrete slabs and is extremely flexible and adapted to operate under a variety of manufacturing conditions.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. Apparatus of the type described comprising:
a. a base frame,
b. means for conveying a concrete form through said base frame,
c. a vertically reciprocal screed carriage,
d. means mounting said screed carriage for reciprocal movement on said base frame toward and away from said conveying means,
e. a rotatable cylindrical drum having an axial length less than, but substantially equal to, the internal width of concrete forms conveyed through said base frame by said conveying means, and
f. means rotatably mounting said drum on said screed carriage with the axis of rotation of said drum extending normal to the direction of travel of concrete forms conveyed through said base frame by said conveying means.

2. The apparatus of claim **1** further comprising:
a. means for varying the pressure with which said drum engages concrete in forms carried therebeneath by said conveying means.

3. The apparatus of claim **1** further comprising:
a. a fluid actuated piston and cylinder, and
b. means attaching said piston and cylinder to said base frame and carriage to cause relative movement therebetween in response to relative movement between said piston and cylinder.

4. The apparatus of claim **1** further comprising:
a. form engaging means mounted on said carriage and engageable with concrete forms conveyed through said base frame to position the surface of said drum with respect to concrete carried by said form.

5. The apparatus of claim **4** wherein:
a. said form engaging means comprises rollers rotatably mounted on said carriage.

6. The apparatus of claim **4** wherein:
a. said form engaging means comprises spaced pairs of rollers, and
b. means rotatably mounting said pairs of rollers on opposite sides of said drum.

7. The apparatus of claim **4** further comprising:
a. means for adjusting with respect to each other the height of said drum and said form engaging means above said conveying means.

8. The apparatus of claim **1** further comprising:
a. means for scraping portions of concrete forms being conveyed through said base frame, and
b. means mounting said scraping means on said carriage.

9. The apparatus of claim **8** wherein said scraping means includes:
a. a first set of opposed scraper blades mounted on one side of said drum.

10. The apparatus of claim **9** wherein said scraping means includes:
a. a second set of opposed scraper blades mounted on a side of said drum opposite said one side.

11. The apparatus of claim **1** further comprising:
a. wiper means engaging the surface of said drum adjacent each end thereof.

12. The apparatus of claim **11** further comprising:
a. wiper arms each pivotally mounted adjacent one end thereof on said carriage,
b. means mounting said wiper means on opposite ends of said wiper arms, and
c. means for pivoting said wiper arms.

13. The apparatus of claim **1** further comprising:
a. trowel means extending transversely of said base frame downstream of said drum.

14. The apparatus of claim **13** further comprising:
a. means for varying the angular disposition of said trowel means with respect to the upper surface of concrete contained in a form conveyed through said base frame by said conveying means.

15. The apparatus of claim **1** further comprising:
a. receiving troughs mounted on said base frame for receiving excess concrete screeded from concrete filled forms conveyed through said base frame.

16. The apparatus of claim **1** wherein said screed carriage mounting means comprises:
a. substantially vertically extending trackways on said base frame, and
b. portions of said screed carriage engaged with and movable along said trackways.

17. The apparatus of claim 1 further comprising:
a. means pivotally attaching said screed carriage to said mounting means.
18. The apparatus of claim 17 wherein said screed carriage comprises:
a. an upper platform pivotally attached to said mounting means by said pivotally attaching means,
b. downwardly depending side members, and
c. means pivotally attaching said side members to opposite sides of said upper platform.
19. The apparatus of claim 18 further comprising:
a. substantially vertically extending trackways on said base frame, and
b. portions of said side members engaged with and movable along said trackways.
20. Apparatus of the type described comprising:
a. a base frame having an upstream end and a downstream end,
b. conveyor means mounted in said base frame for conveying concrete filled forms therethrough in a downstream direction,
c. a screed carriage mounted on said base frame for movement toward and away from said conveyor means,
d. a drum rotatably mounted on said carriage,
e. a first pair of scrapers mounted on said carriage upstream of said drum and angularly disposed outwardly in an upstream direction,
f. a second pair of scrapers mounted on said carriage downstream of said drum and angularly disposed inwardly in said upstream direction,
g. a pair of drum wipers engaging the surface of said drum adjacent each end thereof, and
h. a trowel extending across said conveyor means downstream of said second pair of scrapers.
21. The apparatus of claim 20 further comprising:
a. means for moving said drum wipers axially of said drum.
22. The apparatus of claim 20 further comprising:
a. means for varying the relative vertical positions of said scrapers and said drum with respect to each other.
23. The apparatus of claim 20 wherein:
a. said base frame includes vertical trackways engaged by portions of said screed carriage accommodating said movement toward and away from said conveyor means, and
b. piston and cylinder means attached to said base frame and said carriage for moving said carriage along said trackways.

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