# United States Patent [19]

**Ziegler et al.**

[11] **3,842,602**

[45] **Oct. 22, 1974**


[54] **MINER TRAM CONTROL CIRCUIT**


[76] Inventors: **Donald D. Ziegler**, Van, Pa. 16363; **Glenn A. Daily**, R.D. No. 1, Utica, Pa. 16362



[22] Filed: **July 9, 1973**

[21] Appl. No.: **377,342**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 181,087, Sept. 16, 1971, abandoned.

[52] **U.S. Cl.** ..... **60/327**, 60/420, 60/427, 60/484, 60/486

[51] **Int. Cl.** ..... **F15b 18/00**

[58] **Field of Search** ..... 60/421, 427, 484, 486, 60/327, 447, 420; 180/6.48



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*Primary Examiner*—Edgar W. Geoghegan



[57] **ABSTRACT**

A fluid control circuit for use in a mining machine tram system whereby there is provided a protection control to prevent undesired movement of a mining machine and a selective range of speed controls as may be required under different operating conditions. A plurality of interlocked valve mechanisms are utilized with a means of limiting operation of certain valves when control of a slow speed range is desired.


**5 Claims, 2 Drawing Figures**

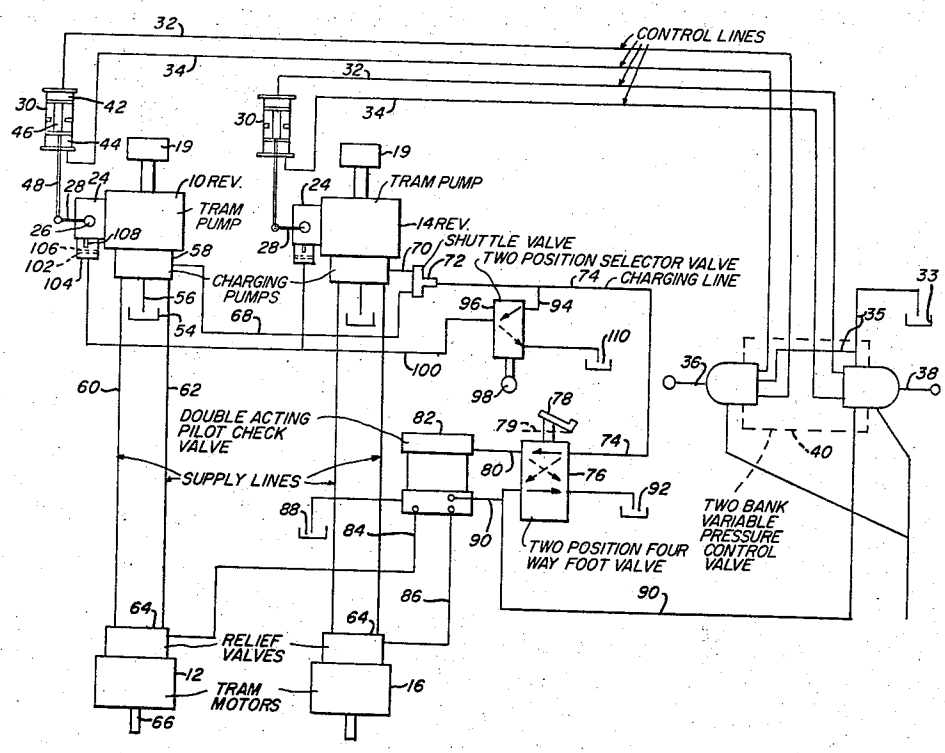
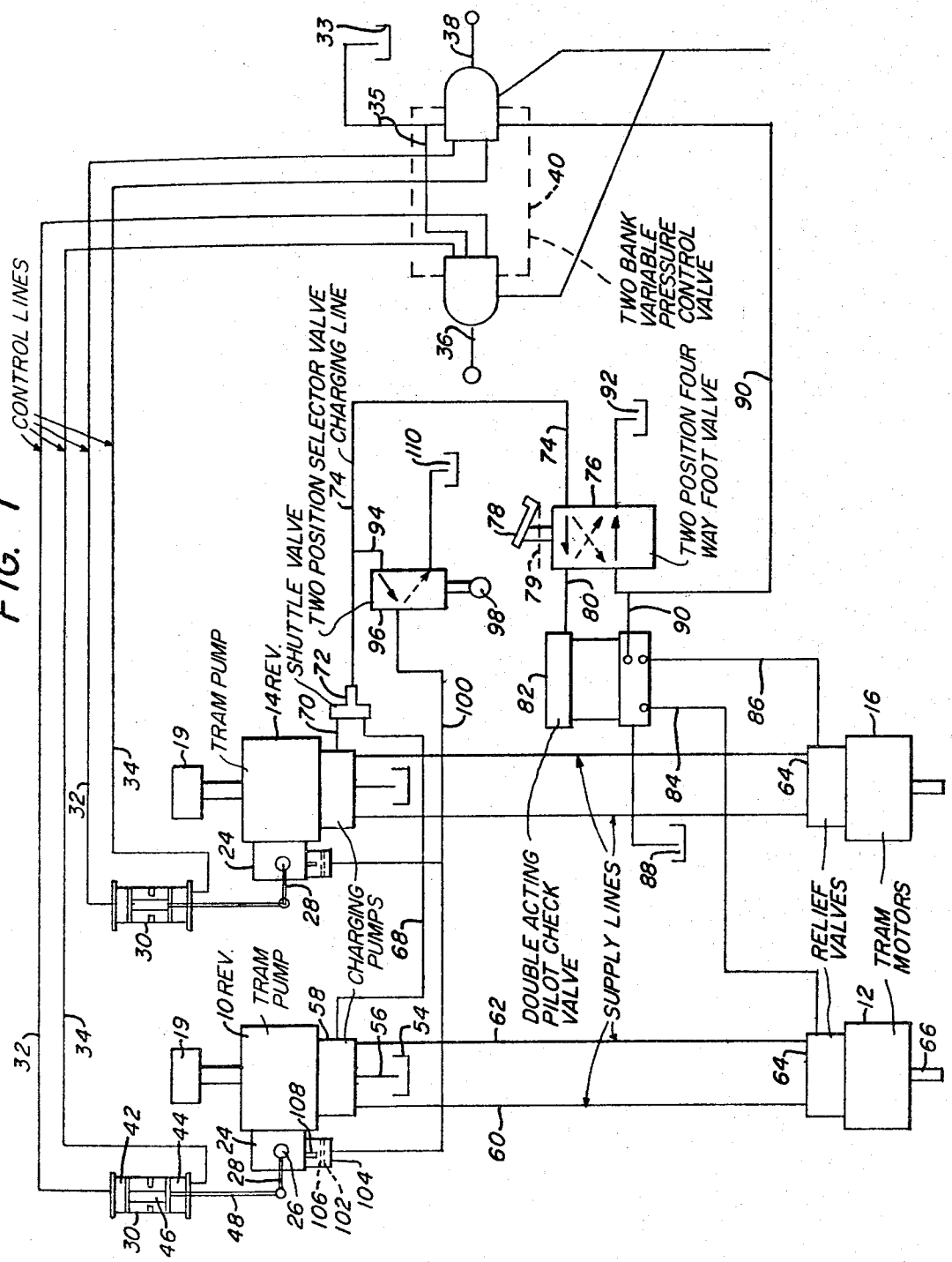


FIG. 1


CONTROL LINES
TWO BANK VARIABLE PRESSURE CONTROL VALVE
TWO POSITION FOUR WAY FOOT VALVE
TWO POSITION SELECTOR VALVE
CHARGING LINE
SHUTTLE VALVE
14 REV. TRAM PUMP
10 REV. TRAM PUMP
CHARGING PUMPS
DOUBLE ACTING PILOT CHECK VALVE
SUPPLY LINES
RELIEF VALVES
TRAM MOTORS

