

Oct. 17, 1967

J. H. MAULDIN

3,347,533

DRIER AND MIXER FOR AGGREGATE AND BINDER

Filed April 29, 1963

4 Sheets-Sheet 1

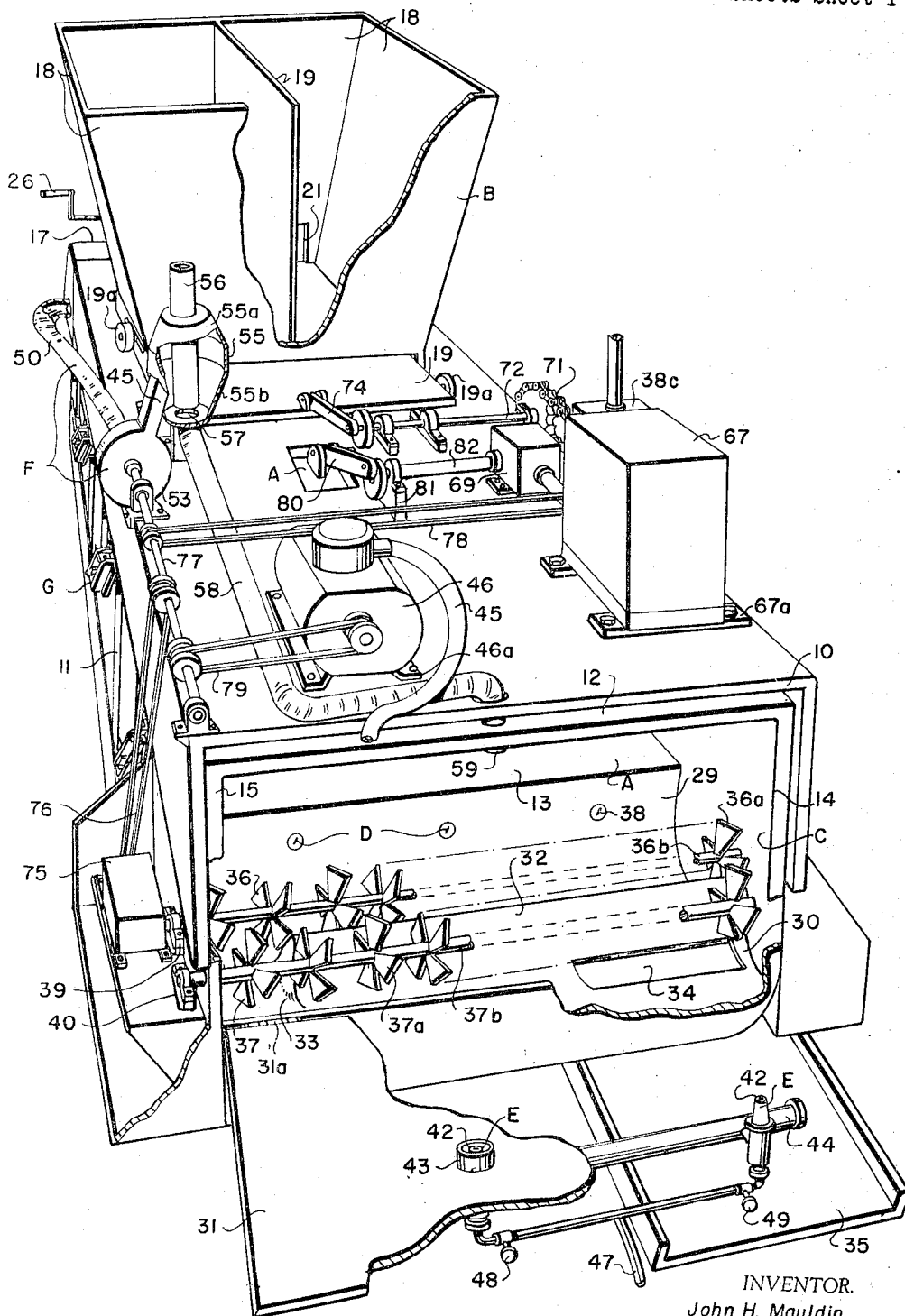


Fig. 1

INVENTOR.
John H. Mauldin

BY

John H. Mauldin, Jr.

