United States Patent

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[54] **PROPORTIONING CONTROL SYSTEM FOR AN ASPHALT PLANT**
11 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **259/154,** 259/159 R
[51] **Int. Cl.** **B01f 15/04,** G05d 11/02
[50] **Field of Search** 259/154–159

[56] **References Cited**

UNITED STATES PATENTS

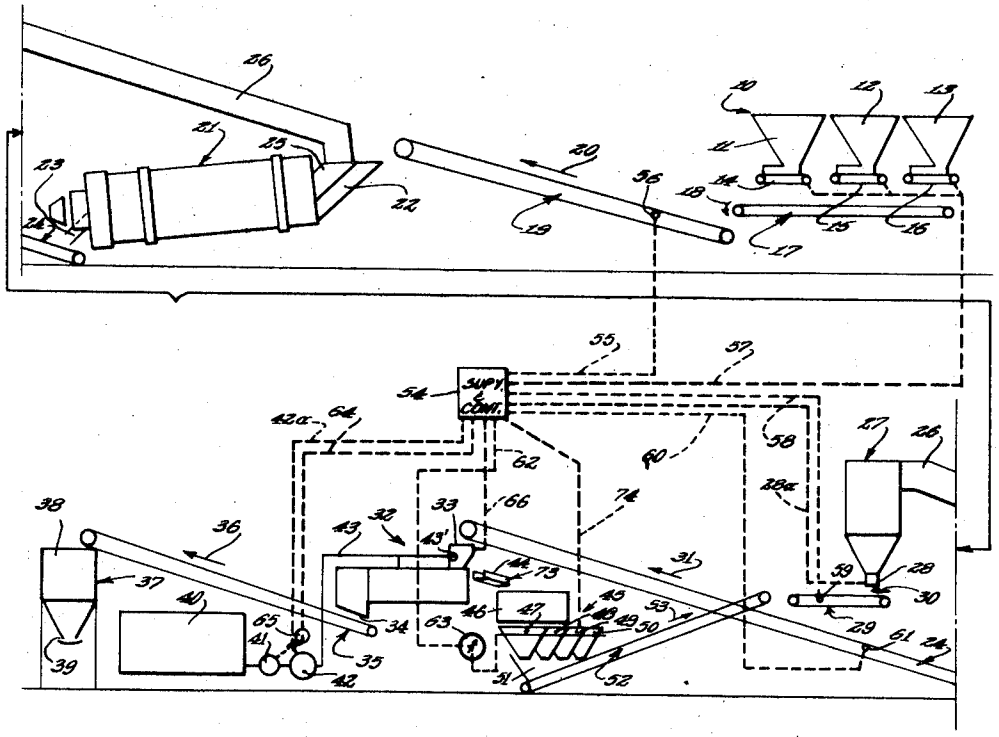
3,263,971	8/1966	Farnham	259/154
Re.26,786	2/1970	Plumb	259/157

FOREIGN PATENTS

1,451,717	7/1966	France	259/154
589,689	3/1959	Italy	259/154

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ABSTRACT: An asphalt plant employs a supervisory control system including weighing apparatus at different plant stations for signalling weights of flowing material in the plant for controlling the amount of material and bitumen flow. Continuous supervision and control of asphalt production enables optimum operation of an asphalt plant utilizing fewer components of production equipment than found in conventional asphalt plants.



