E. SPRENGER.

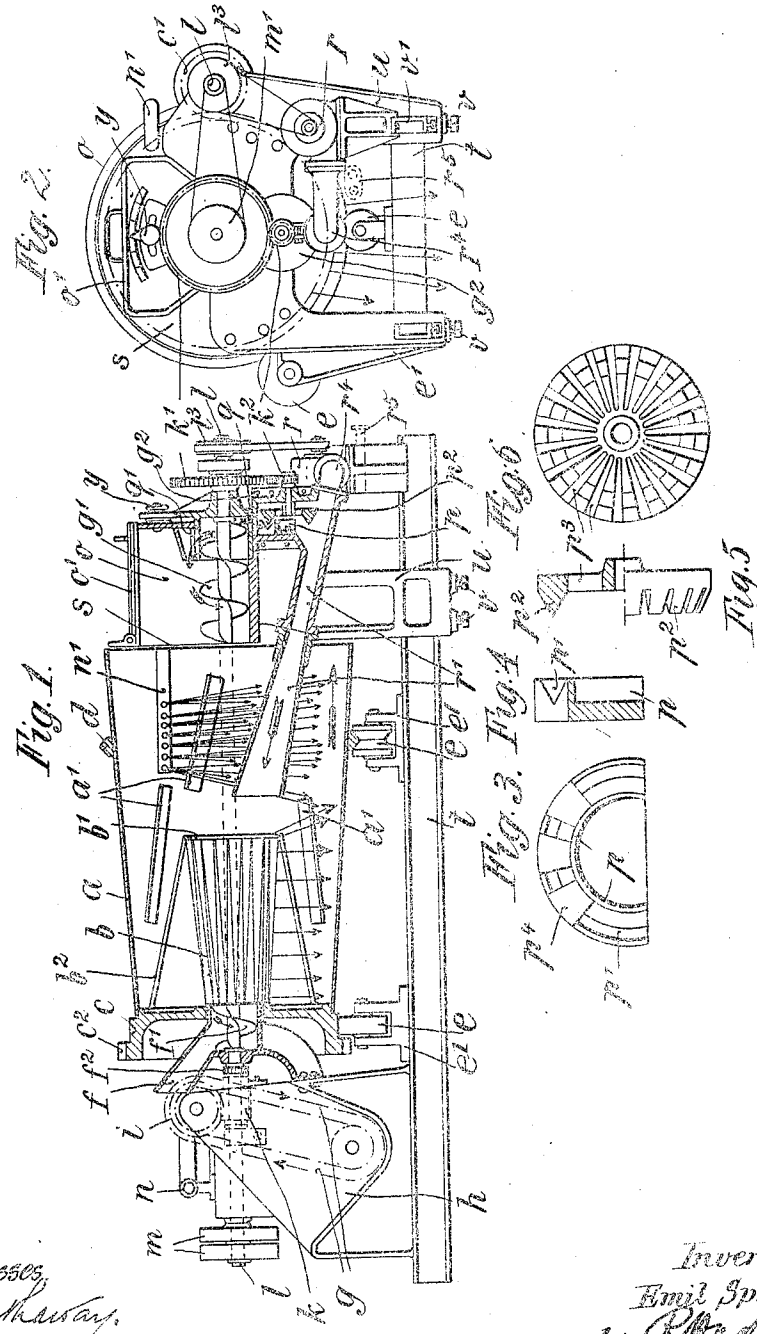
MIXING MACHINE.

APPLICATION FILED JUNE 30, 1911.

1,057,589.

Patented Apr. 1, 1913.

3 SHEETS—SHEET 1.



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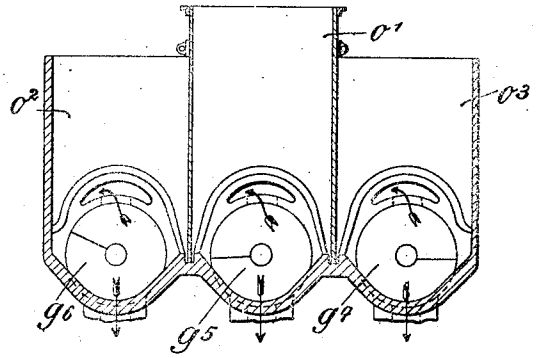


Fig. 11

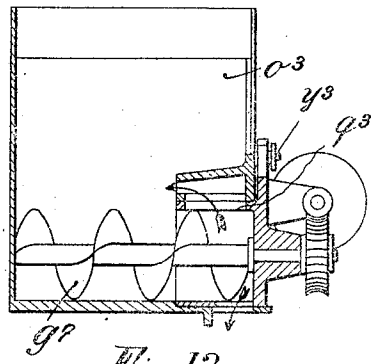


Fig. 12.

