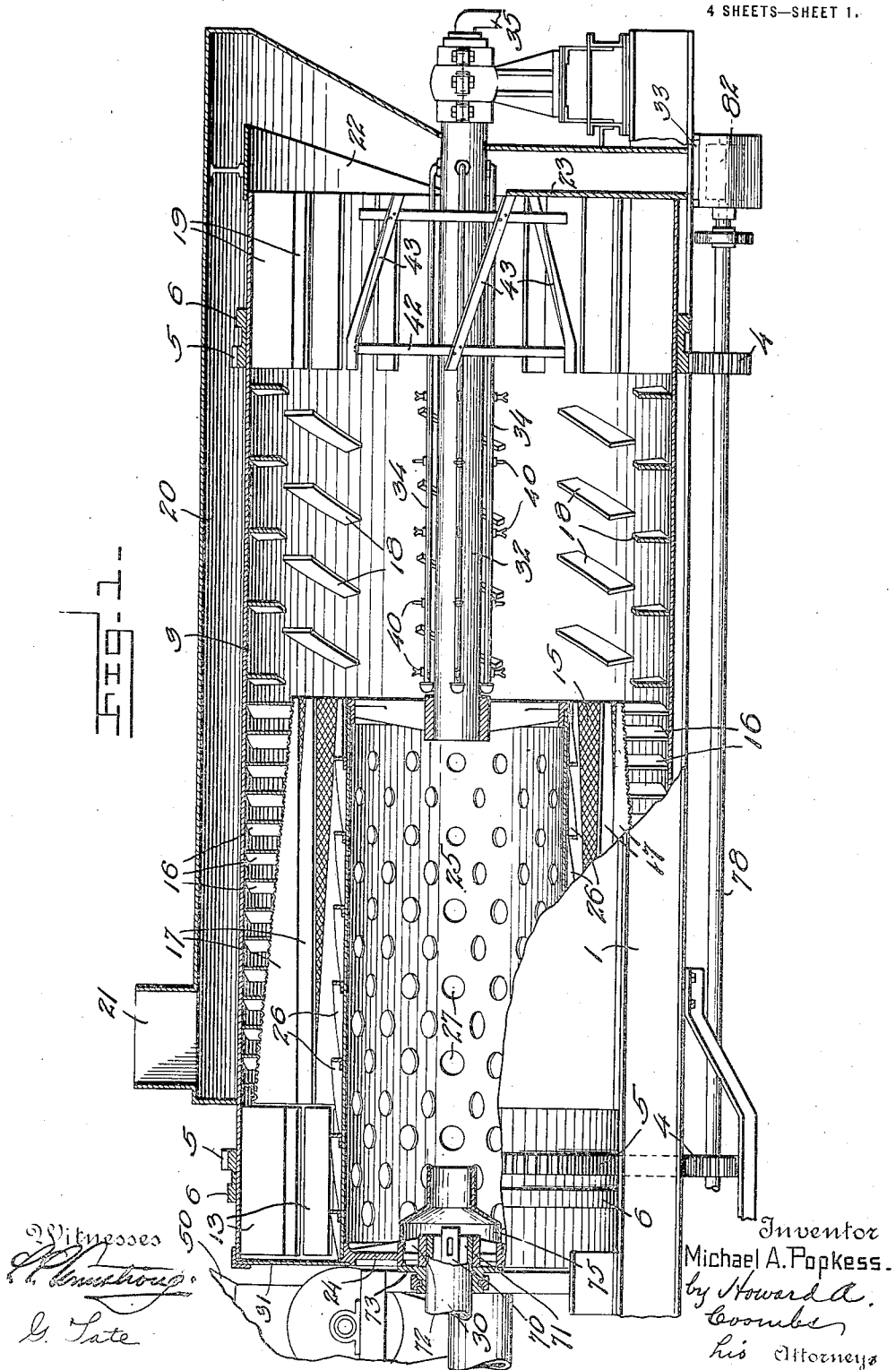


M. A. POPKESS.
 PROCESS OF AND MACHINE FOR TREATING EARTHY MATERIAL.
 APPLICATION FILED APR. 4, 1914. RENEWED FEB. 16, 1917.

1,240,481.

Patented Sept. 18, 1917.

