Sept. 6, 1966 J. H. HOLLAND 3,270,633

UNIVERSAL BITUMINOUS PAVING MACHINE

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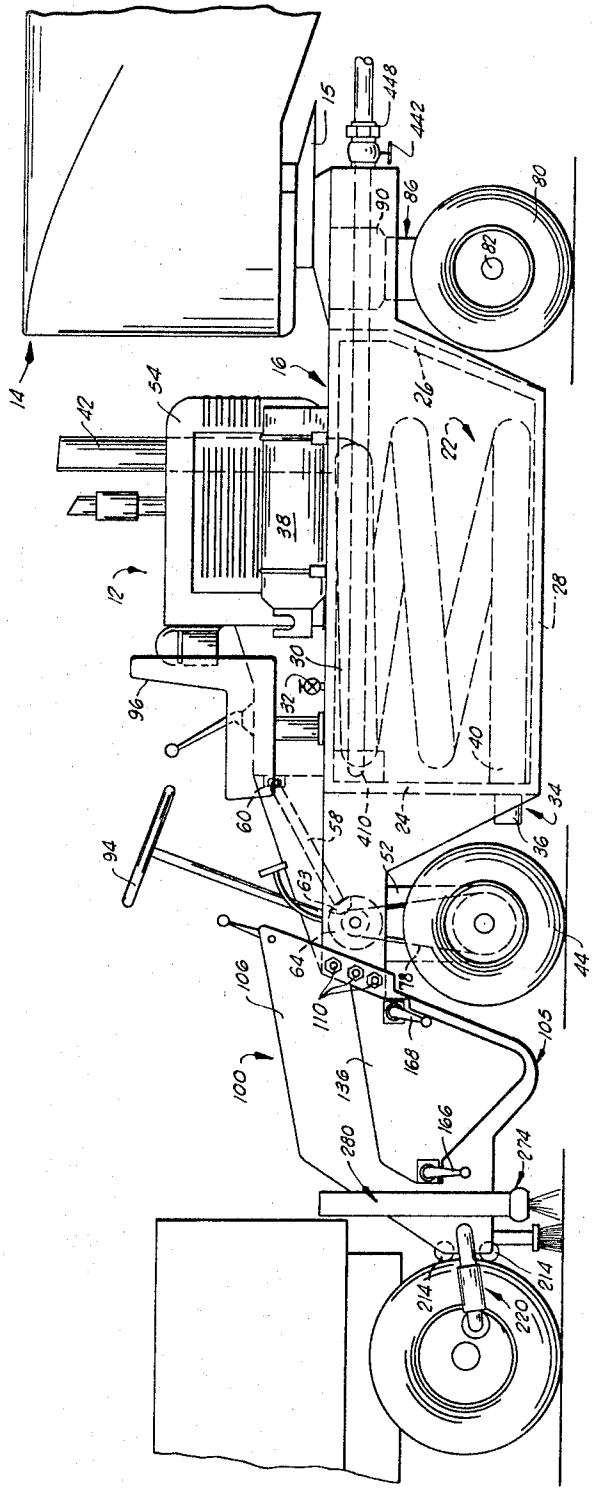

FIG. 2

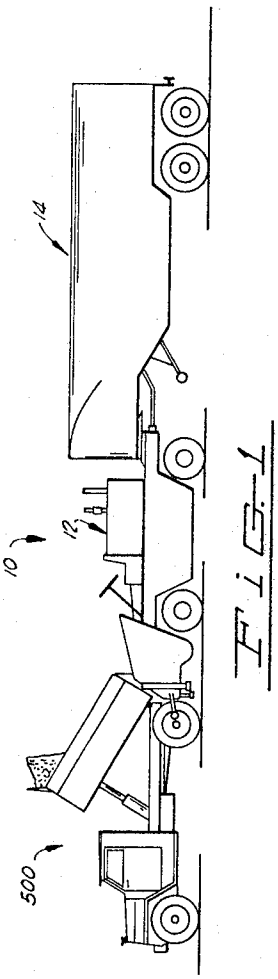

FIG. 1

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Filed Jan. 14, 1963 6 Sheets-Sheet 2

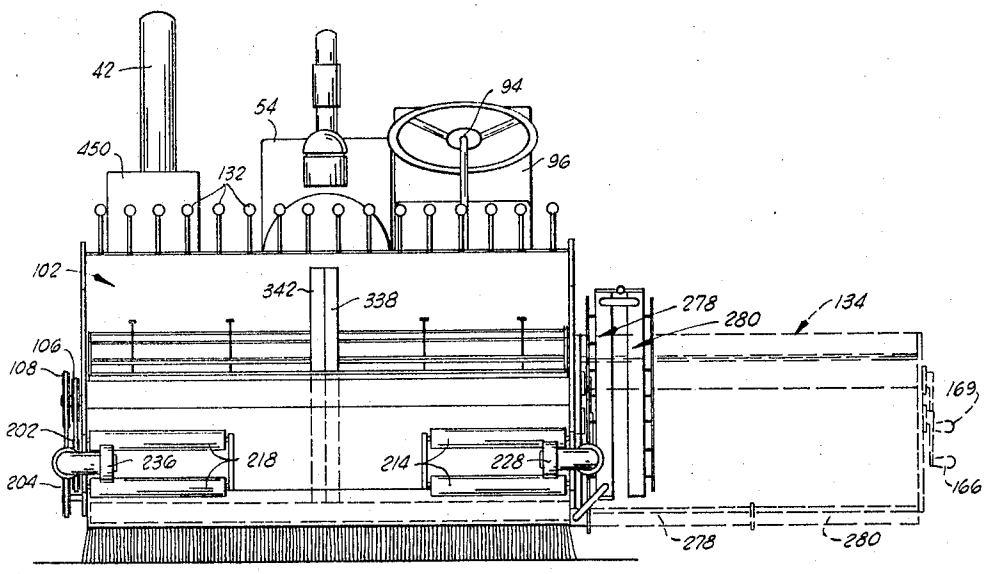

Fig. 3

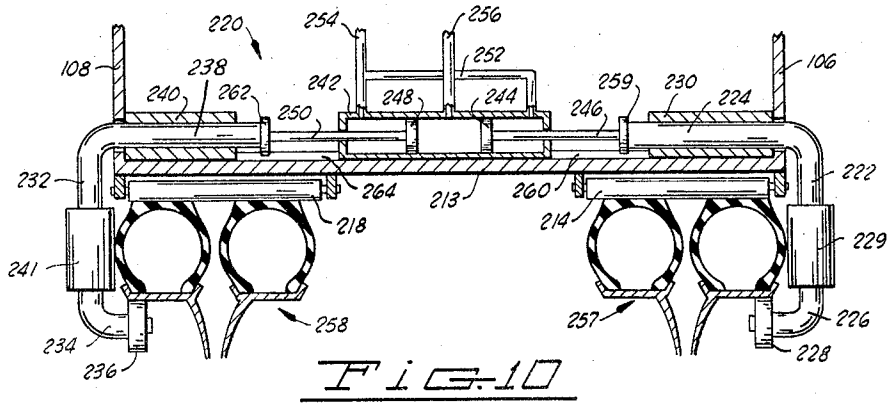

Fig. 10

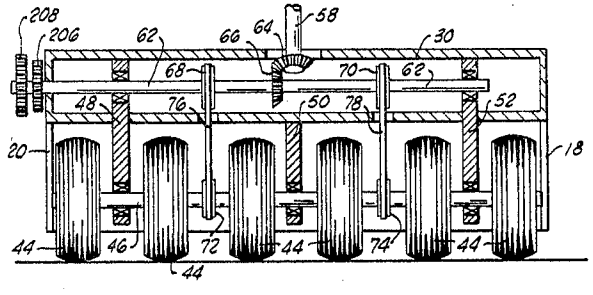

Fig. 5

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UNIVERSAL BITUMINOUS PAVING MACHINE

Filed Jan. 14, 1963 6 Sheets-Sheet 3

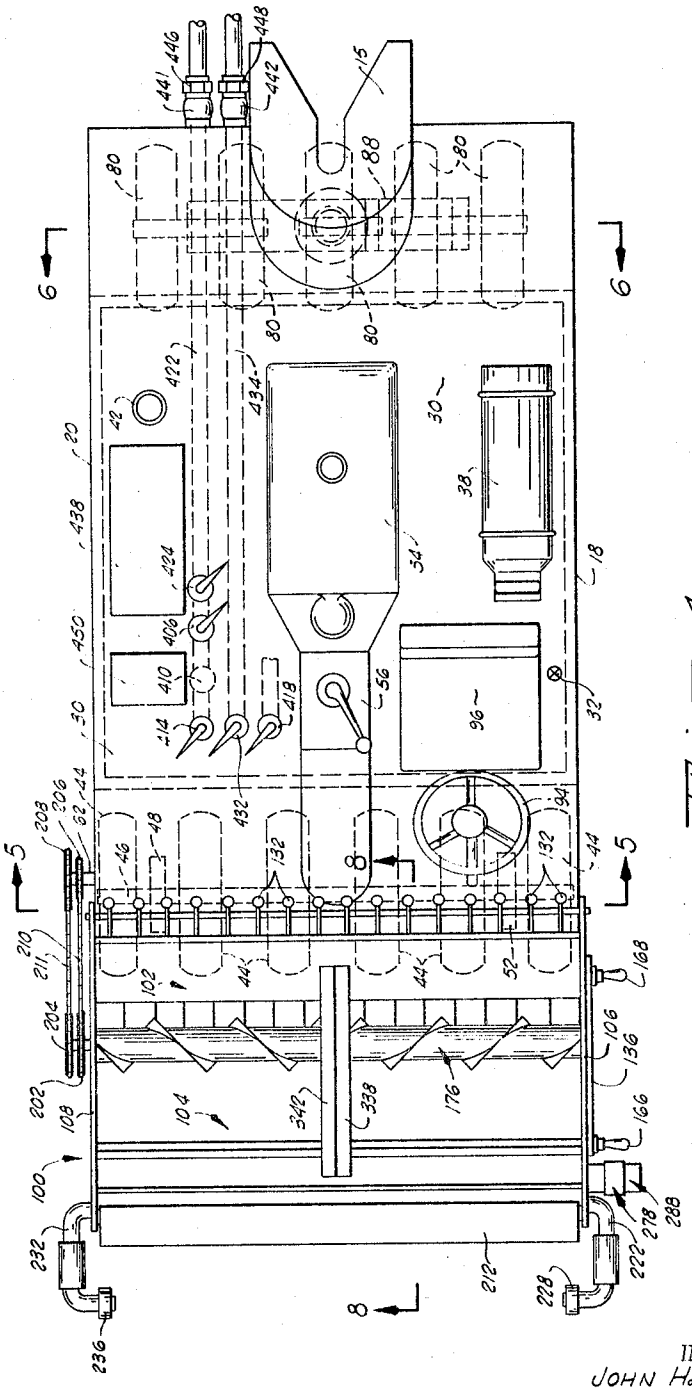

FIG. 4

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UNIVERSAL BITUMINOUS PAVING MACHINE