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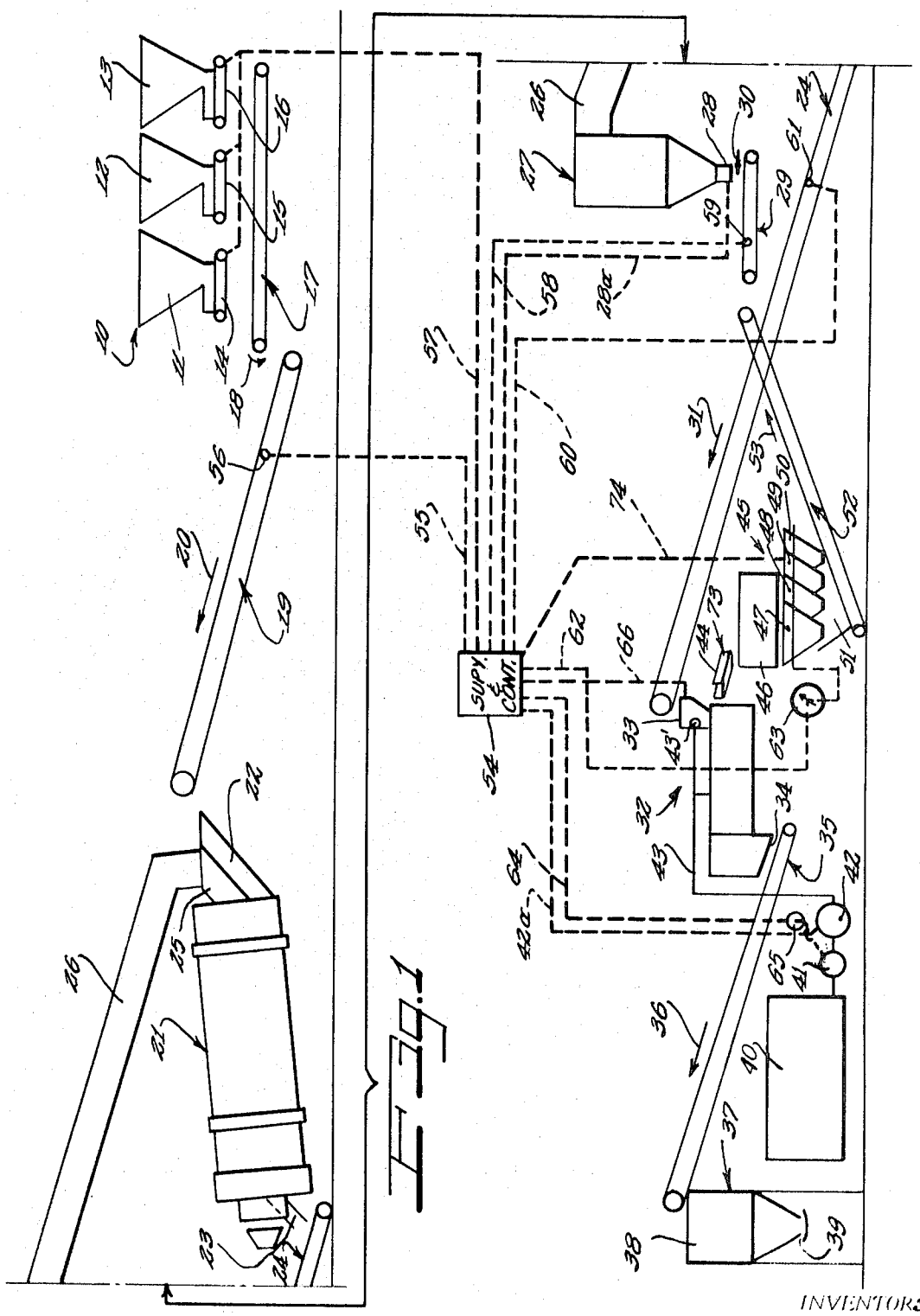