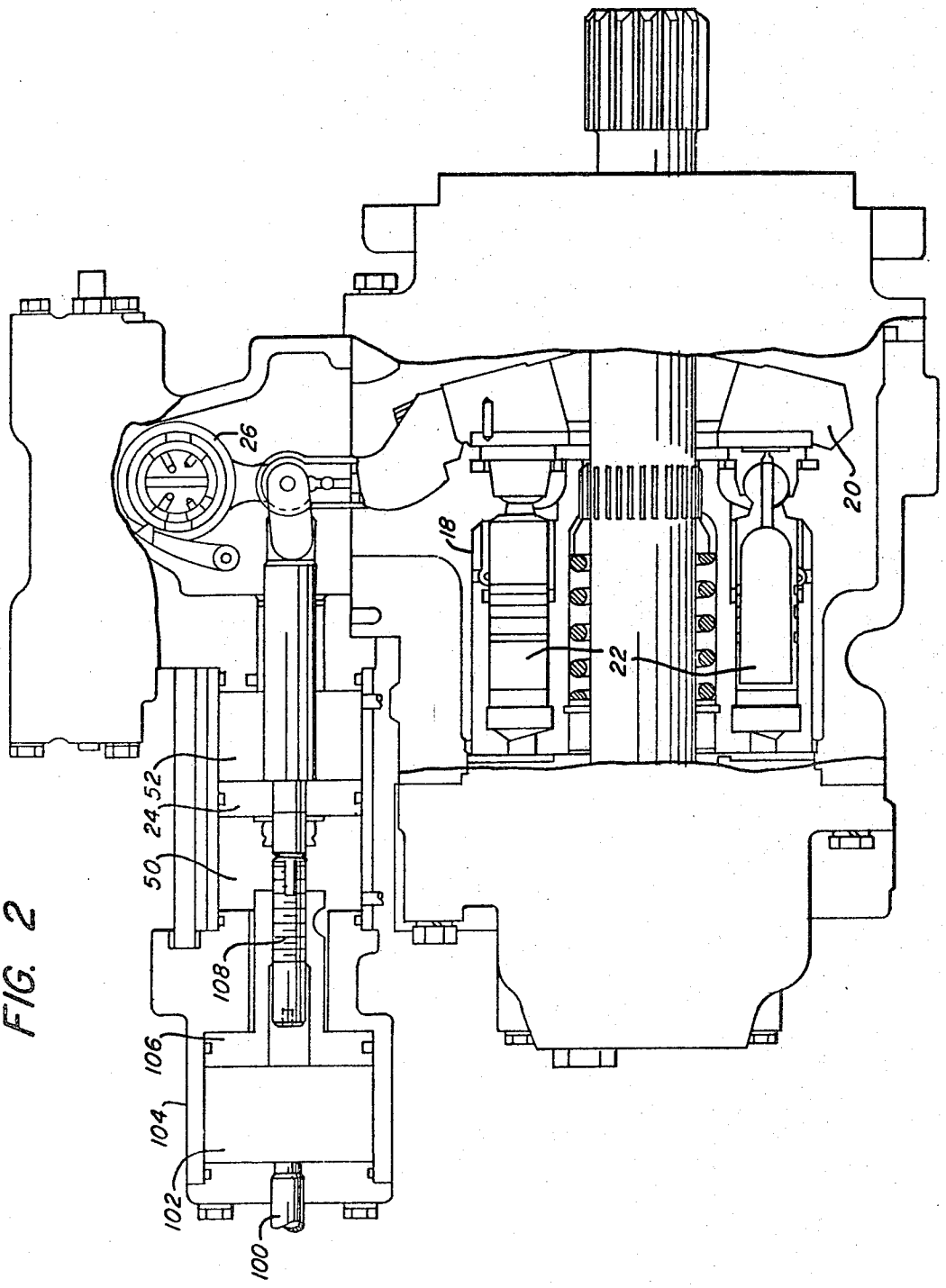



FIG. 2

# MINER TRAM CONTROL CIRCUIT

This is a continuation, of application Ser. No. 181,087, filed Sept. 16, 1971 now abandoned.