Filed Jan. 14, 1963 6 Sheets-Sheet 4

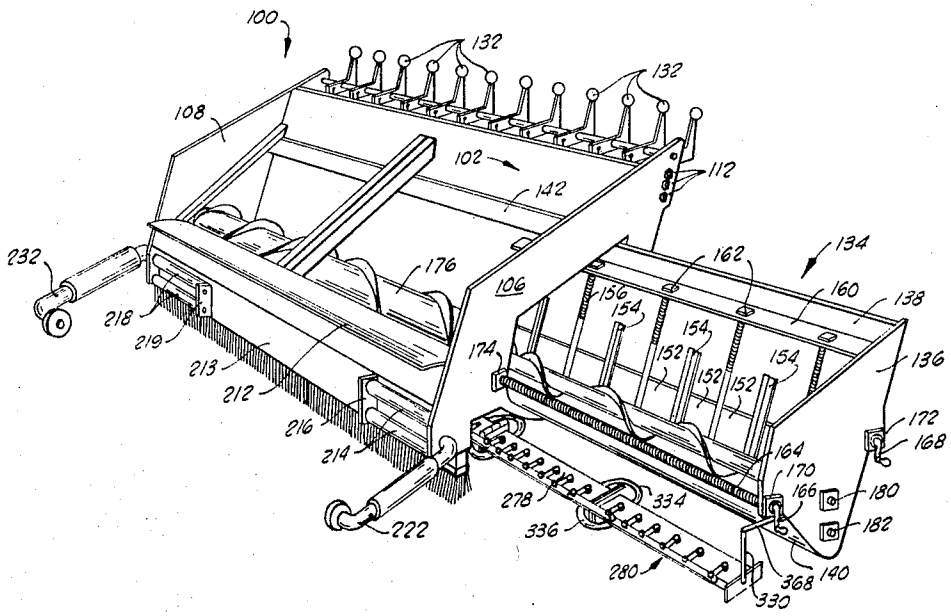

Fig. 1

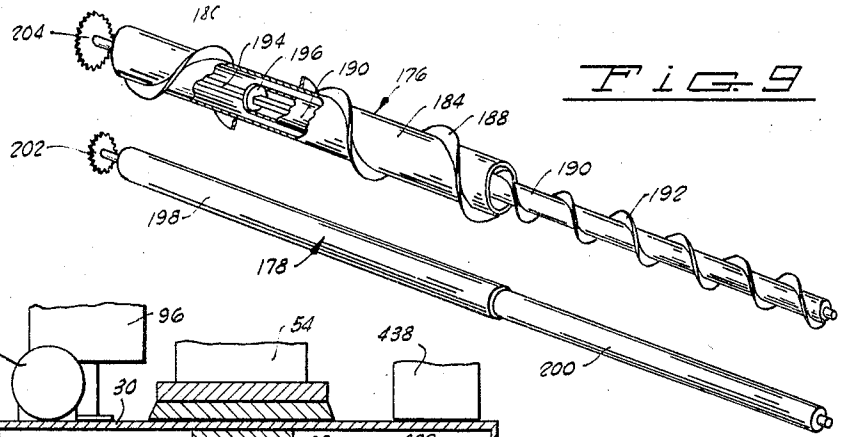

Fig. 9

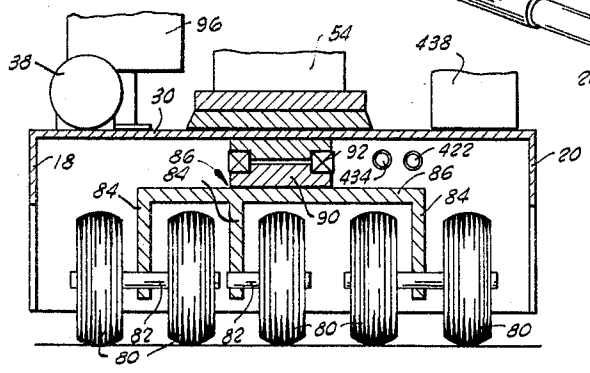

Fig. 6

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UNIVERSAL BITUMINOUS PAVING MACHINE

Filed Jan. 14, 1963 6 Sheets-Sheet 5

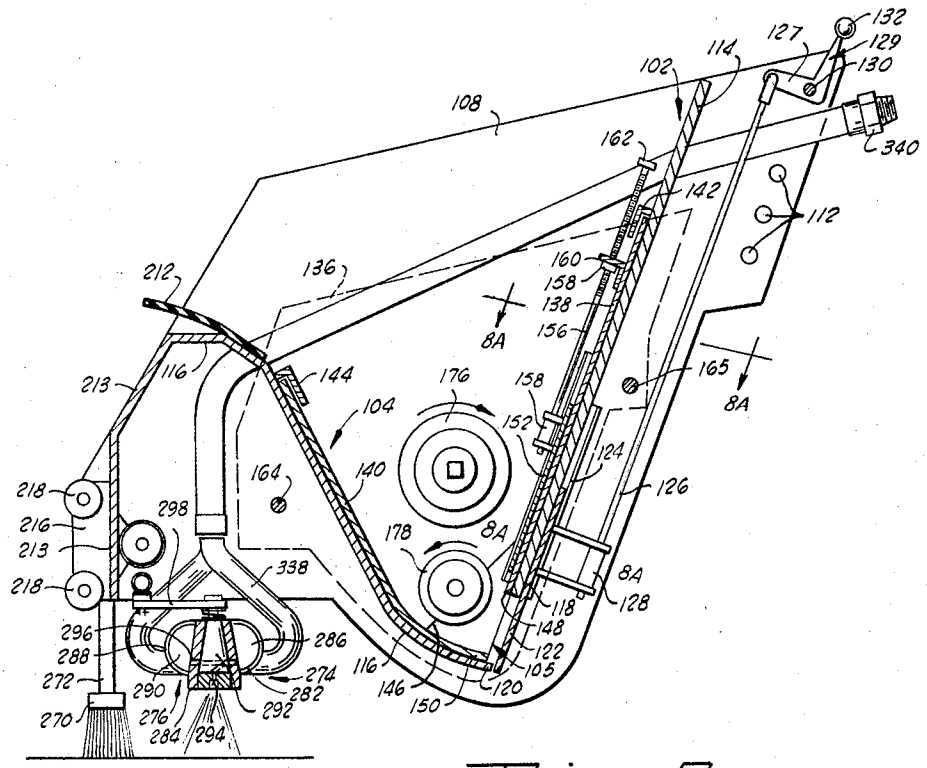

Fig. 8

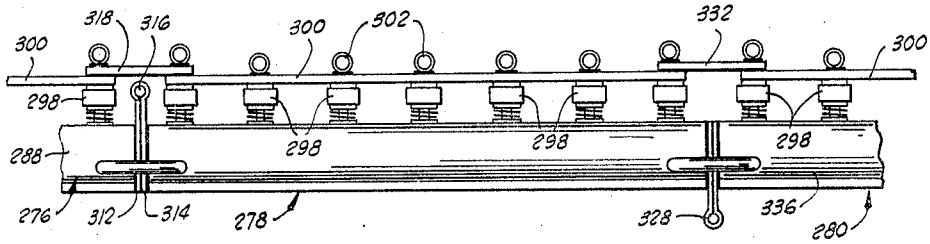

Fig. 12

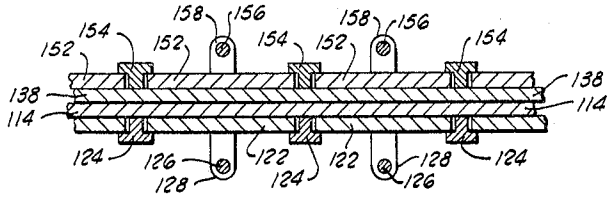

Fig. 8A

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UNIVERSAL BITUMINOUS PAVING MACHINE

Filed Jan. 14, 1963 6 Sheets-Sheet 6

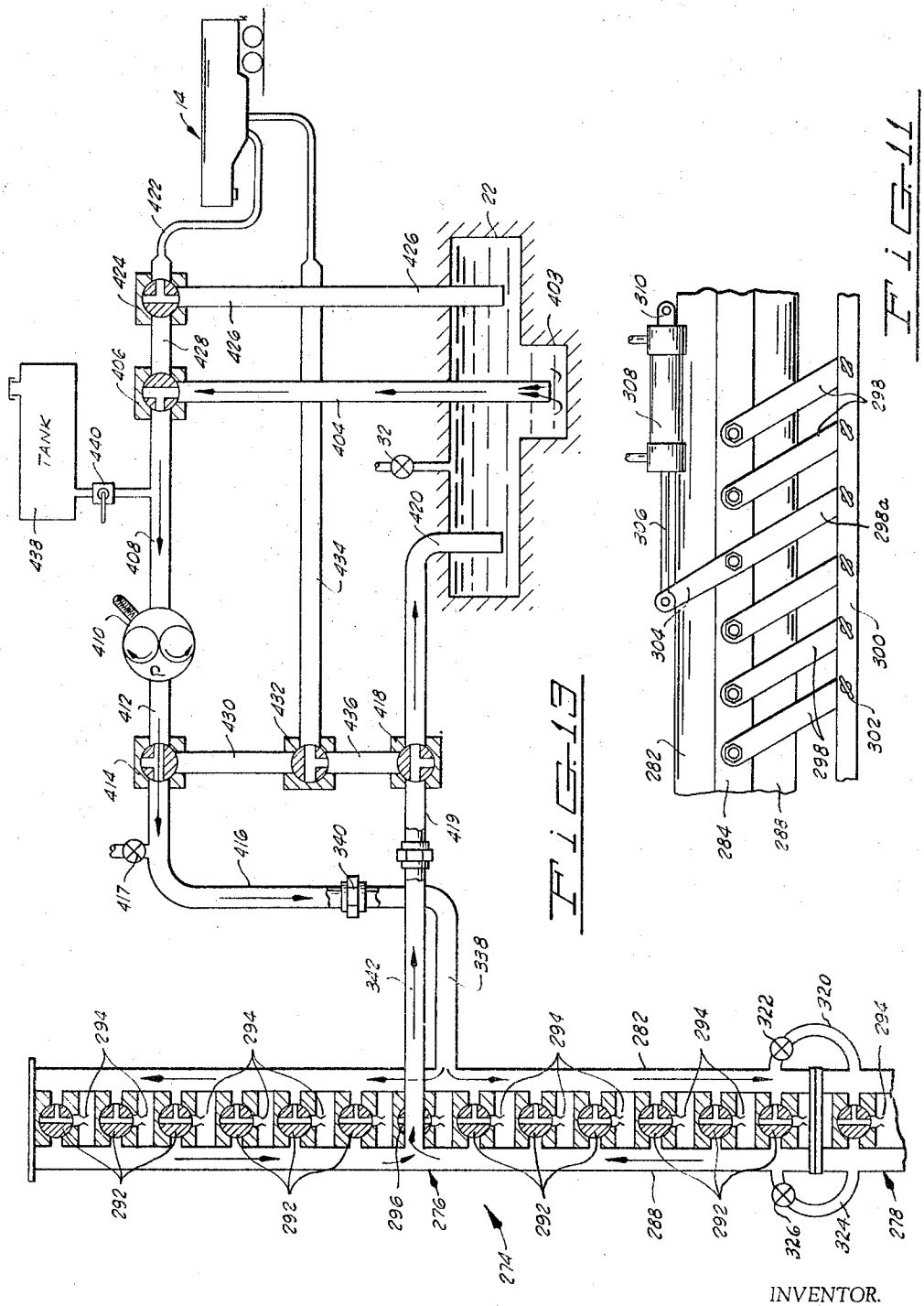

FIG. 11

FIG. 13

FIG. 12

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United States Patent Office

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3,270,633

UNIVERSAL BITUMINOUS PAVING MACHINE

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Filed Jan. 14, 1963, Ser. No. 251,169