FIG. 1

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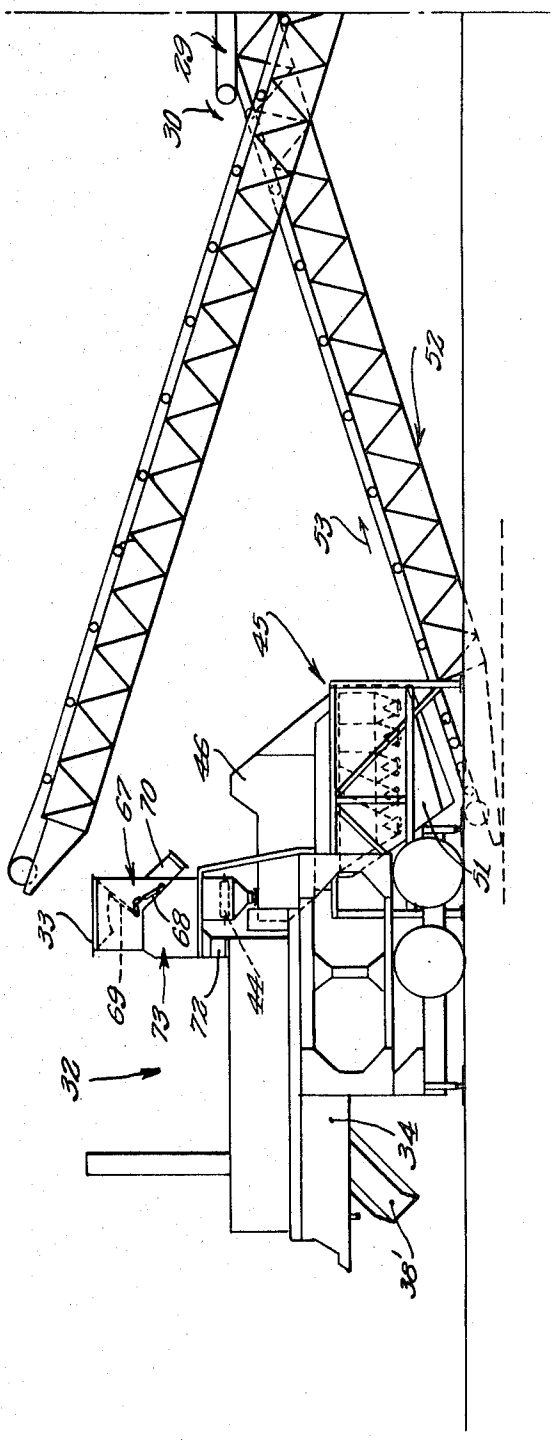
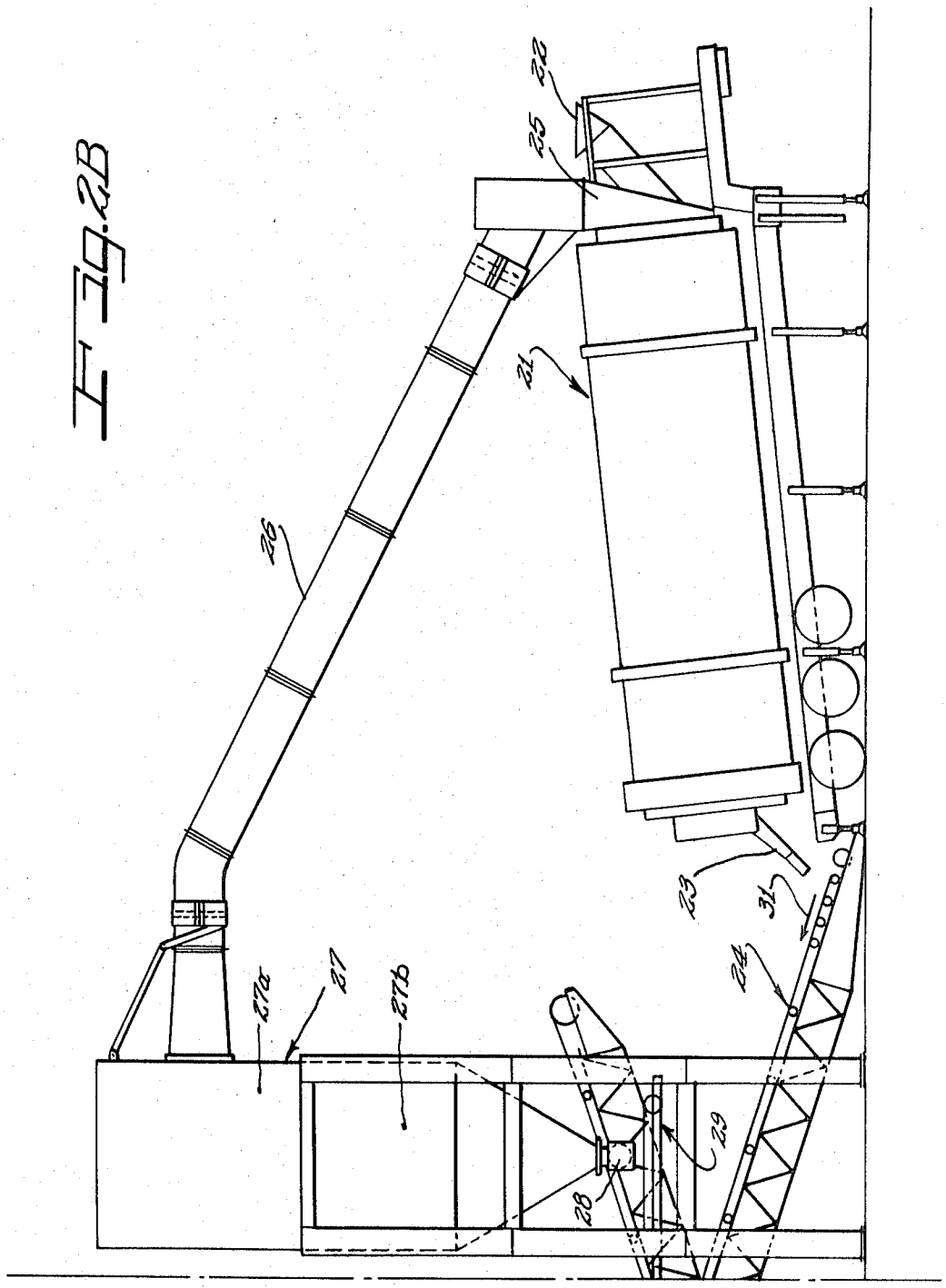


