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L. PULVERMANN.

# PROCESS OF AND APPARATUS FOR MANUFACTURING ARTIFICIAL STONE.

APPLICATION FILED SEPT. 21, 1906. RENEWED AUG. 17, 1907.

FIG. 1.

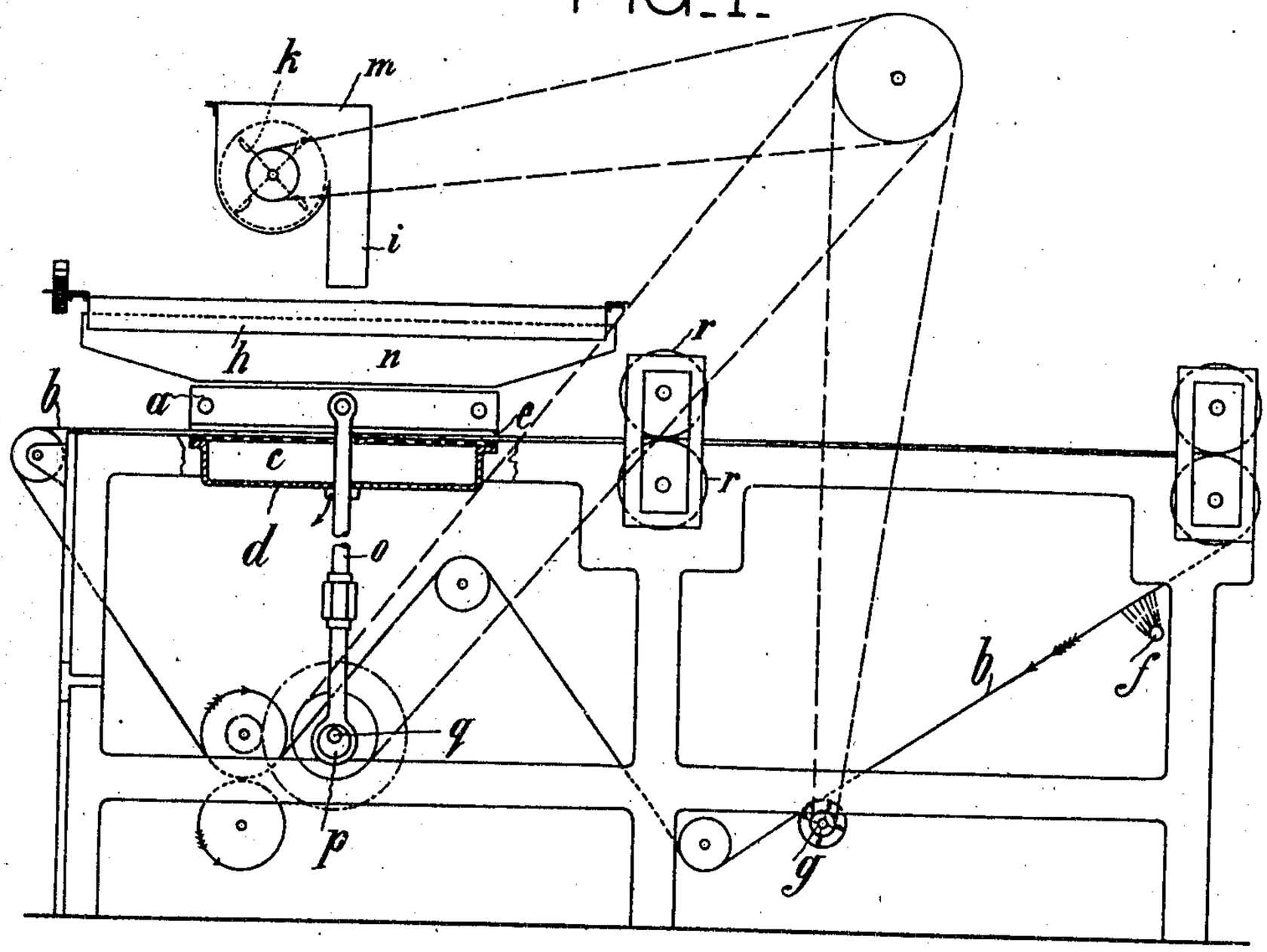



FIG. 3.