7 Claims. (Cl. 94—44)

The present invention relates to the bituminous paving of roads, parking lots, driveways and the like, and more particularly, but not by way of limitation, relates to a paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a course of aggregate over the coat of asphalt, and quickly compacting the aggregate into the asphalt to provide an improved bitumious surface.

As is well known in the art, the methods for applying a bituminous or paved surface to a roadway can be categorized in two broad classes. One class, which is usually more expensive, entails premixing an aggregate with a suitable bituminous binder before spreading the mixture on the roadway and compacting the mixture with a roller. The aggregate is usually crushed stone having relatively small particles of various size and the binder is usually a liquid asphalt. The present invention is concerned with the other class of paving methods wherein the liquid asphalt binding material and the aggregate are applied in separate layers to the roadway and then the aggregate compacted into the binder.

One very common method falling into the latter class is known as a single pass surface treatment or "seal coat." Seal coats may be applied to any prepared surface and are frequently applied to existing bituminous paving in order to provide a new and smoother surface and to make the old paving waterproof, which no doubt gives rise to the term seal coat. A seal coat usually entails the steps of sweeping the old base in order to remove dirt and other foreign matter and then applying a primer coat, such as a thin liquid asphalt, and permitting the primer coat to cure. The seal coat proper is comprised of applying a coat of asphalt binder to the base, covering the coat of asphalt with a layer or course of aggregate, and rolling and brooming the aggregate until the desired surface finish is attained.

Another method of the latter class of road construction is the so-called penetration macadam. In this method, a first layer of coarse aggregate is applied to the roadbed and rolled to compact and lock the aggregate in place. Then a first coat of asphalt binder is sprayed over the first course of aggregate and of course penetrates into the openings between the aggregate particles. Next a second layer of aggregate of smaller size and quantity is applied over the first asphalt binder coat and is rolled into the cracks and voids in the larger aggregate while the binder is still fresh. A second asphaltic binder coat is applied to the second aggregate course and then a third aggregate course of still smaller size and quantity spread over the second asphalt binder coat and rolled to produce the desired final surface texture. The penetration macadam method produces a bituminous surface of considerable thickness which will support substantial loads.

A third method in the latter class which is in common use is the so-called inverted penetration or multiple pass surface treatment. This method is nothing more than two or more single pass coatings or seal coats applied to the same surface. However, the first course of aggregate is usually of larger particle size and is applied in greater quantity and then is keyed by the second aggregate course which is of smaller size to produce substantially the same interlocking effect as the penetration macadam method.

Heretofore, each of the separate steps of applying the liquid asphalt binder, spreading the aggregate and rolling

the aggregate has ben performed by a separate, self-propelled vehicular piece of equipment. For example, the liquid asphalt applicators, which are usually referred to as distributors, comprised relatively large tank trucks having suitable heating means for maintaining the asphalt binder liquid highly fluid, and having a spraybar means extending transversely across the rear of the truck. Application of the aggregate is considerably more difficult because relatively large quantities of the crushed stone is required. Therefore a large number of dump trucks have been used to haul the aggregate to the road site, and a suitable spreader box, either self-propelled or attached to and pulled by the dump trucks, has been used to evenly distribute the aggregate over the asphalt. Separate, self-propelled rollers having large cylindrical steel rollers or a multiplicity of staggered pneumatic wheels have then been passed over the aggregate to compact and press the aggregate into the asphalt. This great variety of machinery resulted in a very expensive operation, in that each of the pieces of equipment is relatively expensive and each required at least one operator. Further, when operating in small areas, such as parking lots, the cost becomes prohibitive if a large quantity of separate pieces of equipment are required.

In more recent times attempts have been made to perfect equipment for performing more than one step of the paving operation during the same pass. For example, several different types of machines have been developed for both applying the liquid asphalt binder and the aggregate. Some of this equipment has means for pushing a dump truck in advance of the machine, an aggregate receiving hopper for receiving aggregate dumped from the truck, a rear distribution hopper and a suitable conveyor belt mechanism for moving the aggregate from the front receiving hopper to the rear spreading hopper. The asphalt is then distributed by a spraybar disposed behind the running wheels of the machine but in front of the distributing hopper for the aggregate such that the aggregate is deposited on top of the asphalt. In addition to requiring the expensive and complicated belt mechanism for transporting the aggregate from the front receiving hopper to the rear distributing hopper, this equipment is limited in capacity by the volume of asphalt which can be transported by the vehicle itself. Further, the asphalt must still be compacted by a separate roller compacting unit. Other machines have combined the functions of distributing aggregate in advance of the vehicle over previously applied asphalt and then compacting the aggregate into the asphalt by the running gear of the machine. This type of machine pulls a dump truck backwards over the aggregate course laid by the machine and the truck dumps its load of aggregate into a receiving hopper disposed at the rear of the machine. Suitable apparatus is then provided for transporting the aggregate from the rear of the machine to a distribution hopper located at the front of the machine. Obviously in this case a separate asphalt distributing vehicle is required in order to precoat the roadbed with asphalt binder before the aggregate is spread. Further, there is always danger that the asphalt binder will become too cooled or contaminated by dirt or rain before covered with aggregate.

One of the greatest disadvantages of all previous equipment is that paving operations can only be performed during periods when the atmospheric temperature is relatively high due to the fact that asphalt becomes highly viscous when cooled so that the aggregate cannot be pressed into and become thoroughly coated by and bonded to the asphalt in cold temperatures. In order to maintain the asphalt sufficiently fluid to be pumped and sprayed from distribution nozzles in a fine coat upon the surface, the asphalt must continually be heated and maintained at a relatively high temperature within the entire asphalt

system. For this reason, various special spraybar constructions have been designed so as to maintain the entire spray nozzle and control valve surrounded by hot asphalt fluid so as to prevent freezing of the asphalt which will disrupt proper operation of the spraybar.

Although the type of bituminous paving with which the present invention is concerned may not, in general, have the lasting qualities of other types of roadway surfacing, it is usually more economical and therefore extensively used for resurfacing old bituminous roadways, widening existing roadways by surfacing the shoulders, surfacing parking lots and driveways, and in more recent times, paving relatively narrow pedestrian walkways and cart trails on golf courses and the like. When paving parking lots and other smaller jobs, the space is highly limited and frequently in close proximity to buildings, fences, shrubbery and the like, and accordingly the conventional equipment used for paving roads cannot be used. Further, the width of the strip which is to be paved in this manner may vary considerably from only a few feet for a cart trail on a golf course to twelve or sixteen feet for one-half of a highway.

The present invention contemplates the novel combination and arrangement of some new and novel components together with some conventional paving components to produce a compact and inexpensive universal bituminous paving machine for performing all necessary steps in the construction of a seal coat type bituminous surface by means of a liquid binder and an aggregate as described above. In particular, the universal paving machine is capable of distributing a coat of asphalt binder, spreading a layer of aggregate over the coat of binder, and then immediately pressing the aggregate into the binder while the binder is still hot and fluid.

Therefore it is an object of the present invention to provide a bituminous paving machine for applying a seal coat to a prepared roadbed by one single pass.

Another object of the present invention is to provide a bituminous paving machine for performing substantially all of the steps required to construct a penetration macadam type surface.

Still another object of the present invention is to provide a bituminous paving machine which can be used to construct an inverted penetration type surface.

Still another object of the present invention is to provide a bituminous paving machine which is completely self-sustained and which provides all the equipment required to pave parking lots and similar restricted and obstructed small areas.

Another object of the present invention is to provide a bituminous paving machine which can be operated in colder atmospheric temperatures.

Yet another object of the present invention is to provide a bituminous paving machine for applying a seal coat of substantially any width, for example, from a few feet for a walkway or cart trail to twelve or sixteen feet for a highway.

Still another object of the present invention is to provide a bituminous paving machine which is very compact and self-propelled yet which can be used to perform the single steps of distributing a liquid primer or asphalt binder, spreading a layer of aggregate, or compacting and rolling the aggregate or other surface in order to attain the desired finished surface.

Still another object of the present invention is to provide a bituminous paving machine which is self-sustaining over long distances and is particularly adapted to apply a substantially finished seal coat to the shoulder of a pavement, requiring only the assistance of the customary dump trucks for transporting aggregate.

A still further object of the present invention is to provide a bituminous paving machine which is compact and self-contained and which is fully roadable, and which can be dispatched as a single piece of equipment operated by a single person to rendezvous with dump trucks at a work site, and there construct a finished, paved surface suitable for use as a parking lot, city street or the like.

Another object of the present invention is to provide a bituminous paving machine which requires only a single operator to perform the many functions of the machine.

Yet another object of the present invention is to provide an aggregate distributing hopper which can be expanded to approximately twice its minimum length in order to spread aggregate over a greater width path.

Another object of the present invention is to provide a universal paving machine of the type described which is considerably less expensive than the several pieces of equipment heretofore required to perform the same paving operations.