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J. H. MAULDIN

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4 Sheets-Sheet 2

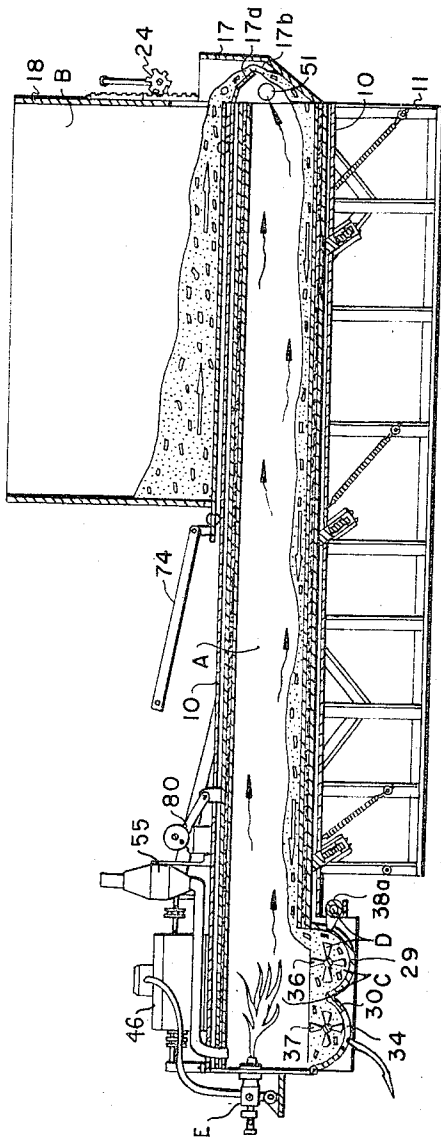


Fig. 3

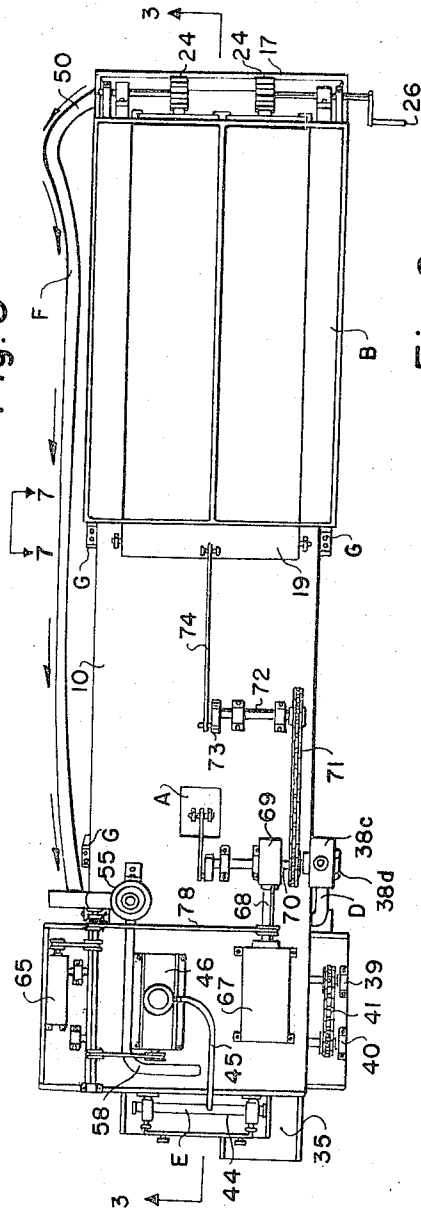


Fig. 2

INVENTOR.