## BACKGROUND OF INVENTION

Tram control of the track chains used on mining equipment is predominately accomplished by hydrostatic controls wherein hydraulic transmission lines are interconnected with valving to control hydraulic pumps and motors to regulate tram speed of continuous miners. Manually operated levers are utilized to position control pistons to effect selected speeds of tramming operation. It has been realized that under different operating conditions it is necessary to select speed changes in different increments of change. When moving a miner from one location to another the speed changes are not as critical as when moving the miner while sumping at a working face, therefore it is desirous to have an option of speed ranges in which different speed changes can be selected. Manually operated levers have heretofore been known to permit an undesired creeping motion of tram operation when a positive standstill is desired.

## SUMMARY OF INVENTION

According to the present invention there is provided a new and improved tram control circuit including a speed range control piston selectively operated to affect a speed control rapidly over a wide range or affect a very close control of speed in a limited slow speed range. The control circuit also includes a novel creep control with an interlocked valve arrangement whereby speed control is locked at a zero speed without simultaneous manual operation of a plurality of cooperatively acting valves.

Other provisions of the present invention will become more apparent when taken in conjunction with the accompanying detailed description and the drawings wherein:

FIG. 1 is a schematic view of the hydraulic control system included the individual interconnected valves, pumps and motors in outline;

FIG. 2 is outline view of a conventional rotary pump partly in section with a limiting cylinder included.

## DESCRIPTION

Referring to FIG. 1 there is shown a hydraulic control circuit for a miner having a constant speed hydraulic pump **10** for driving a constant displacement hydraulic motor **12** on the left side of the miner and a constant speed hydraulic pump **14** for driving a constant displacement hydraulic motor **16** on the right side of the miner. The motors **12** and **16** each in turn drive their individual tracks (not shown) respectively on the left and right side of the miner by conventional gearing means not shown.

In that the pump and motor combinations are similar, a single set of reference numerals is utilized hereinafter for similar elements. The pumps **10** and **14** are of the conventional constant speed, reversible type shown in FIG. 2 each one having a rotary barrel **18** driven by electric motors **19** (FIG. 1), and a variable inclined cam plate **20** operating intake and output pistons **22** in accordance with the angle of inclination of the cam plate **20.** Variations in the supply of fluid under pressure to an internally located control piston **24** changes the positioning of the piston **24** to vary the angle of inclination of cam plate **20** to in turn regulate the pump displacement which determines the speed of operation and direction of operation of motors **12** and **16** in a conventional manner. Reversal of the angle of the inclination of the cam plate **20** affects reversal of the function of the pistons **22** such that the intake function becomes an output function and vice versa to in turn effect reversal of the direction of operation of the associated motor **12** or **16.** Control of the positioning of a control piston **24** is affected by a rotary valve **26** (FIG. 2) within the pump under the control of lever **28** (FIG. 1). The lever **28** (FIG. 1) is positioned by a self-centering double-acting cylinder device **30** (FIG. 1) operative to different lever operating positions responsive to variable pressures in control lines **32** and **34** for each of said cylinder devices **30.** The supply of fluid under pressure to one or the other of the control lines **32** and **34,** one being charged the other being vented to a reservoir **33** by lines **35,** is selectively controlled by positioning of levers **36** and **38** of a manually operated two bank variable pressure control valve **40** located at the operator's station. Supply of fluid under pressure to lines **32** and **34** controls operation of the two cylinder devices **30.** The determination of which track is moved, at what speed it is moved, and in which direction it is moved is dependent on which of the levers **36** and **38** are moved, in what direction they are moved, and how far they are moved in a conventional tram control manner. The valve **40** is a conventional pressure control valve shown as the two lever controls in the outline box **40** where for example a predetermined degree of movement of a lever **36** varies the fluid under pressure from a source described hereinafter to the lines **32** and **34** to the cylinder device **30** to vary the pressures in respective chambers **42** and **44** thereof. The regulation of the pressures in chambers **42** and **44** regulates the position of a piston **46** and connecting rod **48** to position the lever **28,** which in turn positions the regulating valve **26** (FIG. 2). The regulating valve **26** selects predetermined fluid pressure deliveries to the control chambers **50** and **52** of the internal control piston **24** which in turn determines the angle of inclination of the cam plate **20.** Variation of the angle of cam plate **20** varies the intake fluid of the pumps. Such intake to the pump is supplied through lines **56** which communicate between a reservoir **54** and a usual charaging pump **58.** The fluid is then pressurized and supplied via lines **60** and **62** through a high pressure relief valve **64** to the respective motors. Variation of the pressure supplied to the motors effects variation of the speed and direction of tramming of the miner through a drive shaft **66.**