Fig. 13.

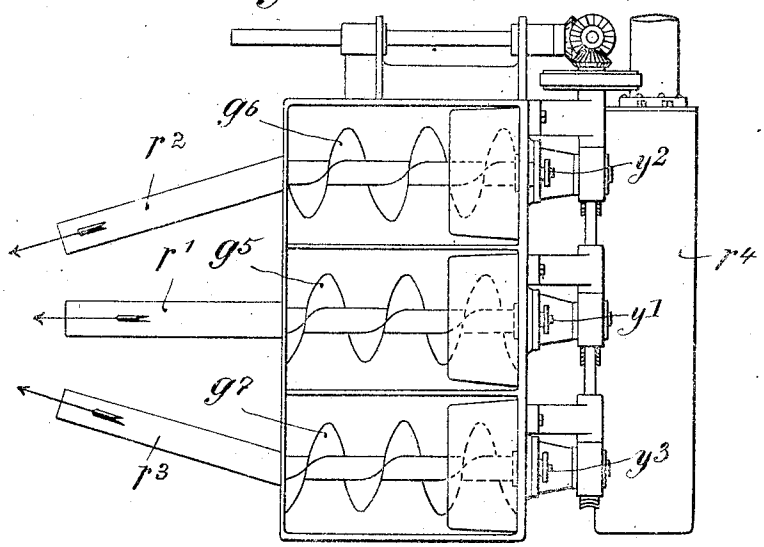
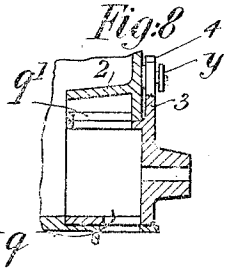


Fig. 7.

Fig. 8



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3 SHEETS—SHEET 3.

Fig. 9.

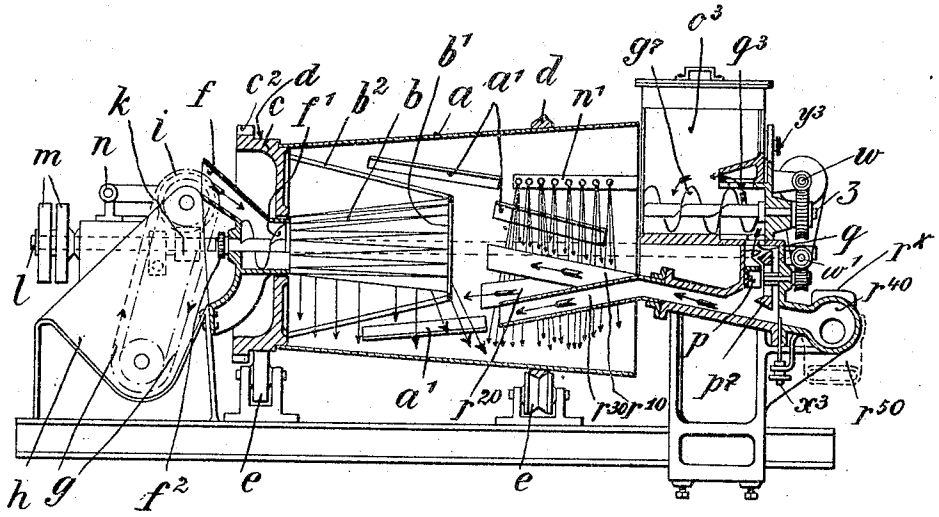
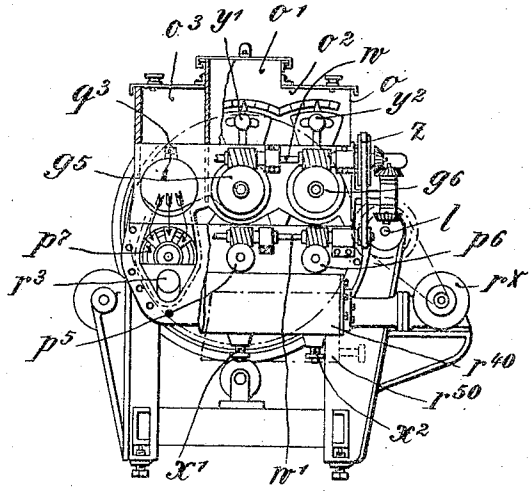


Fig. 10.



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UNITED STATES PATENT OFFICE.

EMIL SPRENGER, OF GOLDACH, SWITZERLAND.

MIXING-MACHINE.

1,057,589. Specification of Letters Patent. Patented Apr. 1, 1913.

