May 15, 1962 J. B. WINN, JR 3,034,732

MONOLITHIC WALL FORMING APPARATUS

Filed July 18, 1957 3 Sheets-Sheet 1

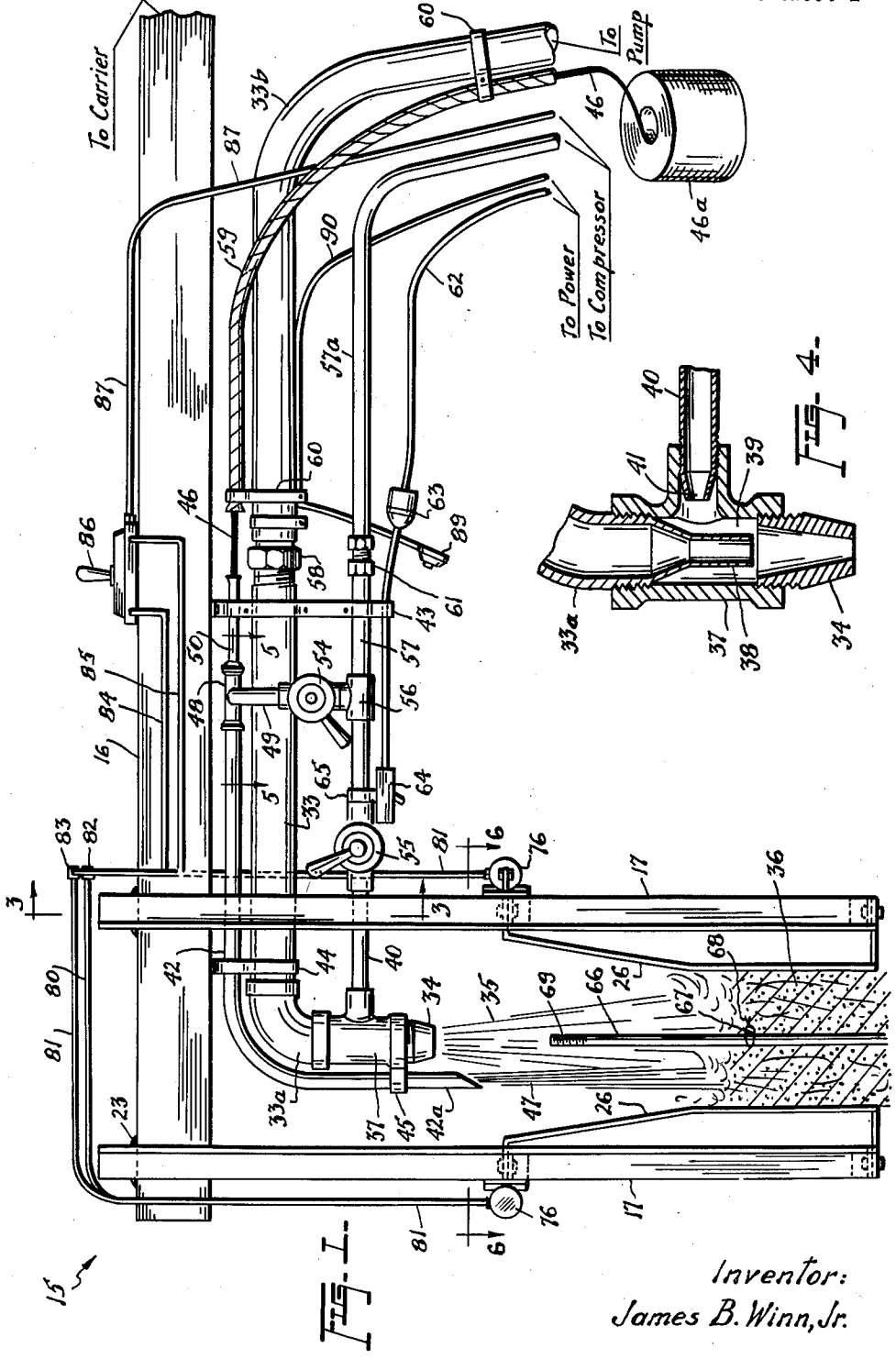

FIG. 1

FIG. 4