John H. Mauldin

BY

John H. Mauldin

Oct. 17, 1967

J. H. MAULDIN

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4 Sheets-Sheet 3

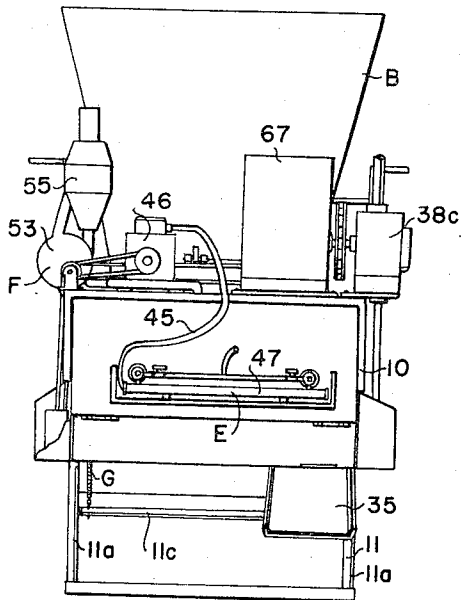


Fig. 4

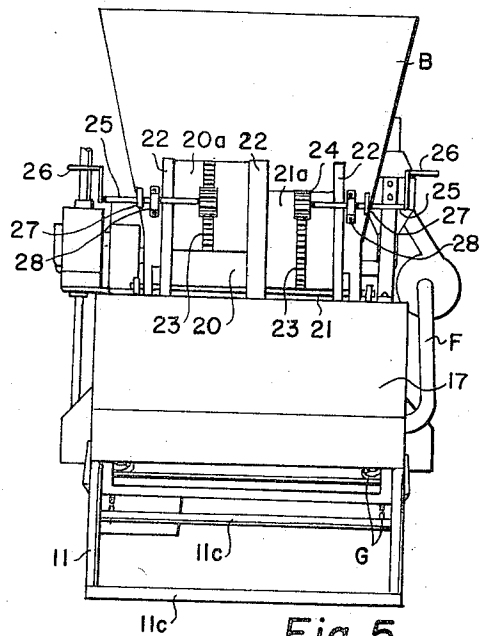


Fig. 5

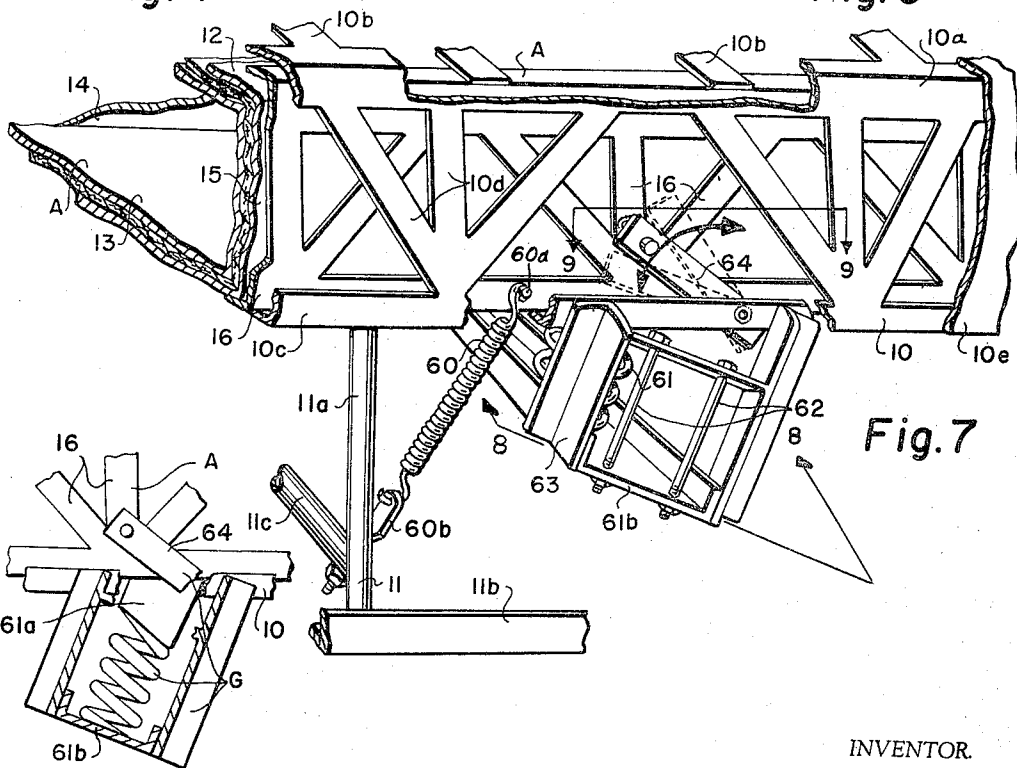


Fig. 7

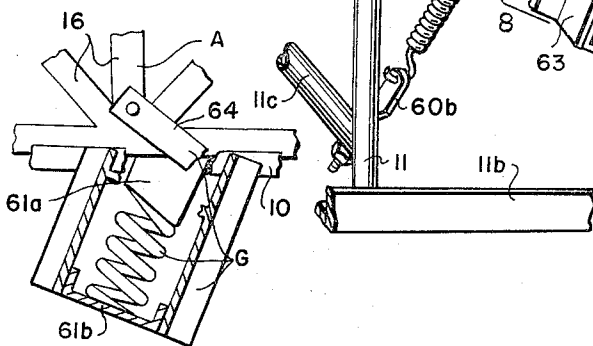


Fig. 8

INVENTOR.

John H. Mauldin

BY *John H. Mauldin*

Oct. 17, 1967

J. H. MAULDIN

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DRIER AND MIXER FOR AGGREGATE AND BINDER