FIG. 2A

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FIG. 2B



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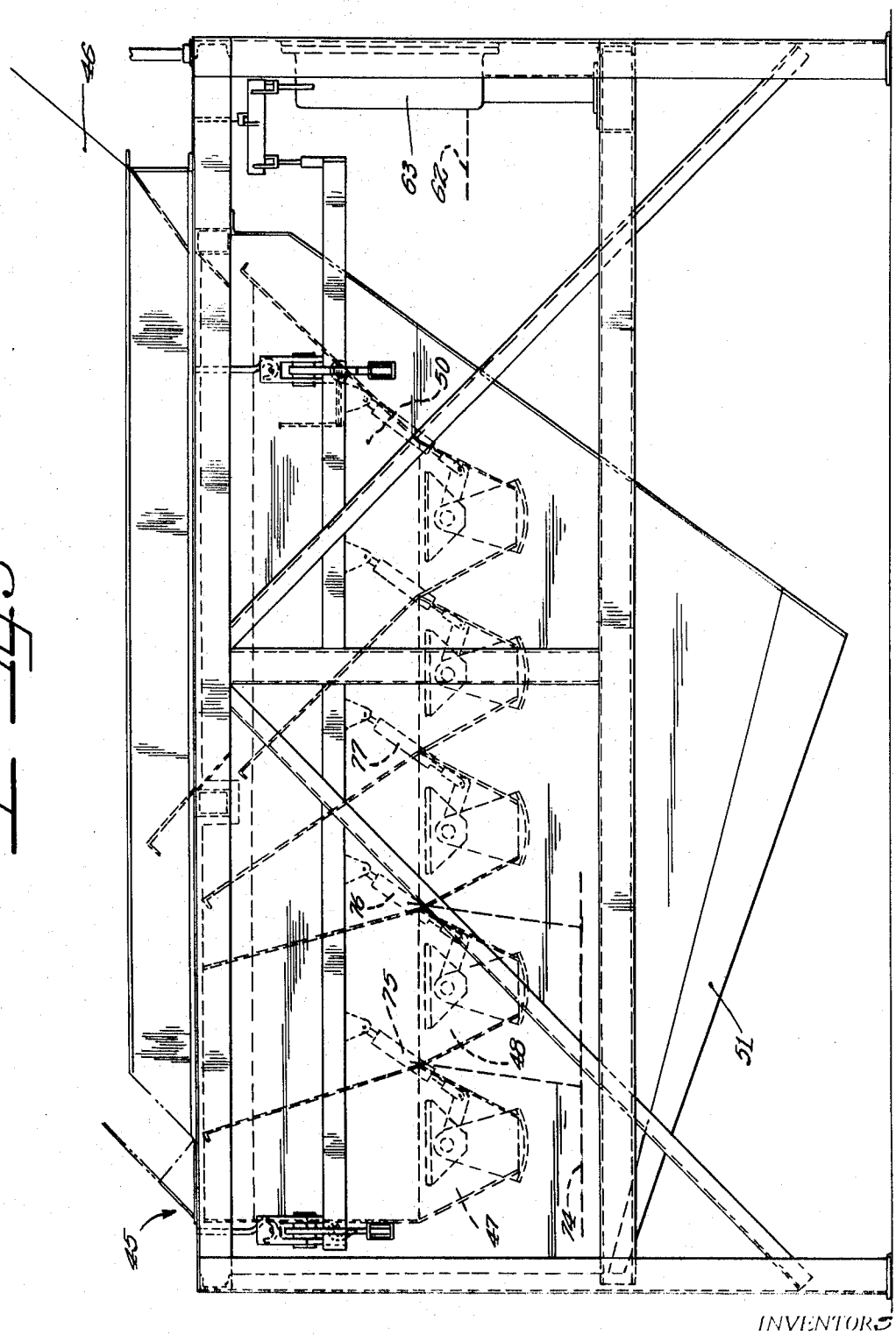