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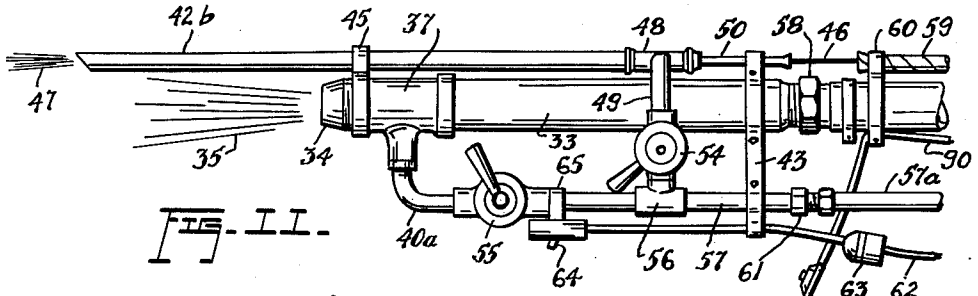

FIG. 11.

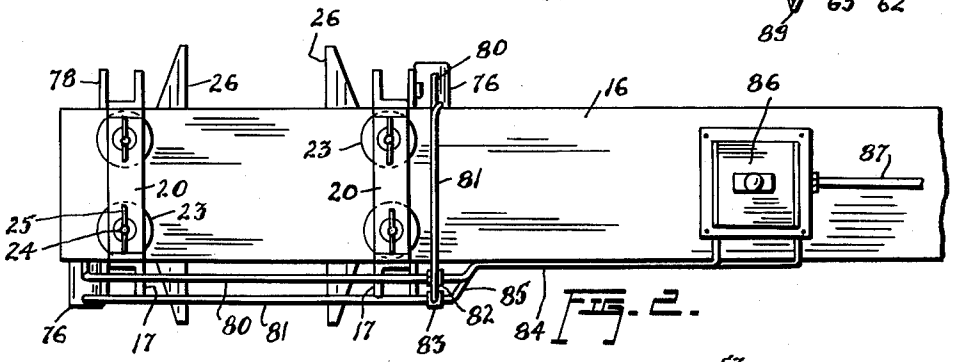

FIG. 2.

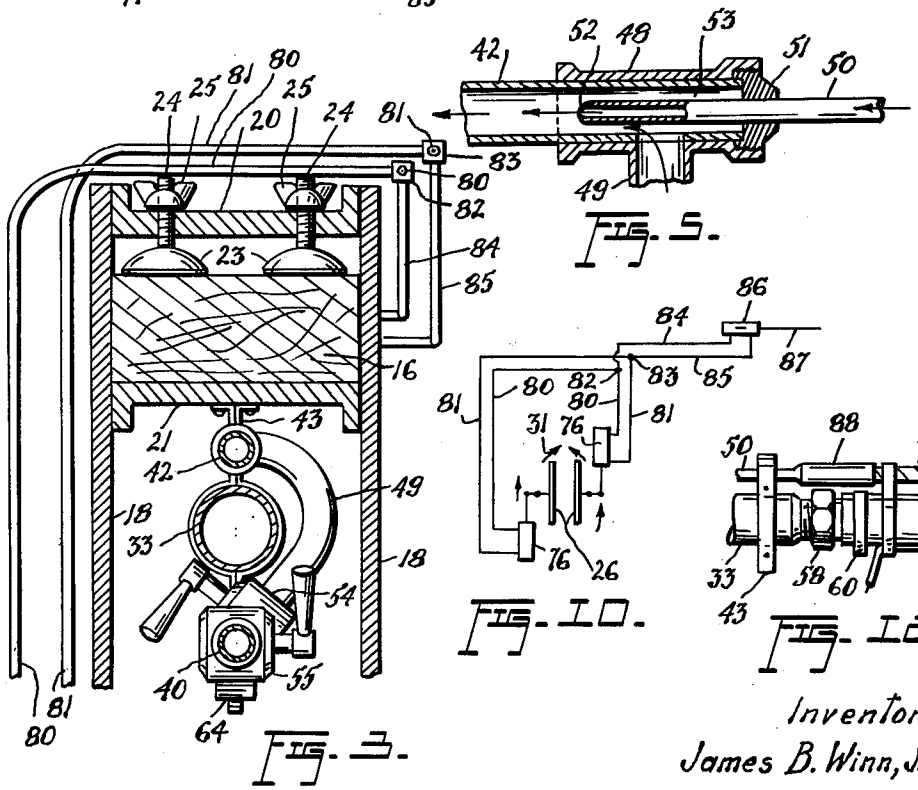

FIG. 3.