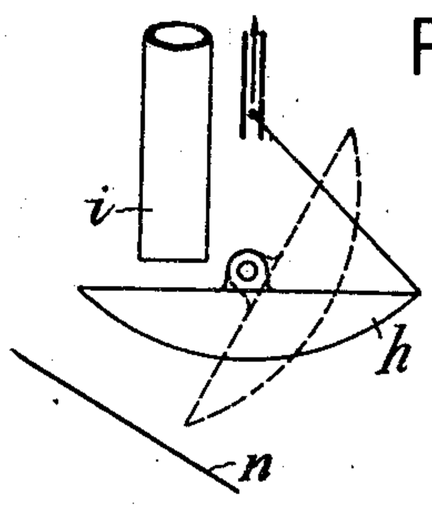



FIG. 4.

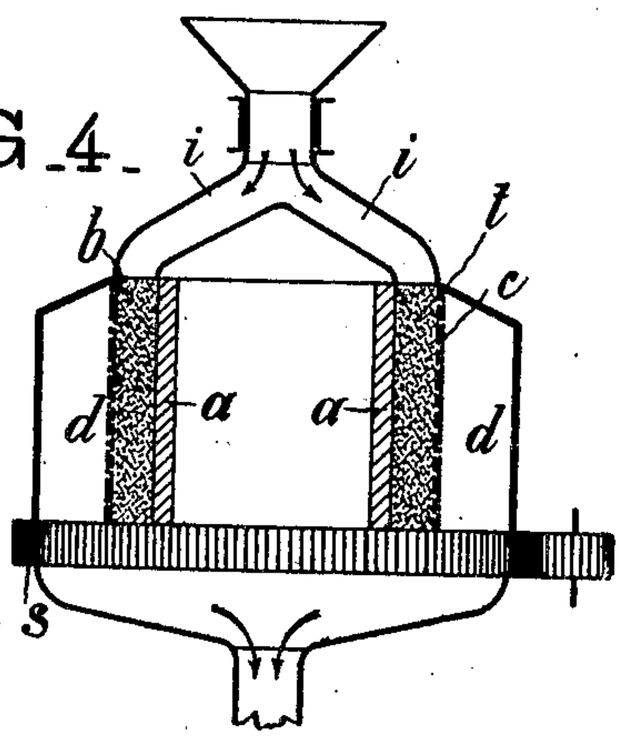
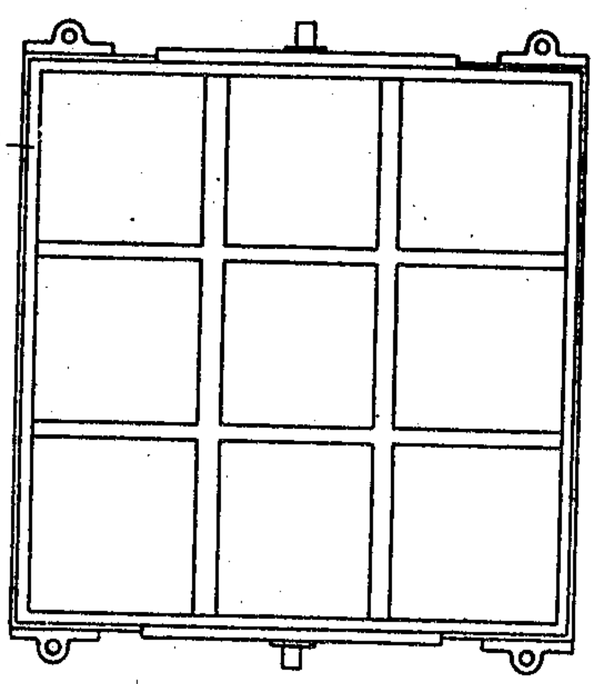



FIG. 2.

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# UNITED STATES PATENT OFFICE.

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## PROCESS OF AND APPARATUS FOR MANUFACTURING ARTIFICIAL STONE.

No. 871,524. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed September 21, 1906, Serial No. 335,564. Renewed August 17, 1907. Serial No. 389,077.

*To all whom it may concern:*

Be it known that I, LEO PULVERMANN, a subject of the King of Prussia, residing at 16 Gellertstrasse, Hamburg, in the Empire of Germany, have invented a new and useful Improved Process of and Apparatus for Manufacturing Artificial Stone, of which the following is a specification.