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4 Sheets-Sheet 4

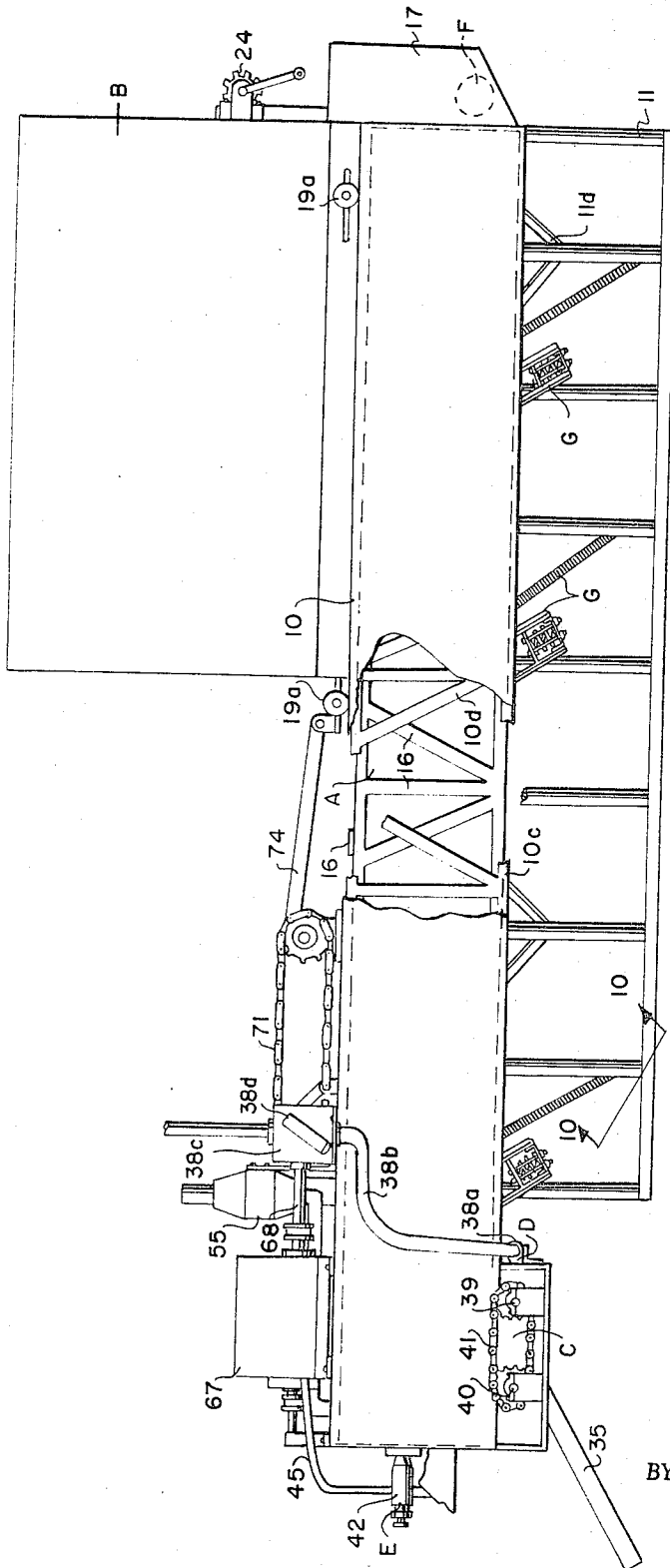


Fig. 6

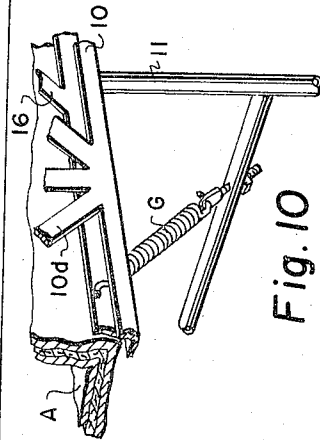


Fig. 10

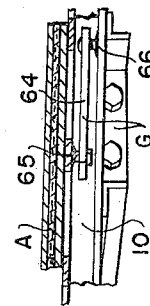


Fig. 9

INVENTOR
John H. Mauldin

BY

[Signature]

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3,347,533

DRIER AND MIXER FOR AGGREGATE AND BINDER

John H. Mauldin, 1606 N. Main St.,
Greenville, S.C. 29609

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9 Claims. (Cl. 259-156)

This invention relates to driers and mixers for aggregate and binder, and especially to a device capable of drying aggregate and mixing same with a bituminous binder for making asphalt.

Devices currently in common use for drying aggregate and mixing same with a binder are predominantly of the batch type in which a relatively large amount of aggregate is dried and then mixed with the binder. Such large quantities of aggregate require relatively heavy mixing equipment since the entire batch of aggregate must be dried at the same time. At least one continuous mixer of the type illustrated in United States Patent No. 2,967,696 issued Jan. 10, 1961, is capable of continuous operation. However, this device has the disadvantage of requiring relatively long drying and mixing chambers which must be subjected to elevated temperatures. The difficulty of maintaining the temperature within the chambers within the operating range of the equipment within these elongated chambers for moving and agitating the aggregate, and yet providing a desirable drying effect, presents a major problem. Considerable power must be extended in operating such agitating and transporting equipment, and the elevated temperatures cause excessive wear on the parts.

Accordingly, it is an important object of this invention to provide a drier and mixer for aggregate and binder in which a simplified drying chamber is provided, requiring a minimum amount of energy to move and agitate the aggregate for an effective drying of the aggregate.

Another important object of the invention is to provide a continuous means for drying aggregate and then mixing same with binder in which heat energy and mechanical energy and materials are most advantageously used.