FIG. 5.

FIG. 10.

FIG. 12.

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MONOLITHIC WALL FORMING APPARATUS

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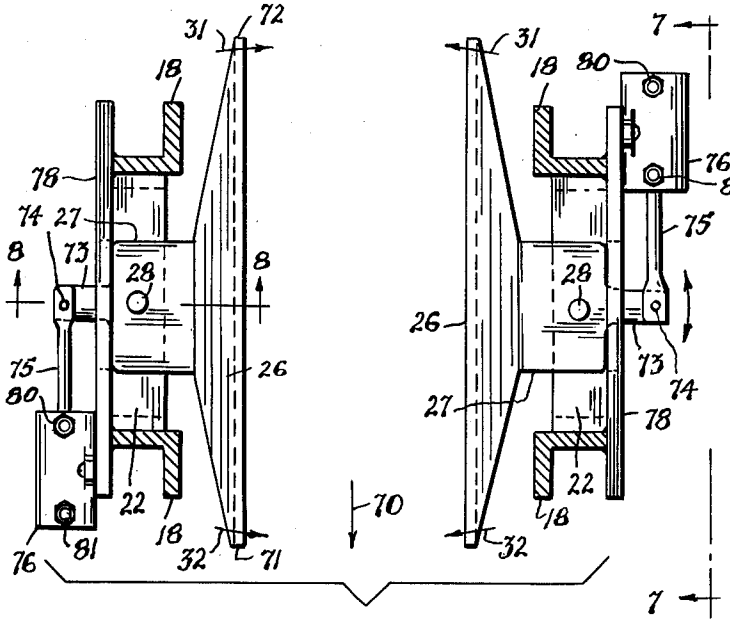

Fig. 6.

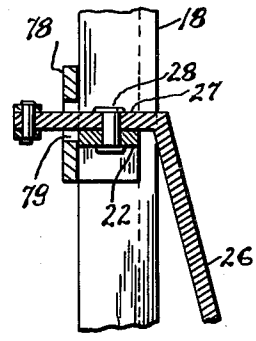

Fig. 8.

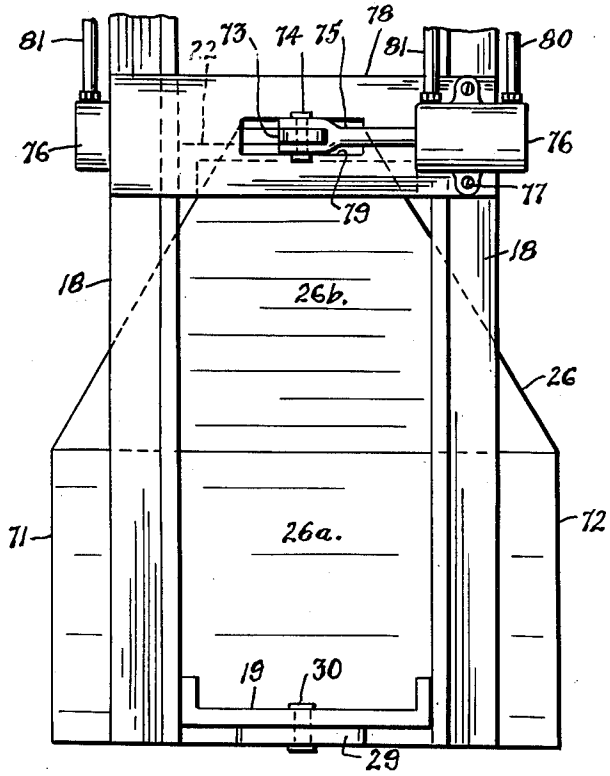

Fig. 7.

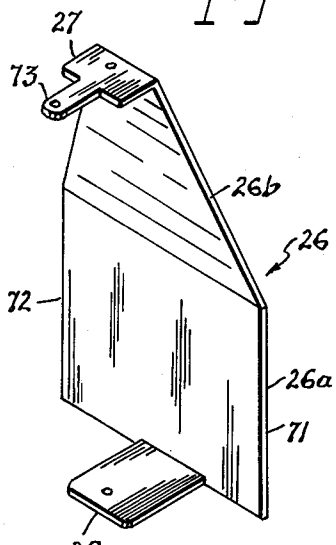

Fig. 9.

