Aug. 27, 1968 K. E. SCHUMANN 3,398,693

CONCRETE PUMPING APPARATUS

Filed Aug. 1, 1966 5 Sheets-Sheet 1

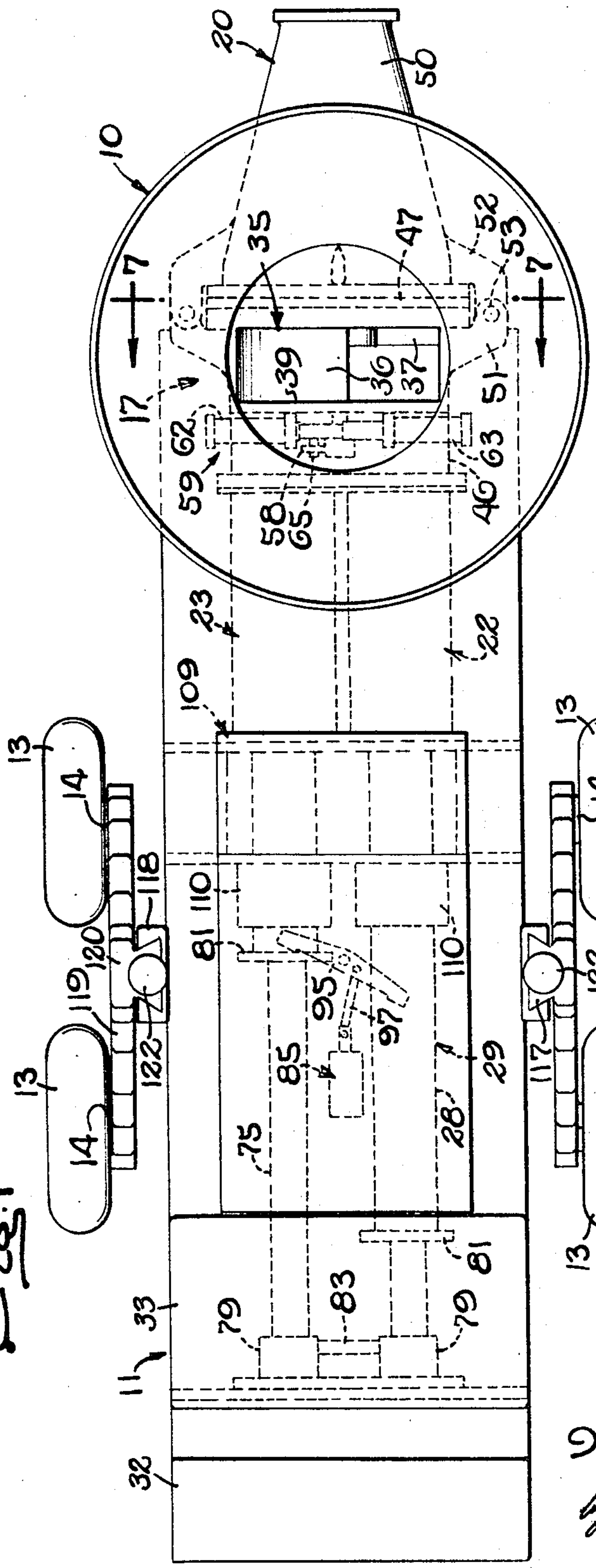

Fig. 1

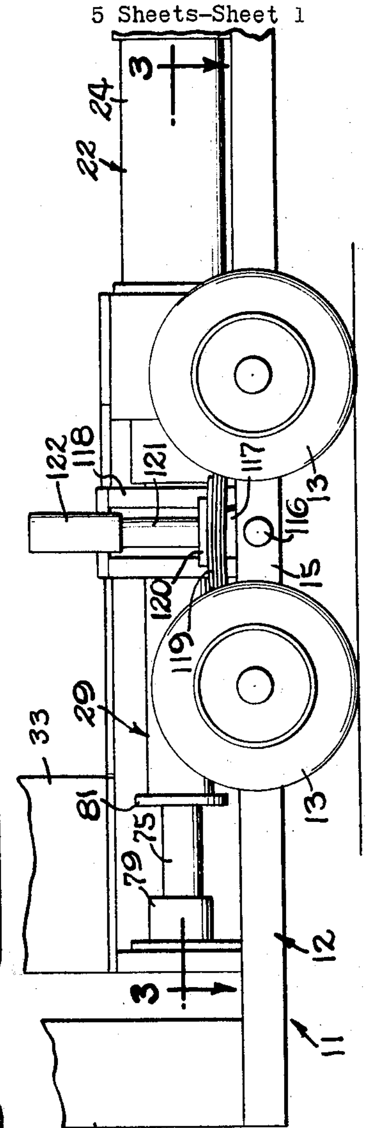

Fig. 2

INVENTOR

Kurt E. Schumann

by Wolfe, Hubbard, Voit & Osann

ATTORNEYS

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CONCRETE PUMPING APPARATUS

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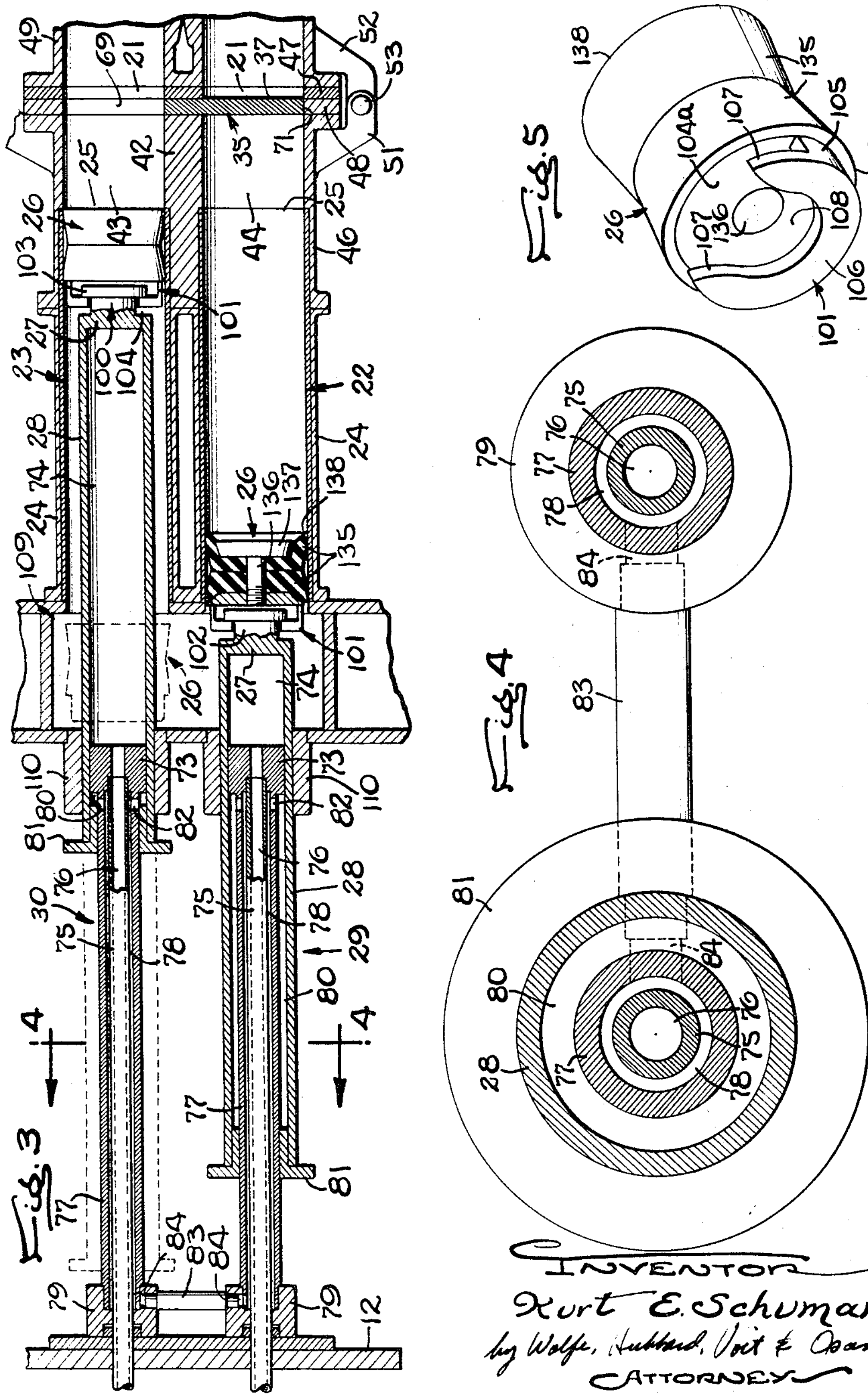