4 SHEETS—SHEET 1.

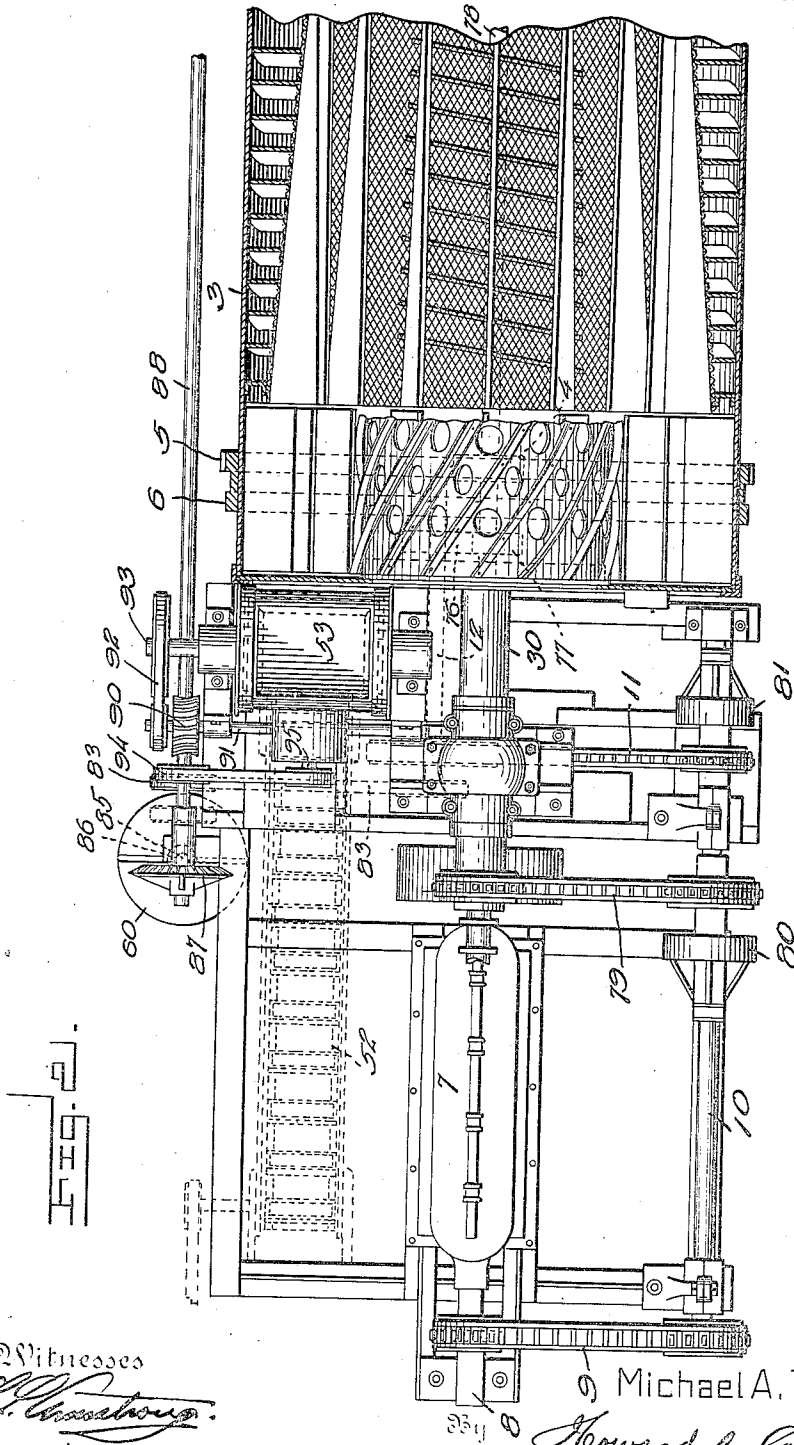


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4 SHEETS—SHEET 2.



Witnesses
H. H. Thompson
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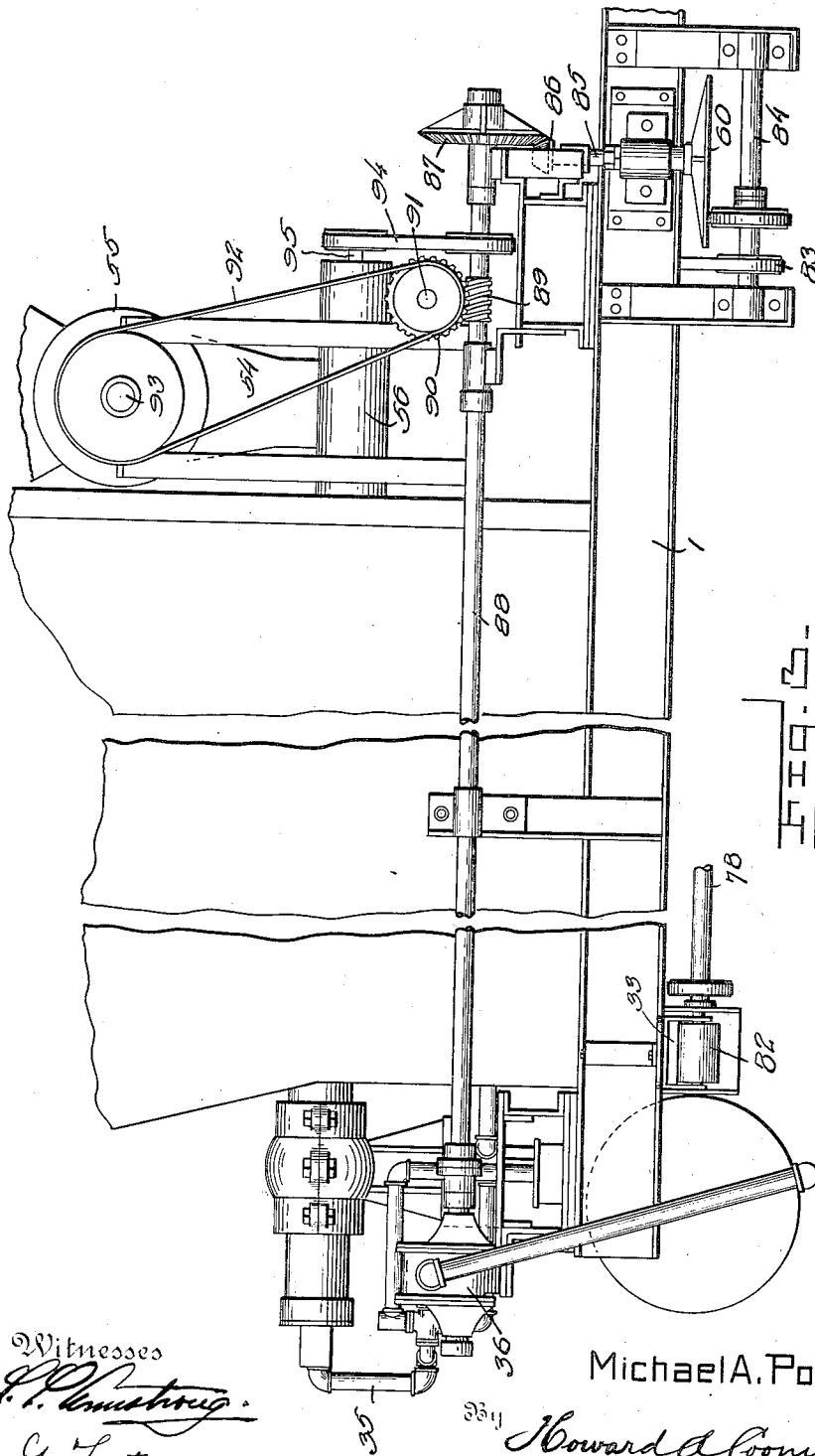
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4 SHEETS—SHEET 3.