Many additional objects and advantages of the present invention will be evident to those skilled in the art from the following detailed description and drawings, wherein:

FIG. 1 is a somewhat schematic side elevational view of a bituminuous paving machine constructed in accordance with the present invention, the paving machine being shown in combination with a conventional dump truck in order to illustrate the operation of the machine;

FIG. 2 is an enlarged side elevational view of the bituminous paving machine of FIG. 1, showing some details of construction in dotted outline;

FIG. 3 is a front elevational view of the bituminous paving machine of FIG. 2, showing the extended position of the novel aggregate receiving and spreading hopper in dotted outline;

FIG. 4 is a plan view of the bituminous paving machine of FIG. 1, showing some features of construction in dotted outline;

FIG. 5 is a sectional view taken substantially on lines 5—5 of FIG. 4;

FIG. 6 is a sectional view taken substantially on lines 6—6 of FIG. 4;

FIG. 7 is a perspective view of the novel aggregate receiving and spreading hopper constructed in accordance with the present invention;

FIG. 8 is a sectional view taken substantially on lines 8—8 of FIG. 4 and showing the relative positions of some components of the hopper in dotted outline;

FIG. 8*a* is an enlarged horizontal sectional view taken substantially on lines 8*a*–8*a* of FIG. 8;

FIG. 9 is a perspective view of the distribution auger and feed roller of the aggregate receiving and spreading hopper of FIG. 5;

FIG. 10 is a plan view, somewhat schematic, of a remotely operatable device for coupling a dump truck to the paving machine;

FIG. 11 is a plan view of a transversely extending section of the novel spraybar construction of the paving machine of FIG. 1;

FIG. 12 is a side elevational view of the extensible portion of the spraybar of the novel hopper and spraybar combination of FIG. 5; and,

FIG. 13 is a flow diagram of the novel liquid handling apparatus of the bituminous paving machine of FIG. 1.

Referring now to the drawings, and in particular to FIG. 1, a bituminous paving machine constructed in accordance with the present invention is indicated generally by the reference numeral **10**. The paving machine **10** comprises a tractor unit, designated generally by the reference numeral **12**, and an auxiliary asphalt supply tank unit, designated generally by the reference numeral **14**. The supply tank unit **14** may be a conventional semitrailer asphalt tank, which is connected to the tractor unit by a conventional fifth wheel **15**, and preferably has a suitable heating unit (not illustrated) for maintaining asphalt at a desired fluid temperature. The supply tank unit **14** may also be provided with suitable pump means or other agitating means for circulating asphalt, or any other bituminous liquid, in order to insure even heating.

The tractor unit **12** is shown in the enlarged views of FIGS. 2, 3 and 4, and comprises a chassis **16** having a

front end and a rear end defining the longitudinal length thereof, the front end being at the left-hand sides of FIGS. 2 and 4 and being that end shown in FIG. 3, and the rear end being at the right-hand sides of FIGS. 2 and 4. The chassis **16** may conveniently be fabricated from a pair of longitudinally extending side plates **18** and **20** which are interconnected by suitable transverse bracing beams (not illustrated). A primary asphalt liquid supply or asphalt ballast tank **22** is formed in the chassis **16** by front plate means **24**, rear plate means **26**, bottom plate means **28** and top plate means **30**, all shown in dotted outline in FIG. 2, which extend transversely between and are connected to the side plates **18** and **20**. The top plate means **30** forms a deck plate which covers substantially the entire unit **10** for supporting other components and hereafter will be referred to as such. All of the surfaces of the tank **22** may be coated with a suitable heat insulating material applied in a conventional manner. The ballast tank **22** is preferably completely fluid-tight and may be provided with a suitable vent which may be closed by a valve **32** protruding from the deck plate **30** in a convenient location. When the valve **32** is closed, the tank **22** is essentially a pressure vessel, for siphoning liquid from the supply unit **14** as will hereafter be described in greater detail. A suitable heating means, indicated generally by the reference numeral **34**, is provided for maintaining the asphalt in the ballast tank **22** at a high temperature. The heating means **34** may conveniently comprise a LPG burner **36** which may be operated from a suitable LPG tank **38** mounted on the deck plate **30**. The gases from the combustion heating unit **36** may pass through a suitable flue **40** coiled within the ballast tank **22** and exit from a stack **42**.

The front end of the chassis **16** is supported by a plurality of transverely spaced pneumatic roller wheels **44** which are connected to a single transversely extending drive axle **46**, as can best be seen in FIG. 5. The axle **46** may be journaled in three transversely spaced pedestals **48**, **50** and **52** by suitable bearings which are schematically illustrated. The drive shaft **46** and therefore the support wheels **44** are driven by a prime mover **54** which is mounted on a deck plate **30** in any convenient manner. By combined reference to FIGS. 4 and 5, it will be noted that the prime mover **54** drives a transmission gear box **56** which in turn drives a shaft **58** by means of a universal joint **60**. The shaft **58** drives a transversely extending shaft **62** by means of intermeshing bevel gears **64** and **66**. The transversely extending shaft **62** may be journaled by any suitable means on the chassis **16**, such as by journal bearings in the pedestals **48** and **52**, and extends beyond the right-hand side of the chassis **16**. A pair of disengageable chain sprockets **68** and **70** are mounted on the shaft **62** and a pair of chain sprockets **72** and **74** are mounted on the shaft **46**. The chain **76** passes over the sprockets **68** and **72** and a similar chain **78** passes over the sprockets **70** and **74** to complete the drive train from the prime mover **54** to the shaft **46** and therefore the wheels **44**. Thus it will be noted that the prime mover **54** is connected to drive the front support wheels **44** in order to propel the tractor unit **12**. The sprockets **68** and **70** are preferably disengageable from the drive shaft **62** at the option of the operator so that other equipment can be operated without driving the tractor unit **12** as will hereafter be described in greater detail.

Referring now to FIGS. 2, 4 and 6, the rear end of the chassis **16** is supported by a plurality of support roller wheels **80** which are disposed at transversely spaced positions, substantially as shown in FIG. 4, so as to be aligned between each of the front roller wheels **44**. The roller wheels **80** are each supported on a stub axle **82** which in turn protrude horizontally from the vertically disposed finger portions **84** of a triple yoke **86** having a transverse crossbar **88**. The triple yoke **86** has a load bearing member **90** which is rotatably connected to the chassis **16** through suitable bearing means **92**. Suitable conventional steering linkage means (not illustrated) is operated by a steering wheel **94** and pivots the yoke **86** so that the tractor unit **12** can be steered by an operator sitting in the seat **96** which is disposed behind the steering wheel **94** and connected to the deck plate **30**.

As previously mentioned, the support roller wheels **80** are aligned so as to track between the front support roller wheels **44**. Therefore, the front support wheels **44** and rear suport wheels **80** in combination form a continuous, transversely extending roller means for compacting aggregate, as will hereafter be described in greater detail. It will be appreciated that other types of compacting roller means may be used for both supporting the chassis **16** and providing a uniform, transversely extending compacting means for compacting aggregate, such as, for example, conventional steel cylindrical rollers. However, the pneumatically inflated roller wheels **44** and **80** will usually be preferable so that the tractor unit **12** will be roadable without damage to streets and the like, as will hereafter be described. It will also be appreciated that the front wheels **44** could be made steerable and the rear wheels **80** driven by the prime mover **54** if desired.

An aggregate receiving and spreading hopper, indicated generally by the reference numeral **100**, is connected to the front end of the chassis **16**. The hopper **100** is comprised of a rear transversely extending wall means **102** which is disposed in generally vertical position, and a front transversely extending wall means **104** which is disposed in upwardly diverging relationship to the rear wall means **102** in order to form an enlarged opening at the top for receiving aggregate from a dump truck, and to form a transversely extending elongated slot **105** at the bottom for dispensing the aggregate in a uniform layer upon the ground, as will hereafter be described in greater detail. The rear wall means **102** and the front wall means **104** are interconnected by side plates **106** and **108** to form an integral structure. The side plates **106** and **108** may ovelap the forward ends of the chassis side plates **18** and **20**, respectively, and may be supportably connected thereto by suitable nut and bolt fastening means **110**, which may pass through the apertures **112** illustrated in FIGS. 7 and 8.

Referring now to the details of FIGS. 7, 8 and 8*a*, the rear wall means **102** is comprised primarily of a generally rectangular plate **114** the ends of which are welded to the two side plates **106** and **108**. The front wall means **104** is comprised primarily of a curved plate **116** which also extends between and is welded to the side plates **106** and **108**. It will be noted that the lower end **118** of the rear plate **114** is slightly spaced from the lower end **120** of the front plate **116** to form the elongated slot **105**. However, the width of the elongated slot **105** can be adjusted or the slot completely closed by a plurality of gates **122** which are held in sliding contact with the back side of the rear plate **114** by a plurality of T-shaped flange strips **124** which are disposed in vertical position between each adjacent pair of gate members **122**. As can best be seen in FIG. 8*a*, the flange strips **124** have flange portions which extend over the edges of the gates **122** so as to permit vertical sliding movement of the gates **122**. The lower end of a tie rod **126** is connected by a suitable bracket means **128** to each of the gates **122**. The upper end of the tie rod **126** is pivotally connected to one lever arm **127** of an actuating lever means **129** which is pivotally journaled on a rod **130** extending transversely between the side plates **106** and **108**. When the upwardly extending lever arms **132** of the actuating lever means **129** are pivoted about the rod **130**, the corresponding gate **122** will be raised or lowered, as will be evident to those skilled in the art, to open or close a portion of the transversely extending slot **105** in the bottom of the hopper **100**. The actuating lever means **129** of the several gates may be interconnected by a gang bar (not illustrated) for simultaneous actuation at the option of the operator, and suitable means may also be provided

for adjusting the position of the gates **122** when they are moved to the up or open position in order to predetermine the width of the slot **105** and therefore the quantity of aggregate which will be dispensed, as hereafter described in greater detail.

An extensible portion of the hopper **100**, indicated generally by the reference numeral **134** in FIG. 7, is telescopically received in the main hopper **100** and is comprised generally of an end plate portion **136** which interconnects the ends of a transversely extending rear extension plate **138** and a transversely extending front extension plate **140**. The rear plate **138** rides flat against the rear plate **114** and the front plate **140** is contoured to ride flush against the front plate **116**, as can best be seen in FIG. 8. The upper edge of the rear plate **138** is contained by a flange strip **142** which is welded to the back plate **114** and the upper edge of the front plate **140** is contained by a similar flange strip **144** which is welded to the front plate **116**. The innermost corners of the extensible plates **138** and **140** may be interconnected by a small brace **146** to provide a rigid structure. Thus it will be noted that the extensible portion **138** is free to slide outwardly from the side plate **106** substantially as shown in FIG. 7 and that the upper edges of the extensible plates **138** and **140** will continually be contained in the flange strips **142** and **144** in order to support the extensible portion **134** in cantilevered relationship to the main hopper portion **100**. When the extensible portion **134** is retracted, as illustrated in FIG. 4, the end plate **136** coacts with the side plate **106** to form the end wall to the main hopper **100**.