INVENTOR
Kurt E. Schumann
by Wolfe, Hubbard, Voit & Osann
ATTORNEYS

Fig. 6

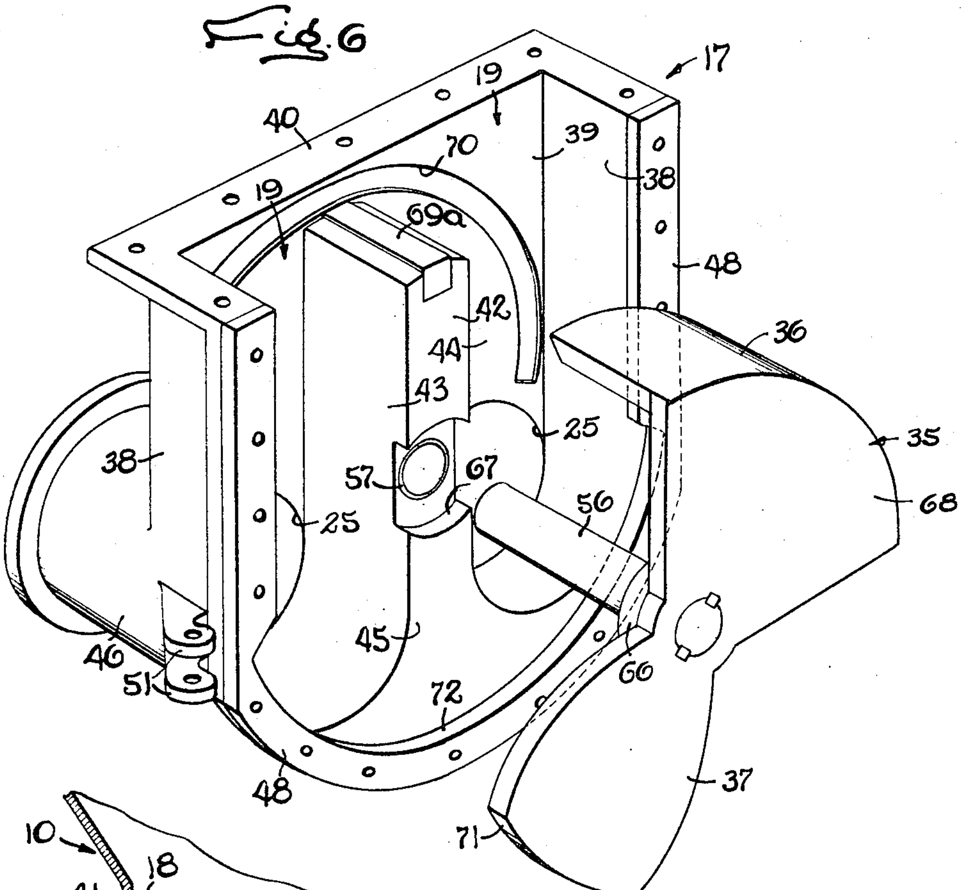
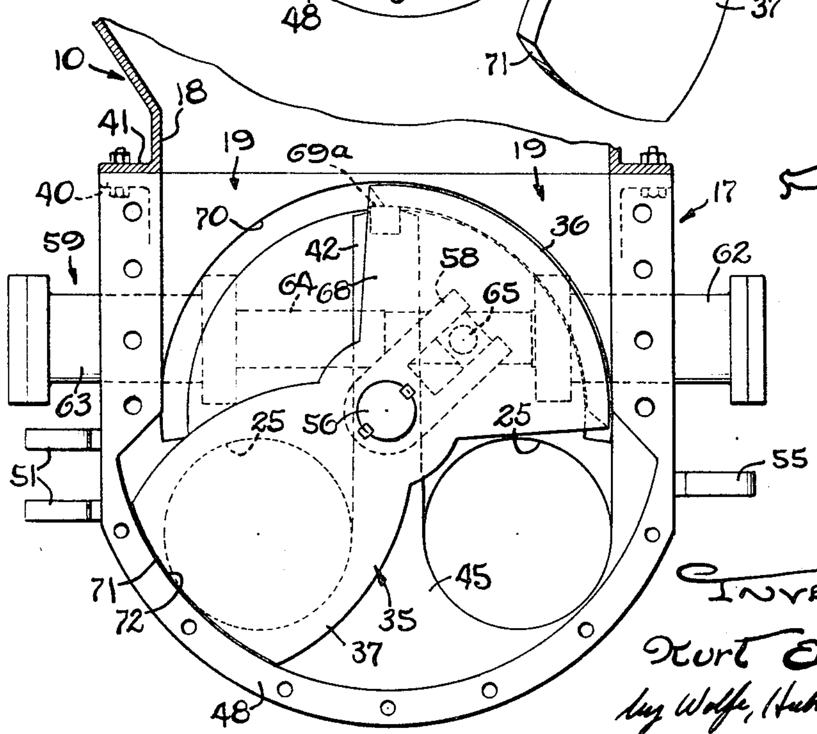