Witnesses
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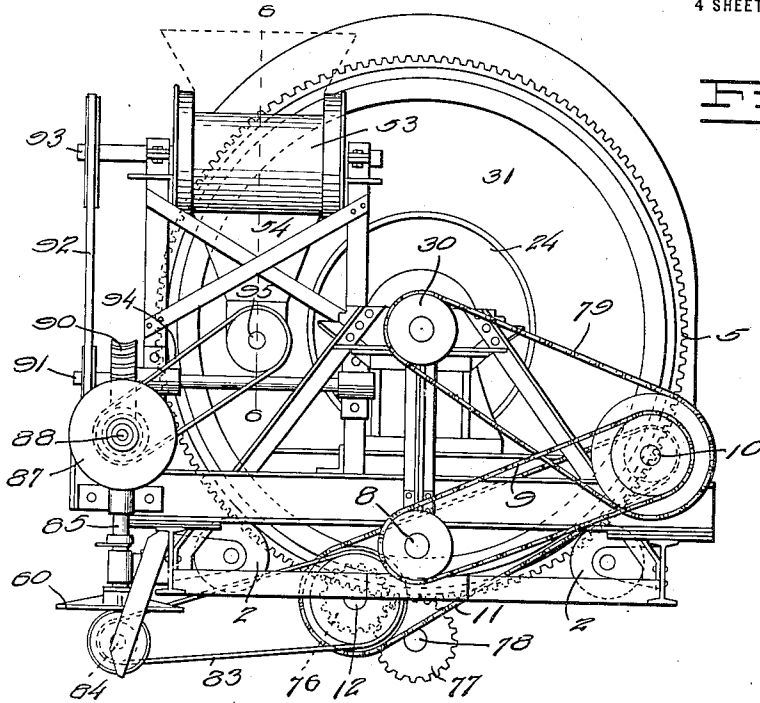


FIG. 4.

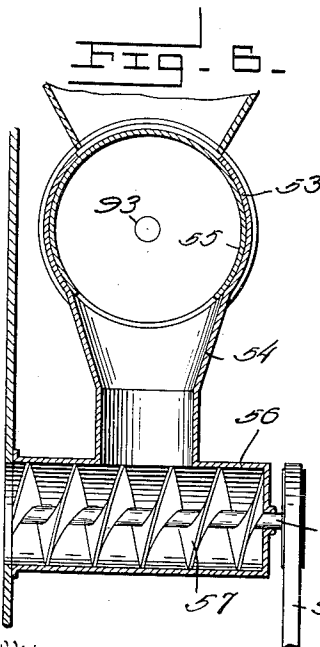


FIG. 6.

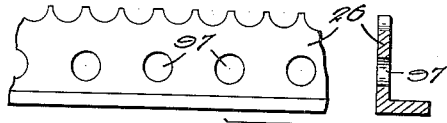


FIG. 7.

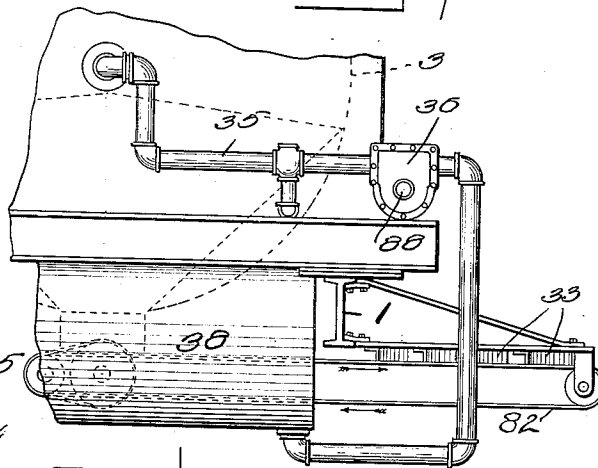


FIG. 8.

Witnesses
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UNITED STATES PATENT OFFICE.

MICHAEL A. POPKESS, OF NEW YORK, N. Y.

PROCESS OF AND MACHINE FOR TREATING EARTHY MATERIAL.

1,240,481.

Specification of Letters Patent.

Patented Sept. 18, 1917.

Application filed April 4, 1914, Serial No. 829,549. Renewed February 16, 1917. Serial No. 149,145.

To all whom it may concern:

Be it known that I, MICHAEL A. POPKESS, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Processes of and Machines for Treating Earthy Material; of which the following is a specification.

This invention relates to a process of and a machine for treating earthy material in such a way as to produce a plastic, waterproof and durable substance especially adapted for paving purposes, and consists in the hereinafter described novel means and combinations.

I have heretofore been granted Letters Patent of the United States for the process of treating earthy material and for the material which said process produces, viz., No. 1,008,433, issued November 14, 1911, and the machine of the present application has been designed for carrying out said process and the process claimed herein, the same comprising the new and useful improvements hereinafter described in connection with the accompanying drawings, in which,

Figure 1 is a longitudinal vertical section of the main part of the machine in its preferred form.

Fig. 2 is a plan view of the front portion of the machine, partially in horizontal section.

Fig. 3 is a side elevation of the machine, looking from the back side of Fig. 1 and with the central portion broken away.

Fig. 4 is an end elevation of the front end of the machine.

Fig. 5 is a partial elevation of the rear end of the machine.

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 4 and on a larger scale, and

Fig. 7 is a detail view, in elevation and section, of one of the pulverizing blades.

The function of the machine, as a whole, is to take earthy material, (by which term is meant any material, such as ordinary soil, loam, clay, peat, or the like, as distinguished from crushed stone, gravel and sand), heat, dry and pulverize said material into fine dust, separating it as formed from the coarser particles, and then to intimately mix the resulting dust with a liquefied bituminous binder, whereby a product is obtained, which is particularly adapted for surfacing roadways, sidewalks, floors, etc., being homogeneous, dense yet malleable, and waterproof.

This treatment is preferably conducted in a long rotary drum, the front portion of which constitutes a heating, drying and pulverizing chamber, and the remaining portion a spraying and mixing chamber or chambers. The means for accomplishing these functions are so constructed and arranged that the fine dust is separated out from the coarser material, as fast as it is formed, and so that none of the fine dust can be blown through the drum and escape unmixed.