FIG. 3

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PROPORTIONING CONTROL SYSTEM FOR AN ASPHALT PLANT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to asphalt plants and more particularly to methods and apparatus for controlling the production of asphaltic mixes.

Description of the Prior Art

Generally, A conventional asphalt plant utilizes certain basic components in order to produce high-type asphaltic mixes for use in, for example, heavy-duty roadways. These components include a multiple aggregate cold feed wherein several sizes of stone and sand are required for a suitable mix; a cold conveyor or elevator to gather and transport material from the cold feeders and elevated to a dryer; a dryer for removing moisture from the aggregate and heating the aggregate to mixing temperature, most commonly about 300° F.; a dust collector which provides one or more stages of dust collection from the exhaust gases of the dryer to return valuable dust to the system and for providing a draft to support combustion in the dryer; a hot elevator or conveyor for transporting the heated aggregate from the dryer to the screen; a screen for separating the output of the dryer into two or more sizes of stone and sand, which sizes may or may not match the cold feed sizes; hot bins to receive and store surges of hot aggregates, which aggregates are divided into compartments to match the size segregation afforded by the screen separations; a hot aggregate proportioning mechanism which is usually a hopper on a scale in a batch plant, and continuous feeders in a continuous plant, for each aggregate; an elevator or conveyor, except in tower plants where the hot bins are mounted over the mixer, for transporting the hot aggregate to the mix; an asphalt proportioning mechanism, usually a bucket on a scale in batch plants, and a calibrated positive displacement pump in continuous plants, for providing the proper amount of asphalt to the mixture in accordance with the amount of hot aggregate; and a mixer, either batch type or continuous, to convert the segregated aggregate and asphalt inputs into a homogeneous mix.

Each of the foregoing equipments are expensive, and of course, require a certain amount of installation area. The screen, for example, is ordinarily a huge machine for present day capacities and would necessarily be increased in size, with an attendant increase in cost, to handle the capacities now being requested for future plants. This alone appears to be impractical. In addition, the hot aggregate proportioning mechanism merely recombines the materials separated by the screen and, inasmuch as material is not manufactured, the cold feed must be correct in order to continue the mixing. In essence, the screen is simply monitoring the operation. The hot bins permit an unbalance in the cold feed to be corrected over an extended period of time, and also compensate for the uneven movement of the trucks hauling the mix away. While the mixing operation can be intermittent, optimum operation of the dryer is on a continuous basis and the dryer should not be frequently started and stopped. In view of the foregoing, we have discovered that certain equipments are extraneous and may be eliminated in a system which runs continuously and includes supervision and control of the various operating components thereof resulting in a more compact and economical facility which may be operated at a high rate of production.