Fig. 7



INVENTOR
Kurt E. Schumann
by Wolfe, Hubbard, Voit & Osann
ATTORNEYS

CONCRETE PUMPING APPARATUS

Filed Aug. 1, 1966 5 Sheets-Sheet 4

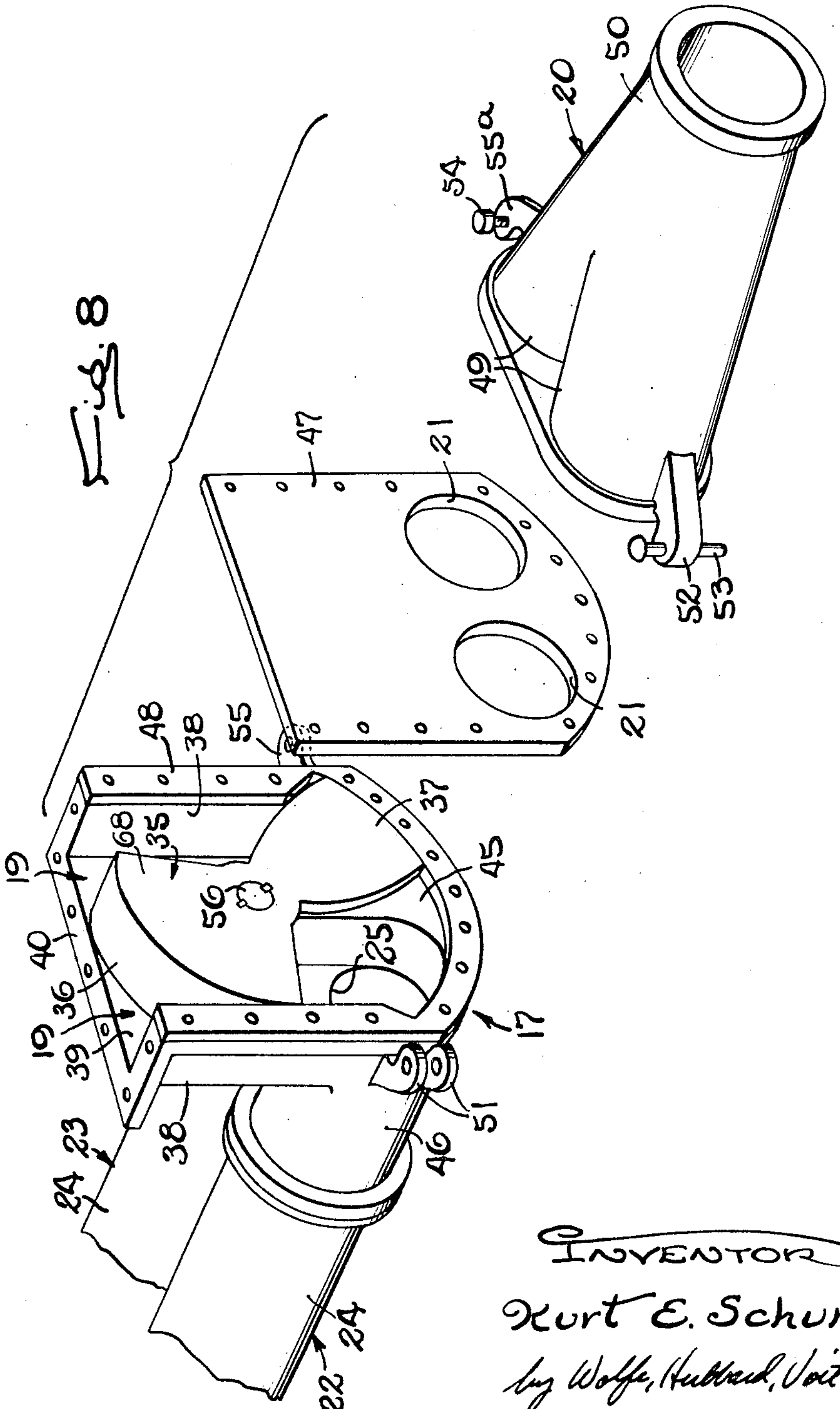


Fig. 8

INVENTOR
Kurt E. Schumann
by Wolfe, Hubbard, Voit & Osann
ATTORNEYS

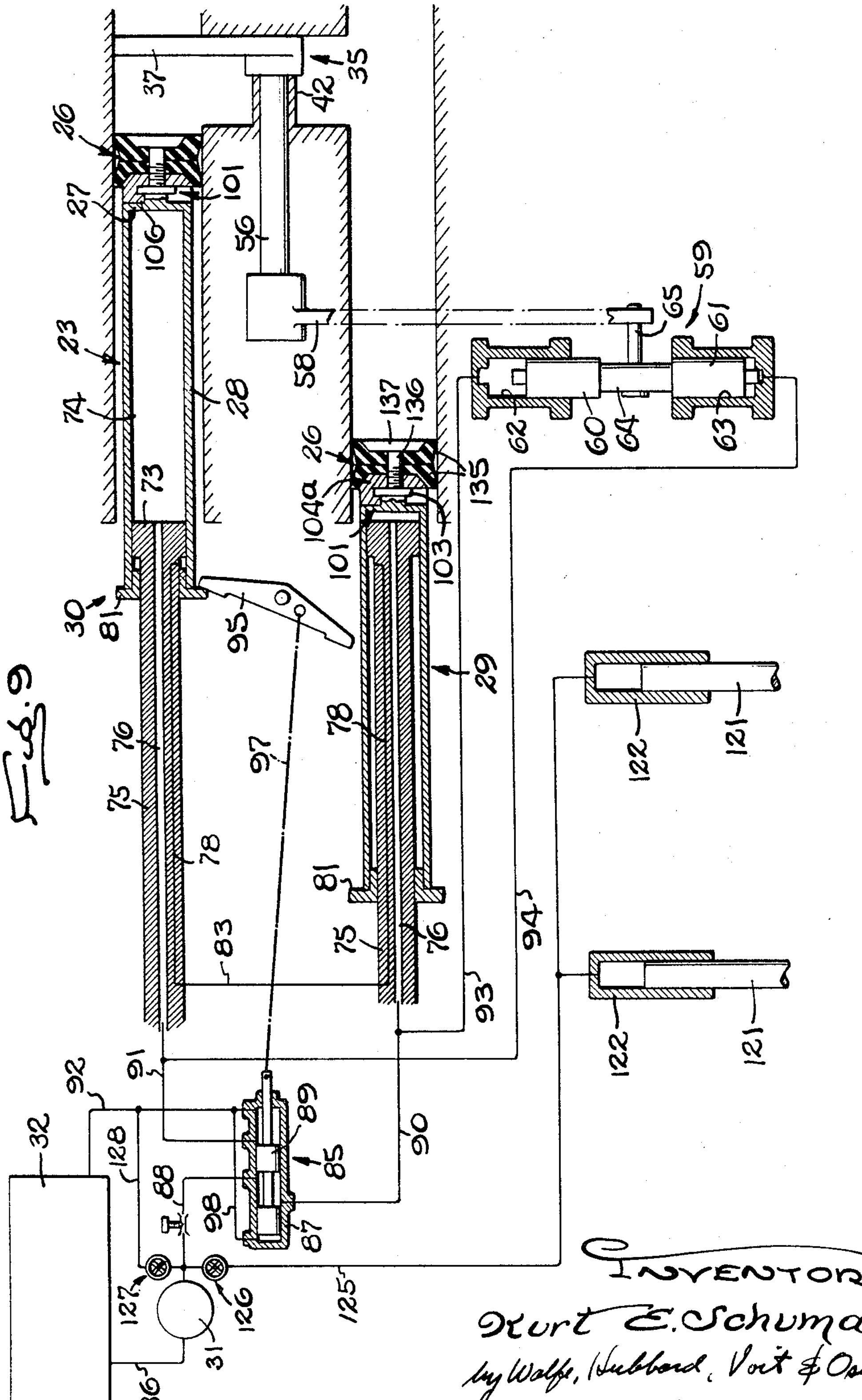


Fig. 9

INVENTOR
Kurt E. Schumann
by Wolfe, Hubbard, Voit & Osann
ATTORNEYS

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CONCRETE PUMPING APPARATUS

Kurt E. Schumann, Milwaukee, Wis., assignor to Danken, Inc., Hartland, Wis., a corporation of Wisconsin