My invention relates to an improved process of and apparatus for manufacturing artificial stone.

In the manufacture of artificial stone, either in the form of slabs, or in the form of pipes or the like, it has been customary to intimately mix asbestos with cement by treatment in the rag engine, and to conduct the mixture, to which water is added, to a paper-making machine, upon the forming cylinder of which the material passes gradually, in order to be transported to a machine for cutting the same to the form of a slab or the like, and then to the hydraulic press. This well-known process was recently improved, it is alleged, by using large quantities of water in mixing asbestos and cement, with the object of achieving a particularly intimate union of these materials. The cement was partly decomposed, separated silicic acid as a gelatinous mass, and was in this manner to be adapted for the taking up and holding of larger quantities of fibrous material. This process has, however, not been used successfully in practice, because the admission of large quantities of water is dependent on cumbrous and expensive apparatus, and the alleged advantages of the more intimate mixing bear no comparison with such an expenditure in view of the insignificant result.

If it be necessary, for introducing 300 kilograms of asbestos and cement, to work with quantities of water amounting to 30000 to 45000 liters in order to obtain only about 400 kilograms of the mixture at the forming cylinder of the paper making machine, this result shows the process to be uneconomical. Such a small output may suffice in the case of a more valuable final product, for instance paper, but not a common slab of artificial stone. Furthermore, these large quantities of water either cause losses of material or necessitate the arrangement of pulp strainers, centrifugal pumps and other expensive and complicated apparatus, in order to recover the stuff running off the paper making machine with the waste water, and to convey the same back to the vat by an extensive system of channels and pipes.

It may moreover be mentioned that with the known process wherein the paper making machine is employed it is requisite to arrange a special mixing apparatus between the vat and the machine, such apparatus being designed to mix the material so as to obviate irregularities on the machine. This shows sufficiently the complicated construction of the paper making machine; but it may be pointed out that the use of cement on such a machine renders it necessary that the stuffing boxes of the bearings should be easily exchangeable, and that mixers and movable sprinkling pipes should be provided. Owing to the soiling and obstruction of the sieves, the sieve cylinders have to be changed once a day, which again is not possible without the inconvenience of raising the entire filtering part; the expensive filters, too, must often be replaced. As however the paper making machine does not supply the slabs ready to be pressed, it was needful to arrange between the machine and the press a cutter on which the slab is laid and divided so as to obtain the right sizes of slabs. But as the material is deposited upon the paper making machine in layers having their fibers directly parallel, and obtains a lamelliform texture, it would be liable to injury by the detachment and separation of the several layers in the transport from the forming cylinder to the cutter. Artificial stones have also been produced from asbestos or similar fibrous materials and cement or other hydraulic binding medium by a process in which the water is removed from the mixture of asbestos and cement by the application of a very high pressure with the aid of a strong mold whose walls are provided with holes and channels and covered with a wire sieve, the pressure applied amounting to about 15000 lbs per sq inch. After the removal of the material from the mold, pressure may be again applied to the material between heavy metal dies with a view to obtaining smooth surfaces.

Another known process consists in mixing the cement with more than sufficient water to insure complete hydration and sufficient to prevent setting when stirred, introducing the same mixed with filling materials into a mold provided with sieves, and then subjecting it to pressure, preferably in a hydraulic press, a pressure of about 200 lbs per sq. inch giving good results.

It has been found that the application of a high pressure in solid molds for the removal of the water gives rise to obstruction both of the admission and discharge channels, thus rendering the working uncertain, and also to cause dissociation, that is to say, the separation of the cement from the asbestos fibers, the holes or channels furnished in the sides of the mold failing to provide for the proper escape of the water to the outside under the high pressure. The sieve allows the escape of a comparatively large amount of material, and is liable to become clogged up, as is likewise the case with the sieve cylinder in the paper-making machine. In the removal of the wire sieve from the stone the particles of asbestos and cement often adhere to the sieve, so that no smooth surfaces are obtained. It will also be understood that the molds required in great number for such high pressures are of necessity very heavy and therefore expensive; furthermore, articles of large dimensions would necessitate the employment of an hydraulic press of enormous cost, and the working expenses would also be very considerable, so as to preclude the working on an industrial scale.