It can thus be seen that the pumps operate in a conventional manner wherein positioning of the control piston **24** regulates the position of the cam plate **20** which in turn regulates the output of the pump and thus the speed and direction of motor operation.

The use of a charging pump **58** at the intake to the pump, supplies sufficient fluid to make up for leakage and supply low pressure fluid for operating the pump control.

Associated with the just described pumping circuit is a control circuit comprising feed lines **68** and **70** supplying fluid under pressure from the charging pumps **58** to a double check shuttle valve **72** where the higher pressure delivered by the two feed lines is effective to block off the lower pressure and is delivered via a charging line **74** to a two position mechanically oper-

ated four-way foot valve **76** having a foot pedal **78.** The foot pedal **78** has two positions, the normal non-depressed position shown, and a depressed position along the dotted line **79** of FIG. **1.** Under normal conditions with the pedal **78** in a non-depressed position (flow through valve **76** when pedal **78** is in a non-depressed position is indicated on FIG. **1** by solid arrowed lines within the rectangle designated **76**); the fluid under pressure delivered thereto from charging line **74** is fed directly therethrough and via line **80** to a double acting pilot check valve **82** to operate internal check valves (not shown) to permit the relief valves **64** of the pump motors **12** and **16** to vent via lines **84** and **86** to the valve **82** and then to a reservoir **88,** a condition in which the motors **12** and **16** do not run. Also while the pedal **78** is in its non-depressed position, a deliverry line **90** leading to the control valve **40** is vented through the foot valve **76** to a reservoir **92.**

When the pedal **78** is depressed (flow through valve **76** when pedal **78** is depressed as indicated on FIG. **1** by dotted arrowed lines within the rectangle designated **76**), the line **80** leading to the valve **82** is vented through the pedal operated valve **76** to the reservoir **92** thereby permitting the check valves (not shown) within the valve **82** to seat and stop the venting thereat, while the charging line **74** is connected through the pedal operated valve **76** to pilot lock line **94** to lock the internal check valves of valve **82** in a position to permit a pressure buildup in the lines **84** and **86** and the relief valves **64** to permit the motors to run. Simultaneously, the fluid under pressure in line **74** is supplied to the delivery line **90** and thence to the control valve **40** to act as a source of control pressure for the lines **32** and **34** as desired as described hereinafter.

Associated with the control circuit just described, is a speed selector circuit including a line **94** from the charging line **74** to a two position selector valve **96** with a selector lever **98** (flow through the valve indicated by the solid arrowed line in FIG. **1**). In one position of the lever **98** the fluid under pressure from line **94** is supplied to selector line **100** and then to each pump volume control at a chamber **102** in a limiting cylinder **104** connected to the control chamber **50** and the control piston **24.** Supply of fluid under pressure in chamber **102** acts on a limiting piston **106** having an adjustable stem **108** which moves against the control piston **24** to limit the travel thereof and thereby limit the volume range of the pumps **10** and **14** and thus limit the speed range of the motors **12** and **16** as hereinafter described.

