

Sept. 17, 1957

D. HAND ET AL
WALL-FORMING PROCESS

2,806,277

Filed May 10, 1950

2 Sheets-Sheet 1

Fig. 1

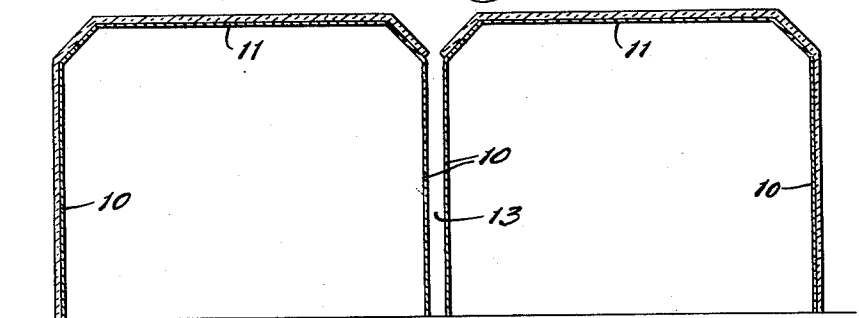


Fig. 2

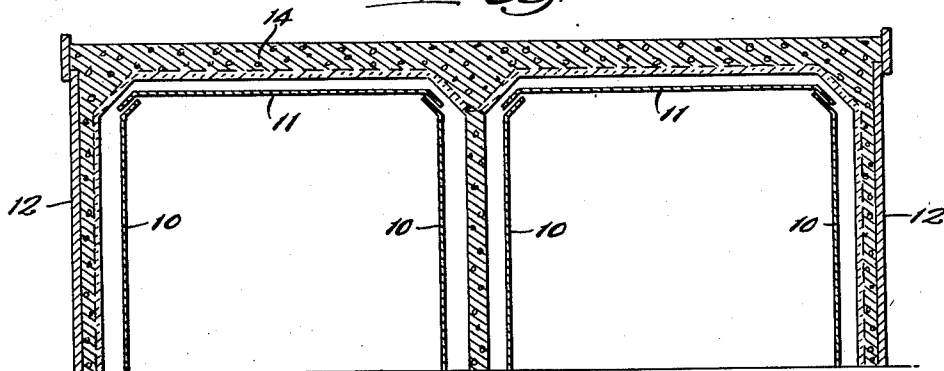
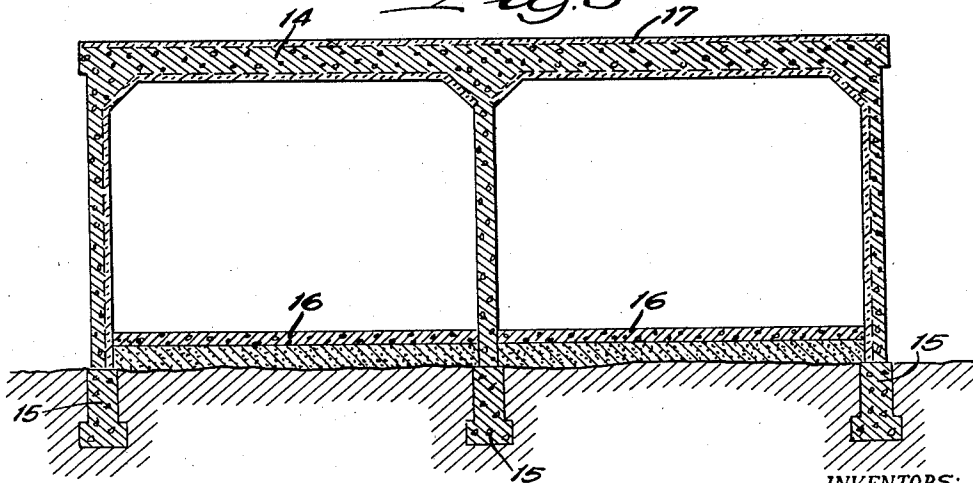