My said invention, which has for its object to obviate all these drawbacks in the simplest manner, is based upon the utilization of the well-known property of one of the ingredients of the mixture, that is to say the asbestos fiber, of being an excellent filtering medium, in order to separate the liquid ingredients without loss of material and at the same time to shape the solid parts of the desired form. For this purpose the mixture of asbestos and cement, without the use of the large quantities of water, is brought in the well-known manner to a state of the finest division, and is immediately conducted to a filter press, filtering drum, suction filter or other suitable filtering apparatus.

The whole working is exceedingly simple and sure, and the wear is very slight.

By the employment of the filtering apparatus I gain the following advantages: The filter is an apparatus which may be operated by any common workman; it has no parts which are subject to rapid wear; and it may be easily taken to pieces and cleaned.

The employment of a filtering apparatus enables all the liquid ingredients to flow off clear, and obviates the loss of any material, as the solid parts are kept back by the asbestos filter that is being formed. Whereas the application of the paper-making machine renders it necessary to use very large quantities of water, it is possible by the employment of the filtering apparatus to reduce the quantity of water to about the fourth or fifth part. Of course, the more water is added to the mixture the more has to be removed again in order to obtain the product which contains little water. In this respect, too, the employment of the filter renders the process more economical.

From the filter the stones are removed in their final shapes, in which they are to be brought into the market.

Owing to the use of the filtering apparatus, the deposition of the material does not take place so as to produce a loose lamelliform texture, as is the case on the paper-making machine, but so as to form a felted texture. The sinewy asbestos fibers, carried away by the stream running through the filter are deposited above and beside one another in all directions and thus form a network with meshes of a suitable width, and also a soft abutment which allows the free passage of the liquid, but retains the suspended ingredients. By this means a more intimate deposition of the fibers in the cement will take place and the texture will be more firm.

It should also be mentioned as an advantage that night work is done away with by the employment of the filtering apparatus in the process of manufacturing artificial stone. When using the process carried out by the paper making machine the night work is necessary in order that the material deposited in the reservoirs which draw up the particles of stuff running from the machine may not set or congeal over-night. All these drawbacks are obviated in the case of the filtering apparatus, because here the complete formation of stone takes place in the filter itself, and no valuable material is liable to escape. Thus the filtering apparatus performs at the same time the following three functions, viz. (1) the separation of the valuable solid ingredients from the excess of water; (2) the felting of the asbestos fibers; (3) the shaping of the stone both in length and width.

The employment of the filtering apparatus has the further advantage that the mass of artificial stone may be quite finished in the filter and that the hydraulic press may be entirely dispensed with. In this manner the cost of the plant and working is considerably reduced, and the manufacture is simplified to an enormous extent.

For carrying out the older process it is necessary to employ (1) a rag engine; (2) a vat; (3) mixing apparatus; (4) a paper-making machine with depositing basins; (5) cutters for dividing the slabs; (6) hydraulic press plant, and (7) a store and setting room. On the other hand, for carrying the improved process into practice, use is made of (1) a rag engine; (2) a vat; (3) a filter and (4) a store and setting room.

With an equal output the reduction of the cost price amounts to nearly forty per-cent for a set of machinery, the saving in wages amounts to nearly thirty-eight per cent. This alone shows the great superiority of the new process over the old one.

In the improved process about 75 kilograms of asbestos and 450 kilograms of a slowly setting cement are placed in a rag engine filled with about 3½ cubic meters of water and in which the mixing takes place. From there the mixed material is conducted to the vat, in which by the addition of the slight quantity of water, say about 2½ to 3 cubic meters, a dilution of the mixture is effected in the well known manner. From that moment no more water is added. This mass is conveyed to the filtering apparatus. The filter may be of any dimensions, so that one rag engine may serve for producing stones of various sizes in the several filters. The operation of the filtering apparatus takes place in the customary manner.

The mixture of asbestos and hydraulic binding agents, which has been prepared in the manner set forth, is periodically introduced by suitable feeding devices into the filtering apparatus which, in the constructional form preferably employed, comprises a mold for the stone material, a movable endless apron and a dehydrating suction vessel, so that the filtration may take place at a slight pressure or by suction. This apparatus enables the manufacture of artificial stones in the form of slabs, tubes or the like to be accomplished in a very simple and exceedingly rapid way.