SUMMARY OF THE INVENTION

According to the invention, the above-described screen, not bins, aggregate proportioning mechanism and hot elevator of present production techniques may be eliminated and asphalt production may be realized by the utilization of a system employing the other mentioned equipments under the control of a supervisory and control system which employs sensing apparatus located at certain flow stations within the plant for signalling a monitoring system which, in turn, controls the amount of material inputs to the mixer. This control is effected by sampling the hot aggregates flowing into the mixer and controlling material flow in accordance with the samples. The amounts of cold and hot feeds to the dryer and mixer, respectively, and dust from the dust collector, are determined by weighing mechanism which provides signals as a function of weight to the control system. The control system causes samples to be made of the hot aggregate for adjusting the flow of aggregate and controls the output of asphalt pumping equipment in accordance with the hot aggregate input into the mixer.

It is therefore a primary object of the invention to provide a new asphalt plant which will operate at a higher rate of production and at a lower rate of cost than present asphalt plants.

Another object of the invention is to provide an asphalt plant in which material flow is continuously monitored and controlled by a supervisory and control system.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention, its organization, construction and operation will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

FIG. 1 is a schematic diagram of an asphalt plant according to the present invention which employs a supervisory and control system;

FIGS. 2A and 2B together form an elevational view of an asphalt plant constructed and operable in accordance with the techniques of the present invention; and

FIG. 3 is an elevational view of a sampling bin which may be advantageously employed in practicing the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings and with particular reference to FIG. 1, an asphalt plant according to the present invention is illustrated in the form of a continuous asphalt plant comprising cold bins, generally referenced **10** for storing multiple aggregate cold feed of several sizes of stone and sand required for a suitable mix in the several compartments, **11**, **12** and **13** thereof. Each of the compartments includes a delivery section **14**, **15** and **16** for metering a prescribed amount of each of several aggregates to conveyor apparatus **17** which is operating in the direction indicated by arrow **18** to deliver aggregate to a second elevator or conveyor or which is moving in a direction indicated by the arrow **20**.

Conveyor **19** delivers the cold aggregate to input **22** of a dryer **21**. In the dryer the aggregate is heated for drying and for elevating its temperature to that suitable for mixing, preferably about 300° F. at which temperature it is delivered from the output **23** of dryer **21** to a conveyor **24** for movement to a mixer. In addition to outlet **23**, dryer **21** has a second output **25** connected to a duct **26** through which air is drawn to support combustion for the dryer and for collecting dust given off from the aggregate during the drying process. This dust is valuable and should be returned to the aggregate flow.

Conveyor **24** operates in a direction indicated by arrow **31** to carry the hot dried aggregate to input **33** of a mixer pug mill **32**.

Asphalt tanks **40** supply a flow of liquid bitumen by way of pump **41**, meter **42** and conduit **43** to an asphalt spray bar **43'** in input **33** of the mixer **32**, whereupon the asphalt and the aggregate are mixed as is well known in the art and delivered by way of mixer output **34** to a conveyor **35** operating as indicated by arrow **36**. Conveyor **35** transports the asphalt composition to a mix storage hopper **37** having an input **38** for receiving the mix and an output **39** for servicing haulage vehicles.

The asphalt material stored in hopper **37** includes the aforementioned valuable dust which is drawn by way of duct **26**

into a dust storage apparatus 27 having a dust collector 27*a* which separates the dust from the exhaust gases, a dust storage bin 27*b* and an output 28 which meters the dust onto conveyor 24 by way of conveyor 29 operating as indicated by arrow 30.

Conveyor 19, conveyor 24 and conveyor 29 each include a continuous weighing device operably associated therewith as referenced at 56, 61, and 59, respectively. Each of these weighing devices continually monitor the amount of aggregate flowing thereover and provides indications to a supervisory and control apparatus 54 over the respective signalling channels 55, 60 and 58. In this manner the amount of material traversing the cold conveyor, the hot conveyor and the dust conveyor may be continuously monitored by weight. In addition to the monitoring of total aggregate weight for delivery to the mixer, the present invention utilizes apparatus for monitoring the quality of the aggregate being supplied. In this connection, attention is invited to conveyor or chute 44 of FIG. 1 which receives samples of hot aggregate from the input to the mixer 32 and provides the sample to a separating screen 46 as a part of the sampling apparatus 73 and the weighing apparatus 45 for the samples. Screen 46 separates and sizes the aggregate into separate bins 47, 48, 49, and 50 for individual weighing thereof. The total weight of the individual aggregates are detected by scale 63 and signals to the supervisory and control circuit 54 over buss or channel 62 for monitoring. Individual weights, obtained by a subtraction process upon dumping, are recorded. Referring specifically to FIG. 3, the weighing apparatus 45 is illustrated in greater detail as comprising a plurality of bins 47–50 each of which includes an aggregate, release apparatus, such as 75, 76 and 77, for releasing individual aggregate components to a chute 51 for delivery from the scale to a conveyor 52, upon receipt of release signals over channel 74. The weighing apparatus 45 is of the type well known in the art and no further description thereof is deemed necessary except that the scale is adapted to record, and deliver indications of such recordings to the supervisory and control system of the individual aggregate components by way of the scale mechanism 63 and information channel 62.