Fig. 3



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2 Sheets-Sheet 2

Fig. 4

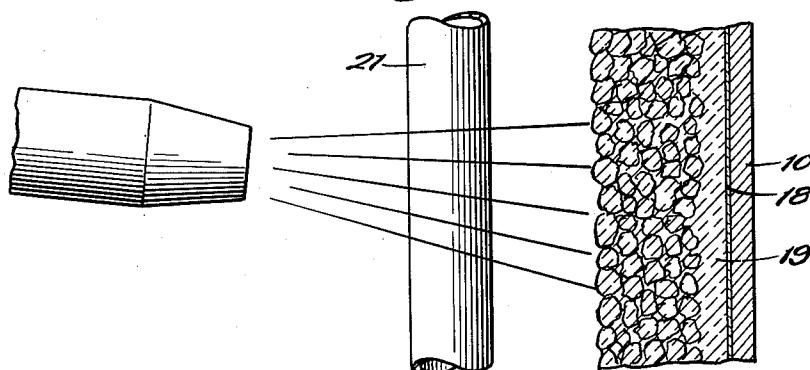


Fig. 5

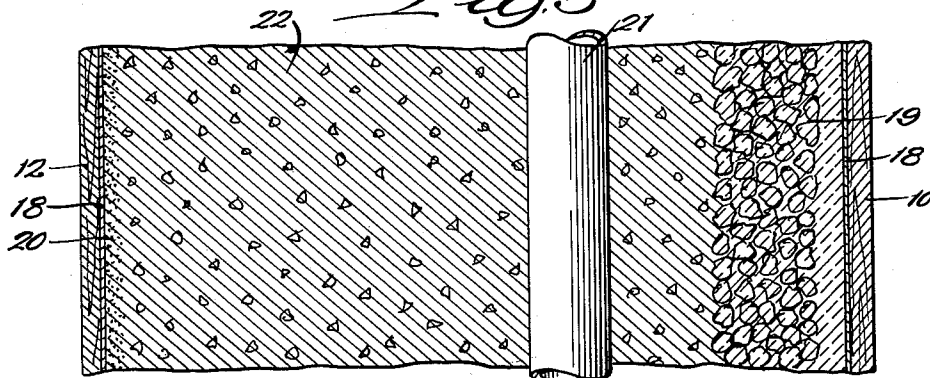
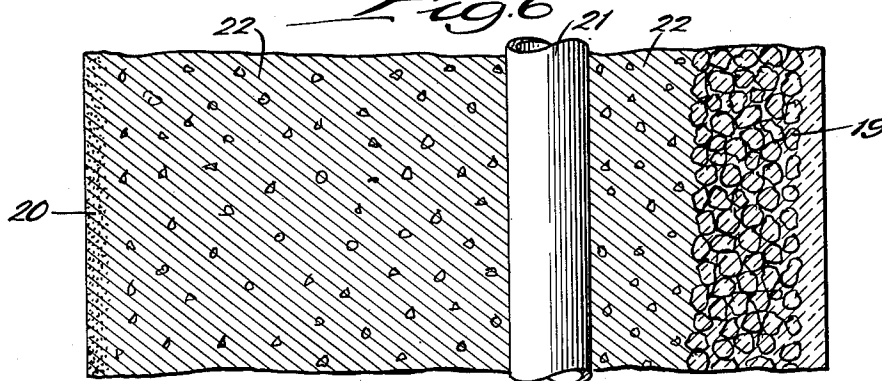


Fig. 6



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1

2,806,277

WALL-FORMING PROCESS

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Application May 10, 1950, Serial No. 161,075

3 Claims. (Cl. 25—155)

This invention relates to a wall and/or ceiling forming process. The invention is particularly useful in the forming of a concrete and plaster wall in the building of houses or other structures although it is understood that the process may be practiced with stabilizing agents other than common gypsum plasters and portland cement concretes. In the following, "wall" is to convey the meaning of wall, ceiling, and partition; concrete and plaster are intended to mean concrete, plaster, adobe, and stabilized earth or other stabilized aggregate.