For the manufacture of artificial stones use has already been made of apparatus having a molding box and wire sieve. Such apparatus, wherein the water is expressed from the stone material by high pressure and in certain cases drawn off by means of an air pump, has the drawback that the disposition of the fibrous and cement particles in layers takes place in a disadvantageous manner, the stones are liable to adhere to the wire sieve, and the latter gets soiled and clogged up. With the filtering apparatus, on the other hand, the entire filtering process takes place at a very slight pressure with the aid of suction air, which, besides insuring the advantageous disposition of the fibers and the proper felting, has also the advantage that the stones are well defined at the walls of the mold and may be easily separated therefrom. The employment of the movable endless apron renders the rapid and rational working feasible, because the filter cloth has not the bad qualities of a wire sieve, but enables a perfect filtration to be achieved.

The periodic movement of the filter cloth in conjunction with the similar movement of the mold arranged to be raised and lowered, and of the feeding device which is adapted to be tilted permits of the manufacture of stones in great numbers, provision being made for the stone material to be introduced in a continuous manner. In this case the feeding device adapted to be tilted effects the change from the continuous introduction of fresh stone material to the periodical formation of stone.

In the accompanying drawings I have represented a constructional form of the apparatus designed for working the improved process.

Figure 1 is a diagram showing the apparatus as used for the manufacture of slabs. Fig. 2 shows the molding box on an enlarged scale. Fig. 3 is a diagram showing the mode of feeding the material. Fig. 4 shows the mold used in this apparatus for the manufacture of tubes and tubular bodies.

As represented in Fig. 1, a mold *a* is arranged above an endless filter cloth *b*, which bears below the said mold upon a filter plate *c* joining a suction chamber *d*. This suction chamber is connected by a tube with an air pump or the like. Between the mold *a* and the filter cloth *b* I arrange a rubber frame *e* designed to make a tight joint. Behind the mold the endless filter cloth *b* is guided between rollers, and below the frame over guide rolls. At a suitable place on the return path of the filter cloth, I may provide spray pipes *f* and a beater *g* for cleaning the cloth. By appropriate subdivision the mold *a* may be made to comprise a plurality of compartments for the simultaneous manufacture of several stones (Fig. 2).

Above the mold *a* is arranged a tilting box *h* into which the material prepared by a stirring device *k* in the feeding or filling trough *m* can pass through a tube *i*. A plate *n* provided below the box *h* allows the material to pass from the tilted box into the mold *a*. Rods *o* fixed to the sides of the mold are connected by eccentrics *p* to a driving shaft *q*. The stones are made by allowing the material prepared in the trough *m* to flow through the tube *i* in a continuous stream into the box *h*, which on being tilted (as indicated in dotted lines Fig. 3) allows the material to pass over the plate *n* into the mold *a*. Just at this moment the mold is moved downwards by the eccentrics *p* and draw rods *o*, and together with the rubber frame *e*, pressed firmly upon the filter cloth *b* and chamber *d*. The periodic movement of the filter cloth is so timed that the filter cloth will stop at this moment. At the same time a vacuum is produced in the chamber *d*, so that the filtration takes place and the material introduced into the mold *a* will be dehydrated, felted and molded. Then the mold *a* is caused by the eccentrics *p* and rods *o* to move upwards, liberates the filter cloth with the molded stones to be conveyed along by the rollers *r*, and is ready to be filled again from the box *h*. By the continuous flow through the tube *i* the mold is filled once more, the same operation being then repeated.

For the manufacture of tubes and tubular bodies the mold *a* constitutes a cylinder ar-

ranged vertically upon a support *s* which is preferably arranged so that it can be turned (Fig. 4). The space for the reception of the stone material is defined or separated by the endless filter cloth *b* and the cylindrical sieve support *c*. Behind the latter is the cylindrical suction chamber *d*. A feeding or filling device with tubes *i* is provided above the cylindrical mold, and a plate below the support *s* serves for the removal of the water of filtration. Through the tubes *i* the stone material passes into the cylindrical mold *a*, and is dehydrated by the production of a vacuum in the chamber *d*, so that the mixture will become felted and molded. The felting will be improved, if the support *s* is turned during the dehydration, so that the fibers will be suitably laid. This improved disposition of the fibers is due to the fact that the turning movement stops the action of the materials, which, through dropping down vertically by gravity, tends to separate the felted asbestos fibers and particles of cement and to cause the dissociation of the ingredients of the mixture. Such a turning movement is extremely useful (especially in the case of large tubes), if in the course of the filtration a thick layer has already formed upon the surface of the filter cloth and the suction is already on the decline. Then the turning movement effects a certain equalization and a thorough felting of the whole mixture.