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14 Claims. (Cl. 103—49)

ABSTRACT OF THE DISCLOSURE

A concrete pumping apparatus includes a pair of side-by-side pumps which reciprocate in unison but in opposite directions so that one pump sucks a charge of fluent concrete from a hopper while the other pump forces a previously received charge into a delivery pipe. A valve for controlling the flow of concrete to and from the pumps is formed with a first closure oscillating back and forth beneath the hopper to establish communication between the latter and alternate ones of the pumps. The valve also includes a second closure swinging in a plane perpendicular to the first closure for establishing communication between alternate ones of the pumps and the delivery pipe, the arrangement of the two closures being such that one pump always communicates with and receives concrete from the hopper while the other pump is communicating with and feeding concrete into the delivery pipe.

This invention relates to concrete pumping apparatus of the type in which fluent concrete dumped into a hopper by trucks or a mixer is forced through a delivery pipe by a pair of reciprocating pumps and is delivered to areas inaccessible to trucks. More particularly, the invention constitutes an improvement over the pumping apparatus disclosed in Schumann Patent No. 3,181,469 in which the pumps reciprocate in unison but in opposite directions, and appropriate valving operable in timed relation with the reciprocation of the pumps alternatiely establishes communication between one pump and the hopper while establishing communication between the other pump and the delivery pipe so that one pump sucks concrete from the hopper while the other pump feeds concrete into the delivery pipe.

The general object of the present invention is to provide new and improved pumping apparatus of the above character which is more rugged and trouble-free in operation while being of simpler construction and more efficient in service use than prior constructions used for related purposes.

Another object is to provide an improved and simplified valve comprising a single movable member formed with a pair of closures which control the flow of concrete into and out of the pumps and which, at the same time, move easily through the concrete and have an extremely long service life.

A more detailed object is to mount the valve member beneath the hopper for back and forth oscillation about a predetermined axis with one of the closures swinging along an arcuate path extending beneath the bottom of the hopper to admit concrete to alternate ones of the pumps, and the other closure swinging in a plane perpendicular to the axis for establishing communication between alternate pumps and the delivery pipe.

Still another object is to provide quick-connect couplings between the pistons and the piston rods of the concrete pumps to enable quick and easy removal of the pistons for purposes of cleaning or replacement.

A further object is to improve the stability of the pumping apparatus and to reduce the set-up time required to put the apparatus in service use.

Other objects and advantages will become apparent from

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the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a fragmentary plan view of a concrete pumping apparatus embodying the novel features of the present invention.

FIG. 2 is a fragmentary side elevation of the pumping apparatus shown in FIG. 1.

FIG. 3 is an enlarged fragmentary cross-section taken along the line 3—3 of FIG. 2.

FIG. 4 is an enlarged fragmentary cross-section taken along the line 4—4 of FIG. 3.

FIG. 5 is a perspective view of one of the pump pistons.

FIG. 6 is a fragmentary exploded perspective view of the valve and part of the valve housing.

FIG. 7 is an enlarged fragmentary cross-section taken along the line 7—7 of FIG. 1.

FIG. 8 is a fragmentary exploded view of the valve housing and the connection leading to the delivery pipe.

FIG. 9 is a schematic view and fluid circuit diagram of the pumping apparatus.

As shown in the drawings for purposes of illustration, the invention is embodied in a concrete pumping apparatus of the type in which fluent concrete is dumped into a hopper **10** by trucks or a mixer and is pumped through a delivery pipe (not shown) to remote points and difficult to reach spots. Such apparatus is especially suitable for pumping concrete to the upper stories of multi-floor buildings under construction, for pouring complicated architectural designs, and for related operations in which concrete is to be placed in areas inaccessible to trucks.

Herein, the pumping apparatus is carried on a trailer **11** comprising a rectangular horizontal frame **12** supported tandem fashion on wheel assemblies including wheels **13** journaled for rotation on stub axles **14** fastened near opposite ends of longitudinally extending bars **15** on each side of the frame. The hopper **10** is supported near the forward end of the frame on a housing **17** (FIGS. 1 and 7) and is formed with an open lower end **18** which is similar in size and shape to the upper open end of the housing. Concrete flows from the opening in the hopper and into the housing through inlet ports **19** (FIGS. 6 and 7), and then to the concrete pumping mechanism to be forced by the latter into the delivery pipe which may be connected to a so-called siamese pipe section **20** (FIG. 1) communicating with the forward end of the housing through outlet ports **21** (FIGS. 3 and 8).

As shown in FIGS. 1 and 3, the concrete pumping mechanism comprises a pair of side-by-side reciprocating pumps **22** and **23** including cylinders **24** extending longitudinally of the frame **12** and communicating at their forward ends with the rear of the housing **17** through intake ports **25** (FIGS. 3 and 6) to receive concrete flowing to the housing from the hopper **10**. Mounted for reciprocation in each cylinder is a pump piston **26** fitting tightly but slidably within the bore of the cylinder and carried on the forward closed end **27** (FIG. 3) of a hollow tubular piston rod **28**. The piston rods also serve as cylinders for hydraulically operated actuating pumps **29** and **30** which reciprocate the concrete pump pistons **26** during the pumping operation. Hydraulic fluid for operating the actuating pumps **29** and **30** is supplied by a fluid pressure pump **31** (shown schematically in FIG. 9) driven in a well known manner by a gasoline motor **33** and communicating with a reservoir **32** (FIGS. 2 and 6) carried on the rear of the frame.

By means of valving **35** (FIG. 6) disposed in the housing **17**, each concrete pump cylinder **24** alternately communicates with the hopper **10** and the delivery pipe, first to receive a charge of concrete from the hopper through one of the inlet ports **19** and one of the intake ports **25** as the associated piston **26** slides rearwardly, and then to pump the charge back through the intake port and into the delivery pipe through one of the outlet ports **21** as the piston slides forwardly. The pistons are reciprocated in unison but in opposite directions so that one piston pumps concrete into the delivery pipe on its forward stroke while the other piston is sucking concrete into its cylinder from the hopper on its return stroke. The valving includes closures **36** and **37** for closing the outlet port of each pump while it is being charged in order to insure a complete fill, and for closing the inlet port of each pump as the latter is pumping in order to insure that the entire charge is fed into the delivery pipe.