An object of the invention is to provide a process for forming a wall structure of sturdy construction and having high insulating properties, the wall being set up in a modicum of time and at low expense. A further object is to provide a method in which plaster is integrated with concrete or cement materials. Still another object is to provide a method of forming a wall structure consisting largely of concrete but having integrated therewith servicing layers which are integrated with the concrete in the forming of a unitary structure. Still another object is to provide a method whereby walls may be formed with great speed and at low economy, the walls having plaster or other layers integrated with concrete. A still further object is to provide a method for producing walls of substantial insulating value while integrating layers of different character in the finished wall. A still further object is to provide a method for forming a wall structure of concrete and plaster or concrete and other materials to form an integrated structure and then sealing the wall against the ingress of moisture. Other specific objects and advantages will appear as the specification proceeds.

The invention is illustrated in one embodiment, by the accompanying drawings, in which—

Fig. 1 is a transverse sectional view of inner forms which may be employed in the practice of our invention; Fig. 2, a transverse sectional view of the finished cast structure with the inner forms collapsed; Fig. 3, a transverse sectional view of the cast structure placed upon foundations and equipped with other layers such as a floor layer, etc.; Fig. 4, a broken sectional detailed view showing the application of plaster, etc. to the outer surface of the inner form; Fig. 5, a broken transverse sectional view showing the portion of the wall structure prior to the removal of the inner and outer form; and Fig. 6, a view similar to Fig. 5 but showing the forms removed.

In the practice of our invention we prefer to employ mold forms such as inner and outer forms between which concrete may be poured in the casting of the walls. Such forms may be of any suitable type or construction. It is desired that the forms be of the collapsible type so that they may be readily removed from the walls after the casting operation.

In one embodiment of our invention, we apply to the outer surface of the inner forms a layer of plaster or other suitable material by spraying this material upon the wall. The material may be sprayed by any suitable means. We prefer to employ the well-known gunite ap-

2

paratus for this purpose, the plaster material being discharged through the central portion of a tube and water, together with compressed air, being discharged about the material at the nozzle so that the plaster mixed with water is deposited upon the wall of the form. By spraying or "guniting" the material upon the wall we find that there is a ready adherence of the material to the wall and the wall surface is quickly covered with a layer of plaster, etc. of substantial thickness, while at the same time the outer surface of the plaster is irregular and is adapted to form a strong inner lock for the concrete when the concrete is later poured. When the inner and outer forms are in position, the concrete is poured into the space between the two forms, and the movement of the concrete as it is poured into the area and flows into position causes it to enter the minute pockets, crevices and recesses in the irregular outer surface of the plaster, etc. layer so that upon the setting of the concrete at a later time an integrated structure is formed.

In another embodiment of the invention, we spray or gunite upon the inner surface of the outer form a layer of material such as cement or other good surfacing material, so as to provide a hard, weather-proof outer surface for the finished wall. The two forms are then brought into position, the inner form having its outer surface provided with the sprayed plaster, etc. layer and the outer form having its inner surface provided with a layer of cement or other finishing material. The concrete aggregate is poured between the forms and the above-mentioned layers of material to form the finished wall.

We prefer to vibrate the concrete as it is poured between the forms and preferably in successive stages as the level of concrete is being raised. The vibrating of the concrete is found not to disturb the layers of plaster or cement, etc. already deposited upon the forms and instead is effective in further causing the concrete aggregate to flow into the recesses of the irregular inner surfaces of such layers to form an integrated structure therewith. The integration is so complete that when the completed wall is subjected to tensile strains, the break occurs at other points than the line of junction between the concrete aggregate layer and the plaster, etc.

In preliminary tests, we expected the applied plaster, etc. to fall in large quantities from the wall of the form and to have very little tendency to stick thereon. To our surprise, the applied layers stuck with great firmness to the forms and there was very little rebound or loss of the material. In fact, our problem with most materials became one of separation of the applied layer from the form, so great was the adhesion of the material to the form. The sprayed plaster adheres tightly to the form sprayed with the preferred mixture of soda base grease and solvent mixture. To our surprise after a period of time sufficient for the concrete to set, e. g., 16 hours, changes occurred at the interface between the sprayed-on plaster and the surface of the form which greatly facilitated the parting of the plaster from the form. In the use of many plaster, etc. materials it was necessary to apply a grease coating or similar material to the wall of the form so that later, after the setting of the wall, the forms could be effectively separated.