While it is preferable to conduct these operations in one continuous rotary drum, it is not essential to my invention that the said drum rotate or that it be integral from end to end, as it may be stationary and contain revolving means for feeding the material therethrough, or be made in sections. Furthermore the pulverizing chamber portion of the drum may be used alone and the mixing be omitted or done elsewhere, if desired, although the complete arrangement, shown in the drawings, is the preferred form when the surfacing product, referred to above, is to be made. Also the coöperating elements, for pulverizing, spraying and mixing in the successive portions of the drum, may be varied to some extent, all as will appear from the following description and as specified in the annexed claims.

An important part of my invention is the construction of the pulverizing chamber, whereby the fine dust is separated, as soon as it is formed, from the coarser particles and is progressively fed rearwardly to the spraying and mixing chamber, out of further contact with the pulverizing means, and the whirling gases and steam,—when heat is employed,—and at a uniform rate and in a relatively quiescent state.

Another feature of my invention lies in the construction and location of the combustion chamber, by means of which the material is, or may be, heated and dried, while it is being pulverized, said chamber lying within the pulverizing means, the burning or highly heated air and gases passing radially out through said means directly into the flying dirt. The separated dust is fed rearwardly slowly and evenly into the next portion or chamber of the drum.

Another important feature is the means for spraying the material in the spraying and mixing chamber, whereby any fine dust, which may be carried directly into said chamber by the pulverizing means and by

the whirling blast of hot air, steam and gases, is caught by the spray. Also, when the final or impact mixing chamber, shown in the drawings, is used, the parts are so arranged that any fine dust, which may have issued from the inside of the screen cylinder and have passed through the spray, will be caught by the flying mixture of dust and binder, as it is dropped onto and struck by said blades.

The machine shown in the accompanying drawings will now be described.

The frame of the machine is indicated as a whole at 1, and is intended to be mounted on wheels, not shown, so that the machine can be conveniently moved as the work progresses, as in surfacing a road, which is the principal use to which the machine is designed to be put. The machine can, however, be used as a stationary plant, if desired, in which case the resulting product will be conveyed to the place of use or formed into blocks to be shipped when needed.

The earthy material to be treated in this machine is, as stated, any clay, loam or soil, substantially free from gravel and sand—although a certain percentage of sand will often be present—or may be peat or the like, and the binder is a relatively soft liquid asphalt, of high penetration.

Certain features of the machine can be used with advantage independently of other features; for example, the pulverizing and drying features can be used, as stated above, without the spraying and mixing features and, where the material to be treated contains very little moisture, the heating and drying features can be omitted.

Rotatably supported on rollers 2 is a drum 3, which constitutes the said pulverizing, spraying and mixing chambers, said drum being rotated slowly,—for example, at 12 revolutions per minute,—by pinions 4 meshing with the girth gears 5, the rollers 2 running on tracks 6 adjoining said gears. A motor 7, preferably an internal combustion engine, is mounted on the front end of the frame, and the shaft 8 of which drives the shaft of said pinions, through intermediate gearing, hereinafter described.

The front end of the drum has elevating cleats or shelves 13 secured to its inner periphery and running substantially parallel to its axis. These shelves extend for a short distance only within the drum and, beyond their rear ends, a screen cylinder 15, preferably made of woven steel wire, is secured within said drum by means of a plurality of short plates 16, arranged at an incline, or spirally, so as to feed the dust rearwardly as the drum and screen cylinder rotate. The screen cylinder is preferably made of larger diameter at its front end than at its rear end, and has elevating

shelves 17 secured to its inner periphery, running substantially parallel with its axis, said shelves tapering rearwardly so that their inner edges are substantially parallel with the axis of the cylinder and drum. The portion or section of the drum, just described, comprises the heating, drying and pulverizing chamber.

The section, immediately in the rear of the screen cylinder, is the spraying and mixing chamber and, in the machine shown in the drawings, contains a plurality of short spiral blades 18, secured to the inner periphery of the drum so as to feed the material rearwardly, as the latter rotates. The last section of the drum, which constitutes the final mixing chamber, contains elevating shelves 19, secured to the inner periphery of the drum, substantially parallel with its axis.

I will now describe the means within said sections or chambers of the drum, which cooperate therewith in the treatment of the material but, before doing so, I will call attention to the fixed casing 20, which surrounds the drum. This casing is closed at its front and rear ends to form an annular space for the hot air and gases which, as they issue from the rear end of the drum, are forced to travel forwardly through said space, to escape through the flue 21 at the front end of said casing. By this arrangement, the wall of the drum is kept hot and the bitumen is prevented from congealing thereon. To prevent any material from being thrown out of the rear end of the drum and onto the top thereof, a semi-circular hood 22, which acts as a baffle plate, is secured to said casing in line with or around the upper half of the rear end of the drum, and a fixed plate 23 is mounted so as to close the lower half of said end. This hood and plate are only necessary when the impact mixer, shown in Fig. 1, is used.

The pulverizing chamber of the drum contains the pulverizing reel 25, to the periphery of which are secured spiral blades 26 and, between said blades, openings 27 are formed for the passage of the hot air and gases, which openings may decrease in diameter toward the rear of said reel. Said reel is supported at its front end by a spider plate 24, fast on the hollow shaft 30, the outer portion of said plate being solid and the inner portion containing air openings 72, hereinafter referred to. The annular space between the reel and the drum is closed at the front end by a fixed plate 31.

The shaft 32, supporting the rear end of the reel, has secured to it, a plurality of pipes 34, communicating, through the hollow end of said shaft, with the pipe 35, through which the binder is forced by the pump 36, shown in Figs. 3 and 7, from the tank 38. Said pipes 34 carry, within the

spraying and mixing chamber of the drum, a plurality of spray nozzles 40, set so as to deliver convergent sprays, alternately at right angles to each other.