In order to provide the sampling as just described in general, apparatus such as a Type "C" cutting sampler is employed at reference 73 as is well known in the crushed stone art. More specifically, such a cutting sampler moves a receptacle through the aggregate flow and delivers the diverted sample of a true cross section of material flow through a conveyor or chute 44 for delivery to screen 46. In this type of an arrangement screen 46 is much smaller than that required previously in the main flow of material and is therefore not pushed to capacity and accordingly can provide a much more accurate gradation analysis. It can make separations much finer than are practical over a screen which is required to handle the full plant capacity. Advantageously, it can be very small and inexpensive.

In addition to monitoring the weights of aggregate at various points of the plant the present invention includes the control of aggregate flow in accordance with the weights sensed. To realize this capability, the plant is provided with a supervisory control system 54 for receiving the weight indications from the sensing devices 42, 56, 59, 61 and 63 by way of their respective signalling channels 42*a*, 55, 58, 60 and 62. Further, the control section of apparatus 54 includes outgoing control channel 57 for controlling the individual aggregate feeds and outputs 14–16 of the cold storage feeder containers 11–13 respectively. Also, the system includes a control channel 64 for controlling the flow from pump 41 by way of a pump flow adjuster 65 and a control channel 28*a* for controlling the output of the dust storage apparatus 27.

The supervisory and control system 54 receives weight signals from the various stations in the asphalt plant and responds accordingly to vary the aggregate feed and pump operation to meet the requirements of the desired mix. The supervisory and control system 54 detects the aggregate flow rate at sensor 61 and employs the signals therefrom to control the proportioning of other additives, the dust and the asphalt, by way of their respective control channels. The sensors and corresponding signalling channels are employed to signal the control system 54 that the correct amounts are being added and corrections are automatically made if the correct proportions are not being added. Total capacity is sensed by sensor 56, and the apparatus 54 adjusts feeders 14–16 so as to maintain the preset desired flow rate over sensor 56. In addition, the proportional relationship between the feed rates of these aggregates is adjusted occasionally in response to the data received in the gradation analysis at elements 44 and 45. This may be done either manually or automatically.

A reject mechanism 67 is provided for diverting an unwanted aggregate mix which may occasion the input to the mixer. The reject mechanism includes a flop gate 69 and an actuator 68 which are operated manually to divert the aggregate into chute 70. This condition most normally will occur when proportions are not yet stabilized upon startup of the process.

All high-type asphalt paving mixes use dried and heated aggregates. However, there are some mixes which have asphalt emulsions for the bitumen and do not require heating and drying of the aggregate, nor dust collection. The present invention also applies to such mixes and may be advantageously employed in the production of these "cold" mixes.

Generally then there has been described a novel asphalt plant having several advantages. Plant cost is reduced, particularly for larger plant sizes in that the components added to the plant of the present invention are less expensive than those eliminated from conventional asphalt plants. Segregation of material in the hot bins is eliminated with the elimination of such bins. There is no material waste such as occurs when the cold feed is out of balance with the gradation unit of a conventional plant. The sampling screen, because it is not in the main flow of material and is therefore not being pushed to capacity, can provide a much more accurate gradation analysis and make separations much finer than are practical over a screen which is required to handle the full plant capacity. In addition, the sampling screen is very much smaller and less expensive than those of conventional plants. The improved cold feed control eliminates surges in the dryer resulting in better dryer operation and the valuable dust is collected and accurately controlled and metered back into the aggregate flow. The asphalt plant becomes more compact and portable with the elimination of the large gradation unit and screen of conventional plants which require a large crane to stack one upon the other.