The lower end **148** of the rear extension plate **138** is spaced from the lower end **150** of the front extension plate **140** a distance corresponding approximately to the spacing between the lower ends **118** and **120** of the main rear plate **114** and the main front plate **116** to form a continuation of the slot **105** when extended. The slot **105** can be partially or completely closed by a series of gates **152** which are similar in construction to the gates **122** and which are retained in vertically sliding contact with the rear extension plate **138** by a plurality of T-shaped retainer strips **154** which are similar in construction to the flanges **124**, as can best be seen in FIG. 8*a*. A threaded rod **156** is connected to each of the gates **152** by a suitable journal bracket **158** which will permit rotation of the rod **156**. The rod **156** is threaded through a nut **159** which in turn is connected to the flange of an angle iron strap **160** which is welded to the rear extension plate **138**. The upper end of the rod **156** is provided with a bolt head **162** so that the rod **156** can be rotated in the nut **159** to adjustably raise and lower the respective gates **152** in a manner which will be obvious to those skilled in the art, so as to open or close or adjust the width of the elongated slot formed between the rear extension plate **138** and the front extension plate **140**. The extensible hopper portion **134** may be extended and withdrawn by a pair of threaded rods **164** and **165** (see FIG. 8) which can be rotated by hand cranks **166** and **168**. The outer ends of the threaded rods **164** and **165** are journaled in suitable bearing means **170** and **172**, respectively, which are connected to the extensible end plate **136** and are threadedly received in suitable nut means **174** connected to the side plate **106**.

A telescoping auger roller **176** and a telescoping feed roller **178** are disposed in the hopper **100** and extend between and are rotatably journaled by suitable bearing means **180** and **182**, respectively, in the end plate **136** of the extensible hopper portion and by similar bearing means (not illustrated) in the side plate **108**. The auger roller **176** has a cylindrical primary portion **184** about which are disposed conventional auger convolutions **186** and **188** which are so arranged as to move aggregate from the center to the outer ends of the hopper. The body of the primary roller **184** is fabricated from a length of cylindrical pipe and receive a secondary or extensible portion **190** which also has auger convolutions **192** for moving aggregate outwardly from the primary roller **176** to the end of the extensible hopper portion **134**. The extensible auger portion **190** may be keyed within the primary auger portion **184** by any suitable means such as a square key rod **194** which passes through a square aperture in the end plate **196** of the center roller **190**. Therefore, as the extensible hopper porion **134** is extended, the extensible portion **190** will be withdrawn from the major portion **184** of the auger roller **176** and the square rod **196** and apertured end plate **196** will provide a positive drive regardless of the position of the hopper extension. The feed roller **178** is also provided with a primary portion **198** which telescopically receives an extensible portion **200**. The extensible portion **200** may be keyed to rotate with the major portion **198** by a square rod and aperture arrangement similar to the square rod **194** and aperture in the end plate **196** of the auger roller **176**. The feed roller **178** may have any suitable longitudinally extending serrations or other means thereon for creating flow of aggregate between the roller **178** and the front plate **116** or **140**, depending upon the position of the extensible portion **134**, as will hereafter be described in greater detail.

A shaft (not referenced) is connected to the auger roller **176** and extends through the side plate **108** and carries a chain sprocket **204**. A similar drive shaft is connected to the feed roller **178** and passes through the side plate **108** and carries a chain sprocket **202**. A pair of disengageable chain sprockets **206** and **208** are connected to the shaft **62**, as best seen in FIG. 5. An endless chain **210** passes over the sprockets **202** and **206**, and a similar chain **211** passes over the chain sprockets **204** and **208**. Suitable clutch means (not illustrated) are preferably provided for selectively disengaging the chain sprockets **206** and **208** so that the auger roller **176** and the feed roller **178** can be selectively operated at any time.

A resilient flapper strip **212** is connected to the top edge of the front plate **116** for providing a resilient seal with a dump truck in order to reduce spillage of aggregate, as will hereafter be described in greater detail. A front bumper plate **213** is connected at its upper end to the front plate **116** and along the opposite edges to the side plates **106** and **108** and extends downwardly, as best seen in FIG. 8. A pair of rollers **214** are journaled between a vertically extending bracket plate **216** which is connected to the bumper plate **213** and the left-hand side plate **106**. It will be noted that the rollers **214** are vertically spaced and extend transversely across the traction unit **12** and are positioned at a height above the ground so as to engage and push the left rear wheels of a dump truck as illustrated in FIGS. 1 and 2. A similar pair of rollers **218** are journaled between a bracket plate **219** and the right-hand side plate **108** and are so positioned to engage the right rear wheel of a dump truck.

A hookup device for connecting the tractor unit **12** to a dump truck is indicated generally by the reference numeral **220** and is illustrated somewhat schematically in FIG. 10. The hookup device **220** is described in detail and claimed in my U.S. Patent No. 3,138,392, issued June 23, 1964 and entitled "Equipment Hookup Device." The hookup device **220** comprises a lefthand arm **222** which has a journal pin portion **224** and a cleat portion **226** upon which a roller **228** is journaled for engaging the rim of a dump truck wheel as hereafter described. A sleeve roller **229** is journaled on the arm **222** for engaging the tire of a dump truck wheel, as hereafter described. The journal pin portion **224** and cleat portion **226** are horizontally disposed in parallel relationship and extend transversely across the tractor unit **12**. The journal pin portion **224** extends through a suitable aperture in the side plate **106** and is rotatably and slidably received within a journal sleeve **230** which may be welded or otherwise connected to the front bumper plate **213**. A similar, right-hand arm **232** has a forward cleat por-

tion 234 upon which a roller 236 is journaled, and a journal pin portion 238 which extends through the side plate 108 and is slidably received within a journal sleeve 240 which also may be welded to the front bumper plate 213. A sleeve roller 241 similar to the sleeve roller 229 is journaled on the arm 232.

A fluid cylinder 242 is connected to the front bumper plate 213. A piston 244 is connected to a piston rod 246 which extends through the end of the fluid cylinder 242 and is connected to the journal pin portion 224. A second fluid piston 248 is connected to a piston rod 250 which extends through the other end of the fluid cylinder 242 and is connected to the journal pin portion 238. A fluid conduit 252 provides continuous fluid communication between the outer ends of the cylinder 242. A fluid conduit 254 is connected to the fluid conduit 252 for introducing and relieving fluid from the outer ends of the fluid cylinder 242. A fluid conduit 256 is connected to introduce fluid to the center of the fluid cylinder 242 between the pistons 244 and 248. A cam disc 259 is connected to the end of the journal pin portion 224 and slides along a cam stop 260 which may be connected to the plate 213. The cam disc 259 engages the cam stop 260 and limits the downward pivotation of the arm 222 so as to maintain the roller 228 sufficiently high to pass over the rim of the rear wheel of a dump truck, as will hereafter be described. A similar cam disc 262 is connected to the journal pin portion 238 and engages an elongated cam stop 264 for limiting the downward pivotation of the arm 232.

A suitable means is provided for introducing hydraulic fluid through the conduit 256 to the center of the fluid cylinder 242 while permitting the escape of fluid from the outer ends of the cylinder 242 through the fluid conduits 252 and 254. Or, in the alternative, the fluid means may introduce fluid under pressure through the conduits 252 and 254 to the outer ends of the fluid cylinder 242 to force the pistons 244 and 248 together while permitting the escape of fluid from the center of the fluid cylinder 242 through the fluid conduit 256. When fluid is introduced between the pistons 244 and 248, the arms 222 and 232 will be moved apart a sufficient distance for the rear wheels 257 and 258 of a dump truck to pass between the cleat means 226 and 234. Then fluid is introduced through the conduit 254 to force the pistons 244 and 248 together and draw the arms 222 and 232 together until the rollers 228 and 236 enter the rims of the wheels 257 and 258 substantially as illustrated in FIG. 10. The sleeve rollers 229 and 241 journaled on the arms 222 and 232 engage the outer face of the wheels 257 and 258 in order to properly space the rollers 228 and 236 and prevent frictional engagement between the arms and the wheels. It will be appreciated that the hookup device 220 may easily be actuated by the operator sitting in the seat 96, as will be described in greater detail. A broom 270 may be suspended from the lower end of the plate 213 by suitable bracket means 272 for spreading any aggregate which may be spilled by the dump truck, as hereafter described.

An elongated spraybar means, indicated generally by the reference numeral 274 is disposed transversely of the chassis 16 beneath the front wall means 104 of the aggregate hopper 100 and in front of the elongated slot 105 formed in the bottom of the hopper at the junction between the lower ends of the rear wall means 104, as can best be seen in FIG. 8. The spraybar means 274 is preferably of the type disclosed in greater detail in my U.S. Patent No. 3,120,927, issued February 11, 1964, and entitled "Improved Spraybar," and comprises a primary section 276, a first extensible section 278 which is pivotally connected to the end of the primary section 276, and a second extensible section 280 which is pivotally connected to the end of the first extensible section 278 so that the extensible section can be folded and withdrawn, as will hereafter be described in greater detail. Each of the three sections is of substantially identical construction and each has a cross sectional view substantially as illustrated in FIG. 8.

Referring now to FIG. 8, the primary section 276 is comprised of a liquid inlet manifold 282 which is connected to a valve body housing 284 in such a manner as to form an inlet passageway 286. A return flow manifold 288 is connected to the opposite side of the valve body housing 284 to form a return flow passageway 290. A plurality of three-way valve bodies 292 are rotatably disposed within valve cavities in the valve body housing 284 and each alternately controls the passage of liquid from the inlet manifold 282 either through a spray nozzle 294 or through a bypass passageway 296 to the return flow manifold 288. For convenience of discussion, the three-way valves 292 will be considered in the "shoot" position when fluid communication is established between the inlet manifold and the nozzles 294, and in the "bypass" position when fluid communication is established between the inlet manifold and the return flow manifold.

Each three-way valve 292 is actuated by a lever arm 298 which is connected to a stem portion which protrudes through the top of the valve body housing 284. As can best be seen in FIGS. 11 and 12, the several lever arms 298 of the several valve bodies 292 are interconnected by a common gang bar 300, so as to provide simultaneous operation of all three-way valves 292. The lever arms 298 are preferably releasably connected to the gang bar 300 by removable pins 302 which can be removed individually so as to selectively disconnect any one of the three-way valves from the gang bar for purposes which will hereafter be described in greater detail. One of the lever arms 298*a* (see FIG. 11) has an extension portion 304 to which the piston rod 306 of a suitable fluid motor 308 is pivotally connected. The cylinder of the fluid motor 308 may be pivotally connected by a suitable bracket 310 to the inlet manifold 282. Upon actuation of the fluid motor 308 by controls located within access of an operator sitting in the seat 96, all three-way valves 292 may be simultaneously moved between the "shoot" and "bypass" positions.