In accordance with the primary aspect of the present invention, the flow of concrete into and out of the pumps **22** and **23** is controlled by a new and improved valve **35** in which the closures **36** and **37** are formed as a single integral unit and, at the same time, are arranged in the housing **17** in a novel manner such that the valve has a longer service life and moves more easily through the concrete than prior valves used for similar purposes. To these ends, the closures are integral with each other and are mounted within the housing to oscillate between two positions about a substantially horizontal axis in timed relation with the reciprocation of the pumps. During the oscillation of the valve, the first closure **36** swings along an arcuate path extending over the axis and beneath the hopper **10** to close alternate inlet ports **19**, and the second closure **37** swings in a plane perpendicular to the axis to close alternate outlet ports **21**. The disposition of the closures within the housing is such that metal-to-metal contact between the closures and the housing is minimized thus reducing the valve wear, and the closures are shaped so as to move through the concrete with a positive slicing action.

In this instance, the housing **17** for the valve **35** is a casting or fabrication comprising opposed parallel side walls **38** (FIGS. 6 and 7) interconnected at their rear edges by an upright and laterally extending rear wall **39**. The upper edges of the housing walls are turned outwardly to form an upwardly facing flange **40** which is bolted to a complementary flange **41** turned outwardly from the lower end of the hopper **10** thus fastening the hopper to the housing. Projecting forwardly from the central portion of the rear wall is a substantially vertical partition **42** dividing the housing into a pair of laterally spaced and upright flow passages **43** and **44** which communicate with the opening **18** in the hopper through the upwardly opening inlet ports **19**, these ports being defined by the partition and the side walls **38**. At its lower end, the partition is formed with a base portion **45** having a rounded lower surface which gradually merges with the side walls to form an arcuately curved bottom for the housing. The intake ports **25** for the pump cylinders are formed in the rear wall **39** near the lower ends of the flow passages and open into laterally spaced tubular pipes **46** (FIGS. 3 and 6) formed integrally with the rear wall and connected to the output or forward ends of the pump cylinders **24** as shown most clearly in FIG. 3.

Forming the forward wall of the housing **17** is a flat upright cover plate **47** (FIG. 8) which is removably bolted to a substantially U-shaped spacer plate **48** (FIGS. 6 and 8) fastened to the front edges of the side walls **38** and the bottom wall of the housing. The cover plate completely closes the front sides of the passages **43** and **44** except for laterally spaced openings in the cover plate leading to the siamese pipe section **20**. These openings constitute the outlet ports **21** (FIGS. 3 and 8) for the pumps **22** and **23** and are alined with the intake ports **25** to establish a substantially straight flow path between the pumps and the siamese pipe section. The latter comprises a pair of separated and laterally spaced pipes **49** which are alined with the outlet ports and which merge into a single forwardly projecting spout **50** adapted for connection with the delivery pipe. Thus, the flow of concrete is from the hopper **10** to the flow passages **43** and **44** of the housing through the inlet ports **19**, and from the passages into the pump cylinders **24** through the intake ports **25**. As concrete is pumped from the cylinders, it flows back through the intake ports, across the bottoms of the passages and into the pipes **49** through the outlet ports **21**, and finally into the spout **50** and the delivery pipe to be placed in the desired location.

In order to permit cleaning of concrete from the valve **35** and the housing **17** after each pumping operation, the siamese pipe **20** is mounted to swing away from the housing to expose the outlet ports **21** so that water introduced into the top of the housing to flush the latter and the valve may drain out of the outlet ports. For this purpose, a pair of vertically spaced and outwardly projecting lugs **51** (FIG. 8) are formed on one of the side walls **38** of the housing and interfit with an ear **52** formed adjacent the rear end of the siamese pipe. The pipe is hingedly connected to the side wall by a vertical pin **53** passing through holes in the lugs and the ear. At its opposite side, the pipe is fastened to the side wall by a removable bolt **54** or other suitable fastening means passing through holes formed in lugs **55** and an ear **55**ª formed on the side wall and the pipe, respectively. Thus, by removing the bolt, the siamese pipe may be swung away from the housing about the pin **53** to enable drainage of water and concrete directly from the outlet ports **21** when the valve and the housing are flushed for cleaning purposes. In addition, by swinging the pipe away from the housing and by unbolting the cover plate **47**, the valve **35** is easily exposed for purposes of repair or replacement.

As shown in FIGS. 6 to 8, the valve **35** is keyed to the forward end of a horizontal shaft **56** projecting forwardly through the rear wall **39** and the partition **42** of the housing **17** and journaled for oscillation in a bushing **57** disposed in the partition just above the level of the intake ports **25**. Fast on the rear end of the shaft is a crank **58** (FIGS. 1, 7 and 9) which is connected to a power actuated mechanism **59** operable to oscillate the valve between the two valve positions. In this instance, the mechanism **59** is fastened to the rear wall **39** exteriorly of the housing **17** and comprises a pair of pistons **60** and **61** (FIG. 9) slidable in a pair of cylinders **62** and **63**, respectively, and interconnected by a common piston rod **64**. The latter is operably connected to the crank **58** by a pin **65** extending transversely through the rod and pivotally connected to the free end of the crank. Oil under pressure first is admitted to the cylinder **62** and then to the cylinder **63** to shift the rod **64** sidewise in opposite directions and, through the crank, to oscillate the valve between the two positions.

The valve is formed with a circular hub **66** (FIG. 6) fitting into a recess **67** in the partition, with an integral sector-shaped plate **68** extending radially and generally upwardly from the hub. Because of the spacer plate **48**, the cover plate **47** is spaced forwardly from the front face of the partition **42** to define a vertically extending slot **69** (FIG. 3) through which the sector plate **68** swings as the valve oscillates with the shaft **56**.

The first valve closure **36** controls the flow of concrete from the hopper into the passages **43** and **44** by opening and closing alternate inlet ports **19**, and is a curved metal plate integral with and projecting rearwardly from the upper end of the sector plate **68**. In one position of the valve (FIG. 8), the curved plate **36** covers the inlet port **19** for the passage **43** to shut off the flow of concrete from the hopper **10** to the pump **22**, while in the other position of the valve (FIG. 7), this plate covers the inlet port for the passage **44** to shut off the flow of concrete to the pump **23**. In each valve position, the curved plate extends between one of the housing side walls **38** and the partition **42** with the lower sides of alternate beveled ends of the plate seating against an insert **69**ª fitted in the top of the partition to prevent concrete from leaking into the passage across the top of the partition. The upper and lower surfaces of the plate are concentrically curved about the axis of the shaft **56** and, as a result, the curved upper surface slices smoothly through the concrete and the lower surface passes in closely spaced relation to the top of the partition as the valve oscillates. To minimize metal-to-metal contact between the valve and the housing, the rear edge of the curved plate **36** rides in an arcuate groove **70** formed in the rear wall **39** and is spaced approximately 1/32 inch from the top and bottom surfaces of the groove. This arrangement prevents concrete from flowing downwardly between the rear edge of the curved plate **36** and the rear wall **39** and yet prevents wear which would be caused by the plate rubbing directly against the rear wall. In addition, the upper surface of the plate extends tangentially to the side walls **38** in each of the valve positions and thus the valve has no edges moving into abutting relationship with the side walls thereby minimizing crushing of rock between the valve and the housing. As a result, the service life of the valve is increased while the amount of power required to oscillate the valve is decreased.