Another object of the invention is to provide a drier and mixer for aggregate and binder in which a continuous forced draft of air reduces the possibility of an explosion.

Another important object of the invention is to provide a vibrating conveyor for agitating and continuously feeding the aggregate while subjecting same to an elevated temperature, thus affording superior drying of the aggregate.

Another object of the invention is to provide a transverse chamber for mixing the aggregate with the binder after the aggregate has been dried in a longitudinal chamber, thus providing a relatively short chamber in which bearings and the like may be mounted externally thereof.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIGURE 1 is a perspective view illustrating a drier and mixer for aggregate and binder constructed in accordance with the present invention,

FIGURE 2 is a plan view of the device looking from the right-hand side of the device illustrated in FIGURE 1,

FIGURE 3 is a longitudinal sectional elevation taken on the line 3-3 in FIGURE 2,

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FIGURE 4 is a front elevation of the drier and mixer for aggregate and binder,

FIGURE 5 is a rear elevation of the drier and mixer for aggregate and binder,

FIGURE 6 is an enlarged side elevation looking toward the left-hand of the device illustrated in FIGURE 1, with parts broken away for purposes of clarity,

FIGURE 7 is an enlarged perspective view taken on the line 7-7 in FIGURE 2,

FIGURE 8 is a sectional elevation taken on the line 8-8 in FIGURE 7,

FIGURE 9 is a sectional plan view taken on the line 9-9 in FIGURE 7, and

FIGURE 10 is an enlarged perspective view taken on the line 10-10 in FIGURE 6.

The drawings illustrate a drier and mixer for aggregate and binder and the like including, an elongated enclosed vibrator conveyor A. A hopper B continuously feeds aggregate to said conveyor. A compartment C communicates with the conveyor A and aggregate is fed from said vibrator conveyor therein at a position remote from the hopper. Means D including nozzles for spraying binder and a spiral paddle screw conveyor mix binder with the aggregate within the compartment. Means E includes nozzle means introducing air and flame into the compartment. The means F exhaust air from the compartment through the vibrator conveyor remote from the compartment. The vibrator conveyor has a spring suspension system G for maintaining the conveyor in a state of balanced spring tension. A pivoted arm accurately controls the path of oscillations impressed upon the conveyor through the application of force to the conveyor transverse to the longitudinal axis thereof. Thus, the binder is mixed with the aggregate in the presence of flame and air, and a draft of heated air flows within the enclosed vibrator conveyor in a direction opposed to the direction of the travel of the aggregate. A fine particle collector is also provided for returning particles which would otherwise be lost and eliminating objectionable smoke.

The various elements described above with the exception of the spring suspension system G are supported by an elongated generally channel shaped frame 10. The frame 10 is constructed of parallel longitudinal angle irons 10a which are provided suitable cross bracing 10b to form an upper horizontal platform. A pair of lower parallel angle irons 10c (FIGURES 6 and 7) are connected to the upper platform by side frame members 10d. These frame members may be covered by a suitable sheet metal surface 10e. The frame 10 is substantially open at the bottom. The lower stringers 10c are supported by a lower frame 11, which has vertical side members 11a carried within longitudinal angle irons 11b. The lower frame 11 has suitable cross bracing 11c and side bracing 11d.

The elongated enclosed vibrator conveyor A is supported within the frame 10 by the suspension means G. The conveyor A is illustrated in the form of an elongated rectangular conduit having a top portion 12, a bottom 13 and sides 14 and 15. The top, bottom and side members are illustrated as being constructed of steel plates having an inner layer of asbestos. In order to prevent deformation, suitable cross bracing 16 encompasses the top, side and bottom thereof. An open chute 17 is carried adjacent one end of the conveyor, into which aggregate is continuously fed from the hopper B over the inclined plate 17a. It will be noted that the inclined plate 17a leaves only a relatively small opening 17b through which the aggregate may pass into the conveyor A.

The hopper B is open at the top, and has sides 18 which together with the bottom shaker portion 19 normally confine the aggregate within the hopper B. The bottom shaker portion 19 is oscillated longitudinally of the conveyor A

on rollers 19a by suitable means which will be described below. A partition 19 is provided so that various sizes of aggregate may be selectively utilized. The rear wall of the hopper B, located adjacent the chute 17, has a pair of openings 20 and 21 therein, which are normally closed by the gates 20a and 21a, respectively (FIGURE 5). The gates 20a and 21a are carried in spaced vertical slides 22, and are moved vertically in either direction by racks 23 and pinions 24 to select the aggregate to be fed into the conveyor A. The pinions 24 are carried by shafts 25 which may be turned by the cranks 26. The shafts 25 are rotatably mounted within brackets 27 and bearings 28.