The first extensible section 278 is of substantially identical construction to the primary section 276 and the like parts are designated by the same reference numerals. The ends of both the primary section 276 and first extensible section 278 are closed by blind plates 312 and 314 which are pivotally interconnected by a pin to form a hinge 316. The actuating lever arms 298 of the first extensible section 278 are also interconnected by a gang bar 300 and pins 302 to provide simultaneous operation. A linkage bar 318 may jump the hinge 316 to interconnect a gang bar of the primary section 276 to the gang bar of the first extensible section 278. A jumper conduit 320 (see FIG. 13) interconnects the inlet manifold 282 of the primary section 276 and the inlet manifold 282 of the first extensible section 278. A valve 322 may be provided in the flexible conduit 320 to isolate the extensible sections 278 and 280. A similar flexible conduit 324 interconnects the return flow manifold 288 of the primary section 276 and the return flow manifold of the first extensible section 278. A valve 326 is also provided in the flexible conduit 324 for isolating the extensible section.

The second extensible section 280 is of the same type construction and like parts are designated by the same reference numerals. The section 280 is connected to the first extensible section 278 by a suitable hinge 328. However, it will be noted that the pin of the hinge 328 is below the two spray-bar sections 278 and 280 so that the two sections may be folded and withdrawn as shown in FIG. 3. It will also be noted that with this hinge arrangement, only the outer end of the second extensible section need be supported when the two sections are extended, as by the cable 330 in FIG. 7, which is connected to the extensible portion of the aggregate hopper. The valve actuating lever arms 298 of the second section

are also interconnected by a gang bar 300 which can be connected to the gang bar 300 of the first section 278 by a jumper bar 332. Flexible conduits 334 and 336 (see FIG. 7) interconnect the inlet manifolds and return flow manifolds, respectively, of the two extensible sections.

Hot asphalt or other liquid is introduced to the input manifold 282 by a conduit 338 which extends upwardly then passes through the front wall means 104 and the rear wall means 102 of the hopper 100. A coupling 340 is provided for connecting the conduit 338 to a conduit extending from a liquid pump hereafter to be described. Asphalt is returned to the supply system presently to be described by means of a conduit 342 which is preferably placed in heat exchange relationship with the conduit 338 and also passes through the front and rear wall means 104 and 102, respectively, as can best be seen in FIGS. 3, 4 and 8.

Referring to FIG. 13, which is a schematic piping diagram of the fluid handling system of the bituminous paving machine 10, it will be noted that all components of the spraybar means 274 are indicated by the same reference numerals. It will also be noted that the asphalt ballast tank 22 is illustrated as having a sump 403. It will be recalled that the valve 32 is a vent valve which can be closed to make the tank 22 airtight so as to effectively siphon liquid from the auxiliary supply tank 14, as will hereafter be described. A suction line 404 extends into the sump 403 and is connected to a three-way valve 406. Another conduit 408 is connected to the valve 406 and to a pump 410 which may be either a positive displacement pump or a constant pressure type pump, as will hereafter be evident. A conduit 412 is connected to the output of the pump 410 and to a three-way valve 414. A conduit 416 interconnects the valve 414 and the conduit 342. A vent valve 417 is provided in the conduit 16 for cleaning purposes hereafter described. Thus it will be seen that a fluid path is established from the sump 403 through the pump 410 to the input manifold 282 of the spraybar means 274 when the valves 406 and 414 are in the positions illustrated in FIG. 14.

The return flow line 338 is connected to a three-way valve 418 by a conduit 419 and a conduit 420 connects the valve 418 to the tank 22 so that fluid from the spraybar means 274 can be returned to the tank 22. A conduit 422 connects the bottom of the auxiliary supply tank 14 and a three-way valve 424. The valve 424 is connected by a conduit 426 to a point in the bottom of the primary supply tank 22 and by a conduit 428 to the valve 406. Therefore, depending upon the positions of the three-way valve 424 and the valve 406, the auxiliary supply tank 14 can be connected either to the primary supply tank 22, to the pump 410, or to the sump 403. A conduit 430 interconnects the valve 414 and a three-way valve 432. A conduit 434 is conected to the valve 432 and to the auxiliary supply tank 14. A conduit 436 connects the three-way valve 432 to the three-way valve 418. A tank 438 is connected by a stopcock 440 to the conduit 408 so that kerosene or other cleaning fluid can be circulated through the system by the pump 410.

As much of the piping shown in FIG. 4 as possible is located within the heated ballast supply tank 22. For example, the valves 406, 414, 418, 424 and 432 will all normally be submerged in the hot liquid in the tank 22. However, actuating levers for the various valves extend above the deck plate, as best seen in FIG. 4, for easy operation. The positive displacement pump 410, as best seen in FIG. 2, and the various conduits 404, 408, 420, 428, 430, 436, and portions of conduits 419, 416, 422 and 434 will also be submerged in the hot asphalt in the tank 22. The conduits 422 and 434 may conveniently extend from the rear end of the tractor unit 12 as best seen in FIGS. 2 and 4 and preferably are provided with valves 441 and 442, respectively, and quick-connect couplings 446 and 448, respectively, for purposes which will presently be described. The pump 410 may be driven by a prime mover 450 mounted on the deck plate 30 as best seen in FIGS. 3 and 4.

Operation

In order to fill the ballast supply tank 22, the conduit 422 may be connected to a source of supply and the liquid drawn in through the valves 424 and 406 by the pump 410 and pumped through the valve 414, valve 432, conduit 436 and conduit 420 into the tank 22. During this operation the vent valve 32 should be open. Of course, during this operation the valve 424 will close the conduit 426, the valve 406 will close the conduit 404, the valve 414 will close the conduit 416, the valve 432 will close the conduit 434, and the valve 418 will close the conduit 419. When the ballast supply tank 22 is filled, the pump 410 may be used to fill the auxiliary supply tank 14 merely by shifting the valve 432 to close the conduit 436 and open the conduit 434. When both tanks are full, the conduit 422 can be connected to the suction line of the tank 14.

Circulation of hot asphalt through the entire system can then be accomplished by closing the vent valve 32 and withdrawing fluid from the sump 403 through the conduit 404 and the valve 406 to the pump 410, then pumping it through the valve 414, the conduits 416 and 338 to the inlet manifold 282, through the bypass passageways of the three-way spray valves 292 into the return flow manifold 288 and through conduits 342 and 419 to the valve 418, then through the valve 432 and conduit 434 to the auxiliary supply tank 14. Circulation from the auxiliary supply tank 14 will then be established by siphoning through the conduit 422, the valve 424, and the conduit 426 back to the ballast supply tank 22 which, it will be recalled, will then be under vacuum pressure because the vent valve 32 is closed. Thus, the single pump 410 can provide the necessary agitation for the asphalt in both the tank 22 and the tank 14 as well as providing continuous circulation through the spraybar means 274 in order to prevent the cooling and congealing of asphalt in any of the systems when the device 10 is not in use. Of course, the automatic heating system in both the auxiliary supply tank 14 and the ballast supply tank 22 will assist in supplying the heat necessary to maintain the asphalt at a constant high temperature. If a separate circulation pump is provided to insure agitation of the asphalt in the auxiliary supply tank 14, circulation of asphalt can be maintained through the spraybar means 274 by withdrawing asphalt from the sump 403 through the valve 406 to the pump 410, then through the valve 414 and the spraybar 274 back to the ballast supply tank 22 merely by shifting the valve 418 to open the conduit 420 and close the conduit 436, so that the recirculated asphalt will be returned to the main ballast tank 22 rather than to the auxiliary supply tank 14. Needless to say, so long as no fluid is removed from the system, no fluid will be siphoned through the conduit 422, the valve 424 and the conduit 426. The spraybar means 274 can be bypassed if desired by shifting valve 414 to close conduit 416 and open conduit 430, shifting valve 432 to close only conduit 434, and shifting valve 418 to close conduit 419 and open conduit 420. It will also be appreciated that in the event it is desired to fill the ballast supply tank 22 from the auxiliary supply tank 14, the conduit 422 is merely connected to the supply tank 14 and fluid pumped either through the spraybar means 274 and valve 418 or the valve 414 shifted so as to direct fluid through the valves 432 and 418.

When it is desired to spray the hot asphalt onto a road surface as will hereafter be described in greater detail, the three-way spray valves 292 are shifted to the "shoot" positions illustrated in FIG. 14 so as to establish fluid communication between the inlet manifold 282 and the spray nozzles 294. Asphalt can then be pumped from the sump 403 through the valve 406, the valve 414 and

conduits 416 and 338 to the inlet manifold 282. As the asphalt is pumped from the ballast supply tank 22, asphalt will automatically be siphoned at the same rate from the auxiliary supply tank 14 through conduit 422 and valve 424, which is shifted to close conduit 428, and through conduit 426 to maintain the ballast supply tank 22 filled at all times and at a constant heavy weight. During spray operation, there will be no return flow of asphalt through the return flow manifold 288, unless it is desired to provide some return flow in order to assist in maintaining the return flow manifold 288 and associated conduits at a high temperature. In that event bypass means can be provided through the valve body housing 284 to provide limited fluid communication between the outer ends of the inlet manifold 282 and the return flow manifold 288. This can be accomplished in any one of several ways such as by disconnecting the three-way valves at the ends of the spraybar means 274 from the gang bars and manually switching them to the "bypass" positions. Or, small bores may simply extend through the valve body housing and provide continuous, restricted, fluid communication between the two manifolds. The return flow can be established either to the ballast supply tank 22 or to the auxiliary supply tank 14, depending upon the setting of the valve 418, as previously described. Of course, if no circulation pump is provided in the auxiliary supply tank 14, it will be highly desirable to provide a return flow to the auxiliary supply tank 14 in order to provide the desired agitation.

It will thus be appreciated that by reason of the novel arrangement of piping shown in FIG. 13, the pump 410 can be used to fill and empty both the supply tank 14 and the ballast supply tank 22, can be used to transfer fluid from the auxiliary supply tank 14 into the ballast supply tank 22 or from the ballast tank 22 to the auxiliary tank 14, and can be used to provide simultaneous recirculatory agitation both for the auxiliary supply tank 14 and the ballast supply tank 22, or separate recirculatory agitation for either. Further, all phases of recirculatory agitation can be conducted whether the three-way valves 292 are in "shoot" or "bypass" position, or the spraybar can be bypassed.