Herein, the second valve closure **37** for controlling the outlet ports **21** is a paddle-shaped plate formed integrally with the hub **66** and disposed in the same plane as the sector plate **68**. As the valve oscillates, the paddle plate swings through the vertical slot **69** between the partition **42** and the cover plate **47** with the rear face of the paddle plate passing in closely spaced relation to the forward face of the partition. The lower or outer end **71** of the paddle plate is concentrically curved about the axis of the shaft **56** and preferably is spaced approximately 1/32 inch from the complementary curved upper surface **72** of a recess cut in the lower portion of the spacer plate **48** on the housing **17** so as not to be in rubbing contact with the spacer plate. Because the paddle plate lies in a single plane and is relatively thin, it slices smoothly through the concrete as the valve oscillates and does not hinder movement of the valve to any appreciable degree. The paddle plate is sufficiently wide to cover one of the outlet ports **21** (FIGS. 3 and 8) in each of the two positions of the valve and is angularly spaced from the curved plate **36** such that, when the valve is positioned as shown in FIG. 7, the paddle plate closes the outlet port for the pump **22** while the curved plate **36** is closing the inlet port **19** for the pump **23**. In the other valve position (FIG. 8), the plates are shifted through an arc of approximately 90 degrees and thus the paddle plate covers the outlet port for the pump **23** and the curved plate covers the inlet port for the pump **22**. Since the valve is oscillated in timed relation with the reciprocation of the pumps, each pump receives a charge of concrete through its open inlet port **19** and through its intake port **25** while its outlet port **21** is closed by the paddle plate **37** and then pumps the charge through its outlet port and into the delivery pipe while its inlet port is closed by the curved plate **36**.

To reciprocate the concrete pump pistons **26**, the actuator pumps **29** and **30** (FIG. 9) conduct oil under pressure from the pressure pump **31** to the tubular piston rods **28** and coact with the latter to force the concrete pistons forwardly under the influence of the fluid pressure. In addition, the two actuator pumps are interconnected by a closed hydraulic circuit in such a manner that forward movement of one concrete piston is operable to produce a corresponding but opposite movement of the other piston. For these purposes, each actuator pump comprises a stationary cylindrical piston **73** fitting tightly but slidably within the bore of the piston rod and forming one end of a fluid-tight chamber **74**, the remainder of the chamber being defined by the closed end **27** and the interior walls of the piston rod. Extending rearwardly from each actuator piston **73** is an elongated tube **75** rigidly fastened at its rear end to a stationary frame member and defining a longitudinal passage **76** which communicates with the oil pump **31** and extends through the actuator piston **73** into the chamber **74**. As oil under pressure is forced through the passage and into the chamber, it reacts against the actuator piston **73** thereby causing the piston rod **28** to slide forwardly on the actuator piston and forcing the concrete piston **26** forwardly or to the right as viewed in FIG. 3.

The closed hydraulic circuit for retracting the concrete pump pistons **26** is formed by an outer tube or sleeve **77** disposed coaxially with the inner tube **76** of each actuator pump **29** and **30** and spaced from the inner tube to define a longitudinal passage **78** extending between the sleeve and the tube. At its rearward end, the sleeve **77** is fastened to a gland **79** on the frame **12** while the forward end of the sleeve is telescoped into the bore in the piston rod **28** and joined to the actuator piston **73**. The inner walls of the piston rod and the outer walls of the sleeve form a chamber **80** which is closed at its forward end by the actuator piston **73** and at its rearward end by a flanged bushing **81** threaded into the end of the piston rod and slidable on the sleeve **77**. The chamber **80** communicates with the passage **78** by means of ports **82** formed in the forward end of the sleeve near the actuator piston **73**, and the passages **78** of each actuator pump communicate with each other through a cross pipe **83** which interconnects ports **84** (FIG. 4) formed in each gland and in the rearward end of each sleeve. With this arrangement, the chambers **80** and passages **78** of the two actuator pumps, in conjunction with the cross pipe **83**, form a closed hydraulic circuit between the pumps and this circuit is always filled with a constant volume of oil. Accordingly, as one of the piston rods **28** slides forwardly under the influence of the pressure fluid admitted through the passage **76**, the flanged bushing **81** moves toward the actuator piston **73** thereby reducing the size of the associated chamber **80** and forcing the oil therein through the ports **82** and into the passage **78**. From this passage, the oil flows into the cross pipe **83** and then into the passage **78** and the chamber **80** of the other actuator pump. As the fluid enters the opposite chamber **80**, it exerts pressure between the rear side of the actuator piston **73** and the flanged bushing **81** thereby to slide the piston rod **28** rearwardly on the actuator piston **73** and to retract the concrete piston **26**. There is no flow of oil in the closed circuit except between two actuator pumps and the direction of this flow periodically reverses to retract alternate concrete pistons **26**.

For reciprocating the concrete pump pistons **26** in unison, but in opposite directions and for oscillating the valve **35** in timed relation with reciprocation of the pump pistons, oil from the pressure pump is introduced alternately to the passages **76** of the actuator pumps **29** and **30** and also to the cylinders **62** and **63** of the oscillating mechanism **59** through a 4-way valve **85** which is controlled automatically by the motion of the concrete pumps. As shown in FIG. 9, the pressure pump **31** draws oil from the reservoir **32** through a pipe **86** and pumps the same into a body **87** of the valve **85** through a feed pipe **88**. In accordance with the position of a spool **89** slidably mounted in the valve body, the oil flows from the body into one of a pair of pipes **90** and **91** connecting the body with the passages **76** for the actuator pumps **29** and **30**. When the spool is positioned as shown in FIG. 9, fluid is admitted from the pressure pump **31** into the pipe **90** and then into the passage **76** and the chamber **74** of the actuator **29** to force the piston **26** of concrete pump **22** forwardly. The piston of the other concrete pump **23** simultaneously retracts because of the closed hydraulic circuit between the pumps, and as a result, oil in the chamber **74** of the actuator pump **30** exhausts through the passage **76** and the pipe **91** into the valve body, and then to the reservoir through a return line **92** connected between the valve body and the reservoir. In addition, oil flows from the pipe **90** through a branch line **93** connected to the valve oscillating cylinder **62** to shift the piston rod **64** to the left (FIG. 7) thereby positioning the concrete valve **35** in accordance with the condition of the concrete pumps. Oil from the cylinder **61** exhausts through a branch line **94** connected to the pipe **91**. Because less power is required to oscillate the valve **35** than to reciprocate the pumps, the valve will shift to its proper position just before the piston **26** begins its forward stroke.