5 The rear end of said shaft 32 carries spider arms 42, to the outer ends of which are secured inclined or spiral impact blades 43, which, in coöperation with the lifting blades 19, perform the final mixing operation. These blades will not be necessary in
10 all cases, and a mixer, other than an impact mixer, such as a screw conveyor or worm, may sometimes be used instead.

The earthy material is fed into the front
15 end of the drum through a hopper 50, into which it may be raised by a bucket-elevator, indicated at 52 by dotted lines in Fig. 2, from which hopper it passes into a measuring device, comprising a cylindrical casing
20 53, open at its top to said hopper and at its bottom to a chute 54, and containing a rotary cylinder 55, having an opening in its periphery equal in size to the openings in the said casing, and driven from the
25 motor by the transmission hereinafter described. Said chute 54 leads into the horizontal casing 56, containing a screw conveyor or worm 57, driven in unison with said cylinder, said casing opening into the
30 front end of the drum 3 at one side of the pulverizing reel 25.

The pump 36 for the binder, the measuring device cylinder 55 and the worm 57 are all driven by the motor through an adjustable friction drive, 60, so that their speed is
35 simultaneously controlled. The function of the measuring device is to receive and deliver a certain amount of material at regular intervals, and that of the worm 57 to
40 feed into the drum a substantially uniform stream of material, the amount of binder forced in corresponding to the rate of feed of the material. In this way, the relative proportions of dust and binder, best suited
45 for the work in hand, are automatically controlled, and I may state here that, in the formation of my surfacing product, as described and covered in my said Patent No. 1,008,433, I use a larger amount of bitumen
50 than is ordinarily used in paving mixtures, frequently about 16 per cent., by weight.

At 70 is indicated the liquid fuel or oil burner, which projects into the pulverizing reel through the hollow shaft 30. It may
55 be of any known type, and is fed with high-pressure air and oil, and sometimes also with low pressure air surrounding the high pressure feed pipe, which lies axially in the burner. The annular space 71 admits atmospheric air for combustion, and atmospheric air may also be admitted through the
60 spaces 72, surrounding said shaft 30, the inlet to said spaces being controlled by a valve or damper 73, keyed to slide on shaft 30.

65 The mixture of burning gas and air issues

into the hood 75, projecting into the reel and reduced in diameter at its front end, so as to form a combustion chamber in which the atmospheric air mixes with the
70 burning mixture and reduces the temperature of the products of combustion, the mixed air and gases being directed by said hood axially into the reel, and thereby preventing overheating of the front end of the
75 latter.

In practice, it is an advantage to preheat the oil and the air of the forced draft to a certain degree, which can conveniently be accomplished by conducting them in contact
80 with or within the muffler and through the radiator of the motor, respectively.

The drives for the various moving parts are shown in Figs. 2, 3 and 4. The crankshaft 8 of the motor drives through a chain
85 9, the countershaft 10 which, in turn, drives, through a chain 11, the shaft 12, which carries a pinion 76, in mesh with a pinion 77 on the shaft 78 carrying the girth pinions 4. Shaft 10 also drives, through chain 79, the
90 shaft 30 of the pulverizer reel. 80 and 81 indicate clutches on the shaft 10, by which the pulleys, driving the chains 11 and 79, are connected or disconnected from said shaft.

82 indicates a transverse traveling belt or the like, for receiving the product from the
95 rear end of the drum and conveying it laterally. Although such delivery means is not an essential part of the machine, it is a useful adjunct, reducing the manual labor required in surfacing a road, for example.
100 When used, it will preferably be driven from said shaft 78, and will pass under scraper blades 33, projecting progressively farther over said belt, so as to distribute the material uniformly throughout the
105 transverse travel of said belt.

Shaft 12 drives, by chain 83, a countershaft 84, carrying the roller of the friction drive 60, the coöperating disk of said drive
110 being carried by a vertical shaft 85, on which is a bevel pinion 86 in mesh with a bevel gear 87 on the shaft 88, which runs to the rear of the machine on the other side of the machine from shaft 10. Shaft 88 carries a worm 89, in mesh with a worm wheel
115 90 on a shaft 91, which drives, by a chain or belt 92, the shaft 93, of the measuring device cylinder 55. Shaft 88 also drives, by a chain or belt 94, the shaft 95, carrying the worm 57, and finally, shaft 88 drives the asphalt pump 36. It will be seen that, when
120 the speed of the vertical shaft 85 is varied by means of the friction drive 60, the speeds of the measuring device, of the worm and of the pump are all varied, so that the proper relative amounts of earthy material and of binder fed to the machine are always maintained automatically as before stated.

The operation of the machine may be briefly summed up as follows:

The burner being started up and the motor driving the various parts, the material is fed, by the bucket elevator 52, or otherwise, into the hopper 50, passes through the measuring device 53 into the casing 55, in which the worm 57 feeds it, in a uniform stream, into the drum 3, where it is picked up by the shelves 13 and dropped onto the front end of the pulverizer reel 25, the blades of which cut and break it up and at the same time feed it rearwardly. To increase the extent of the cutting edges of said blades, I may make them scalloped, as shown in Fig. 7, which also shows holes 97 formed in said blades to diminish the resistance offered by them in revolving. Neither of these features is essential, but they tend to increase the capacity of the machine.

The dirt, thus more or less broken up, soon passes into the portion of the drum containing the screen cylinder, and continues to be subjected to the pulverizing action of the reel blades 26, being dropped thereupon by the shelves 17. The hot air and gases, passing out through the holes 27 assist, of course, in the pulverizing action. Some of the material now becomes fine dust and passes through the screen into the space between the latter and the drum, where it is slowly fed rearwardly by the spiral plates 16. Before it reaches the end of the screen cylinder, something like 95 per cent. of the material has passed through the screen, so that nearly all of it is fed into the spraying chamber slowly and uniformly, and only a very small proportion is carried into said chamber by the whirling air and gases surrounding the reel within the cylinder.