A specific example of the process is illustrated by the accompanying drawings. In the illustration given, 10 designates the vertical wall portions of the inner forms and 11 designates the ceiling portion. The forms may be collapsed as illustrated in Fig. 2. The outer form 12 may be of a simple rectangular box structure in inverted position. Forms of this type are well-known. They are employed in house building machines of the type known as the Le Tourneau house building machines. For the

practice of the present invention, it will be understood that any suitable forms providing space into which concrete aggregate may be poured may be employed, the forms being movable or arranged so that the layer of plaster or cement, etc. may be applied to the desired surfaces of the forms prior to the pouring of the concrete. In the specific illustration given, there are two inner forms which are placed side by side to form a space 13 therebetween. Similarly, the outer form 12 provides with the wall portions 10 and 11 of the inner forms, spaces into which the concrete may be poured to provide the finished wall structure 14 as illustrated in Figs. 2 and 3.

In one manner of practicing the invention, the wall structure 14 is formed and the structure then deposited upon foundations 15, as shown in Fig. 3. A concrete floor 16 may then be poured and a surfacing layer 17 may be formed on the top of the wall structure 14.

The process of forming a wall is illustrated best in Figs. 4, 5 and 6. In the specific embodiment thus illustrated, the inner form is first provided with a thin layer of grease 18 or any similar material for effecting a ready separation of the finished wall from the form (in Figures 4 and 5, only a vertical wall portion 10 of the inner form is shown; and these illustrations depict steps subsequent to such plastering of the coating 18 thereon). The grease is preferably sprayed upon the wall and after the evaporation of the solvent therein forms a coating over the wall surface. The door and window frames are preferably fastened to the inner form to be in proper position for pouring of the concrete. The plaster 19 is next sprayed or gunited upon the wall. We prefer to employ a plaster containing vermiculite or other suitable material for providing an insulating and low costing material. If desired, chopped corn cob particles or chopped stalks which have a hard stem may be substituted for the vermiculite.

If the outer surface of the concrete wall is to be provided with a hard cement and sand layer, or other finishing surface, we spray upon the inner surface of the outer form 12 first a grease layer 18 and then a layer 20 of white or tinted cement containing a fine silicate sand, etc. (of the three enlarged views, only in Figure 5 is a portion of the outer form shown; and it is there depicted subsequent to the plastering of the coating 18 thereon and application of the layer 20 thereover). It will be understood that any desired finishing material for this purpose may be sprayed upon the outer form and it is usually found sufficient to spray this material to the depth of $\frac{1}{16}$ to $\frac{1}{8}$ inch. After the spraying of the forms as described, the reinforcing rod 21 is preferably arranged so as to be in the proper position for the pouring of the concrete.

The concrete aggregate 22 is then poured as illustrated in Figs. 5 and 6. The concrete is preferably of the light-weight aggregate type, but it will be understood that heavier concretes may be used. Pumice concrete aggregates have been found highly satisfactory, as well as other light and heavy concrete aggregates.

By allowing the plaster containing the vermiculite or other compressive and insulating materials to set for about one or two hours, it is found that no injurious compression of the plaster is caused by the pouring of the concrete aggregate. In fact, a great latitude with respect to the time of pouring the concrete is afforded. The concrete may be poured promptly after the forming of the coatings or it may be poured after considerable time has elapsed. It is found that the pouring of the concrete aggregate into the space between the walls forms a close integration with the plaster and cement, etc. layers by reason of the flowing and moving of the concrete into the recesses afforded by the outer surfaces of the gunited layers and a sturdy inner lock is produced. This inner lock is further improved by vibrating the concrete aggregate so as to increase its flowing properties during the raising of the concrete level. Such vibrating operations are

preferably carried on in stages as the level of the poured concrete is raised.