The present invention makes a recordation practical with respect to continuous plants, such recordation being required by increasing numbers of highway departments and including a printed record of the weight of each ingredient of every batch for quality control of the mix. In practicing the present invention, as each aggregate sample is removed, screened and weighed, a quality control record is produced.

We claim:

1. An asphalt plant comprising: a mixer for combining liquid bitumen and aggregates into an asphalt composition; means for delivering aggregate to said mixer including a dryer for drying aggregate, means for delivering cold aggregate to said dryer and means for delivering hot aggregate from said dryer to said mixer; means for delivering bitumen to said mixer; first sensing means operably associated with said means for delivering hot aggregate for sensing the weight of aggregate being delivered to said mixer; control means operably connected between said first sensing means and said means for delivering bitumen for controlling the flow of bitumen in accordance with the weight of aggregate being delivered, and second sensing means operably associated with said means for delivering cold aggregate and connected to said control means for providing indications of the cold aggregate feed in accordance with the weight thereof.

2. The asphalt plant according to claim 1, wherein said means for delivering aggregate further comprises dust collecting means connected to said dryer or collecting dust from the

aggregate being dried and connected to and operably controlled by said control means to deliver dust to said means for delivering hot aggregate in accordance with the weight of aggregate sensed by said first sensing means.

3. The asphalt plant according to claim 1, wherein said means for delivering aggregate to said mixer further comprises sampling means for determining aggregate composition, said sampling means including sample cutting means operable to divert a sample of hot aggregate from the aggregate flow, segregating means for separating the aggregate into separate components, means for weighing each of the components of the sample, the last-mentioned means being connected to said control means and operable to provide indications of component weights thereto; said control means being effective to reduce bitumen flow accordingly upon each sampling operation.

4. An asphalt plant comprising: a mixer for combining liquid bitumen and a plurality of aggregates of different sizes to an asphalt composition; means for delivering the plurality of aggregates of different size to said mixer; means for removing a small representative sample portion of the aggregates from said means for delivering the aggregates to the mixer; means for classifying the sample portion of aggregates into the individual constituent parts thereof in accordance with aggregate size; means for returning the classified aggregates to said means for delivering the aggregates to the mixer; sensing means for sensing the weight of aggregate being delivered to said mixer; means for delivering bitumen to said mixer; and control means operably connected between said sensing means and said means for delivering bitumen for controlling the amount of bitumen addition to said mixer in accordance with the weight of aggregate being delivered to said mixer.

5. The asphalt plant according to claim 4, comprising means connected to said mixer for receiving the asphalt composition and delivering the composition for haulage as a surge storage means.

6. The asphalt plant according to claim 4, wherein said means for delivering liquid bitumen comprises pump means connected for fluid delivery between said mixer and a supply of liquid bitumen, said pump means including means for adjusting the amount of bitumen addition to said mixer in response to the operation of said control means.

7. The asphalt plant according to claim 6, comprising a flow meter interposed between said pump means and said mixer.

8. In an asphalt plant including means for delivering cold aggregate to a dryer, means for delivering hot aggregate from the dryer to a mixer, and means for delivering liquid bitumen to the mixer, a proportioning control system comprising first weighing means operably associated with said means for delivering cold aggregate, second weighing means operably associated with said means for delivering hot aggregate, and monitor means connected to said first and second weighing means and to said hot and cold aggregate delivering means for controlling the flow of the respective aggregates in accordance with predetermined aggregate flow.

9. The control system set forth in claim 8, comprising flow control means in said means for delivering liquid bitumen, said flow control means being operated by said monitor means to control liquid bitumen delivery in accordance with the weight of hot aggregate sensed by said second weighing means.

10. The control system set forth in claim 8, comprising means for sampling the constituent components of the hot aggregate including means for separating the hot aggregate into its constituent components, third weighing means for weighing each of the components, said third weighing means being connected to said monitor means for providing indications of component weight thereto.

11. The control system set forth in claim 8, comprising control connections between said monitor means and said means for delivering cold aggregate to the dryer for controlling the rate of delivery of the cold aggregate.

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