It will be understood that the pulverizing action is carried on in this machine under the most favorable conditions and with the expenditure of a minimum of power. The lumps of earthy material are subjected simultaneously to the cutting and in part action of the rapidly revolving blades, to the attrition and impact action of particles striking against each other while some are falling and others are being dashed against them, and to the disintegrating effect of the heat which evaporates the moisture carried by the material, the resulting steam causing the particles to momentarily swell, in which condition they are the more readily pulverized. The power required is reduced by the separation of the dust as soon as it is formed, as only the coarser particles fall back on the blades and strike other particles, whereas, without the separating screen, the coarser particles would be cushioned, as it were, by the large percentage of agitated dust.

The rearmost of said spiral plates 16 is longer than the others, making a complete spiral turn around the reel, the object being to feed the dust slowly and uniformly out of

said space between the cylinder and drum, and prevent too rapid an issuance of air and gases therefrom.

The dust, delivered evenly from the rear end of the screen cylinder into the spraying chamber of the drum, is carried up for a short distance on the wall of the latter by the spiral blades 18, which also feed it rearwardly, and, at the same time, it is sprayed with the binder issuing from the revolving nozzles 40, by means of which the whole chamber is filled with a mist, so to speak, of whirling spray, whereby any particles of dust, carried into the chamber by the whirling gases, without having passed through the screen, are caught and combined with the binder.

While I prefer to spray the dust in the manner and by the means just described, it can be done, with efficient results in some cases, by stationary, instead of revolving nozzles, and a worm be used to thoroughly mix the dust and binder.

To insure a thorough mixing, and to prevent the possible escape of any unmixed dust, I provide, in the machine illustrated, the impact mixer, consisting of the spiral blades 43 and the lifting shelves 19, the action of which is, of course, somewhat similar to that of the pulverizing means.

The pulverizer, and its shaft 32, carrying the nozzles and said impact blades 43, revolve at a very much higher speed than the drum, and the result is that all of the dust is thoroughly mixed before being delivered from the rear end of the drum onto the ground or onto a conveying means, such as the belt 82.

Various modifications can, of course, be made in the construction and arrangement of the parts above described and illustrated in the drawings, what I believe to be novel being defined in the following claims:

1. In a machine of the class described, the combination of a drum, means within the same for raising the material toward the top thereof, revolving pulverizing means within said drum upon which the material falls, and means within said drum for collecting the fine dust as it is formed and for maintaining it out of further contact with said pulverizing means.

2. In a machine of the class described, the combination of a rotary drum, revolving pulverizing means within said drum upon which the material falls, means between said drum and pulverizing means for collecting the fine dust as it is formed and for maintaining it out of further contact with said pulverizing means, and means between said drum and collecting means for feeding the dust rearwardly in the drum.

3. In a machine of the class described, the combination of a drum having an inlet for the material to be treated, revolving means

within said drum to pulverize the material and at the same time feed it rearwardly, a rotary screen cylinder between said drum and pulverizing means, means within said cylinder to raise the material and drop it onto said pulverizing means, and means between said cylinder and drum to feed the material, which has passed through the cylinder, rearwardly as said cylinder rotates.

4. In a machine of the class described, the combination of a rotary drum, means to introduce the material into the front end of the same, a revolving pulverizer within said drum, a screen cylinder secured to but spaced away from the inner periphery of the drum, said cylinder being of greater diameter at its front end than at its rear end and means secured to the inside of said cylinder to raise the material and drop it onto said pulverizer.

5. In a machine of the class described, the combination of a drum, revolving means within the same to pulverize the material and feed it through the drum, means to separate out the fine dust as fast as it is formed and means to feed the separated dust through the drum.

6. In a machine of the class described, the combination of a drum, revolving means within the same to pulverize the material by repeated impact, means to heat and dry the material while it is being acted upon by said pulverizing means, means to separate out the fine dust as fast as it is formed, and means to feed the separated dust through the drum.

7. In a machine of the class described, the combination of a rotary drum and means to introduce the material into one end thereof, revolving pulverizer blades within said drum, means secured to the inside of said drum to collect the fine dust as it is formed and prevent it falling back upon said blades, and means to force a blast of combustible gas and air into said drum.

8. In a machine of the class described, the combination with a rotary drum and means to introduce the material into one end of the same, of revolving spirally-arranged pulverizer blades within said drum, a screen between said pulverizer blades and drum and secured to the latter to catch the fine dust and prevent it falling back upon the blades, means between said screen and said drum to progressively feed the dust rearwardly as they rotate, and lifting shelves secured longitudinally to the inside of said screen.

9. In a machine of the class described, the combination of a rotary drum having an inlet for the material at its front end, a pulverizing reel within said drum, means within the drum to repeatedly raise the material and drop it onto said reel, means to retain the fine dust, as soon as it is formed, from further contact with said reel, and means

to play heat upon the material being pulverized, said reel and retaining means being constructed and arranged to feed the material rearwardly.

10. In a machine of the class described, the combination of a rotary drum, a screen cylinder therein, lifting shelves on the inside of said cylinder, a plurality of spirally arranged plates between said drum and cylinder, a rotary pulverizing reel within said screen cylinder and having openings in its periphery, and means to force a combustible mixture of air and gas into said reel.

11. In a machine of the class described, the combination of a drum, a rotary pulverizing reel within the same, means to elevate the material and drop it on said reel, means to direct a blast of heated air and gas into said drum, a screen cylinder between said drum and reel to collect the fine dust as fast as it is formed and means to feed said dust rearwardly in the drum.

12. In a machine of the class described, the combination with a rotary drum and means to feed the material into the front end thereof, elevating shelves secured inside said drum, means to rotate said reel at a higher rate of speed than said drum, a screen cylinder secured to said drum and extending around said reel in the rear of said shelves, lifting shelves carried inside said cylinder, the whole arranged to feed the material rearwardly in the drum, and means to play heat into the material as it is fed along.

13. In a machine of the class described, the combination with a rotary drum and means to feed the material into the front end thereof, elevating shelves secured inside said drum, revolving spiral pulverizing blades within said drum, a screen cylinder between said reel and drum in the rear of said shelves, short spiral plates connecting said cylinder to said drum, and lifting shelves secured to the inside of said cylinder, whereby the material is pulverized and the fine dust collected outside the screen as fast as it is formed, and both the fine dust and the coarser material are fed rearwardly through the drum.