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United States Patent Office 3,034,732 Patented May 15, 1962

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MONOLITHIC WALL FORMING APPARATUS

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Filed July 18, 1957, Ser. No. 672,723
1 Claim. (Cl. 239—419)

This invention relates to new and useful improvements in monolithic wall forming apparatus, that is, apparatus such as may be used for forming a wall in a continuous manner in situ.

More specifically, the present invention relates to certain improvements in the apparatus disclosed in my earlier application serial No. 524,010, filed July 25, 1955, now Patent No. 2,877,530, of which this application is a continuation-in-part.

The principal object of the present invention is to facilitate formation of a strong, rigid wall without the use of conventional forms or molds, such a wall being well able to retain its form without slumping or sagging while the material thereof is setting.

The above object is attained in the present apparatus by the provision of means for discharging fluid cementitious material in the space where a wall is to be formed and simultaneously discharging fibrous reinforcing material therein, so that the fibrous material becomes intermixed with and embedded in the cementitious material during setting of the latter and substantially reinforces the same.

An important feature of the present invention resides in the provision of means for discharging the cementitious and fibrous materials from the apparatus under the force of compressed air and varying the air pressure under which each material is discharged, whereby the relative proportions of the two materials in the mixture may be varied as desired.

Another feature of the present invention resides in the provision of improved wall forming plates in the apparatus, and in the provision of improved means for actuating these plates so as to effectively shape and mold the wall being formed.

Another feature of the present invention resides in the provision of means whereby the apparatus may be either supported by a universally movable boom for formation of a wall in accordance with a pre-selected geometrical pattern, or may be supported by the hand of an operator and freely manipulated as a portable tool for finishing walls with proofings, plaster, and the like, or for building up reinforced mixes over open mesh wire, etc.

With the foregoing more important objects and features in view and such other objects and features as may become apparent as this specification proceeds, the invention will be understood from the following description taken in conjunction with the accompanying drawings, wherein like characters of reference are used to designate like parts, and wherein:

FIGURE 1 is a side elevational view of the present invention shown as being supported by a universally movable boom;

FIGURE 2 is a fragmentary top plan view thereof;

FIGURE 3 is a cross-sectional view on an enlarged scale, taken substantially in the plane of the line 3—3 in FIGURE 1;

FIGURE 4 is an enlarged vertical sectional view of the nozzle used in the invention;

FIGURE 5 is a sectional detail of the jet pipe, taken substantially in the plane of the line 5—5 in FIGURE 1;

FIGURE 6 is a horizontal sectional view on an enlarged scale, taken substantially in the plane of the line 6—6 in FIGURE 1;

FIGURE 7 is a fragmentary elevational view, taken substantially in the plane of the line 7—7 in FIGURE 6;

FIGURE 8 is a sectional detail, taken substantially in the plane of the line 8—8 in FIGURE 6;

FIGURE 9 is a perspective view of one of the wall forming plates;

FIGURE 10 is a diagramatic illustration of the compressed air lines and plate actuating cylinders connected thereto;

FIGURE 11 is a side elevational view of a slightly modified form of the invention, detached from the supporting boom and adapted for portable use; and

FIGURE 12 is a fragmentary elevational view of a slightly modified arrangement of the jet pipe connection.

Referring now to the accompanying drawings in detail, particular to FIGURES 1–10 inclusive, the monolithic wall forming apparatus in accordance with the present invention is designated generally by the reference numeral 15 and is adapted to be supported by a suitable, universally movable boom 16. As in my earlier application Serial No. 524,010, the boom 16 may be power actuated and adapted for movement in a straight or a curved path selectively in any desired direction. However, since the arrangement and actuation of the boom does not form a part of the present invention, further description thereof is regarded as unnecessary in this disclosure.