Application filed June 30, 1911. Serial No. 636,249.

To all whom it may concern:

Be it known that I, EMIL SPRENGER, a citizen of the Swiss Republic, residing at Goldach, Canton of St. Gall, in Switzerland, have invented a certain new and useful Improvement in Mixing-Machines, of which the following is a specification.

The object of this invention is to provide efficient and easily controlled apparatus for mixing granular matter with binding agents, coloring matter and other substances (which may be likewise granular, or liquid) by the method of sifting the primary granular matter, so as to separate granules of different degrees of fineness, and at the same time subjecting it to the action of a stream or streams of the admixture, delivered in such manner that the periods during which the granules are exposed to the stream vary according to the size of the granules, the granules with larger surface area being exposed to the stream for longer periods than the smaller granules, so that a uniform and thorough mixing effect is obtained. Examples of substances which can with advantage be dealt with in this manner are sand, ground slag, saw-dust, cork and the like (primary granular substances), with admixtures such as cement, lime, gypsum and the like, with or without added coloring matter, the mixtures being for example used for the manufacture of concrete, artificial stone, compositions for use as substitutes for wood etc., in connection with which the qualities of strength, durability, uniformity of setting and the like are largely dependent on the thoroughness and uniformity of the mixing process and the accuracy with which the proportions of the ingredients are measured.

In general I feed the primary granular material to the sifting apparatus in a wet state, in order to secure the highest qualities of binding strength, as for example in making mixtures of lime and sand. In the case of the mixers for similar materials heretofore used, thoroughly uniform mixtures can only be obtained with dry materials, and it is one of the objects of my invention to enable efficient and uniform mixing to be carried out with wet granular materials.

The invention is illustrated in the accompanying drawing, in which:—

Figure 1 is a longitudinal section of a machine for mixing a primary granular substance with another granular substance, and Fig. 2 is a view thereof, seen from the right hand end of Fig. 1. Figs. 3 to 6 are views, on a larger scale, of a grinding appliance used in the machine illustrated, Figs. 3 and 4 being respectively an elevation and a cross section of one of the members, and Figs. 5 and 6 being respectively a side-view, partly in section, and an axial view, of the other member. Figs. 7 and 8 are views, on a larger scale, of the mechanism controlling the feed of material to the said grinding appliance, Fig. 7 being an elevation of a rotatable valve, viewed from the left hand side of Fig. 1, and Fig. 8 a cross-section of the said valve within its shell. Fig. 9 is a longitudinal section of a machine which is exactly similar to that shown in Figs. 1 and 2, in regard to the mixing drum and the feed and sifting appliances for the primary granular substance, but which has apparatus for separately injecting several kinds of granular admixture; Fig. 10 is a view of the machine shown in Fig. 9, partly in section, viewed from the right hand end. Figs. 11 to 13 are views of mechanism for feeding the several kinds of granular admixture to the grinding mechanism of the machine shown in Figs. 9 and 10, Fig. 11 being a section of the containers from which the admixtures are fed, Fig. 12 a section perpendicular to the plane of Fig. 11, and Fig. 13 a plan view of the said containers.

Referring in the first place to Figs. 1 and 2, the apparatus illustrated comprises a rotary drum *a* forming the mixing chamber, coned and provided with runners *d* by means of which it rests upon rollers *e* mounted in bearings e^1 on a bed-frame *t*. The conical shape of the drum is not essential to the invention; a cylindrical drum or a drum of polygonal cross-section may be used. The drum has at one end a fixed head *c*, and is open at the other end, where it fits closely around a non-rotatable wall *s*. The head *c* has a central aperture, from the circumference of which a tubular sifting device *b* projects into the interior of the drum. This device, consisting of bars placed longitudinally side by side, is flared toward the interior, so that the apertures between the bars gradually widen toward the interior of the drum, where they are joined to a ring b^1 supported by stays b^2. A feed nozzle *f* terminates in the aperture of the head *c*, and contains a feed-worm f^1 actuated by the laterally disposed driving shaft *l* and chain

gear f^2, for feeding the primary granular material through the nozzle into the tubular sifter, so that during the rotation of the drum the granules fall between the bars of the sifter, as indicated in Fig. 1 by arrows, the larger granules being retained in the sifter longer than the smaller granules, as they must advance till the gaps between the bars become sufficiently wide to give them passage. The drum has internal ribs a^1 forming auxiliary mixing appliances by which the granular matter is carried upward from the bottom of the drum, and then dropped.