14. In a machine of the class described, the combination of a rotary drum, means to introduce the material into one end thereof in a uniform stream and in regulable quantity, means to pulverize the material as it passes through said drum, means to force a blast of burning gas and air into said drum, and means to deliver the pulverized material in a constant uniform stream, comprising a screen cylinder carried by said drum around said pulverizing means and spirally arranged plates connecting said cylinder and drum, whereby the material, as soon as it is pulverized,

passes through said screen and is slowly fed rearwardly out of contact with the pulverizing means and the blast of air and gas.

15. In a machine of the class described, the combination of a drum and means to feed the material thereinto, a revolving reel carrying pulverizer blades within said drum, a hollow shaft supporting said reel, and having openings in its wall between said blades, and a liquid fuel burner projecting into said drum through said shaft.

16. In a machine of the class described, the combination of a rotary drum and means to introduce the material into one end thereof, elevating shelves carried on the inside of said drum, a relatively rapidly rotating pulverizing reel within said drum, said reel carrying spiral blades and having openings through its wall between said blades, and means to force a combustible mixture of air and gas into said reel.

17. In a machine of the class described, the combination of a rotary drum comprising pulverizing and mixing chambers, a rotary shaft within said drum, pulverizing means carried by said shaft within said pulverizing chamber, spray nozzles carried by said shaft within said mixing chamber, means carried by said drum within both said chambers to raise the material toward the top thereof, and means to feed a bituminous binder to said nozzles.

18. In a machine of the class described, the combination of a rotary drum comprising pulverizing and mixing chambers, a rotary shaft within said drum, pulverizing means carried by said shaft within said pulverizing chamber, spray nozzles carried by said shaft within said mixing chamber, means carried by said drum within both said chambers to raise the material toward the top thereof, means to feed a bituminous binder to said nozzles, and means to intimately mix the pulverized material and binder together.

19. In a machine of the class described, the combination of a rotary drum, means to deliver a blast of hot air and gas into said drum, means to feed earthy material into the front end of said drum, revolving means within said drum to pulverize said material, means between said drum and pulverizer to catch the fine dust and feed it rearwardly, means within said drum in the rear of said pulverizer to deliver a plurality of sprays of liquefied binder into said dust, and means to mix the dust with the binder and feed it to the rear end of the drum.

20. In a machine of the class described, the combination with a rotary drum and means to feed earthy material thereinto, of means within said drum for pulverizing said material and means for simultaneously heating and drying the same, means to col-

lect the fine pulverized material as it is formed and to feed it rearwardly without coming again in contact with said pulverizing means, means to spray said material with a bituminous binder in such a way as to catch any particles not so collected, and means to thoroughly mix said dust with said binder.

21. In a machine of the class described, the combination of a rotary drum, the front portion of which constitutes a drying and pulverizing chamber, revolving pulverizing means within the same and means to inject heated air and gases thereinto; the middle portion of said drum constituting a spraying chamber, spray nozzles therein and means to supply a liquid binder thereto; the rear portion of said drum constituting a mixing chamber, revolving means therein, and means on the inside of said drum to progress the material therethrough.

22. In a machine of the class described, a rotary drum, means inside the same to progress the material therethrough, means in the front portion of said drum to pulverize, screen and dry the material to dust, means in the central portion of said drum to spray a liquid binder into the dust, and means in the rear portion to intimately mix the binder and dust.

23. In a machine of the class described, the combination with a rotary drum into and through which the earthy material is fed, successive zones of said drum constituting, respectively, a pulverizing and dust-collecting chamber, a spraying and mixing chamber, and an impact mixing chamber, and said zones containing, respectively, means for drying, pulverizing and collecting the dust, means for spraying in the binder and mixing it with the dust, and means for further mixing them by impact.

24. In a machine of the class described, the combination of a rotary drum, revolving pulverizing means within the front portion of the same, means for directing a blast of burning gas and air into the front end of said drum, means in the central portion of the drum to spray a liquid binder into the material, means in the rear portion of said drum to thoroughly mix the material and binder, and a casing outside said drum, closed at its ends and having an outlet flue at its front end, whereby the heated air and gases are forced to pass through the drum to its rear end and then forwardly between said drum and casing to escape at the front end of the latter.

25. In a machine of the class described, the combination of a rotary drum, revolving pulverizing means and spray nozzles for the binder within said drum, of means to deliver measured quantities of earthy material into said drum, means to feed a measured quantity of binder to said noz-

zles, and mechanism, common to and controlling the speed of both said means, whereby both are simultaneously accelerated or retarded.

26. In a machine of the class described, the combination with a rotary drum, means to feed earthy material into one end of the same, means on the inside of said drum to carry said material upwardly as the drum rotates, a hollow rotary pulverizer axially mounted within said drum and carrying spiral blades on its periphery, the latter having openings therethrough between said blades, a liquid fuel burner projecting axially into the front end of said drum, means to supply air under pressure to said burner, a tubular hood surrounding and projecting beyond the nozzle of said burner, the outer end of said hood being of larger diameter than said burner so as to leave an annular space between them for the admission of air drawn in by the fan effect of the pulverizer blades and the injector effect of the burner, the inner end of said hood being reduced in diameter so as to form a combustion chamber and to direct the burning air and gas axially into the pulverizer, and means to control the admission of air into said annular space.

27. In a machine of the class described, the combination with means for drying the material, means for pulverizing the same and means for separating out the fine dust, of means for mixing the latter with a liquid while it is still hot.

28. In a machine of the class described, the combination with means for drying the material, means for pulverizing the same and means for separating out the fine dust, of nozzles for spraying said dust with a liquid, a pump for forcing the liquid to said nozzles, means for feeding the material to said drying and pulverizing means, and means for simultaneously varying the speed of said pump and said feeding means.