The aggregate which is fed into the conveyor A from the hopper B is fed in the direction of the white arrows in FIGURE 3 into a compartment C remote from the hopper B. The compartment C is generally formed by a pair of transverse arcuate channel portions 29 and 30, together with the top 12 and the sides 14 and 15 of the conveyor A. The adjacent end of the conveyor A opens into the channel 29 which is an extension of the bottom 13 of the conveyor. The other end of the compartment C is closed by the compartment door 31, hinged to the compartment as at 31a. It will be noted that the adjacent portions of the channels 29 and 30 form a substantially vertical wall 32 between the channels. The wall 32, however, has an opening 33 adjacent one end thereof, so that the aggregate may be fed from the channel 29 into the passageway 30. The channel 30 has a discharge opening 34 therein for discharging the finished asphalt through a chute 35.

Means D for mixing the binder with the aggregate includes a pair of spiral paddle screw conveyors 36 and 37 carried within the channels 29 and 30, respectively. The nozzles 38 spray the binder upon the aggregate within the channel 29. The blades 36a of the screw conveyor 36 are carried by a shaft 36b and move the aggregate from right to left in FIGURE 1. The ends of the shaft 36 are mounted in suitable pillow block bearings 39, and the left-hand end of the shaft 36b is driven as will be described below. The aggregate carried by the screw conveyor 36 is moved through the passover opening or passover 33 into the channel 30 where it is moved from left to right in FIGURE 1 by the blades 37a carried by the shaft 37b. The ends of the shaft 37b are mounted in suitable pillow block bearings 40. The shaft 37b is driven by the shaft 36b through the chain and sprocket drive 41 (FIGURES 2 and 6). The nozzles 38 are carried by a transverse pipe 38a (FIGURES 3 and 6) carried by the compartment C, and are connected through suitable flexible tubing 38b to an asphalt pump 38c. The asphalt pump has a by-pass valve 38d (FIGURE 6) so that when the pressure of the asphalt delivered by the pump becomes excessive, it may be returned to its main source of supply (not shown).

Means E is provided for introducing air and flame into the compartment C in the form of a pair of nozzles 42 which project through an open casing 43 in the compartment door 31. The nozzles 42 are supported upon a transverse pipe 44 having fixed connection with the compartment door 31. The pipe 44 is supplied with air under pressure through a flexible connection 45 with a compressor 46. The compressor 46 has suitable mounting 46a upon the frame 10. Fuel is supplied to the nozzles through a flexible supply hose 47 from a suitable source (not shown). Control valves 48 and 49 are provided for controlling the fuel supply of each burner, respectively. It will be noted that air is continuously fed to the nozzles whether fuel is supplied or not.

Means F is provided for exhausting air from the vibrator conveyor A remote from the compartment C. The means F includes a flexible conduit 50 which has communication with the interior of the conveyor A through the lower portion of the hopper 17 beneath the inclined plate 17a through the opening 51 (FIGURE 3). The conduit 50 communicates at its other end with a circular fan 53 which discharges through the conduit 54 into a vertical housing 55. The vertical housing 55 is constricted

toward its top and bottom as illustrated at 55a and 55b, respectively. A vertical pipe 56, open at both ends, is axially disposed within the casing 55 and the lower portion thereof terminates immediately above an opening 57 in the bottom of the casing 55. The top of the casing 55 is closed around the pipe 56. The fine particles received from the conveyor A are drawn through the opening 57 and through the flexible conduit 58 where they are delivered into the compartment C as at 59.

The spring suspension means G is provided to carry the conduit A for oscillation in arcuate path from a lower position upwardly and forwardly so that aggregate may be fed therethrough from the hopper B to the compartment C. The spring suspension means G includes a tension spring 60 tending to pull the conveyor A downwardly while a compression spring 61 tends to push the conveyor A upwardly so that the conveyor is normally maintained in balanced spring tension in both directions. The spring 60 is fixed as at 60a to the conveyor A at its upper end, and is carried for adjustment by the turnbuckle 60b at its lower end carried by the frame 11. The compression spring 61 bears at its upper end against a bearing member 61a carried by the conveyor A, and bears at its lower end against a channel member 61b (FIGURES 7 and 8) having fixed connection with the frame 10. The position of the channel member 61b may be adjusted with respect to the frame 10 through manipulation of the threaded bolts 62 which extend through a housing 63 for connection with the frame 10.

The arcuate path of oscillation of the conveyor A is controlled by links 64 associated with each spring suspension system G. The links 64 each have pivotal connection with the conveyor A upon a stub shaft 65 welded to the conveyor (FIGURES 7, 8 and 9). A second stub shaft 66 is welded to the frame 10 and pivotally carries the link 64 adjacent its free end.