Instead of arranging the cylindrical chamber *d* exteriorly, and the cylindrical mold interiorly, as represented in Fig. 4, the inner space may also constitute the chamber *d* for the dehydration by a vacuum, the outer annular space forming the mold *a*. The latter arrangement resembles that of a drum filter, with which the process may likewise be carried into effect. Otherwise the manipulation of the tubular mold is exactly the same as that of the square or rectangular mold, only in the former case the endless filter cloth, in conformity with the nature of the body, is raised together with the molding box. Then the stone is removed, and the suction and feeding or filling are repeated.

It will be understood that, besides the suction filter hereinbefore described, any other suitable filtering apparatus may be employed for carrying out my process, such as for instance filtering drums, filter presses, and the like.

In lieu of asbestos, use may also be made of other fibrous materials having similar filtering properties, such as glass wool.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The hereinbefore described method of manufacturing artificial stone consisting in dehydrating, felting and molding a mixture of asbestos, hydraulic cement and a small quantity of water by using the filtering properties of the asbestos of the mixture to assist in the retaining of all the solids of the mixture while permitting the escape of the waste water.

2. Filtering apparatus for the purpose specified comprising a filter-cloth, means for moving the filter-cloth, a mold adapted to bear upon the filter-cloth, and a dehydrating chamber in communication with the mold.

3. Filtering apparatus for the purpose specified, comprising an endless filter cloth adapted to be moved periodically, a mold adapted to bear upon the filter cloth and to be raised therefrom, and a dehydrating chamber in communication with the mold.

4. Filtering apparatus for the purpose specified, comprising an endless filter cloth adapted to be moved periodically, a mold adapted to bear upon the filter cloth and to be raised therefrom, and a rubber frame adapted to form a tight joint between the mold and the filter cloth.

5. Filtering apparatus for the purpose specified, comprising an endless filter cloth adapted to be moved periodically, a mold adapted to bear upon the filter cloth and to be raised therefrom, a dehydrating chamber and a filter plate placed between the latter and the filter cloth.

6. Filtering apparatus for the purpose specified, comprising an endless filter cloth, means for periodically moving said cloth, a mold adapted to bear upon the filter cloth, means for periodically moving this mold up and down, a dehydrating chamber in communication with the mold, and means for producing a suction in such chamber.

7. Filtering apparatus for the purpose specified, comprising an endless filter cloth, means for periodically moving said cloth, a mold adapted to bear upon the filter cloth, means for periodically moving this mold up and down, a dehydrating chamber placed below the said filter cloth, a box arranged above the mold and adapted to be tilted, and an inclined plate arranged between the said box and mold.

8. Filtering apparatus for the purpose specified, comprising an endless filter cloth, means for periodically moving said cloth, means for spraying this cloth and means for beating the same, a mold adapted to bear upon the said filter cloth, means for periodically moving this mold up and down, and a dehydrating chamber arranged below the filter cloth opposite the said mold.

9. Filtering apparatus for the purpose specified, comprising a filter cloth adapted to be moved periodically, a mold adapted to bear upon the filter cloth and to be raised therefrom, a dehydrating chamber arranged opposite the said mold and below the filter cloth, a tilting box placed above the mold,

an inclined plate arranged between the tilting box and mold, a trough provided above the tilting box, a tube depending therefrom, and an agitator arranged in said trough.

10. Filtering apparatus for the purpose specified comprising a filter-cloth, means for moving the filter-cloth, a multiple mold adjacent to the filter cloth for forming a plurality of articles at the same time and a dehydrating chamber in communication with the mold.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LEO PULVERMANN.

Witnesses:

ERNEST H. L. MUMMENHOFF,

HUGH PITCAIRN.