When it is desired to purge the system of asphalt, the valve 414 may be shifted to close the conduit 416 and open conduits 412 and 430, the vent valve 417 opened and the three-way spray valves 292 moved to "bypass" position. The pump 410 can then withdraw fluid from the sump 403 through the valve 406 and pump it through the valves 414 and 432 and the conduit 434 either to the auxiliary supply tank 14 or to any other suitable storage facility. As the asphalt is pumped from the ballast tank 22, a suction will be created and atmospheric pressure entering the vent valve 417 will purge the spraybar means 274 and conduits 438 and 416. Or, the pump 410 can be reversed, the vent valve 32 on the ballast supply tank 22 opened and the asphalt withdrawn from the ballast tank 22 and the spraybar means 274 and passed from the system through conduit 422. After the major portion of the asphalt has been pumped from the system, kerosene or other asphalt solvent may be introduced to the system from the tank 438 by opening the stopcock 440. The kerosene may then be pumped through the spraybar means 274 and the three-way valves 292 momentarily shifted from "bypass" position to "shoot" position to provide thorough and complete cleaning of the entire system. By reversing the pump 410, the kerosene can be returned to the tank 438 by closing the conduit 408 by the valve 406.

Assume now that the bituminous paving machine 10 is to be used to apply a seal coat approximately eight feet wide to the shoulder of an existing highway. Of course the shoulder would, for a substantial distance in advance, be prepared for paving by grading, brooming and by applying a primer coat if required. Next the asphalt supply tanks of the paving machine 10, including the ballast supply tank 22 and the semitrailer auxiliary tank 14, would be charged with liquid asphalt from a suitable source as described above. The necessary burners to heat the asphalt should be lighted and circulation established by means of the pump 410 through the spraybar means 274 through the ballast supply tank 22 and auxiliary supply tank 14, as described above.

After the desired operating temperature has been reached and the desired pressure or volume flow conditions established in the spraybar means 274, the paving machine 10 is moved into position on the shoulder to be paved. This can, of course, be easily accomplished by means of the prime mover 12 which drives the front roller wheels 44 as previously described. Next a dump truck 500 is backed against the roller means 214 and 218 substantially as shown in FIG. 2. Of course, the arms 222 and 232 would initially be spread sufficiently for the rear wheels of the dump truck to pass therebetween, as previously described. The arm means 222 and 232 can then be moved together by the fluid motor means previously described so that the rollers 228 and 236 will engage the rims of the rear wheels and hold the rear wheels in close proximity to the rollers 214 and 218, substantially as shown in FIG. 10. The loadbed of the dump truck 500 is then raised to dump a portion of its load of aggragate into the receiving and spreading hopper 100. If desired, the spreading auger 176 can be actuated initially without moving the machine 10 in order to spread the aggregate uniformly over the length of the hopper 100 by disengaging the chain sprockets 68 and 70 and the dispensing roller sprocket 208 from the shaft 62. Then operation of the spreading auger 176 can be controlled by the transmission and clutch disposed between the prime mover and shaft 62. The dump truck 500 is thrown out of gear so that it can be pushed by the paving machine 10.

Next the chain sprockets 208, 206, 68 and 70 are engaged with the transversely extending drive shaft 62. The main clutch for the prime mover 12 may then be slowly engaged so as to smoothly start the dump truck 500 and the paving machine 10 forward while simultaneously starting rotation of the auger roller 176 and the feed roller 178. Upon reaching the desired starting point, the fluid motor 308 is actuated in such a manner as to move all the three-way valves 292 of the spraybar means 274 from the "bypass" position to the "shoot" position. A uniform coat of asphalt will immediately be applied to the surface of the roadbed as the paving machine 10 moves forward. As soon as the elongated slot 105 in the bottom of the aggregate hopper 100 passes over the beginning of the asphalt coat laid down on the roadbed, the lever arms 132 are simultaneously actuated to raise the gates 122 to a predetermined level such that aggregate will be spread in an even layer over the freshly applied asphalt as the paving machine moves forward. As the support roller wheels 44 pass over the aggregate and asphalt, the aggregate will be very efficiently pressed into the freshly laid and still hot liquid asphalt.

The substantial weight of the asphalt carried in the ballast supply tank 22 will be applied through the support rollers 44 so as to provide a very heavy compacting means. Also, the weight of the aggregate carried in the receiving and distributing hopper 100 will be applied to the front support rollers 44. As the ballast supply tank 22 passes over the partially compacted aggregate and asphalt, heat from the asphalt within the tank, which will normally be on the order of 200°–300° Fahrenheit, will be radiated downwardly to heat the asphalt on the roadway and tend to keep it in a fluid state. Then the rear roller wheels 80 will complete the compacting process by passing over that portion of the aggregate which passed between the front support rollers 44, since it will be recalled that the rear support rollers 80 are aligned between the front support rollers 44. The weight of the asphalt within the ballast tank 22 will also be applied to the rear support rollers

80 as well as a major portion of the weight of the asphalt within the semitrailer auxiliary supply tank 14. By the time the conventional road wheels of the semitrailer supply tank 14 pass over the freshly laid asphalt and aggregate, the aggregate will be sufficiently compacted that the wheels will not cause any appreciable ruts. Of course, if desired, additional rolling may be accomplished by separate rolling equipment trailing behind the asphalt paving machine 10. However, this can be accomplished at a later, more convenient time without adverse effects and can be repeated until the desired surface finish is attained.

As the paving machine 10 moves forward the aggregate in the hopper 100 will, of course, be depleted. However, on a prearranged signal the driver of the dump truck 500 can raise the loadbed a little higher so as to dump additional aggregate into the hopper 100. The hopper 100 will hold a substantial amount of aggregate so that the machine can be operated independently of a dump truck over a considerable distance. During this period of travel another dump truck having a full load of aggregate can be connected to the front of the paving machine 10, as previously described. This can be accomplished without stopping the paving machine, provided the driver of the dump truck is sufficiently skilled to synchronize movement of his truck with the movement of the paving machine 10 in such a manner as to prevent an excessive jolt upon contact. The hookup means 220 can be actuated by the operator of the paving machine 10 sitting in the seat 96, as previously described.

Of course the asphalt is also continually withdrawn from the ballast supply tank 22. However, the ballast supply tank 22 can continuously be maintained full by siphoning from the auxiliary supply tank 14, as previously described. Thus it will be noted that the paving machine 10 is capable of laying a substantially completed seal coat for a substantial distance without stopping due to the relatively large capacity of the auxiliary supply tank 14 and the ability to receive an additional supply of aggregate from a dump truck without stopping.

In some instances the prime mover 12 may not have sufficient power to pull the auxiliary supply tank 14 uphill. In this case the auxiliary supply tank 14 can be disconnected and the tractor unit 12 operated by taking asphalt only from the ballast supply tank 22. If desired, the dump truck 500 can assist in pulling the paving machine 10 uphill by means of the hookup means 220 which exerts a tension force between the tractor unit 12 and the dump truck 500. It will also be appreciated that the hookup means 220 will maintain the dump truck 500 in the proper position with relation to the aggregate receiving and spreading hopper 100 as the two vehicles travel downhill without the driver of the dump truck riding on the brake. These are important considerations because the machine 10 should move forward at a constant rate in order to lay down a seal coat of uniform thickness and quality.

In most operations, the extensible hopper and extensible spraybar sections are in the retracted positions as shown in FIG. 3. Assuming standard road width for the paving machine 10, a seal coat eight feet in width can be laid down by the paving machine without extending the hopper and spraybar. However, in many cases it will be desirable to lay down a seal coat twelve to fourteen feet in width, such as would be the case when paving one-half of a twenty-eight foot roadway, for example. In this case the paving machine 10 would be operated in the same manner as described above except with the extensible hopper portion 134 and the extensible spraybar sections 278 and 280 extended substantially to the positions illustrated in FIG. 7, and in dotted outline in FIG. 3. The paving machine 10 is then driven along the right-hand edge of the road so that the extensible portions extend to the center of the roadway. The outside edge of the seal coat will then be completed by distributing asphalt, spreading aggregate and rolling the aggregate along the outer edge. A separate roller unit may then trail closely behind the paving machine 10, or be towed by the paving machine 10, to complete the center portion of the seal coat strip. Most state highway agencies require in their specifications that the rolling of the aggregate begin at the outer edge and work toward the center of the roadway.

When using the paving machine 10 to construct a penetration macadam type surface, the roadbed is first prepared by brooming and applying a primer coat if conditions make it necessary or desirable. Then the tractor unit 12 can be used as described above to both spread and roll the first, large aggregate course during one pass. Then during the next pass both the tractor unit 12 and the semitrailer auxiliary tank unit 14 may be used to spread a coat of asphalt over the previously laid course of large aggregate, immediately deposit the second course of middle sized aggregate over the asphalt, and then immediately roll the aggregate into the asphalt. Then a third pass can be made to simultaneously distribute the second coat of asphalt, spread the third course of small aggregate into the freshly spread asphalt and thereby key the previous courses in place. The multiple pass or inverted penetration type paved surface can be constructed merely by making two or more seal coat passes with the paving machine 10, as described above.

Perhaps the greatest utility of the paving machine 10 is for paving limited areas such as parking lots and city streets. Since the tractor unit 12 and auxiliary supply tank 14 will preferably be the standard road width of eight feet, and since the tractor unit 12 preferably has pneumatic rubber support wheels 44 and 80, although it is to be understood that one or more steel drum type rollers can be used, the tractor unit can be driven over city streets and highways to the construction site, and can pull the auxiliary supply tank 14 if that volume of asphalt is required. Upon arriving at the construction site the auxiliary supply tank 14 can be disconnected and set aside in a convenient spot so that the ballast supply tank 22 can then be filled as needed from the auxiliary supply tank 14. Of course, equipment required to prepare the surface, such as graders, spiked rollers, brooms, and other conventional equipment may be used to prepare the surface for paving. The tractor unit 12 can be used solely as a distributor to apply an initial primer coat if desired merely by actuating only the spraybar means 274 and driving the tractor unit 12 in reverse so that the support wheels 44 and 80 travel in advance of the liquid distributed by the spraybar means. When the tractor unit is operated in this manner, it will be noted that the operator faces rearwardly and can more easily monitor the liquid coat laid down and thereby guide the unit more accurately. After the primer has cured, the hopper 100 can be filled by a dump truck with sufficient aggregate to make a pass of substantial length, and the ballast supply tank 22, which in a standard design may hold as much as 2,000 gallons, can be filled from the auxiliary supply tank 14 as required. Then by making a series of passes, refilling the aggregate hopper 100 from the dump truck and the ballast supply tank 22 as required, and moving forward on each pass, a series of substantially finished seal coat strips eight feet wide can be laid down side by side until the area is completely paved. Due to the compact nature of the tractor unit 12 and the relatively short wheel base which provides relatively high maneuverability, it will be appreciated that the seal coat can be applied in close proximity to buildings, fences and other obstructions and even fairly close into the corner of an L-shaped building. As the seal coat is laid down, the aggregate will be immediately rolled into the freshly laid asphalt by the support rollers 44 and 80 as previously described, so that the paving operation can be performed in substantially colder weather than is now permissible. However, it is generally desirable to roll the aggregate a plurality of times in order to insure complete compacting and in

order to obtain the desired surface finish. Therefore, after the area is completely paved, or as is convenient, the ballast supply tank **22** can be completely filled so as to provide maximum weight and the tractor unit **12** can then be driven back and forth over the paved area until the aggregate is fully compacted and the paving complete. In most instances only the operator of the paving machine **10** will be required for this type of job although a helper will usually be available. Of course, the dump truck and any other equipment used must be driven by other personnel. When the job is complete the paving machine **10** can move on to the next job location or can return to the company yard if more convenient, without the assistance of a transporting truck or other vehicle.