A pair of spaced frame members 17 are adjustably mounted on the boom 16, each of these frame members consisting of a pair of spaced uprights 18 having a lower cross-piece 19 and a set of upper cross-pieces 20, 21 extending therebetween, as is best shown in FIGURES 3 and 7. An intermediate cross-piece 22 also extends between the uprights 18, the various cross-pieces being secured to the uprights in any suitable manner, such as for example, by welding. The cross-pieces 21 of the two frame members 17 are adapted to abut the underside of the boom 16 while pressure pads 23, carried by screws 24 extending through threaded holes in the cross-piece 20, clampingly engage the upper surface of the boom, whereby to securely fasten the frame members 17 to the boom. The screws 24 are provided with suitable lock nuts 25 to prevent them from turning after the pads 23 have been clamped against the boom. It will be noted from the foregoing that the frame members 17 may be readily applied to or removed from the boom, and moreover, the spacing or distance between the frame members may be pre-adjusted, as desired.

A pair of opposing wall forming plates 26 are supported by the respective frame members 17, these plates having substantially parallel, vertical lower portions 26*a* and mutually divergent upper portions 26*b*, as shown. The plates 26 are provided at their upper edges with outwardly projecting lugs 27 which are pivoted to the cross-pieces 22 by suitable pins or rivets 28. The lower edges of the plates are similarly provided with outwardly projecting lugs 29 which are pivoted to the cross-pieces 19 by the pins or rivets 30. The pivots 28, 30 of each plate are vertically aligned, so that the two plates may rock about the vertical axes of the pivots as indicated by the arrows 31, 32 in FIGURE 6.

A duct 33 for fluid cementitious material extends longitudinally under the boom 16 and is provided with a down-turned portion 33*a* equipped with an outlet nozzle 34. The latter is disposed between the frame members 17 above the plates 26 so that material discharged through the nozzle is delivered into the space between the two plates 26 to form a wall. The flow of material from the nozzle is indicated at 35 in FIGURE 1, while the formed wall is shown at 36.

As illustrated in FIGURE 4, the nozzle 34 is provided on the down-turned portion 33*a* of the duct, being connected thereto by a suitable T-coupling 37 which accommodates therein a reduced portion or jet 38 formed at the end of the duct portion 33*a* itself in such manner that the

jet 38 is spaced from but discharges into the nozzle 34 and that a space 39 exists in the coupling 37 around the jet and in communication with the nozzle, as illustrated. A compressed air line 40 is also connected to the coupling 37 and has a reduced end or jet 41 communicating with the space 39, so that when fluid cementitious material is delivered under pressure from a suitable pump (not shown) through the duct 33 and the jet 38, compressed air passing into the space 39 through the jet 41 causes the material to be forcibly discharged through the nozzle 34 as shown at 35.

A jet pipe 42 extends substantially in parallel with the duct 33 and is secured thereto by suitable clamps 43, 44, which may also serve to secure both the duct and the pipe 42 to the boom 16, if so desired. The pipe 42 has a downturned end portion attached to the coupling 37 by a clamp 45 and projecting somewhat beyond the nozzle 34, as indicated at 42*a*. The pipe 42 is adapted for delivery of a suitable fibrous reinforcing material 46 into the wall being formed, such material being discharged through the end portion 42*a* of the pipe in a substantially parallel direction to the flow of material from the nozzle 34, as indicated at 47.

As is best shown in FIGURE 5, the pipe 42 is provided with a T-coupling 48 having a compressed air line 49 connected thereto, the reinforcing material 46 being delivered into the coupling through a pipe 50 which enters the coupling longitudinally or axially through an end cap 51 with which the coupling is equipped. The pipe 50 has a reduced jet end 52, surrounded by an air space 53 in the coupling, so that compressed air delivered into the space 53 through the line 49 may forcibly draw the material through the pipe 50 and discharge the same through the pipe 42, as indicated at 47.

The rate of flow of compressed air through the line 49 is controlled by a suitable valve 54, while the flow of compressed air through the line 40 is controlled by a similar valve 55. The lines 40, 49 are connected together by a T-coupling 56 which also communicates with a compressed air supply line 57.

The duct 33 is connected by a quickly separable coupling 58 to an extension 33*b* leading from a suitable pump for fluid cementitious material. A flexible conduit 59, secured to the duct extension 33*b* by suitable clamps 60, serves to deliver the fibrous reinforcing material 46 into the pipe 50 from a roll 46*a* or some other suitable supply of such material, it being noted that a space exists between the pipe 50 and the adjacent end of the conduit 59 so that it is not necessary to provide a separable connection between these parts. When the apparatus is in operation, the space between the conduit 59 and the pipe 50 is traversed by the flow of material therethrough. The compressed air supply line 57 is connected by a quickly separable coupling 61 to an extension line 57*a* leading from an air compressor (not shown), while an electric conductor 62, equipped with a quickly separable connector 63 and with a suitable switch 64, is in circuit with a source of electric power and with motors for driving the air compressor and the cementitious material pump.