The drive means for the various devices described above includes a motor 67, having a suitable mounting 67a upon the frame 10. Through its power take-off shaft 68 the motor drives a gear reducer 69. The gear reducer 69 drives the shaft 70 which in turn drives chain and sprocket drive 71. The chain and sprocket drive 71 drives a shaft 72 which carries an eccentric member 73 which through the pivoted linkage 74 oscillates the platform 19 back and forth to deliver aggregate continuously to the conveyor A. The shaft 36b of the mixing means D is driven from a gear reducer 75 which is driven by the motor 67 through the belt 76 which is driven from the shaft 77 by the belt 78. The compressor 46 is also driven from the shaft 77 through a belt 79. The shaft 70 also drives the asphalt pump 38c. The conveyor A is operated by power received through a link 80 which has pivotal connection with the conveyor A on one end thereof, and with an eccentric 81 on the other thereof. The eccentric 81 is driven by the shaft 82 which is driven from the gear box 69. The fan 53 of the exhaust means F is driven from the shaft 77.

Operation

In operation the aggregate in the form of crushed rock or sand and the like is fed into the conveyor A, selectively, through the openings 20 and 21 in the hopper B. For example, sand may be stored in one of the compartments of the hopper B formed by the partition 19, while crushed rock may be stored in the other. It is possible to feed either one or the other from the hopper B into the conveyor A by opening the proper door 20a or 21a. If desired a proportional mix of the aggregates may be fed by opening the doors 20a and 21a only partially depending upon the proportion of a given type aggregate desired in the final mix.

FIGURE 3 is a flow diagram in which the aggregate is indicated by the white arrows being fed from the hopper B over the plate 17a of the chute 17, and into the conveyor A where the aggregate continues to move in the direction of the white arrows into the compartment C

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where it is mixed with a binder by the means D. As the aggregate is vibrated, the particles are subjected on all sides to the heated air (black arrows in FIGURE 3) resulting from the air and flame being fed from the nozzles E into the compartment C. Since the compartment C communicates and is carried by the conveyor A, this heated air contacts the particles of the aggregate on all sides, thus drying same relatively rapidly. The dried aggregate is then mixed with a binder, customarily in the form of a bituminous binder by the means D. The aggregate is sprayed with binder from the nozzles 38a and mixed by the blades 36a of the spiral paddle conveyor 36. Such agitation in the presence of the flame from the nozzles E results in the removal of excess liquid medium from the bituminous binder, whether the binder be in the form of a cut-back or emulsion, and the like. Since the mixture of aggregate and binder is moved from right to left in FIGURE 1, the mixture will be fed from the transverse channel 29 into the transverse compartment 30 through the passover 33. The agitation and feeding of the mixture is continued by the spiral paddle conveyor 37 which moves the aggregate to the opening 34 and into the delivery chute 35.

A continuous draft of air is maintained within the conveyor A since air and flame are fed therein from the nozzles E supplied by the compressor 46 and is withdrawn therefrom by the means F which includes the conduit 50 (arrows in FIGURE 2) receiving air from the end of the conveyor A remote from the nozzles E and forced by the fan F into the fine particle remover. The fine particle removed permits the escape of air therefrom, only through the vertical pipe 56 and the flexible conduit 58. Relatively little air flows through the conduit 58 because of the relatively high pressure obtaining within the compartment C with which the conduit 58 communicates. In order for air to pass through the pipe 56, it must do so at a point near the bottom of the housing 55 adjacent the opening 57 through which the conduit 58 communicates with the housing 55. Thus, the fine particles drop to the bottom of the housing 55 and are fed through the flexible conduit 58 to the mixing chamber C.

The aggregate is moved from right to left in FIGURE 3 by the vibratory action of the conveyor A which is in balanced spring suspension by virtue of the suspension means G. Vibratory motion is intermittently imparted to the conveyor by the eccentric member 81 transversely to the longitudinal axis of the conveyor. The oscillatory path of the conveyor A is defined by the movement of the links 64, the limits being defined by the dotted line positions illustrated in FIGURE 7, the solid line position being a neutral position. Thus, the path of oscillation is from a lower point upwardly and forwardly and along the same arcuate path downwardly and rearwardly.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A drier for aggregate and the like including, an elongated conduit, means continuously feeding aggregate into said conduit, spring suspension means maintaining equal resilient forces tending to raise and lower said conduit, a frame extending substantially the length of the conduit, rigid linkage means pivotally carrying the conduit on one end of the linkage means and being pivotally connected with the frame on the other end thereof for guiding movement of the conduit, said linkage means being inclined in one direction with respect to the horizontal axis of the conduit, mechanical means exerting forces upon the conduit to raise and lower the conduit, and means introducing heated air adjacent one end of the conduit while exhausting same from the other end of the conduit.