After the concrete has set, the inner form may be collapsed. It is preferred to leave the inner form in place until the entire structure has been moved to deposit the structure upon the prepared foundations.

The spraying or guniting may be accomplished by any suitable spraying apparatus. It is only necessary to mix the plaster or cement or other material with water and to direct it against the wall so that it is applied thereto. We prefer the gunite device in which the plaster or cement, etc. is passed through the central tube of the device and water and air are applied in an annular body around the material as it is discharged, thus thoroughly mixing the water with the plaster, etc. material. The water and air carry the mixed material to the form surface.

The spray method as described is particularly effective in the present operation in that it permits the surfaces of the forms to be covered in a very brief time and to a suitable thickness, while at the same time the outer surface of the material forms pockets or recesses and irregularities which become highly effective in forming the integration when the concrete material is later brought into contact therewith.

The spray method is also particularly effective in providing smooth and flat wall surfaces with virtually no hand finishing except at the parting lines at the corners of the form. At the time the main wall surfaces are sprayed by this method, suitable shapes in the forms are adaptable to the formation of door and window trim, decorative features, lighting coves, cold storage facilities, etc. all integrated with the basic structure.

Instead of employing the grease heretofore referred to, it will be understood that any material which is effective in preventing the adherence of the plaster or cement, etc. to the form may be employed. Soap may be used, and, if desired, lacquers, silicate of soda, kaolin, liquid rubber, paper pulp, and a variety of similar materials may be used. Further, it is possible with some materials that are applied to the form to make unnecessary the use of such separating materials.

The proportions of the vermiculite to the plaster may be varied considerably. We have found good results by using from 4 to 10 pounds of plaster to 1 cubic foot of vermiculite. Excellent results have been obtained with 7 pounds of conventional fibered plaster to 1 cubic foot of house insulation fill-type vermiculite.

The concrete aggregate, as already stated, may be of the light-weight type, such as pumice concrete aggregate, or may be of a heavier concrete type. There is no limitation as to the form of concrete which may be employed but in general practice we prefer to employ a light-weight concrete aggregate.

After the walls have been formed, and the structure placed upon the foundations, we prefer to apply a coating of paint suitable for concrete to the outer surfaces of the walls to exclude water.

To prevent internal condensation or dampness within the wall we prefer to apply an effective vapor barrier to the inside surface of the wall.

Any coating providing an effective vapor barrier may be employed. We have found that by spraying an aluminum powder pigment in combination with a Bakelite base or an asphaltic vehicle, that a highly effective coating for the inside wall surface is effected. The coated wall may then be painted or otherwise treated.

Specific examples may be set out as follows:

Example I

The outer surface of the inner steel form was sprayed with two coats consisting of one part grease and two parts of solvent. When the solvent evaporated, a very thin tenacious layer of grease remained on the form. A thin layer of plaster-vermiculite mix was then sprayed upon the grease-covered form to produce a one inch thick

layer. This plaster mix consisted of 1 cubic foot of vermiculite to 7 pounds of fibered plaster. Light-weight pumice concrete aggregate was then poured into the space between the two forms. After approximately 16 hours the walls had set and the forms were removed.

The plaster fell free from the greased panel as soon as the inner form was collapsed, and at the same time very little grease remained on the inner surface of the finished wall.

Example II

The process was carried through substantially as described in Example I except that prior to the applying of the plaster-vermiculite mix we applied a thin layer (approximately $\frac{1}{8}$ inch thick) to the greased surface by guniting. The mixture consisted of 57% fine pumice aggregate and 43% by weight of gauging plaster. When the inner form was collapsed, it was found that the inner surface was extremely smooth and attractive, while the entire wall formed an integrated material in which the thin layer was firmly united to the plaster-vermiculite layer and the latter layer firmly united to the concrete wall.

Example III

The process was carried through very much as described in Example I except that the inner surface of the outer form, after being greased, was gunited to deposit a white cement and fine silicate sand mix onto the greased surface. This material was deposited to a depth of $\frac{1}{16}$ to $\frac{1}{8}$ inch. A marble-like hard finish was produced on the outside of the concrete layer when the forms were removed.