29. In a machine of the class described, the combination with means to pulverize the material, of means to feed the same into the machine, comprising a measuring device, constructed and adapted to feed predetermined quantities at regular intervals, and a continuously acting conveying means, receiving the material from said measuring device and conveying it in a uniform stream into the machine.

30. In a machine of the class described, the combination with a drum in which the material is pulverized to dust and then sprayed with a liquid, of means to deliver the liquid to be sprayed under pressure, a hopper to receive the material to be treated, a measuring device to receive the material from said hopper and deliver it periodically, a screw conveyer to receive the material from said measuring device and deliver it

into the machine in a uniform stream, and power connections, including a common speed-changing means, for driving said pump, said measuring device and said screw conveyer, whereby the proportion of liquid and of material fed into the machine is kept constant.

31. In a machine of the class described, the combination with a drum and means to feed the material thereinto at a uniform rate, of means within said drum for pulverizing the material, comprising means to force thereinto a combustible mixture of heated air and fuel, whereby the moisture is driven off and the material caused to disintegrate, mechanical means to further disintegrate the material and means to collect the dust as soon as it is formed and feed it rearwardly of said drum out of contact with said mechanical means.

32. In a machine of the class described, the combination with a drum and means to feed the material thereinto at a uniform rate, of means within the front portion of said drum to drive the moisture out of the material and to pulverize it to fine dust, means, also within said front portion, to collect the dust as fast as it is formed and to feed it into the continuation of said drum at a uniform rate, means to fill said continuation with sprays of liquid, whereby said dust is impregnated with the liquid and means, in the rear portion of said drum, to mix the dust and liquid and feed it out of said drum.

33. In a machine of the class described, the combination with a drum and means to feed the material thereinto at a uniform rate, of means within the front portion of said drum to drive the moisture out of the material and to pulverize it to fine dust, means, also within said front portion, to collect the dust as fast as it is formed and to feed it into the continuation of said drum at a uniform rate, means to fill said continuation with sprays of liquid, means in the rear portion of said drum to thoroughly mix the dust and liquid, comprising revolving spiral impact blades, and a hood over the upper half of the rear end of said drum to collect the mixed dust and direct it downwardly.

34. In a machine of the class described, the combination with a drum and means to feed the material thereinto at a uniform rate, of means within said drum for pulverizing the material, comprising means to force thereinto a combustible mixture of heated air and fuel, whereby the moisture is driven off and the material caused to disintegrate, mechanical means to further disintegrate the material, means to collect the dust as soon as it is formed and feed it rearwardly of said drum out of contact with said mechanical means, means in the central portion

of said drum to spray the dust with a liquid, and revolving impact means in the rear portion of said drum to thoroughly mix the dust and liquid.

35. In a machine of the class described, the combination with a drum and means to feed the material thereinto at a uniform rate, of means within said drum for pulverizing the material, comprising means to force thereinto a combustible mixture of heated air and fuel, whereby the moisture is driven off and the material caused to disintegrate, mechanical means to further disintegrate the material, means to collect the dust as soon as it is formed and feed it rearwardly of said drum out of contact with said mechanical means, means in the central portion of said drum to spray the dust with a liquid, revolving impact means in the rear portion of said drum to thoroughly mix the dust and liquid, and means below the rear end of the drum to convey the mixed material transversely of the machine.

36. In a machine of the class described, the combination with the frame and a prime mover mounted thereon, of a drum rotatably supported on said frame, connections between said drum and said prime mover whereby the former is slowly rotated, means, also connected with said prime mover, to feed material into the front end of said drum, means within the latter to carry the material up toward the top of the same, a pulverizer reel mounted within said drum, connections between said reel and said prime mover whereby the former is rotated at a relatively high speed, means within said drum, to the rear of said reel, to spray and mix the pulverized material with a liquid binder, an endless belt running transversely of the machine from beneath the rear end of said drum, connections between said belt and prime mover and scraper blades of progressively increasing length, supported by the frame over said belt, whereby the mixed material can be delivered uniformly upon the roadway.

37. In a machine of the class described, the combination of a drum, means within the same to constantly raise material toward the top thereof, a rotary pulverizing reel, having openings in its periphery, mounted within said drum, a liquid fuel burner projecting into said reel, a combustion chamber surrounding said burner and means to regulate the admission of atmospheric air to said chamber.

38. In a machine of the class described, the combination of a drum, means within

the same to constantly raise material toward the top thereof, a rotary pulverizing reel, having openings in its periphery, mounted within said drum, a liquid fuel burner projecting into said reel, a combustion chamber surrounding said burner, means to regulate the admission of atmospheric air to said chamber, and means within said drum to the rear of said reel to spray and mix the pulverized material with a liquid.

39. In a machine of the class described, the combination of a drum, means within the same to constantly raise material toward the top thereof, a rotary pulverizing reel, having openings in its periphery, mounted within said drum, a liquid fuel burner projecting into said reel, a combustion chamber surrounding said burner, means to regulate the admission of atmospheric air to said chamber, means within said drum to the rear of said reel to spray the pulverized material with a liquid, and means within said drum to the rear of said spraying means to mix the pulverized material and liquid by repeated impact.

40. The process of producing material for use in surfacing roads, making brick and the like, consisting in taking earthy material in a cold and damp state and a binder having adhesive and waterproof properties, and mixing the said ingredients thoroughly together, and then passing the mixture through a disintegrator to comminute the same.

41. The process of producing material for use in surfacing roads, making brick and the like, consisting in taking earthy material in a cold and damp state and an asphaltic binder having adhesive and waterproof properties, and mixing the said ingredients thoroughly together, and then passing the mixture through a disintegrator to comminute the same.

42. A machine for preparing paving material comprising a mixer, a disintegrator, means to operate both mixer and disintegrator, means to deliver a measured quantity of earthy material to said mixer, means to deliver binding material to said mixer in quantity proportioned to the quantity of earthy material delivered to said mixer, and means to automatically deliver mixed material from said mixer to said disintegrator.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

MICHAEL A. POPKESS.

Witnesses:

FRANK McGRANE,
HARRY L. POWELL.