The connector 63 is disposed adjacent the couplings 58, 61, while the switch 64 is attached to the air line 40 adjacent the valve 55 by a suitable clamp 65, the switch 64 being used to turn on or off the air compressor and the material pump, as desired.

When the apparatus is placed in operation, fluid cementitious material is discharged through the nozzle 34 while fibrous reinforcing material is simultaneously discharged through the jet pipe 42 into the space between the plates 26, where these materials are mixed and molded by the plates to form the wall. As the apparatus is moved, the wall forming operation proceeds in a continuous fashion so that the wall is formed monolithically. The simultaneous discharge of the cementitious and fibrous materials results in a homogeneous mixture which lends characteristics of strength and durability to the formed wall.

The proportion of reinforcing material in the mixture may be effectively controlled by the valves 54, 55, and if desired, solid reinforcing rods 66, 67 may be also embedded in the formed wall during the forming procedure, by simply installing the same in place between the plates 26. Such rods may extend both vertically and horizontally and be connected together at points of crossing with suitable tie wires, as indicated at 68. The rods may also be screw-threaded as indicated at 69 for longitudinal connection with one another, as formation of the wall progresses.

The thickness of the wall under formation may be pre-adjusted by varying the spacing of the frame members 17 on the boom 10, thus correspondingly varying the distance or space between the plates 26. The parallel lower portions 26*a* of the plates effectively form the wall, while the divergent upper portions 26*b* function in the nature of a funnel for guiding the streams 35, 47 of material into place between the plates.

As the wall is being formed, the apparatus is shifted by the boom 16 longitudinally of the wall and it is desirable to exert a lateral compressive force on the sides of the wall so as to produce a certain amount of tamping action of the cementitious material and to finish the sides of the wall with a substantial degree of smoothness. This is effected by virtue of the pivotal mounting of the plates 26, whereby these plates may be turned about the axes of the pins 28, 30 in the directions of the arrows 31 in FIGURE 6, so that, considering the apparatus to be moving along the wall in the direction of the arrow 70, the leading edges 71 of the plates 26 are drawn apart, while the trailing edges 72 thereof are drawn together and into a pressing engagement with the sides of the wall being formed.

Movement of the plates 26 is effected by providing the upper lugs 27 with arm-like extensions 73 which have connected thereto by suitable pivots 74 the piston rods 75 of a pair of air cylinders 76. The latter are secured by suitable screws 77 to a pair of straps 78 which, in turn, are welded or otherwise secured to the aforementioned uprights 18 of the frame members 17. One of the straps 78 carrying one of the cylinders 76 is provided on each frame member 17 for actuating the plate 26 associated therewith, the straps 78 being disposed substantially at the level of the cross-pieces 22 and being provided with slots or recesses 79 in which the extensions 73 are freely movable.

The cylinders 76 are double-acting, each being provided with a pair of compressed air lines 80, 81. These lines extend upwardly to and above the boom 16 and are joined together by suitable couplings 82, 83 in such manner that when air under pressure is admitted to the cylinders through the lines 81, the plates 26 are actuated so that the trailing edges 72 thereof are drawn together. On the other hand, when compressed air is admitted through the lines 80, the leading edges 71 of the plates are drawn together as indicated by the arrows 32.

While primarily it is desired to draw together only the trailing edges of the plates, actuation of the cylinders 76 to draw the leading edges of the plates together permits release of lateral compressive forces at the trailing edges. Moreover, if the cylinders are actuated alternately in opposite directions, the resultant rocking motion of the plates 26 will impart a degree of tamping action to the wall being formed, when so desired.

The aforementioned couplings 82, 83 communicate with air lines 84, 85, respectively, leading from a suitable control valve 86 mounted on the boom 16, the valve 86, in turn, being connected by a line 87 to a source of compressed air, such as for example, the compressor which feeds the aforementioned line 57*a*. By actuation of the valve 86, compressed air may be delivered to the cylinders 76 selectively through the lines 80, 81.