When the selector lever **98** is in a second position (flow therethrough indicated by the dotted arrowed line in FIG. **1**), the selector line **100** is vented therethrough to a reservoir **110** to vent the limiting cylinder **104** and prevent the described limiting of the movement of control piston **24** thereby restoring the full volume and speed range to the pump and motor drive system, respectively, as described hereinafter.

It should be noted that although numerous reservoirs **33, 54, 88, 92** and **110** are shown for convenience of description, it is necessary to have only one reservoir with the appropriate lines connected thereto.

## OPERATION

From the foregoing description it can be seen that there is no motor operating control until the foot pedal **78** is depressed. Prior to depression of the foot pedal **78,** the delivery line **90** is vented to the reservoir **92** thus there is no supply of fluid under pressure for the control levers **36** and **38.** Also, the supply of fluid under pressure from the charging line **74** is through the foot valve **76** to line **90** and thence to pilot check valve **82** wherein internal check valves (not shown) are opened to permit venting (to reservoir **88**) of relief lines **84** and **86** and the relief valves **64** on the two motors **12** and **16** thereby preventing an operative buildup of fluid under pressure at the motors to prevent any undesired creeping or movement of the miner.

Depression of the foot pedal **78** permits a supply of fluid under pressure from the charging line **74** to the delivery line **90** and thence to control valve **40** where such fluid under pressure is utilized as desired by manipulation of the control levers **36** and **38,** to supply fluid under pressure to the control lines **32** and **34** and effect the conventional control of pump and motor system as desired. Depression of the pedal **78** also effects cut-off of the venting of the check valves (not shown) of valve **82** and locks the internal valving (not shown) such that an operating pressure buildup occurs in the relief lines **84** and **86** and relief valves **64** to permit operation of the motors.

The speed range of the pump and motor system is determined by the positioning of the control piston **24** (FIG. **2**) in the conventional manner. When it is desired to reduce the speed range, the lever **98** of selector valve **96** is moved to the position shown in FIG. **1** wherein fluid under pressure is supplied therethrough from the charging line **74** to a control line **100** to act on the limiting piston **106** in the limiting cylinder **104** in a manner that the adjustable piston stem **108** thereof is moved into the operating space of the control piston **24** to thereby limit the movement of the control piston **24** to the left which in turn according to conventional operating procedures will limit the operating output range of pumps in the forward direction and thereby prevent excessive undesired speeds of the miner while sumping.

It is to be noted that modifications can be made to the preferred embodiments described hereinabove without departing from the scope of the invention herein; for example selector valve **96** is described hereinabove as being manually operable by means of lever **98,** however, a pilot operable valve can be substituted therefor which is made operable by pressure responsive or electrical means, and the like.

What is claimed is:

**1.** A method of controlling the tramming rate of a mining machine having a constant speed hydraulic pump means and at least one hydraulic driving motor for tramming comprising the steps of: directing at least a major portion of the output of pressurized hydraulic fluid from said pump means to said driving motor for hydraulic energization thereof; directing a first control portion of such pressurized hydraulic fluid from said pump means to a first control valve means; selectively moving said first control valve means to vary the quantity of output of pressurized hydraulic fluid from said pump means; directing a second control portion of such pressurized fluid from said pump means to a second control valve means; selectively moving said second control valve means to limit the maximum quantity of output of pressurized hydraulic fluid from said pump means.

2. The method as specified in claim 1 wherein said pump means includes a charge pump portion and said first and second control portions of pressurized hydraulic fluid are directed from the output of said charge pump portion.

3. A method as specified in claim 1 wherein said second control portion selectively limits the quantity of said output from said pump means between a first maximum output and a second maximum output less than said first maximum output.

4. A method as specified in claim 3 wherein during said first maximum output said directing of said second control portion of said pressurized hydraulic fluid is to a reservoir.

5. A method as specified in claim 3 wherein during said second maximum output said directing of said second control portion of said pressurized hydraulic fluid cooperates with said first control portion to limit said output of pressurized hydraulic fluid from said pump means to said second maximum output.

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