Close to the wall s, outside the drum, is fixed a container o, with hinged cover o^1, for granular matter to be mixed with the primary granular matter fed at the other end into the sifter. This secondary granular matter, which I will call the admixture, is fed by a worm g^1 in the container to a delivery orifice controlled by a rotary valve q (Figs. 7 and 8) which works in a shell 2 formed in the container and can be fixed by means of a screw y passing through a slotted projection 3 of the valve into the wall of the container. The projection 3 has a pointer 4 indicating the position of the valve. In addition to a hole at the bottom, for the passage of the admixture to the delivery orifice of the container, the valve has a hole at the top, through which the excess of granular material, choked back from the delivery orifice, passes through a hole q^1 in the shell back to the container o.

Below the delivery orifice of the container there is a grinder p, the purpose of which is to disintegrate such portions of the admixture as may be too coarse for efficient mixing. It will be understood that this grinder is not essential if the admixture is already in a uniform, sufficiently fine condition. The grinder comprises a fixed member of semicircular outline, with a groove p^1 of V-shaped cross-section near its circumference, and with several gaps p^4 at its upper part. The rotary member of the grinder is of circular outline, with teeth p^2 at its circumference, adapted to work in the groove p^1. The rotary member has apertures p^3. The granular admixture falls into the gaps p^4 and finds its way through the grinder between the teeth and the walls of the groove p^1, being reduced to the requisite degree of fineness by the action of the teeth. During this grinding action the material is subjected to a stream of air delivered by a blower r through a pipe r^4 into a blow-pipe r^1, which extends into the drum toward the inner end of the tubular sifter b. The air sweeps through and under the grinder p, and carries the granular or powdered admixture into the drum. A heating appliance r^5 is provided, enabling the air to be heated in the pipe r^4; steam or liquid or solid fuel may be used for this purpose, and in the making of a mixture for the manufacture of cement the setting quality of the cement may be to a very large extent, regulated by regulating the heating of the admixture.

The stream of air-borne admixture sweeps through the drum and along the sifter, and acts longest, by direct impact, on those portions of the primary granular which are longest retained in the sifter. Inside the drum the mass tumbled about by the mixing appliances a^1, is still acted on by the residual free admixture blown into the drum, and granules of different sizes separated by the mixture are again mixed together.

The shaft l carries loose and fast pulleys m for a driving belt, enabling the machine to be driven by a motor, but the construction described is also suitable for small, manually driven machines. The primary granular matter is fed to the nozzle f from a trough h, by means of a bucket conveyer g actuated by the shaft l and worm gear k i. The feed worm g^1 is driven by the shaft l and a belt and pulley m and the spindle of the grinder p, having bearing in a cover g^2, is actuated by this worm by means of gear wheels k^1, k^2. The blower r is actuated by the shaft l by means of a belt and pulley l^2. The drum itself is rotated by means of a toothed wheel c^1 on the shaft, meshing with a rack c^2 on the drum.

The primary granular matter in the trough h may be moistened with water from a pipe n and the mixture in the drum may be sprayed with water from a perforated pipe n^1. Liquids other than water may be applied in this manner, for example coloring matter in solution, or solutions such as are used as admixtures in the manufacture of cement.

The blower, grinder and container o are carried by a frame u which is fixed to the frame t by means of screws v and can be removed from the latter, after unfastening the screws, in order to give access to the open end of the drum.

With some admixtures it is of advantage to use steam instead of air, as a carrier therefor, in which case the blower is disconnected and a steam pipe is joined to, or inserted into, the pipe r^4, similarly a pump nozzle may be inserted into the said pipe r^4 for supplying admixtures in a liquid state, in the form of spray.

The apparatus described works with a perfectly regular action, which can be adjusted, as regards speed and rate of feed, etc., so that the mixing process is entirely independent of the skill and attention of the persons in charge of the machine. This automatic regulation of the proportions is particularly desirable in cases where several admixtures are to be used, and Figs. 9 to 13 show appa-

ratus for injecting three different admixtures, the supply of each being automatically regulated. The drum, sifter and parts directly accessory thereto being exactly similar to those shown in Fig. 1, the same references are used for these parts in Fig. 9. The admixture apparatus in this case has three containers, marked o^1, o^2, and o^3, and in the following description it will be assumed that these are used, in the order enumerated, for Portland cement, slag cement and hydraulic lime respectively. The ingredients are fed by worms g^5, g^6 and g^7 to grinders p^5, p^6 and p^7, these grinders being similar in construction to the grinder described with reference to Figs. 3 to 6. The blower r^x delivers air through a pipe r^{40} to three pipes r^{10}, r^{20} and r^{30}, provided with valves x^1, x^2, x^3 for regulating the currents of air, the latter heated by a heater r^{50}. The feed of the admixtures to the grinders is regulatable by valves q^3 similar to the valve shown in Figs. 7 and 8, and these valves can be fixed, after adjustment, by means of screws y^1, y^2, y^3.