Example IV

The inner form was sprayed with a soapy material to form a soap deposit thereon. A plaster mix consisting of 4 pounds of plaster to 1 cubic foot of vermiculite was gunited upon the soap-covered surface and the layer allowed to set. This took from one to two hours. The reinforcing was placed into position. The outer form was then brought into proper position with respect to the inner form and pumice concrete was poured into the space between the forms. The concrete aggregate was vibrated in vertical layers of about three feet each as the concrete walls was built up. After approximately twelve hours the concrete was found to set and the inner forms were collapsed. The outer forms were then removed.

Example V

The process was carried through as described in Example IV except that ground corn cobs were used in the place of vermiculite and the plaster consisted of approximately 15 pounds of plaster to 1 cubic foot of such ground corn cobs.

After the walls were formed and the forms were removed, a coating was applied to form a vapor barrier for the walls. The coating consisted of a Bakelite base with aluminum powder pigments.

Example VI

The process was carried through substantially as described in Example I to form a wall 6 inches thick composed of 5 inches of pumice concrete weighing 80 pounds per cubic foot (or approximately half the weight of conventional concrete) and 1 inch of light-weight vermiculite plaster weighing 2.5 pounds per square foot. The concrete was reinforced with steel mesh of 6 x 6 mesh composed of No. 6 wire. This wall was loaded

with sand bags in a manner to simulate the wind pressure produced by a hurricane of over 200 miles per hour. No cracks, permanent set or other evidence of structural failure were evident.

In the foregoing description we have set forth a few instances in which the wall structure is formed through the use of the spraying step in combination with the pouring or casting step. The two steps have been found to produce an integrated wall structure which is effective in itself as a suitable wall for a dwelling. It provides insulation, while at the same time being sturdy, and the entire wall is formed as one unitary structure. A transverse section of the finished wall shows the plaster body merging into the concrete body and the concrete merging into the cement finish layer with no distinct separation therebetween. There is no tendency for cleavage between these various parts of the wall, but instead it is impossible to separate the wall at such points of junction between these materials under tensile strength. The process is accomplished in an extremely brief time. By guniting the forms the layers thereon are built up quickly and the succeeding step in which the concrete aggregate is poured effects the desired union between these layers and the concrete. After the forms are removed, essentially no further finishing steps are required except for applying the material for creating the vapor barrier.

While in the foregoing specification we have set forth certain steps and structures in considerable detail for the purpose of illustrating embodiments of the invention, it will be understood that such details may be varied widely by those skilled in the art without departing from the spirit of our invention.

We claim:

1. A process employing spaced-apart inner and outer mold forms in the forming of a vertical building wall, comprising the steps of applying a coating of plaster to the outer wall of the inner form to deposit a plaster layer thereon, applying a cement and sand mix coating to the inner wall of the outer form to deposit a layer thereon, and filling the space between said forms with a concrete aggregate while vibrating the aggregate material directly and thereafter allowing the aggregate to set to form an integrated building wall.
2. The process of claim 1 in which said aggregate is vibrated at successive levels after being received in the space between said forms.
3. The process of claim 2 in which an adhesion-resisting coating is applied to the outer and inner walls respectively of said inner and outer forms prior to coating the same, and said plaster and said cement and sand mix are sprayed upon said walls of the forms.

References Cited in the file of this patent

UNITED STATES PATENTS

186,647	Weiland	Jan. 23, 1877
719,244	Mooney	Jan. 27, 1903
1,180,472	Clark	Apr. 25, 1916
1,472,516	Dula	Oct. 30, 1923
1,570,617	Copeman	Jan. 26, 1926
1,727,580	White	Sept. 10, 1929
1,747,555	Pelton	Feb. 18, 1930
1,789,791	Tonnessen et al.	Jan. 20, 1931
1,841,581	Garrett	Jan. 19, 1932
1,848,014	Horn	Mar. 1, 1932
2,000,409	Minutoli	May 7, 1935
2,018,192	Sexton	Oct. 22, 1935