As the piston **26** of the concrete pump **22** reaches the end of its forward stroke, the flange on the bushing **81** engages the end of a lever **95** (FIG. 9) to rotate the lever counterclockwise about the pin on the frame. The lever is connected to the valve spool **89** by a link **97** which shifts the spool forwardly as the lever rotates thereby to establish fluid communication between the feed pipe **88** and the pipe **91** leading to the passage **76** of the actuator pump **30**. Accordingly, the piston **26** of the concrete pump **23** then is forced forwardly and the piston of the concrete pump **22** retracts with the fluid from the chamber **74** exhausting through the pipe **90** into the valve body **87**, and then to the reservoir **32** through a return pipe **98** connecting the valve body with the return pipe **92**. At the same time, oil is supplied to the branch line **94** and the cylinder **63** thereby shifting the piston rod **64** to the right (FIG. 7) and reversing the position of the concrete valve **35** just before the piston **26** of the pump **23** begins its forward stroke. The valve spool **89** is returned to the position shown in FIG. 9 when the piston of the concrete pump **23** reaches the end of its forward stroke and the flange on the associated bushing **81** engages the opposite end of the lever **95** to rotate the latter clockwise. Accordingly, the valve spool is shifted between its two positions each time one of the concrete pistons reaches the end of its forward stroke thus causing oil to be supplied first to one actuator pump and then to the other and simultaneously causing oil to be supplied to alternate cylinders of the oscillating mechanism **59**. Since the reversal of the pumping action and of the valve position is controlled by the motion of the pumps themselves, the flow of concrete to the delivery pipe is substantially continuous throughout the pumping operation.

The present invention also contemplates novel means enabling quick and easy removal of the concrete pistons **26** from the piston rods **28** when it is necessary to clean or replace the pistons. In this instance, these means comprise a male connector **100** (FIG. 3) on each piston rod and a female connector **101** (FIG. 5) on each piston, the two connectors interfitting to restrict movement of the piston axially of the rod while permitting movement of the piston radially of the rod for uncoupling the piston from the rod. As shown in FIG. 3, the male connector **100** is a short cylindrical shank **102** projecting forwardly from the closed end **27** of the piston rod and formed with an annular button or head **103** on its forward end. The forward end of the rod and the rear face of the head form a pair of axially spaced shoulders which, in conjunction with the shank **102**, define an annular groove **104** between the button and the end of the rod. The female connector **101** (FIG. 66) comprises a flat disk **104**^{a} at the rear end of the piston, and a semi-circular lip **105** projecting axially from the disk and formed at its free end with an inturned radial collar **106**. A pair of toes **107** depending from the transverse ends or legs of the collar act with the latter to define a downwardly opening U-shaped notch **108** which has a transverse width slightly greater than the diameter of the shank **102** of the male connector.

As shown most clearly in FIGS. 3 and 9, the collar **106** on the piston **26** fits within the groove **104** formed by the male connector with the lip **105** overlying the upper surface of the head **103** and with the toes **107** straddling the shank **102**. Opposite faces of the collar and the toes abut against the shoulders formed by the head and the end of the piston rod to restrict axial movement of the piston while the U-shaped notch **108** permits uncoupling of the rod and the piston simply by lifting the latter in a radial direction.

Herein, the pistons **26** are composed of a flexible material such as rubber so as to maintain a tight fit within the cylinders **24**. Specifically, each piston comprises a pair of rubber sleeves **135** (FIG. 9) fitted over the shank **136** of a bolt threaded into the disk **104**^{a}. The sleeves are sandwiched between the disk and an enlarged head **137** integral with the shank and are formed with front and rear outwardly turned scraping edges **138**. As a result of this arrangement, any concrete that might possibly work past the forward scraping edge on the forward stroke of the pistons will be carried rearwardly from the cylinders by the rear scraping edge on the return stroke. The sleeves may be removed for replacement purposes merely by unthreading the bolt from the disk and slipping the sleeves off of the shank.

The frame **12** and the cylinders **24** are arranged to provide convenient access to the pistons **26** thus permitting uncoupling of the pistons and the rods **28** without having to dismantle any of the other pumping elements. For this purpose, a box-like sub-frame **109** (FIG. 3) is supported on the main frame **12** and has an open upper side and a fore-and-aft dimension greater than the length of the pistons. The cylinders **24** are connected to the front wall of the sub-frame and open into the interior thereof, while the piston rods **28** are slidably mounted in bushings **110** fastened to the rear wall of the sub-frame and project forwardly into the cylinders. When the pumps **22** and **23** are operating, the normal stroke of the piston rods is such that the pistons are always confined within the cylinders, as shown in full lines in FIG. 3, and thus the pistons remain connected to the rods. When a piston change is necessary however, the piston rods may be slid manually and rearwardly to pull the pistons out of the cylinders and into the opening defined by the sub-frame as shown in dotted lines in FIG. 3. The pistons then are fully exposed and may be lifted off of the rods and replaced with pistons fitted with new rubber sleeves **135**.

When the pumps **22** and **23** are operating, it is desirable to have the frame **12** as stable as possible to prevent movement of the frame under the influence of the reaction forces produced by the reciprocation of the pump pistons **26**. In the past, it has been the practice to block each side of the wheels **13** or to jack up the frame and place blocks thereunder to keep the frame stable, these operations requiring a considerable amount of set-up and tear-down time. In another of its aspects, the present invention contemplates mounting the frame and the wheels for relative vertical movement under the control of hydraulic operators **115** whereby the frame may be lowered to rest firmly on the ground or other supporting surface when the pumps are operating simply by actuating the hydraulic operators. For this purpose, each bar **15** mounting the wheels is pivotally connected at **116** to the lower end of an upright post **117** (FIGS. 1 and 2) which is slidably received in a vertical channel **118** fast on the side of the frame. To restrain movement of the bars about the pivot **116**, semi-eliptical springs **119** are compressed between the upper side of the bars and flanges **120** projecting outwardly from the posts **117**. The piston rods **121** of the hydraulic operators are fastened to the upper ends of the posts **117** and slide in cylinders **122** rigid with the frame. In FIG. 2, the trailer **11** is shown in transport position with the frame **12** spaced above the ground and with the posts **117** located in the lower ends of the channels **118**. In this position, the operators **115** are energized by oil admitted into the cylinders **122** through a line **125** (FIG. 9) communicating with the pressure pump **31** and controlled by a valve **126**. To lower the frame to operating position, it is necessary only to open the valve **126** and a valve **127** in a return line **128** thereby releasing the oil in the cylinders and allowing the frame to slide downwardly on the posts **117** and relative to the wheels. As a result, the frame may be lowered in a matter of seconds to rest directly on the ground or on planks placed under the frame and thus will be in a very stable condition during operation of the pumps.