2. A drier and mixer for aggregate and binder and the

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like including, an elongated conduit, means continuously feeding aggregate into said conduit, spring suspension means maintaining equal resilient forces tending to raise and to lower said conduit, a frame extending substantially the length of the conduit, linkage means pivotally carrying the conduit on one end of the linkage means and being pivotally connected with the frame on the other end thereof for guiding movement of the conduit, mechanical means exerting forces upon the conduit producing movement of the elongated conduit transverse to the longitudinal axis of the elongated conduit, means introducing heated air adjacent one end of the conduit while exhausting same from the other end of the conduit, a tortuous conveyor into which said aggregate is fed from said conduit, and means mixing a binder with the aggregate in such tortuous conveyor.

3. In an elongated mixer and drier for mixing aggregate with binder having a mixing chamber and an elongated conduit connected to the mixing chamber on one end of the conduit for communication therebetween, means introducing flame and air in a forced draft within the mixing chamber, and means withdrawing said air from the conduit opposite the end thereof connected to the chamber, the improvement including, a substantially vertical housing, a pipe within said housing opening at the top to the outside air and having an opening in the bottom thereof, means introducing air from the means exhausting air from the chamber into the vertical compartment substantially above the opening adjacent the bottom of the pipe, and means connecting the lower portion of the housing below the bottom of the pipe with the mixing chamber.

4. A drier and mixer for aggregate and bituminous binder and the like including, an elongated enclosed conveyor, spring means maintaining said conveyor in a balanced state of spring tension, means intermittently impressing a force upon the conveyor producing movement of the elongated conduit transverse to the longitudinal axis of the conveyor, linkage means guiding said conveyor through an arcuate path upwardly and forwardly upon the application of the force, a hopper for continuously feeding aggregate to said conveyor, a compartment communicating with said conveyor into which aggregate is fed from said conveyor positioned remote from said hopper, means mixing bituminous binder with the aggregate within the compartment, means introducing air and flame into the compartment, and means exhausting air from the conveyor remote from the compartment, whereby the binder is mixed with the aggregate in the presence of flame and air, and whereby a draft of heated air flows within the enclosed conveyor.

5. A drier and mixer for aggregate and bituminous binder and the like including, an elongated enclosed vibrator conveyor, a hopper for continuously feeding aggregate to said conveyor, a compartment communicating with said conveyor into which aggregate is fed from said vibrator conveyor positioned remote from said hopper, screw conveyor means within said compartment transverse to the longitudinal axis of the conveyor for mixing bituminous binder with the aggregate within the compartment, means introducing air and flame into the compartment, and means exhausting air from the vibrator conveyor in a forced draft remote from the compartment, whereby the binder is mixed with the aggregate in the presence of flame and air, and whereby a draft of heated air flows within the enclosed vibrator conveyor.

6. The method of making asphalt including, vibrating a continuously fed supply of aggregate so as to move same in one direction while agitating the aggregate, while so vibrating the aggregate subjecting same to the flow of hot gases so that the individual aggregate particles are vibrated in a stream of hot gases, then spraying the aggregate thus dried with bituminous binder in the presence of flame and hot gases, and subjecting the aggregate and binder to agitation and movement so as to thoroughly

mix the aggregate and binder and remove the excess liquid medium of the binder.

7. The method of making asphalt including, vibrating a continuously fed supply of aggregate so as to move same in one direction while agitating the aggregate, while so vibrating the aggregate subjecting same to the flow of hot gases in a direction opposed to the direction of travel of the aggregate so that the individual aggregate particles are vibrated in a stream of hot gases flowing in the opposite direction so as to dry the aggregate, then spraying the aggregate thus dried with bituminous binder in the presence of flame and hot gases, and subjecting the aggregate and binder to agitation and movement so as to thoroughly mix the aggregate and binder and remove the excess liquid medium of the binder.

8. The method of drying aggregate and mixing same with a binder including, continuously feeding aggregate into an elongated chamber, imparting motion to said chamber causing the chamber to move from a low position upwardly and forwardly to a high position and then from the high position downwardly and rearwardly to the low position in sufficiently rapid succession to cause the aggregate to be moved upwardly and forwardly with respect to the chamber, subjecting the aggregate continuously fed from the chamber to a tortuous passage, spraying binder upon said aggregate while being subjected to the tortuous passage, passing flame and air over said

aggregate while being subjected to said tortuous passage, and creating a draft of heated air throughout the chamber.

9. The method of making asphalt including, vibrating a continuously fed supply of aggregate so as to move same in one direction while agitating the aggregate, while so vibrating the aggregate subjecting same to the flow of hot gases in a direction opposed to the direction of travel of the aggregate, then moving the aggregate thus dried in a direction transverse to the former path of the aggregate while agitating the aggregate, spraying the aggregate while being thus agitated with a bituminous binder, subjecting the aggregate and binder while being thus agitated to flame and hot gases, and then moving the aggregate and binder while agitating same in an opposed transverse direction in the presence of flame and hot gases.

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WALTER A. SCHEEL, *Primary Examiner*.