In the event it is desired to lay a seal coat over a width less than eight feet, as for example when constructing a four foot wide walkway or a cart trail on a golf course, a portion of the actuating lever arms **298** for the three-way valves **292** can be disconnected from the gang bar **300** and manually moved to the "bypass" position. The disconnected valves may be selected at either end of the main spraybar section **176** or a portion can be disconnected at each end. Similarly, the actuating levers **132** for the corresponding gates **122** may be disconnected from the mechanism for simultaneously operating all gates and actuated to close the respective gates. Therefore, when the fluid motor **308** is actuated to move those lever arms **298** which are still connected to the gang bar **300**, only approximately one-half of the three-way valves **292** will be shifted from "bypass" to "shoot" positions and a coat of asphalt will be distributed only over approximately one-half the length of the main section **276** of the spraybar means **274**. Similarly, aggregate will be distributed only from the corresponding one-half of the hopper **100** when the corresponding gates **122** are actuated by simultaneous movement of the actuating lever arms **132**. The support roller wheels **44** and **80** will continue to compact any aggregate which may be spread regardless of its transverse position relative to the tractor unit **12**.

From the above detailed description it will be evident to those skilled in the art that an improved paving machine has been described which has great utility in the paving art. In particular it will be appreciated that the novel arrangement of the spraybar means **274**, the aggregate receiving and spreader hopper **100**, and the support roller wheels **44** and **80** provides a means for conducting the paving operation in weather considerably colder than was heretofore possible. This is due to the fact that the aggregate is rolled and pressed into the asphalt distributed by the spraybar means **274** before it has sufficient time to cool. Also, in rainy weather the paving machine can be operated until the first drops begin to fall and wet the roadbed in advance of the machine. Heretofore care had to be taken not to spread asphalt too far in advance because if wetted by rain before covered by aggregate and compacted, the entire roadbed usually had to be plowed up in order to remove the ruined coat of asphalt. It will also be appreciated that by reason of the novel arrangement of the three basic paving elements, the spraybar means, the aggregate spreader hopper and the roller means, the complete seal coat paving operation can be performed during a single pass of a single machine without danger of contaminating the fresh coat of asphalt or of forming undesirable ruts in the aggregate before it is rolled. The paving machine **10** is compact and self-propelled, and can be driven onto a flatbed semitrailer or can be driven along roads and highways. Only one operator is required, although a helper for monitoring the shot and spotting the dump truck is desirable, and the paving machine can be used either to distribute a fluid, spread an aggregate, or compact if so desired. In addition to these advantages, the total cost of the paving machine **10** can be considerably less than the cost of the several separate pieces of conventional equipment required to perform the same job.

Although a particular embodiment of the paving machine has been described in detail it is to be understood that various changes, substitutions and alterations can be made in the overall combination of elements and parts and in the elements of the various novel subcombinations of the invention without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. An asphaltic paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt and compacting the aggregate in to the asphalt, the machine comprising, in combination:

chassis means having a front end and a rear end defining the longitudinal length thereof;

an asphalt supply tank carried by the chassis;

front support roller means connected to and supporting the front end of the chassis means, rear support roller means connected to and supporting the rear end of the chassis means, the support roller means constituting a transversely extending, compacting roller means for uniformly compacting the roadbed as the machine passes thereover, at least one of the support roller means being pivotally connected to the chassis means such as to be steerable for guiding the movement of the machine;

steering means operatively conected to the steerable roller means for guiding the machine over a desired path;

a prime mover mounted on the chassis means and operatively connected to at least one of the support roller means for driving the roller means and propelling the machine;

an aggregate receiving and spreading hopper means connected to the front end of the chassis means, the hopper means having a large opening in the top for receiving aggregate from a dump truck and an elongated, relatively narrow opening in the bottom extending transversely of the chassis for spreading a layer of aggregate on the ground in advance of the front support roller means;

asphalt spraybar means for coating the ground with asphalt connected to the machine and disposed transversely of the chassis and in front of the elongated, relatively narrow opening;

pump and conduit system means operatively interconnecting the asphalt supply tank and the asphalt spraybar means for supplying asphalt under pressure to the spraybar means; and,

means connected to the front of the hopper means for engaging and pushing a dump truck as the truck dumps its load of aggregate into the hopper,

whereby as the machine is driven forward, aggregate can be supplied to the hopper, the ground will be coated by asphalt from the spraybar means, a layer of aggregate will be deposited from the hopper onto the fresh asphalt, and the compacting support roller means will immediately press the aggregate into the asphalt due to the weight of the machine and the weight of the asphalt and aggregate transported thereby.

2. An asphalt paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt and compacting the aggregate into the asphalt, the machine comprising the combination as defined in claim **1** further characterized by:

auxiliary asphalt supply tank means having separate support wheels;

coupling means connected to the rear end of the chassis means and to the auxiliary supply tank means for connecting the auxiliary supply tank means to the chassis means whereby the auxiliary supply tank means will be towed behind the chassis means; and,

conduit means operatively interconnecting the auxiliary asphalt supply and the pump and conduit sys-

tem means for transmitting liquid asphalt from the auxiliary asphalt supply tank to the pump and conduit system means for ultimate distribution from the spraybar means.

3. An asphalt paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt and compacting the aggregate into the asphalt, the machine comprising the combination as defined in claim 2 wherein the pump and conduit system means and the conduit means operatively interconnecting the auxiliary asphalt supply tank and the pump and conduit system means comprises:

a liquid pump;

first conduit means operatively interconnecting the supply tank and the pump for withdrawing asphalt from the supply tank;

second conduit means operatively interconnecting the pump and the spraybar means for supplying asphalt to the spraybar means;

third conduit means operatively interconnecting the spraybar means and the supply tank for returning unused asphalt to the tank; and,

fourth siphon conduit means extending between the auxiliary asphalt supply tank and the supply tank for siphoning liquid asphalt from the auxiliary supply tank to the supply tank as asphalt is used from the supply tank.

4. An asphalt paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt and compacting the aggregate into the asphalt as defined in claim 3 further characterized by:

fifth conduit means operatively interconnecting the first and fourth conduit means for bypassing asphalt around the supply tank;

valve means operatively disposed in at least one of the first, fourth and fifth conduit means for selectively closing each of the first, fourth and fifth conduit means;

sixth conduit means operatively interconnecting the second and third condit means for bypassing fluid around the spraybar means;

seventh conduit means operatively interconnecting the sixth conduit means and the auxiliary supply tank; and,

valve means operatively disposed in at least one of the second, third, sixth and seventh conduit means for selectively closing the respective second, third, sixth and seventh conduit means.

5. An asphalt paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt and compacting the aggregate into the asphalt as defined in claim 1 wherein the aggregate receiving and spreading hopper is comprised of:

an elongated, stationary portion affixed to the chassis means and having a rear wall plate member and front wall plate member extending transversely of the chassis means, the wall plate members being disposed in upwardly diverging relationship to form an elongated, narrow opening at the bottom and an elongated, large opening at the top; and,

an elongated extensible portion having rear and front wall plate members slidably resting on the rear and front wall plate members of the stationary portion and having an elongated, narrow opening at the bottom registering with the narrow opening at the bottom of the stationary portion, the elongated extensible portion being moveable transversely of the chassis means to provide an extensible hopper.

6. Paving apparatus for attachment to the front end of a self-propelled vehicle having a supply of asphalt under pressure, the apparatus comprising:

elongated aggregate hopper means having a front end and a rear end and an elongated, relatively narrow opening extending transversely across the bottom for dispensing a layer of aggregate carried by the hopper as the hopper is moved over the ground by the vehicle and an enlarged opening in the top for receiving aggregate directly from a dump truck;

an elongated spraybar means connected to the hopper means and disposed in front of the relatively narrow opening for spraying a coat of asphalt on the ground as the spraybar is moved over the ground by the vehicle;

liquid conduit means operatively connected for supplying liquid to the spraybar means and extending to the rear end of the hopper means for connection to the supply of asphalt under pressure; and

power operated connecting means mounted on the front end of the hopper means for engaging and pushing a dump truck in advance of the hopper means and maintaining the dump truck properly spaced from the hopper means such that the dump truck can dump its load of aggregate into the hopper means.

7. An asphalt paving machine for spraying a coat of asphalt on a prepared roadbed, spreading a layer of aggregate over the coat of asphalt, and compacting the aggregate into the asphalt, the machine comprising:

an asphalt supply tank forming a chassis means having a front end and a rear end;

a plurality of front pneumatic rollers supporting the front end of the chassis means and a plurality of rear pneumatic rollers supporting the rear end of the chassis means, the rollers being transversely staggered to provide a continuous compaction means extending transversely substantially across the chassis means, at least a portion of the support roller means being pivotally connected to the chassis means and thereby steerable for guiding the machine;

steering means operatively connected to the steerable support rollers for guiding the machine over a desired path;

a prime mover mounted on the chassis and operatively coupled to at least one of the support rollers for propelling the machine;

an aggregate receiving and spreading hopper means connected to the front end of the chassis means, the hopper means having a large opening in the top for receiving aggregate from a dump truck and an elongated, relatively narrow opening in the bottom extending transversely of the chassis for spreading a layer of aggregate on the ground as the machine travels;

asphalt spraybar means for coating the ground with asphalt connected to the machine and disposed transversely of the chassis and in front of the elongated, relatively narrow opening;

conduit means operatively interconnecting the asphalt supply tank and the asphalt spraybar means for supplying asphalt under pressure to the spraybar means; and,

means positioned at the front of the hopper and connected to the machine for engaging a dump truck and maintaining the dump truck properly spaced with relation to the hopper means as the machine travels forward such that the truck can dump its load of aggregate into the hopper,

whereby as the machine is driven forward, aggregate can be supplied to the hopper from a dump truck, the ground will be coated by asphalt from the spraybar means, a layer of aggregate will be deposited from the hopper onto the fresh asphalt, and the compacting support roller means will immediately press the aggregate into the asphalt with the weight of the ma-

chine, and the weight of the asphalt and the aggregate transported by the machine.

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