The feed worms g^5, g^6, g^7, are actuated by means of a worm shaft w, and the grinders are actuated by a worm shaft w^1, these two shafts being geared to each other by means of a belt z, and the shaft w being driven by bevel gear from the main shaft l.

The pipe r^{10} delivers Portland cement directly on to the primary granular matter rolling upon the bars of the sifter b, the finest ground, and therefore most valuable, particles of the cement being those which reach the sifter and there mingle with the primary granular matter, penetrating the interstices and thoroughly enveloping the granules. Coarser particles of the Portland cement fall to the bottom of the drum before reaching the sifter.

The pipe r^{20} delivers a stream of slag cement to the granular matter, already enveloped with Portland cement, falling through the apertures of the sifter, this stream being directed so that it acts on the granules immediately after they leave the sifter. Coarser particles of slag cement fall to the bottom of the drum before reaching the sifter.

The stream of hydraulic lime emitted by the pipe r^{30} strikes the falling primary granular matter at a level below the stream of slag cement, so that falling granules receive a layer of the finest particles of hydraulic lime, superimposed upon the layer of slag cement, which has in turn been superimposed upon the layer of Portland cement. The coated granules are mixed, in the drum, with the coarser particles of Portland cement, slag cement, and hydraulic lime which have fallen to the bottom of the drum before reaching the sifter.

When the most suitable proportions of ingredients for any particular purpose have once been determined, by practice, the valves can be adjusted for these proportions, and the operation is then, as regards the proportions, wholly independent of intervention on the part of the workmen in charge of the machine. Tables can be made, setting forth the proportions suitable for different purposes and different materials, and the adjustment of the valves can then be made according to such tables.

With suitable modifications, all within the scope of the subjoined claims, the machine may be constructed with an inclined or vertical drum.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. A mixing machine comprising a mixing drum, a sifter in said drum, means for feeding a primary granular material across the sifting surface of said sifter, the apertures in said surface increasing in size with their distance from the feed end of the sifter, and means for projecting a stream of finely divided admixture over said sifting surface in a direction opposed to the direction of feed of said primary granular material.

2. A mixing machine comprising a revolving mixing drum, in said drum a revolving sifting drum, means for feeding granular material into said sifting drum, the perforations in said sifting drum increasing in size with the increase of their distance from the entrance of said material, and means opposite to the discharge end of said sifting drum for spraying an admixture in a finely divided state over the granular material graded and rolling along in said sifting drum, and around said sifting drum into the sifted material falling through the perforations thereof.

3. A mixing machine comprising a mixing drum, a sifter in said drum, means for feeding a primary granular material across the sifting surface of said sifter, the apertures in said surface increasing in size with their distance from the feed end of the sifter, and means for simultaneously projecting a plurality of streams of finely divided admixtures over said sifting surfaces in a direction opposed to the direction of feed of said primary granular material.

4. A machine for mixing granular materials with a plurality of finely divided admixtures, consisting of a revolving mixing drum, in said drum a revolving sifting drum, means for feeding the granular material into said sifting drum, the perforations in said sifting drum increasing in size with the increase of their distance from the entrance of said granular material, and means opposite to the discharge end of said sifting drum for spraying the several admixtures simultaneously in a finely divided

state over the material graded and rolling along in said sifting drum.

5. A mixing machine comprising a mixing drum, a sifter in said drum, means for feeding a primary granular material across the sifting surface of said sifter, the apertures in said surface increasing in size with the increase of distance from the feed end of the sifter, a blower, and a grinder for admixing material, having an apertured revolving grinding member disposed in the path of the blast from said blower so that material finely divided for admixing purposes by said grinder is carried by said blast over said sifting surface, in a direction opposed to the direction of feed of the primary granular material.

6. A mixing machine comprising a mixing drum, a sifter in said drum, means for feeding a primary granular material across the sifting surface of said sifter, the apertures in said surface increasing in size with the increase of distance from the feed end of the sifter, a feed chamber for admixing material, a feed worm for expelling said admixture from said chamber, a rotary valve surrounding the delivery end of said feed worm and having a regulatable delivery passage and a regulatable passage through which material choked back from said delivery passage is forced by the worm back into said chamber, and a blower disposed so that the blast therefrom carries a stream of the admixture over said sifting surface, in a direction opposed to the direction of feed of the primary granular material.

In witness whereof I have signed this specification in the presence of two witnesses.

EMIL SPRENGER.

Witnesses:
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ALBERT PHILLIPS.