I claim as my invention:

1. In a machine for pumping fluent concrete through a delivery pipe, the combination of, an elongated frame, a hopper on said frame for receiving a quantity of concrete to be pumped and having an open lower end, a valve housing disposed beneath said hopper and including opposed laterally facing side walls, an upright partition located within said housing between said walls and dividing the housing into first and second laterally spaced delivery passages extending downwardly from said hopper, the upper ends of said passages defining side-by-side upwardly opening inlet ports communicating with the open end of said hopper for admitting a gravity flow of concrete from the hopper into the passages, said passages having laterally spaced side-by-side outlet ports opening out of said housing below said inlet ports and adapted to communicate with the delivery pipe, first and second reciprocating pumps on said frame and communicating with said passages through side-by-side intake ports opening into said housing below said inlet ports and being alined with said outlet ports, means for reciprocating said pumps in unison but in opposite directions whereby one pump draws concrete from its respective passage through its intake port while the other is pumping concrete through its outlet port, a valve member mounted in said housing for back and forth oscillation between first and second angularly spaced positions about a predetermined axis extending through said partition, said valve having an upwardly facing plate thereon formed with upper and lower surfaces arcuately curved about said axis and swingable during such oscillation along an arcuate path extending between said side walls and over said partition, said plate overlying and closing said first inlet port in said first valve position and overlying and closing said second inlet port in said second valve position thereby alternately opening and closing said inlet ports to control the flow of concrete to said passages, said valve also having a second plate disposed in a plane perpendicular to said axis and swingable during such oscillation in a path extending between said side walls and across both of said outlet ports, said second plate overlying and closing said second outlet port in said first valve position and overlying and closing said first outlet port in said second valve position, and mechanism for oscillating said valve between said positions in timed relation with the reciprocation of said pumps whereby each pump receives concrete through its respective inlet port while its outlet port is closed and then pumps the concrete through its outlet port while its inlet port is closed.

2. In a concrete pumping apparatus, the combination of, a frame, a hopper on said frame for receiving a quantity of wet concrete to be pumped and having an open lower end, a housing disposed beneath said hopper and having first and second delivery passages extending downwardly from laterally spaced side-by-side inlet ports communicating with said open end to receive concrete from said hopper, said passages having laterally spaced side-by-side outlet ports opening out of said housing below said inlet ports, first and second reciprocating pumps for drawing concrete from said hopper through said passages and pumping the concrete through said outlet ports, each pump having a cylinder opening into the respective passage, and a valve member mounted in said housing for back and forth oscillation about a predetermined axis between first and second angularly spaced positions, said valve having an upwardly facing closure thereon swingable during such oscillation along an arcuate path extending across said inlet ports and overlying and closing said first inlet port in said first valve position and overlying and closing said second inlet port in said second valve position thereby alternately opening and closing the inlet ports to control the flow of concrete thereto, said valve also having a second closure disposed in a plane perpendicular to said axis and swingable during such oscillation along a path extending across both of said outlet ports, said second closure overlying and closing said second outlet port in said first valve position and overlying and closing said first outlet port in said second valve position, and means for reciprocating said pumps and oscillating said valve in timed relation to hold said valve in said first position while said first pump is pumping and said second pump is drawing concrete from said hopper, and to hold the valve in said second position when the condition of the pumps is reversed.

3. Concrete pumping apparatus as defined in claim 2 in which said housing comprises opposed longitudinal side walls and laterally extending end walls interconnecting said side walls, said delivery passages being formed by said walls and by an upright partition disposed between said side walls and extending longitudinally from one end wall toward the other end wall.

4. Concrete pumping apparatus as defined in claim 3 in which said valve member oscillates about an axis extending through said partition, and said first closure comprises an upwardly facing plate having upper and lower surfaces curved arcuately about said axis, said plate oscillating in a path extending between said side walls with the lower surface of said plate passing over the upper end of said partition during such oscillation.

5. Concrete pumping apparatus as defined in claim 4 in which said plate extends tangentially to alternate side walls in alternate valve positions.

6. Concrete pumping apparatus as defined in claim 4 in which said one end wall has an arcuately curved groove therein and said plate has a similarly curved edge riding in said groove.

7. Concrete pumping apparatus as defined in claim 3 in which said partition terminates short of said other end wall to define a vertically extending slot between the other wall and the opposing face of the partition, and said second closure comprises a plate disposed in an upright plane and swingable through said slot during oscillation of said valve member.

8. Concrete pumping apparatus as defined in claim 7 in which said housing is formed with an arcuately curved bottom interior surface, and said second closure plate is formed with a similarly curved lower end riding closely adjacent to said surface during oscillation of said valve member.

9. Concrete pumping apparatus as defined in claim 3 in which said cylinders communicate with said passages through laterally spaced side-by-side intake ports formed through said one end wall, said outlet ports being formed through the other of said end walls and being alined with said intake ports to establish a substantially straight flow path from said cylinders to said outlet ports.

10. Concrete pumping apparatus as defined in claim 3 further including a siamese pipe section communicating with said outlet ports, and means hingedly connecting said section to said housing.

11. Concrete pumping apparatus as defined in claim 2 further including a piston and a piston rod mounted for reciprocation in each of said cylinders, a male coupling on one end of said rod and including an annular shoulder axially spaced from said end to define an annular groove between the shoulder and the end of the rod, and a female coupling on the end of said piston facing said rod and including a U-shaped collar fitting over said male coupling and within said groove and engaging said shoulder to restrict uncoupling movement of said piston axially of said rod while enabling uncoupling movement of the piston radially of the rod.

12. Concrete pumping apparatus as defined in claim 2 further including wheel assemblies on each side of said frame for supporting the latter, means mounting said frame on said wheel assemblies for up and down sliding between a transport position in which the frame is disposed above the level of a supporting surface and the weight of the frame is supported by said wheel assemblies, and an operating position in which the frame rests upon the supporting surface with substantially none of its weight carried by the wheel assemblies, and actuating mechanism connected between said wheel assemblies and said frame for raising the latter from said operating position to said transport position.

13. In a concrete pumping apparatus, the combination of, a housing having two upright flow passages disposed in laterally spaced side-by-side relation, two laterally

spaced inlet ports opening into the upper ends of said passages in side-by-side relation, and two laterally spaced outlet ports opening into the lower portions of said passages in side-by-side relation; and a valve mounted in said housing for back and forth oscillation about a predetermined axis between two angularly spaced positions, said valve having a first upwardly facing closure movable along an arcuate path across said inlet ports and alternately opening and closing the latter during such oscillation, said valve also having a closure disposed in a plane perpendicular to said axis and swingable back and forth in said plane during such oscillation to close the outlet port of each passage when the inlet port of the passage is open.

14. Concrete pumping apparatus as defined in claim **13** in which said valve comprises a hub and an upright plate projecting radially upwardly from said hub, said first closure comprising an arcuate plate disposed perpendicular to said upright plate and having upper and lower surfaces curved concentrically about said axis, and said second closure comprising a plate projecting radially downwardly from said hub and disposed in a plane perpendicular to said axis.

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ROBERT M. WALKER, *Primary Examiner.*