As already stated, the fibrous reinforcing material 46 bridges the gap or space between the adjacent ends of the pipe 50 and the conduit 59. However, if so desired,

this space or gap may be closed by the installation of a suitable connecting sleeve or tube 88 as shown in FIGURE 12, which permits materials such as setting agents, coloring agents or various other ingredients to be blown into the cementitious mixture of the wall in substitution for or in addition to the fibrous reinforcing material 46.

It may also be noted that while the aforementioned electric switch 64 may be used to control both the air compressor and the cementitious mixture pump, separate controls may be provided therefor by the installation of another switch, such as for example, a switch 89 on a conductor 90 which is held by one or more of the clamps 60. The switch 89 may freely hang adjacent the valves 54, 55 for convenient operation.

The apparatus as thus far described is primarily intended to be supported by the universally movable boom 16, or forming walls in accordance with a pre-selected geometrical pattern.

However, it may be readily detached from the boom and used, without the wall forming plates 26, in the manner of a portable tool known in the trade as a "cocoon gun." This modified arrangement is shown in FIGURE 11 wherein it will be noted that in this instance the downturned portion 33*a* of the duct 33 is preferably omitted so that the nozzle 34 is in axial alignment with the duct 33, and that the jet tube 42*b* is similarly straight and projects beyond the nozzle to a greater extent than in the arrangement previously described. The compressed air line 40*a* is curved so as to feed laterally into the coupling 37, but the arrangement of the other components is substantially the same. The boom 16, the frame members 17 and the plates 26, of course, are omitted, and the apparatus thus arranged may be held and freely manipulated by the hand of the operator so as to discharge the cementitious mixture alone, or cementitious mixture together with fibrous reinforcing material, setting agents, coloring agents, etc., onto the surface of a rough wall already formed, or onto open mesh wire, or the like. As such, the portable apparatus is well adapted either for wall construction or wall finishing such as in plastering, weather proofing, sizing etc. The portable apparatus may, of course, be used with or without either of the switches 64, 89, and with or without the connecting sleeve 88, as desired.

Referring again to the form of the invention shown in FIGURE 1, it should be noted that the plates 26 are positioned well downwardly from the nozzle 34, so that they engage the formed wall 36 at a level where they properly straddle the reinforcing rods 66, 67 in the wall. This positioning of the plates enables the apparatus to be moved easily back and forth along the formed wall, without interfering in any way with the reinforcing rods, the cementitious mixture being blown in and around the rods without the necessity of tamping or vibrating the mixture.

While in the foregoing there has been shown and described the preferred embodiment of the invention, various modifications may become apparent to those skilled in the art to which the invention relates. Accordingly, it is not desired to limit the invention to this disclosure, and various modifications may be resorted to, such as may lie within the spirit and scope of the appended claim.

What is claimed as new is:

In a monolithic wall forming apparatus, the combination of a duct of a relatively large diameter for fluid cementitious material, a discharge nozzle provided at one end of said duct, a jet pipe of a relatively small diameter for fibrous reinforcing material extending in parallel alongside and secured to said duct, said jet pipe having an outlet end portion projecting longitudinally beyond said nozzle and oriented substatnially in parallel to a flow of material from the nozzle, means for introducing cementitious material from said duct axially into the nozzle in spaced relation from the side wall of the nozzle, a compressed air line connected laterally to the nozzle for introducing air under pressure into the space at the side wall of the nozzle in surrounding relation with cementitious material therein whereby to forcibly discharge the cementitious material from the nozzle, means for introducing fibrous material axially into said jet pipe in spaced relation from the side wall of said pipe, and a compressed air line connected laterally to the jet pipe for introducing air under pressure into the space at the side wall of the pipe in surrounding relation with the fibrous material therein whereby to propel the fibrous material through the outlet of said pipe for intermixing with the cementitious material discharged from said nozzle.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,034,732 May 15, 1962

James B. Winn, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 12, and in the heading to the printed specification, lines 3 and 4, name of assignee, for "The Archilithics Co.", each occurrence, read -- The Archilithic Co. --; column 2, line 14, for "particular" read -- particularly --; column 6, line 14, for "substatnially" read -- substantially --.

Signed and sealed this 9th day of October 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents