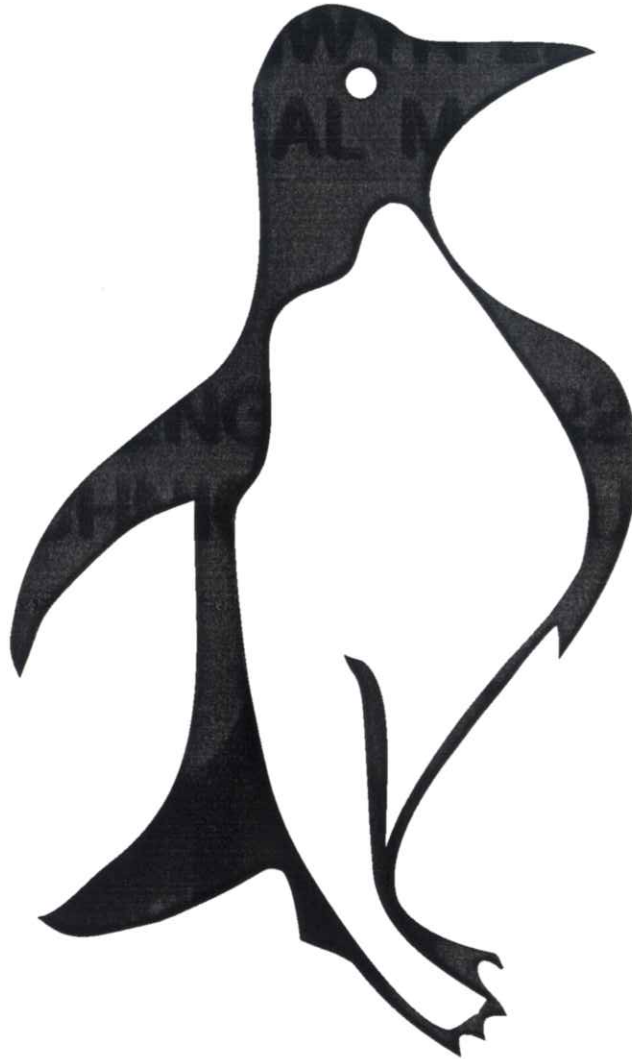


PENGWYN 222 TECHNICAL MANUAL



PENGWYN SNOW CONTROL SYSTEMS
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TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION	PAGE 1 - 1
THE AUTOSUCKER PUMP	PAGE 1 - 6
THE HYDRAULIC SYSTEM	PAGE 1 - 7
THE ELECTRICAL SYSTEM	PAGE 1 -10

CHAPTER 2

OPERATION OF THE CONTROL CONSOLE	PAGE 2 - 1
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CHAPTER 3

SETTING THE SPEED CONSTANT	PAGE 3 - 1
SETTING THE DISTANCE MEASURING	PAGE 3 - 2
SETTING THE AUTOMATIC SPREADER	PAGE 3 - 3
SETTING THE MINIMUM VALVES	PAGE 3 - 4
SETTING THE DAY AND TIME	PAGE 3 - 5
PRESSURE ADJUSTMENTS	PAGE 3 - 6

CHAPTER 4

MANIFOLD DIAGRAM	PAGE 4 - 1
HOSING DIAGRAM	PAGE 4 - 2

CHAPTER 5

TROUBLESHOOTING	PAGE 5 - 1
SOLENOID ENERGIZING CHART	PAGE 5 - 2
TROUBLESHOOTING CHART	PAGE 5 - 4

CHAPTER 6

PARTS LIST OF AUTOSUCKER PUMP	PAGE 6 - 1
PARTS LIST OF MANIFOLD 222	PAGE 6 - 3
PARTS LIST OF CONTROL CONSOLE 222	PAGE 6 - 5
PARTS LIST OF MISC. ITEMS	PAGE 6 - 6

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CAUTION

**DISCONNECT AMPHENOL
PLUG FROM MANIFOLD
BEFORE WELDING ON THE
TRUCK.**

**DO NOT OVER TIGHTEN
SOLENOID COIL NUT - THE
COIL SPINDLE IS HOLLOW
AND EASILY DAMAGED**

* * * * *

INTRODUCTION

The **PENGWYN 222** is an electronically operated hydraulic system for dump trucks utilized for snow and ice control. The design objective of the Pengwyn's engineering is to combine reliability with advanced machining, modern electronics, and maintenance free hydraulics into a compact, cost effective package. The result is a practical state of the art product that is management controlled, efficient, convenient, safe method for operating a snow truck hydraulic system.

The Pengwyn controls the following functions from one fixed displacement pump source:

1. Dump Body Hoist (single and double acting cylinders)
2. Plow Lift
3. Plow Angle
4. Auger Rotation (manual and ground sense)
5. Spinner Rotation
6. Wing Plow (as required)

A fixed displacement AUTOSUCKER "ON DEMAND" pump is utilized because it provides the highest total efficiency, most rugged design and great power when required.

At the heart of the control console is a 'MICROPROCESSOR'. It is able to easily analyze data and perform calculations almost instantaneously while controlling the auger and spinner valves. The control display indicates:

1. Accurate truck speed in MPH
2. Material application rate in Pounds Per Mile

3. Day of week & time of day
4. Distance measuring in Feet
5. Distance measuring in Miles

through an LCD display.

The system has many benefits to help the operator and management personnel. The following are some of the major features:

1. The unique series circuit which utilizes an AUTOSUCKER pump and reaches full effectiveness at low engine speeds.
2. The valving has a much quieter operating noise level than the popular two knob manual or electrically powered control systems.
3. The "ON DEMAND" pump reduces heat, fuel usage and has GREATER OVERALL EFFICENCY than expensive load sense piston pump systems.
4. There are no hoses or fittings inside the cab. This increases operator comfort and safety.
5. One manifold block contains all the hydraulic functions. The need for the interconnecting plumbing of breadboard circuits is eliminated.
6. Elimination of excess plumbing affords easy low cost installation and reliability.
7. The control console and manifold easily convert to either single or double acting bed cylinders.
8. The manifold can be plumbed for single or double acting plow cylinders.
9. A pressure compensated flow control is incorporated into the bed circuit. This gives nearly constant bed down speed whether the bed is empty or fully loaded.

10. Since all electrical components are in the cab, all exterior electrical problems due to salt water corrosion are eliminated.
11. The fluid reservoir size and mounting are not restricted by the Pengwyn system.
12. All troubleshooting and repairs, if needed, can be performed in the cab with the bed down without draining the reservoir or shutting it off.
13. The system utilizes solenoid valves of the poppet-type which are high flow, zero slippage, dirt tolerant, inherently reliable and low cost.
14. The entire hydraulic system is controlled by an easy to mount, small control console.
15. The LCD display allows the operator to continuously confirm the proper operation of the ground sense system.
16. The LCD readout displays truck speed in MPH and the calculated rate of material flow in pounds per mile.
17. The spinner has SEVEN selectable speeds.
18. The spreader has FIFTEEN selectable speeds in the manual mode of operation and FIFTEEN selectable rates when in the automatic mode.
19. The spreader circuit is equipped with a BLAST function that opens all the auger valves so that it rotates at maximum speed for as long as the BLAST switch is depressed. And this function is operable only when the spreader switch is in either the automatic or manual mode.
20. The FIFTEEN automatic rates are management set to any rate desired and then key locked.

21. No special tools, calibrators, simulators or equipment are necessary to change the control console's calibration parameters. Just operate the key switch in the right side of the control box, and all parameters can be altered by using the front panel switches.
22. The initial flow rate to the auger motor can be set from 1 to 5 GPM. This occurs with initial truck movement and is useful in applying greater application rates at intersections or preventing gaps due to auger motor slippage.
23. The control console also has an automatic output to turn the AUTOSUCKER pump on when it's needed rather than leaving it on all of the time. This feature saves fuel by eliminating unnecessary pump drag which may be most of the engine running time.
24. Closed loop analog systems must have an auger shaft feedback transmitter, whereas, digital valving eliminates this costly and environmentally vulnerable feedback requirement that the analog system must have and the digital system is inherently reliable, repeatable, extremely dirt tolerant, and inexpensive.
25. The series design allows the auger and spinner to function without interruption while operating the bed or plow at the same time.
26. All seals are static O-ring type that are not subject to wear from sliding spools, shafts, or rotary valve stems therefore, the manifold and valve assembly is virtually leak proof.

27. Both the plow lift and the bed hoist cylinders are operated by poppet-type valves which can hold the bed or plow elevated when de-energized. These poppet valves also perform like load checks, an additional safety feature preventing momentary down drift found in some circuits.
28. An auger manual lock out key switch is provided so that management can prevent use of the manual mode in the winter if desired.

THE AUTOSUCKER PUMP

The AUTOSUCKER PUMP was designed to give the best combination of rugged configuration as well as superior fuel efficiency in a cost effective package. This was achieved by incorporating an internally piloted sudden shut off valve into a proven type gear pump.

The one piece package incorporates:

- 1) Heavy duty gear pump with pressure loaded side plates and D. U. bearings.
- 2) A 1" straight keyed shaft and an SAE "B" mounting pad.
- 3) An integral solenoid controlled poppet type suction shut off valve. This valve is internally piloted and does not require air lines, air valves, or a pneumatic cylinder.
- 4) In the shut off or free wheeling mode, engine drag is negligible. A .5GPM lube oil flow wets the gears and is drained separately back to tank.
- 5) The shaft seal area is drained to atmosphere preventing sucking in air and foaming the hydraulic fluid.
- 6) Pump displacements from 1.08in³ to 3.88in³ are available however 2.37in³ is most popular for the PENGWYN applications.
- 7) A priority flow control is incorporated to limit maximum pump flow - this is generally set to 17GPM.
- 8) The maximum pump pressure is 3200PSI.
- 9) The maximum speed is in excess of 3000RPM. Consult factory for recommendations above 3000RPM.

THE HYDRAULIC SYSTEM

The Pengwyn hydraulic circuit is essentially a series circuit design. The purpose of this design is to reduce the pump requirement to an absolute minimum. The smaller flow gives greater fuel efficiency, reduced hydraulic noise and it also reduces the system cost.

One rule of thumb applied to central hydraulic circuits is that you need about 7.5 GPM for the auger, about 2.5 GPM for the spinner and an additional 10 GPM for the bed and plow functions so as not to interrupt the spreader operation when simultaneously operating the bed hoist or the plow. In parallel hydraulic circuit designs, all of the flow requirements are additive, i.e. $7.5 + 2.5 + 10$ for a total of 20 GPM. This flow was determined to be desirable at a minimum engine speed of 1000 RPM. Hence, a large amount of horsepower is wasted at high engine speeds when only the spreader is operating. This loss seriously affects truck fuel economy, and the hydraulic reservoir size must be larger to dissipate the large amount of heat that is generated.

The Pengwyn's circuit is in series, so the flow from the pump first satisfies the requirements of the auger. The entire flow from the pump is then available to the spinner and then, if needed, it is available for the bed hoist and the plow functions. The pressures for each function are additive and the peak pressure for the series circuit is higher than for the parallel circuit. The typical pressures for the auger with free flowing material is 300 to 500 PSI, and the pressure for the spinner is, usually, under 200 psi. The bed or plow may require an additional 1000 to 1300 PSI when fully loaded. This yields a maximum operating pressure of, approximately, 1400 to 1900 PSI, which is well within the range of the 3250 PSI pump that is recommended. The Pengwyn system

is supplied with an Autosucker hydraulic pump source that provides 20GPM @ 2000 RPM. The maximum supply pressure should be around 2300 to 2500 PSI.

The beauty of this arrangement is that in a series circuit, the additional pressure for the bed and plow occur only when needed. Therefore, no horsepower is wasted in having pump capacity available for the bed and plow when they are not in use. This is a tremendous advantage over the parallel pump system.

The view of the manifold (page 4-1) shows the layout of the solenoid valves. Solenoids 2, 3, 4, 5, and 6 are the auger valves. These valves are arranged in parallel and each has a different flow rate. They are added together when each of them is energized. Therefore, its flow rates as shown on the auger as shown on the auger flow chart

(pages 5-2, 5-3) are available by operating the different combinations.

Similarly, valves 7, 8, and 9 control the spinner. Refer to the spinner solenoid flow chart (page 5-2) for the spinner solenoids.

Valve 1 dumps the hydraulic fluid back to tank when the fluid is not needed for the bed or plow functions. When fluid is needed for the bed or plow functions, this valve is then energized, blocking the bypass to tank. It is operated with any cylinder motion that requires positive pump pressure. Refer to the bed hoist and plow charts (page 5-2) for visual reference. Valve 12 is energized for lifting the bed, valve 13 is bed down slow and valve 14 is bed down fast. The bed down slow rate is adjustable on the "blind port" valve #23 (page 4-1). Plow angling is achieved by energizing either valve 16 for angle left or valve 15 for angle right. To raise the plow, valve 10 is energized, and to lower it, valve 11 is energized.

The manifold offers many opportunities for mounting. Due to its compact size, it can be mounted behind a bench seat with the hydraulic connections coming out the back cab wall. Mounting the manifold inside the cab affords protection for the electrical wiring while still having the safety of all the hydraulic plumbing outside.

THE ELECTRICAL SYSTEM

The electric console controls the entire hydraulic system from inside the cab. The console has a two-position maintained on-off toggle switch. This switch puts the hydraulic system in standby and turns on the console night lights.

The dump hoist is controlled by one-three position momentary toggle switch and one push button switch. When the toggle switch is held in the down position, the bed will descend at a slow speed. And when the push button switch is depressed in conjunction with the toggle switch (down), the bed will descend at a high speed.

The plow lift is controlled by one-three position momentary toggle switch. And the plow angle is controlled by one-three position momentary toggle switch.

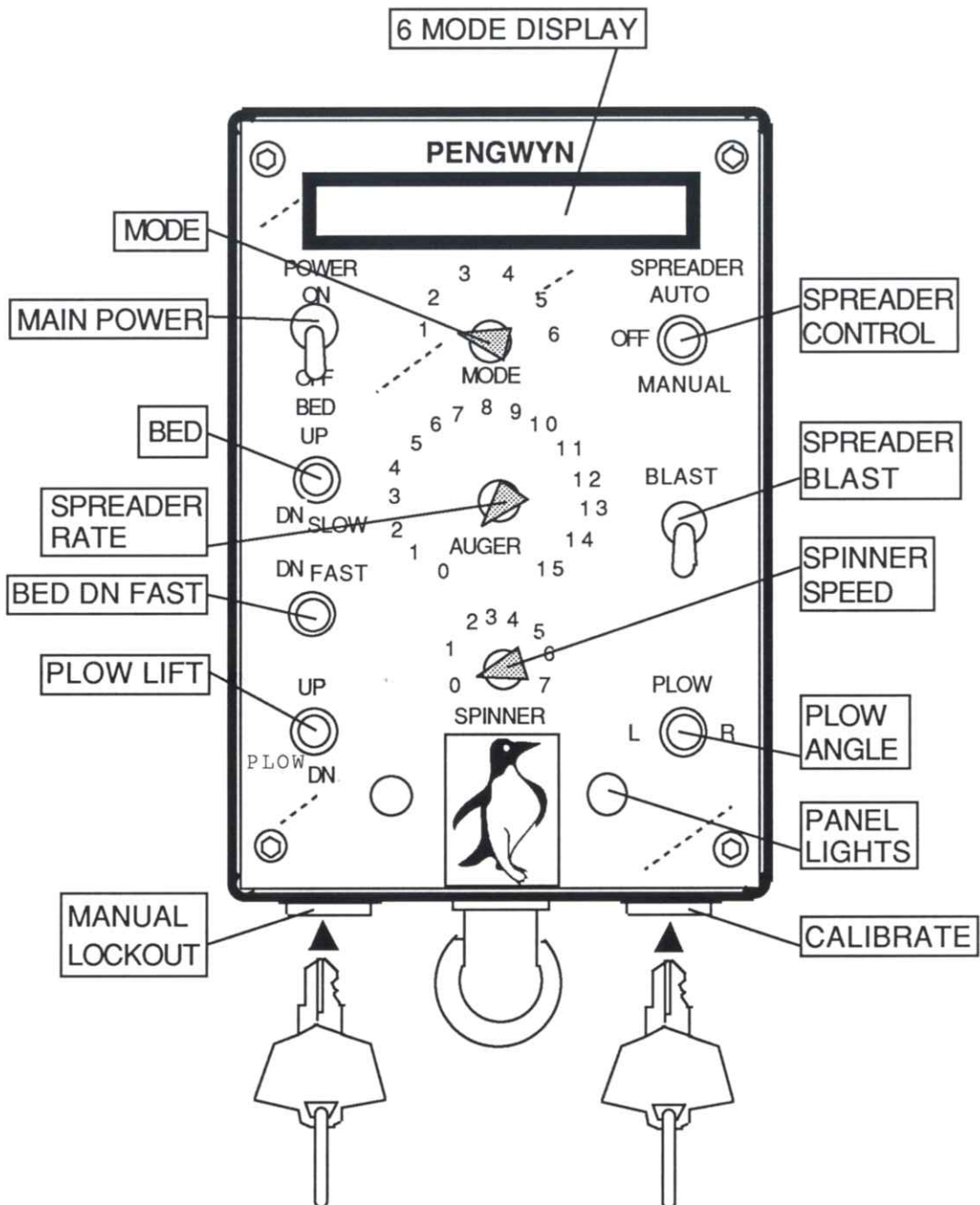
The spreader is controlled by one-three position maintain toggle switch. This has three modes of operation: automatic; off; and manual. In automatic or manual modes, both the spinner and blast switches can be activated. The spinner is set by a zero to seven rotary switch. Each settings in are per the spinner flow chart. The blast switch is a two position momentary toggle switch. When operated, all auger valves will open and when released, all auger valves will return to previous mode.

In manual mode, the auger speed is adjusted with a 16 position rotary switch. Each number on the face plate represents the GPM output ie. position 1 is 1GPM etc. In automatic mode, the auger rates are ground oriented. The rotary switch has 15 setable rates. In automatic, the auger speed is regulated by the speed of the truck. In manual the auger speeds are constant even if the truck is stopped.

The display is a sixteen character LCD (liquid crystal display), with LED (light emitting diode) back lighting for good night time visibility.

The electric console is prewired to the hydraulic manifold and then tested as a unit. The only wiring that must be completed on the truck is 12 volt DC power from the key switch, continuous 12 volt DC power, pump control wire, ground, the pulse input from either a pulse generator installed in the mechanical speedometer cable or a direct connection to the electronic speedometer wiring, and if needed, a two speed rear axle wire. All switches are environmentally sealed. Also, the electrical wiring going into the control console shall enter through liquid tight connectors and conduit.

FUNCTIONS OF SWITCHES

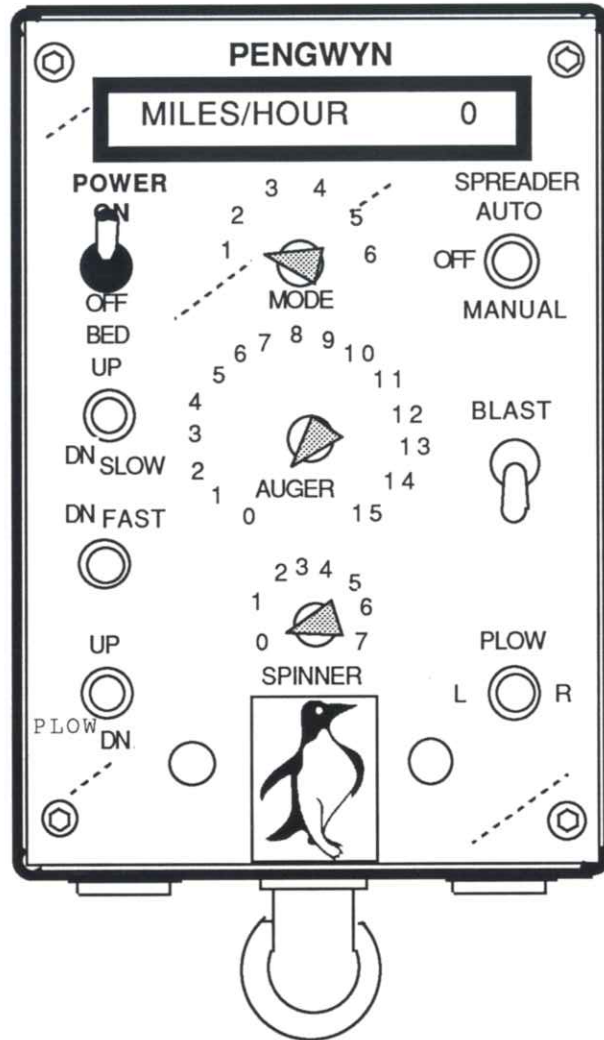


OPERATION OF CONTROL CONSOLE

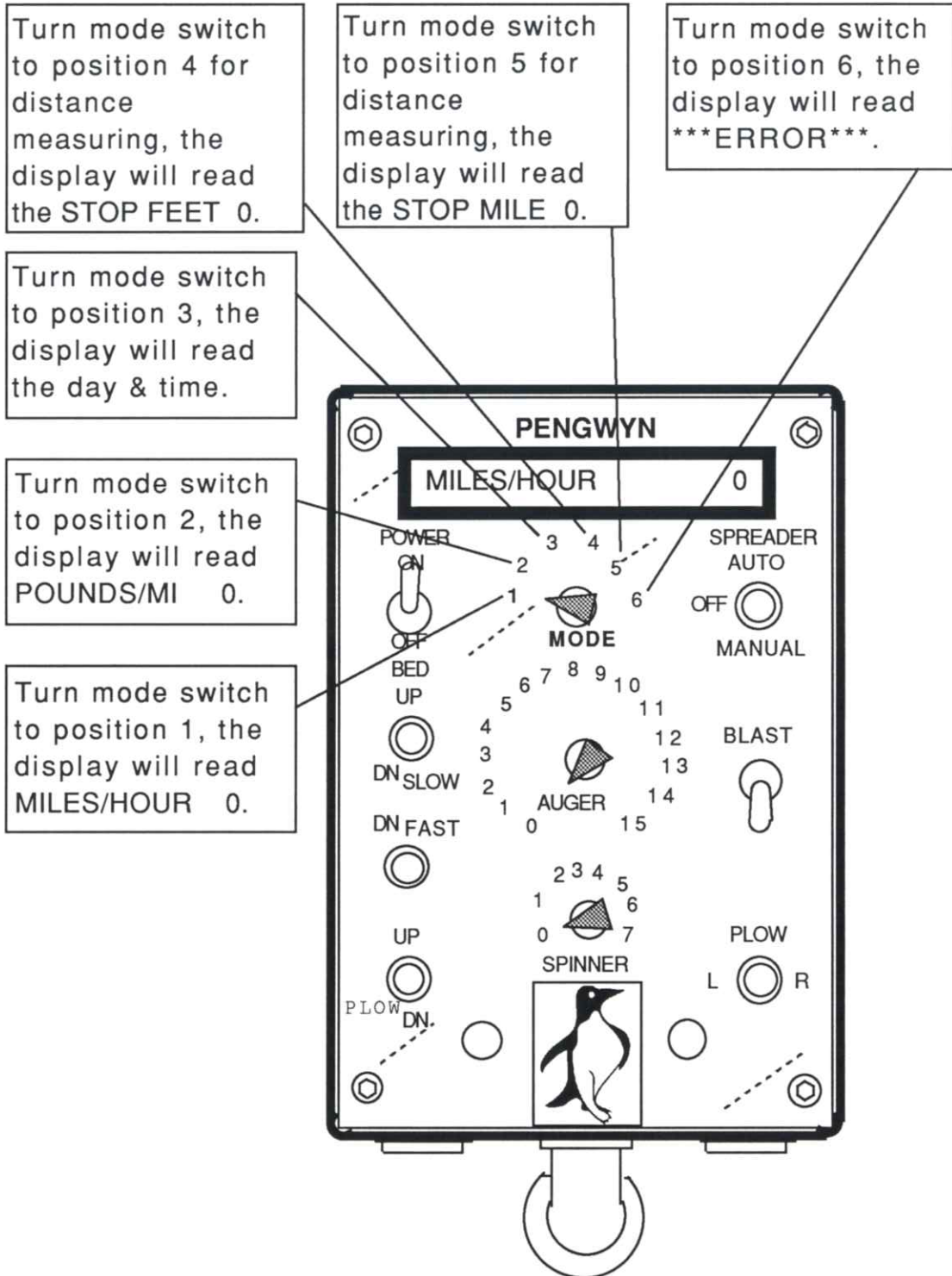
PENGWYN 222 V1.0

5 BIT MANIFOLD

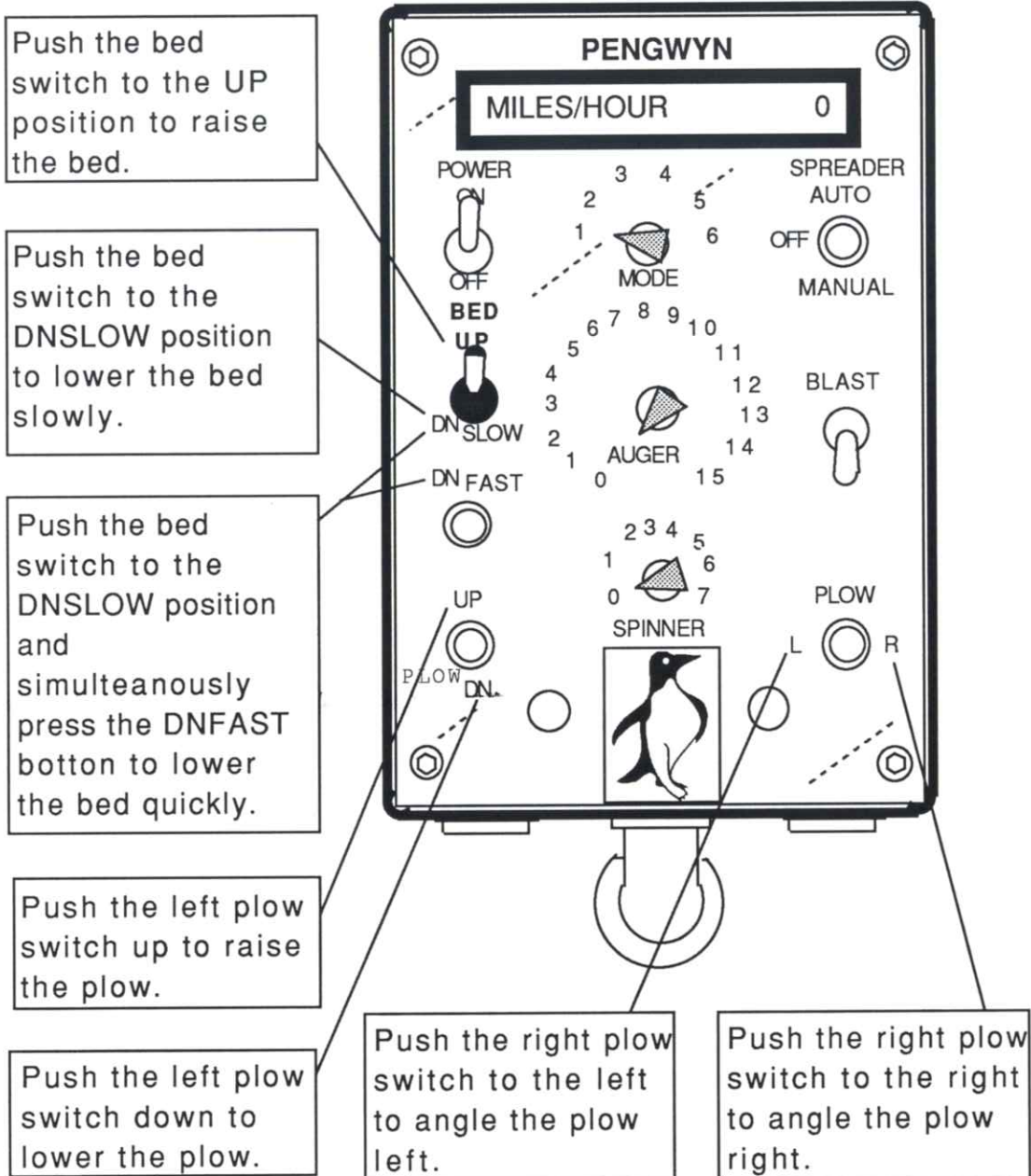
Turn the MAIN POWER switch to the ON position. The panel lights will turn on, and the display will show the current software update (PENGWYN 222 V1.0). Then the display will show 5 BIT MANIFOLD (if the manifold is a 5 bit). And then the display will show the mode.



DISPLAY MODE SWITCH

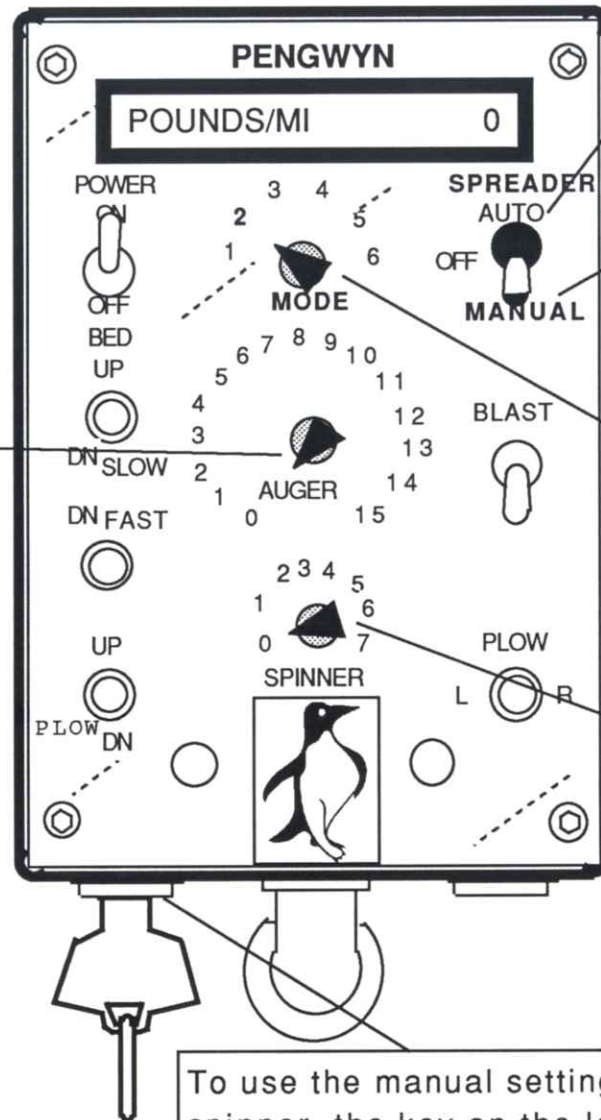


BED AND PLOW SWITCHES



SPREADER SWITCHES

Turn the auger rotary switch clockwise to increase the speed of the spreader output. In manual, each number is equal to the hydraulic flow to the auger pressure port in GPM. In automatic, this switch selects the rate of material application in POUNDS/MILE adjusting automatically with vehicle speed.



Spreader switch is pushed up to AUTO to use the ground oriented auger rate and pulled down to MANUAL to have a continuous flow rate.

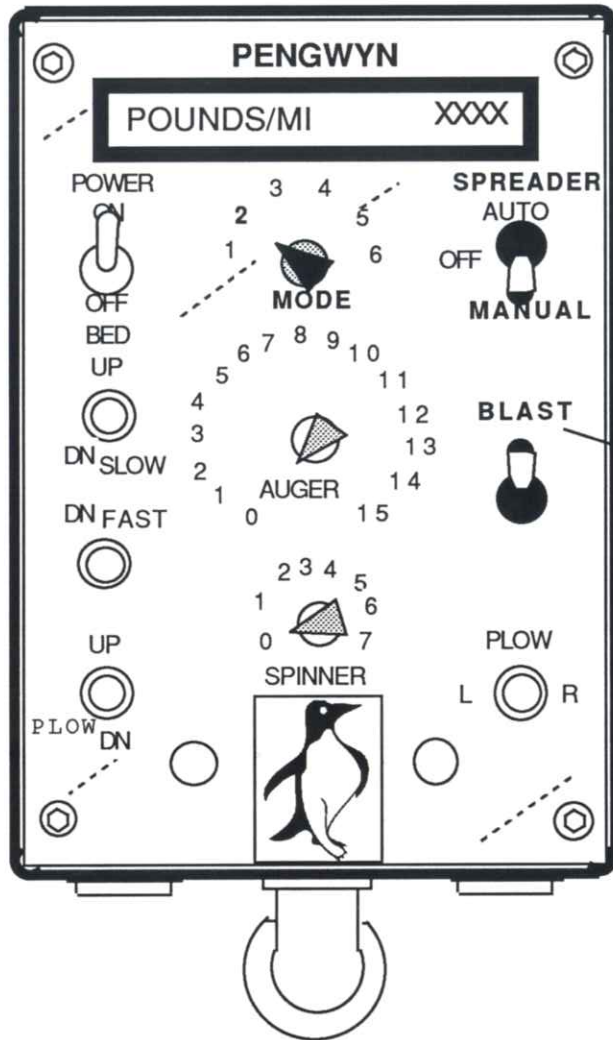
Mode 2 shows the calculated rate of material application in POUNDS/MILE.

Turn the spinner rotary switch clockwise to increase the speed of the spinner.

To use the manual settings for the auger or spinner, the key on the left side of controller must be vertical. To lockout manual settings, this key must be horizontal.

The manual spreader setting can be used to power hydraulic tools or temporarily operate the spreader in the event there is a problem with the processor.

BLAST



The blast switch will instantaneously give maximum hydraulic flow to the spreader motor. The switch is spring loaded and when released the spreader motor will instantly return to the previous mode of operation. The actual blast rate will also be calculated and displayed.

DISTANCE MEASURING

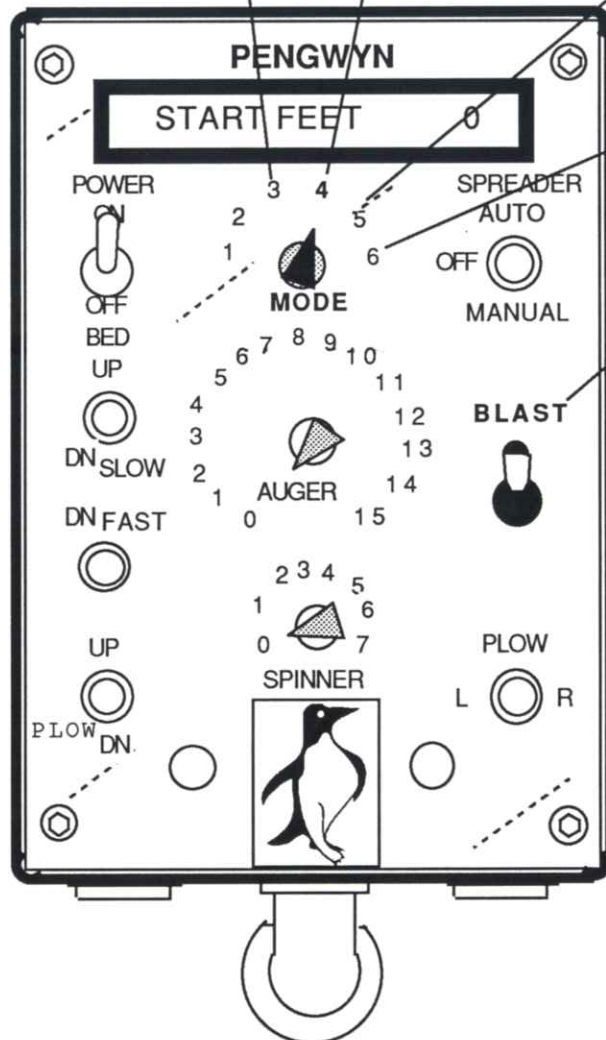
Mode 3 will clear the distance measuring in feet and miles.

Mode 4 displays distance in feet. When the display reads STOP, switch to mode 5 to see this in miles.

Mode 5 displays distance in hundredths of a mile. When the display reads STOP, switch to mode 4 to see this in feet.

Mode 6 will clear the distance measuring in feet and miles.

Pushing the blast switch up and then releasing, will either start or stop the distance measuring in either feet or miles.



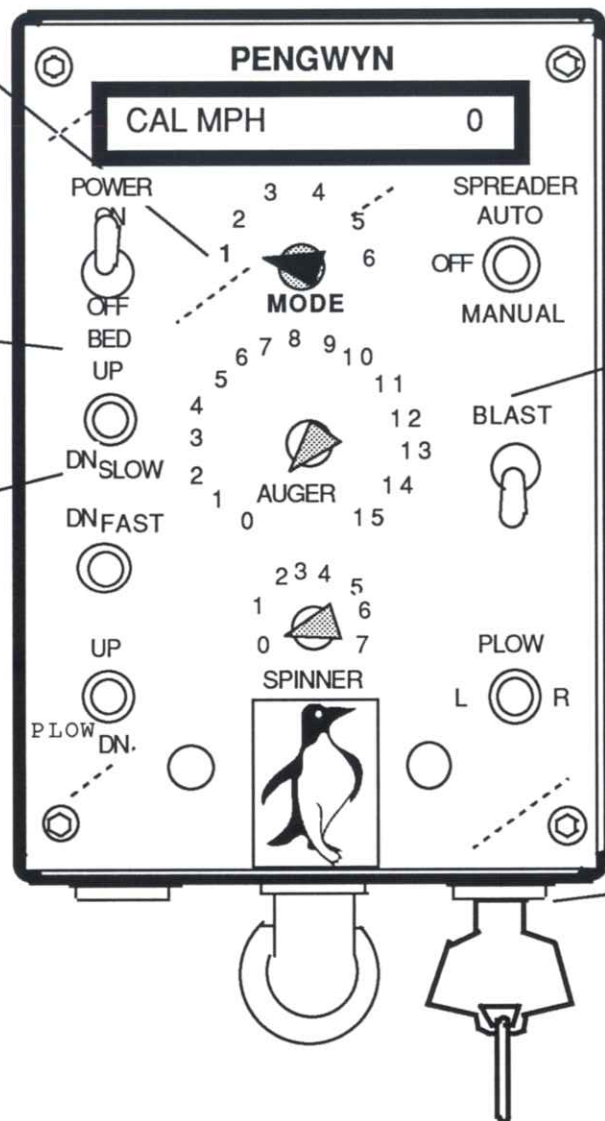
SETTING THE SPEED CONSTANT

STEP 2:

Turn the mode switch to "1". The display will read "CAL MPH 0".

STEP 3:

When the vehicle is driven at a constant speed of 30 MPH or more, press the bed switch up to increase the MILES/HOUR or press the bed switch down to decrease the MILES/HOUR to make the Pengwyn equal to the speedometer. .



Push up on the blast switch to see the display read "MPH CONST XXXX". This constant can be used later when programming other similar trucks or in the event of console replacement.

STEP 1:

Put the key in the right hand switch, turn it to the horizontal position to program.

NOTE: The speed and distance measuring constants are the same - the surveyed mile method is the most accurate

NOTE: Always remove the calibrate key before turning the main power switch off.

SETTING THE DISTANCE MEASURING

USING KNOWN CONSTANT

USING A SURVEYED MILE

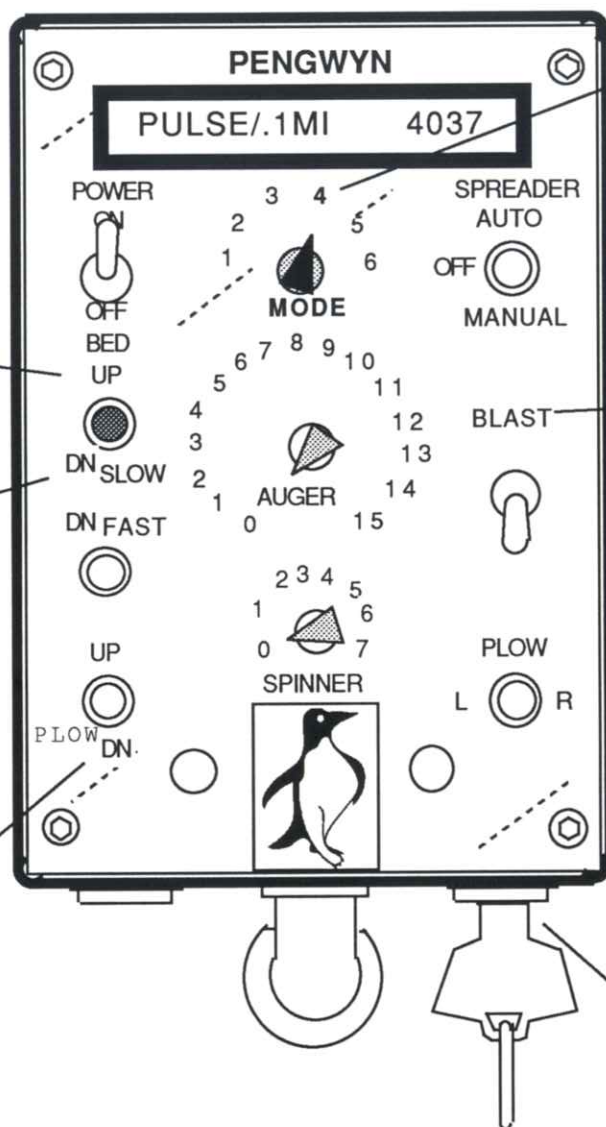
STEP 1:

Turn the calibrate key to horizontal

STEP 2:

Press the bed switch up to increase the PULSE/.1MI or press the bed switch down to decrease the PULSE/.1MI to match it to a known constant.

When increasing or decreasing a large number push the left plow switch down to increase or decrease the hundreds digit.



STEP 2:

Turn the mode switch to "4". The display will read "PULSE/.1MI XXXX".

STEP 3:

Push up on the blast switch, the display will read "CAL MI 0", then drive the vehicle one measured mile. The computer will count the Pulses per Mile. After that measured mile press up on the blast switch again and the display will show PULSES/.1 MI.

STEP 1:

Put the key in the right hand switch, turn it to the horizontal position to program.

NOTE: Distance measuring and speed constants are the same - the surveyed mile method is the most accurate.

NOTE: Always remove the calibrate key before turning the main power switch off.

SETTING THE AUTOMATIC SPREADER

STEP 2:

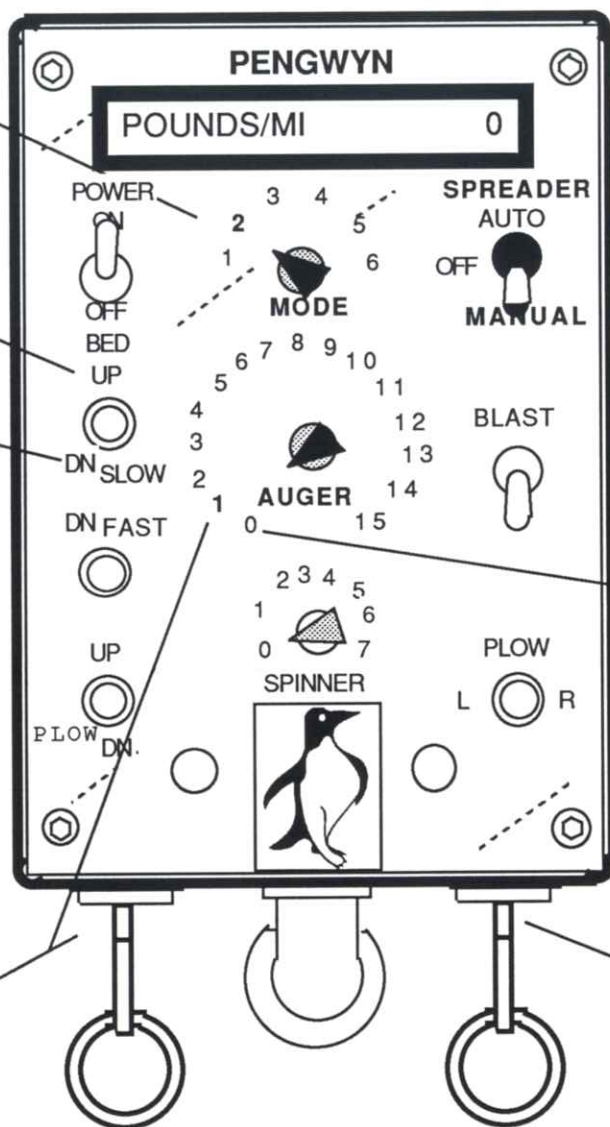
Turn the mode switch to "2".

STEP 5:

Press the bed switch up to increase and down to decrease the poundage settings.

STEP 1:

Turn key on the left side of controller to the vertical position. Then turn the auger rotary switch to 1. With material supplied to the auger turn the spreader switch to MANUAL. Time for one minute. Weigh the material.



STEP 4:

Turn the auger rotary switch to 0 after the material has been weighed, use bed switch to input the weight of material. Then turn the auger switch to 1 through 15 and input, using the bed switch, the application rates required.

STEP 3:

Put the key in the right hand switch turn it to the horizontal position to program.

NOTE: Always remove the calibrate key before turning the main power switch off.

SETTING THE MINIMUM VALUES

STEP 2:

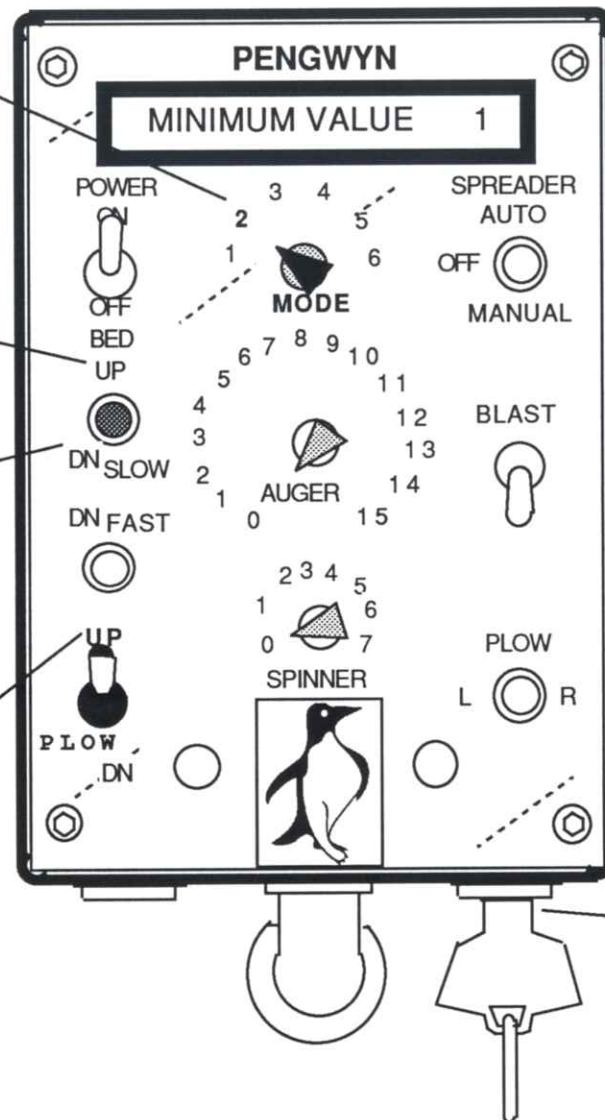
Turn the mode switch to "2".

STEP 4:

While holding the plow switch up press the bed switch up to increase or down to decrease minimum values.

STEP 3:

Push the left plow switch up, the display will show "MINIMUM VALUE X".



STEP 1:

Put the key in the right hand switch, turn it to the horizontal position to program.

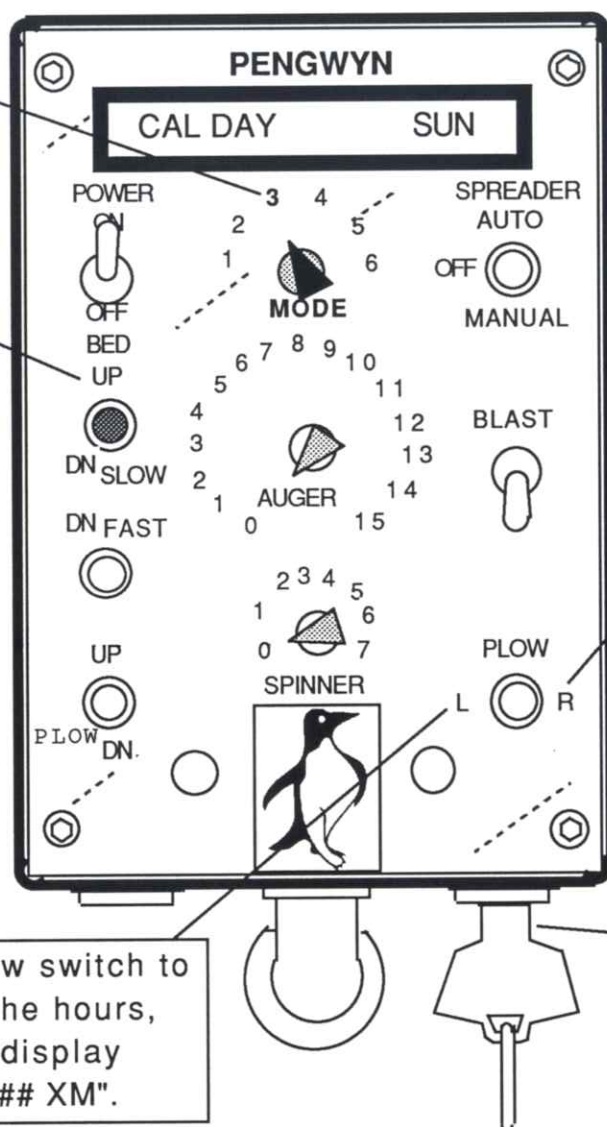
NOTE: Always remove the calibrate key before turning the main power switch off.

SETTING THE DAY & TIME

STEP 2:

Turn the mode switch to "3". The display will read "CAL DAY SUN".

Press the bed switch up to increase day and increase time while holding the plow switch.



STEP 4:

Push the right plow switch to the right to change the minutes, this will make the display read "CAL MIN ##:##XM".

STEP 1:

Put the key in the right hand switch, turn it to the horizontal position to program.

STEP 3:

Push the right plow switch to the left to change the hours, this will make the display read "CAL HRS ##:## XM".

NOTE: Always remove the calibrate key before turning the main power switch off.

PRESSURE ADJUSTMENTS

The hydraulic system incorporates 3 relief valves. These valves are checked for operation during assembly and are set for testing only. These valves should be reset after truck assembly to the values recommended by the manufactures of the equipment installed on the trucks. Refer to page 4-1 for location of valves.

A. SPREADER RELIEF

- 1) Install gage at auger out pressure port, which will dead head auger circuit into the gage.
- 2) Start engine.
- 3) Turn Pengwyn on.
- 4) Turn SPREADER switch to MANUAL.
- 5) Turn AUGER to 1.
- 6) Quickly read the gage.
- 7) Turn engine off.
- 8) Remove cap from spreader relief.
- 9) With allen wrench, adjust internal screw CW to increase pressure setting or CCW to decrease pressure setting.
- 10) Replace cap.
- 11) Repeat above procedure until proper setting is achieved.

NOTE: *One revolution of adjusting screw will change pressure approx. 300-400 psi.*

B. BED UP/PLOW UP RELIEF

- 1) Install gage in plow lift line, dead heading the plow/bed circuit into the gage.

- 2) Start engine.
- 3) Turn Pengwyn on.
- 4) Operate PLOW UP button to dead head plow circuit.
- 5) Quickly read gage.
- 6) Turn engine off.
- 7) Remove Plow/Bed relief cap.
- 8) With allen wrench, adjust the valve CW to increase pressure setting or CCW to decrease pressure setting.
- 9) Replace cap.
- 10) Repeat the above procedure until proper setting is achieved.

NOTE: *One revolution of adjusting screw will change the pressure approx. 300-400 psi.*

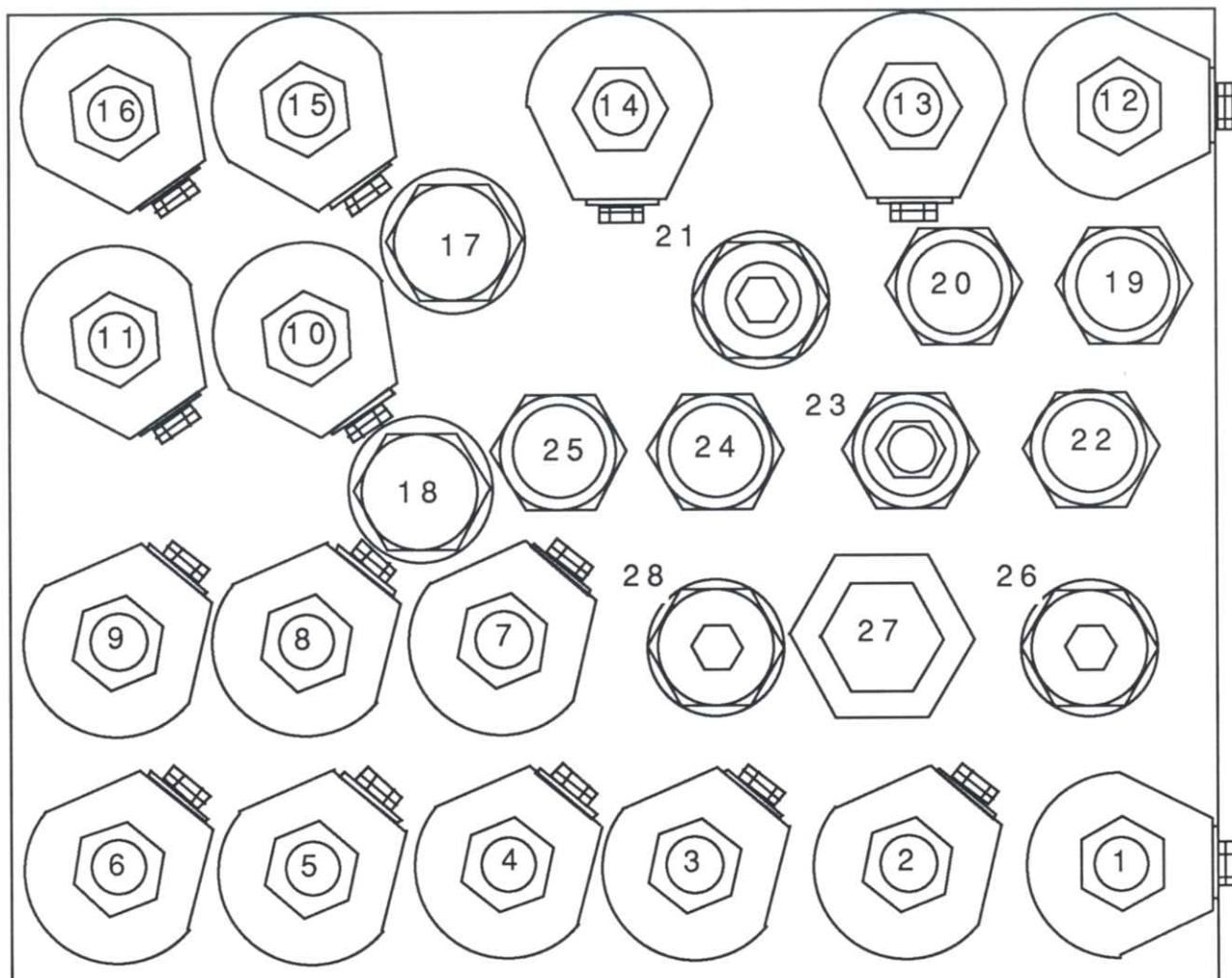
C. BED DOWN PRESSURE RELIEF (FOR DOUBLE-ACTING ONLY)

- 1) Raise the bed and BLOCK.
- 2) Turn engine off.
- 3) Disconnect bed up hose and plug manifold side and cylinder side. (This is for safety)
- 4) Install dead head gage in rod line to manifold. Plug rod cylinder hose.
- 5) Start engine.
- 6) Turn Pengwyn on.
- 7) Operate BED DNSLOW.
- 8) Quickly read gage.
- 9) Turn engine off.
- 10) Remove cap on Bed Down Relief.

- 11) With allen wrench, adjust internal screw CW to increase pressure setting or CCW to decrease pressure setting.
- 12) Replace cap.
- 13) Repeat the above procedure until proper setting is achieved.

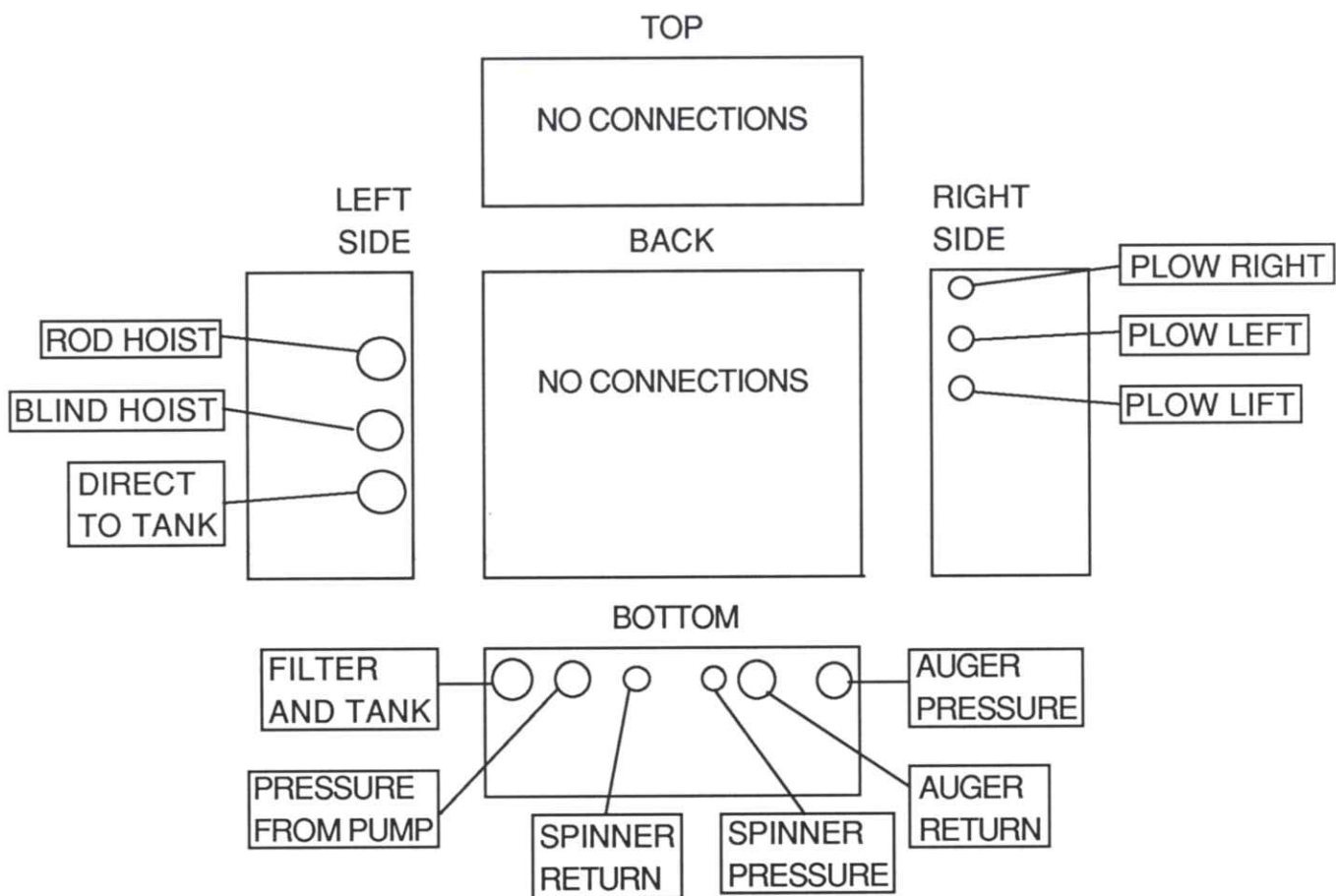
NOTE: One revolution of the adjusting screw will change pressure approx. 300-400 psi.

VALVE FUNCTION DIAGRAM SERIES 222



VALVE	WIRE COLOR	FUNCTION	VALVE	FUNCTION
1	WHITE/BLACK	PUMP BYPASS	17	PILOT PRESSURE CHECK VALVE
2	PINK	AUGER .5	18	PILOT PRESSURE CHECK VALVE
3	WHITE	AUGER 1	19	ROD PORT PRESSURE
4	WHITE/YELLOW	AUGER 2	20	ROD PORT TANK ✓
5	WHITE/GREEN	AUGER 4	21	ROD PORT RELIEF
6	WHITE/BLUE	AUGER 8	22	BLIND PORT PRESSURE ✓
7	WHITE/ORANGE	SPINNER1	23	BLIND PORT ADJ.
8	WHITE/BROWN	SPINNER2	24	BLIND PORT FAST ✓
9	WHITE/PURPLE	SPINNER4	25	BLIND PORT FAST ✓
10	WHITE/GRAY	PLOW UP	26	BED/PLOW RELIEF
11	BROWN	PLOW DN	27	BED DOWN COMPENSATOR
12	ORANGE	BED UP	28	SPREADER RELIEF
13	WHITE/RED	BED DN SLOW		
14	YELLOW	BED DN FAST		
15	PURPLE	PLOW ANGLE RT		
16	GRAY	PLOW ANGLE LT		

MANIFOLD PLUMBING DIAGRAM BACK OF TRUCK CAB



TROUBLESHOOTING

To check if a function is operating properly, touch the 1/2" 20 nut at the top of the coil with a steel tool, such as a screwdriver. You should be able to feel the magnetism generated by the coil when it is energized.

The following solenoid charts shows which solenoids are energized with each different function. "E" denotes energized.

Solenoid 1 (the pump bypass valve) is not required to operate the auger and the spinner. When the auger and the spinner are disconnected from the truck, the spreader switch must be turned off. For safety, make sure the auger and spinner switches are set to zero.

For the best safety practice, operate the power switch only when all of the toggle switches are in the off position. Do not hold the bed and plow switches for long periods after their respective cylinders are completely extended.

* * * * *

CAUTION

**DISCONNECT AMPHENOL PLUG FROM MANIFOLD
BEFORE WELDING ON THE TRUCK.**

**DO NOT OVER TIGHTEN SOLENOID COIL NUT - THE
COIL SPINDLE IS HOLLOW AND EASILY DAMAGED**

* * * * *

SOLENOID ENERGIZATION & FLOW CHARTS

AUGER MANUAL

RATE	SOLENOID #					GPM
	3	4	5	6	PUMP	
0					E	0
1	E				E	1
2		E			E	2
3	E	E			E	3
4			E		E	4
5	E		E		E	5
6		E	E		E	6
7	E	E	E		E	7
8				E	E	8
9	E			E	E	9
10		E		E	E	10
11	E	E		E	E	11
12			E	E	E	12
13	E		E	E	E	13
14		E	E	E	E	14
15	E	E	E	E	E	15

SPINNER

RATE	SOLENOID #				GPM
	7	8	9	PUMP	
0				E	0.0
1	E			E	0.8
2		E		E	1.6
3	E	E		E	2.4
4			E	E	3.2
5	E		E	E	4.0
6		E	E	E	4.8
7	E	E	E	E	5.6

PLOW

COND.	SOLENOID #					
	1	10	11	15	16	PUMP
UP	E	E				E
DOWN			E			
LEFT	E				E	E
RIGHT	E			E		E

BED DOUBLE ACTING

COND.	SOLENOID #				
	1	12	13	14	PUMP
UP	E	E			E
DOWN SLOW	E		E		E
DOWN FAST	E		E	E	E

AUGER AUTOMATIC

VALVE SOLENOID # / GPM						
2 / 0.5	3 / 1.0	4 / 2.0	5 / 4.0	6 / 8.0	PUMP	GPM
					E	0
E					E	0.5
	E				E	1.0
E	E				E	1.5
		E			E	2.0
E		E			E	2.5
	E	E			E	3.0
E	E	E			E	3.5
			E		E	4.0
E			E		E	4.5
	E		E		E	5.0
E	E		E		E	5.5
		E	E		E	6.0
E		E	E		E	6.5
	E	E	E		E	7.0
E	E	E	E		E	7.5
				E	E	8.0
E				E	E	8.5
	E			E	E	9.0
E	E			E	E	9.5
		E		E	E	10.0
E		E		E	E	10.5
	E	E		E	E	11.0
E	E	E		E	E	11.5
			E	E	E	12.0
E			E	E	E	12.5
	E		E	E	E	13.0
E	E		E	E	E	13.5
		E	E	E	E	14.0
E		E	E	E	E	14.5
	E	E	E	E	E	15.0
E	E	E	E	E	E	15.5

NOTE: "E" denotes energized

TROUBLESHOOTING CHART

BEFORE TROUBLESHOOTING THE PENGWYN SNOW CONTROL SYSTEM, CHECK ALL QUICK DISCONNECTS TO BE SURE THAT THEY ARE IN GOOD WORKING ORDER AND ARE CONNECTED PROPERLY. THIS IS THE MOST COMMON PROBLEM.

PROBLEM	CAUSE	SOLUTION
Solenoid valve stays open or closed all the time	Coil nut too tight and cartridge spindle has been stretched	Replace cartridge
Noisy pump	Low on fluid	Add hydraulic oil
Pump noisy all the time especially under a load	Solenoid valve stuck	Clean valve and check operation electrically while removed from pump then reinstall
	Main poppet stuck	Carefully clean poppet bore with fine emery cloth - check for free movement with fingers
	Suction line or strainer plugged	Clean suction line and sump strainer
Pump noisy oil aerated	Pump solenoid cartridge loose allowing air in	Tighten pump solenoid cartridge
	Pump check valve cartridge loose	Tighten pump check valve cartridge
	Shaft seal leaking	Replace shaft seal

Nothing works Pump runs	Out of fluid	Add hydraulic oil Check for leaks
	Pump bypass valve stuck	Remove and clean
	Solenoid bad on pump bypass valve	Replace coil
	Suction poppet stuck	Clean suction poppet
	Bypass coil nut over tightened	Replace bypass cartridge
Solenoid does not magnetize when turned on	Bad electrical ground	Remove cartridge carefully punch threads replace cartridge
Auger does not change speeds smoothly	One of the auger solenoids not working	Set auger to (1), (2), (4), and (8) to find bad valve. Clean valve or change coil as needed
Auger runs all the time	Dirt holding one of the auger solenoid valves open	Clean solenoid valve
Auger turns on & off but runs too fast when empty & stalls when loaded	Dirt in auger compensator spool	Remove auger compensator spool on outside of truck clean and reinstall
Spinner turns on & off but runs too fast when empty & stalls when loaded	Dirt in spinner compensator spool	Remove spinner compensator spool on outside of truck clean and reinstall

Spinner does not change speeds smoothly	One of the spinner solenoids not working	Set spinner to (1), (2), and (4) to find bad valve. Clean valve or change coil as needed
Spinner runs all the time	Dirt holding one of the spinner solenoid valves open	Clean solenoid valve
Bed won't go up	Bed down valve stuck open	Clean bed down valves
	Bed up solenoid failed	Replace bed up coil
	Bed up coil nut over tightened	Replace bed up cartridge
	Pump bypass valve not operating	Clean or repair
Bed goes up when plow up is operated	Dirt in lift port pressure valve	Clean valve
	Dirt in bed up solenoid valve (12)	Clean valve
Bed drifts down	Dirt in any one of the lift port valves	Clean all valves Check poppets for spring action
	Dirt in bed down slow valve	Clean valve
	Dirt in bed down fast valve	Clean valve

Bed drifts down	Dirt in logic valves	Clean valves refer to parts drawing and parts list pgs. 6-3, 6-4
Bed will only creep down (no high speed)	Compensator cartridge bad	Replace compensator cartridge
Bed chatters down	Compensator cartridge bad	Replace bed compensator cartridge
Plow won't go up	Plow down valve stuck open	Clean valve
	Plow up valve failed	Clean or replace valve
	Plow down valve partially stuck open	Clean valve
	Plow up coil nut over tightened	Replace plow up cartridge
Plow drifts down	Dirt in plow up valve	Clean valve
	Dirt in plow down valve	Clean valve
	Plow down coil over tightened	Replace plow down cartridge
Plow will go up, but won't go down	Faulty plow quick disconnect	Clean or replace as necessary

Hydraulic fluid too hot	Low fluid level	Add hydraulic fluid
	Bypass valve stuck closed	Clean valve
	Bypass coil nut over tightened	Replace bypass cartridge
Speed display slow or erratical	Transmitter pick up out of adjustment or failed	Adjust or replace transmitter

* * * * *

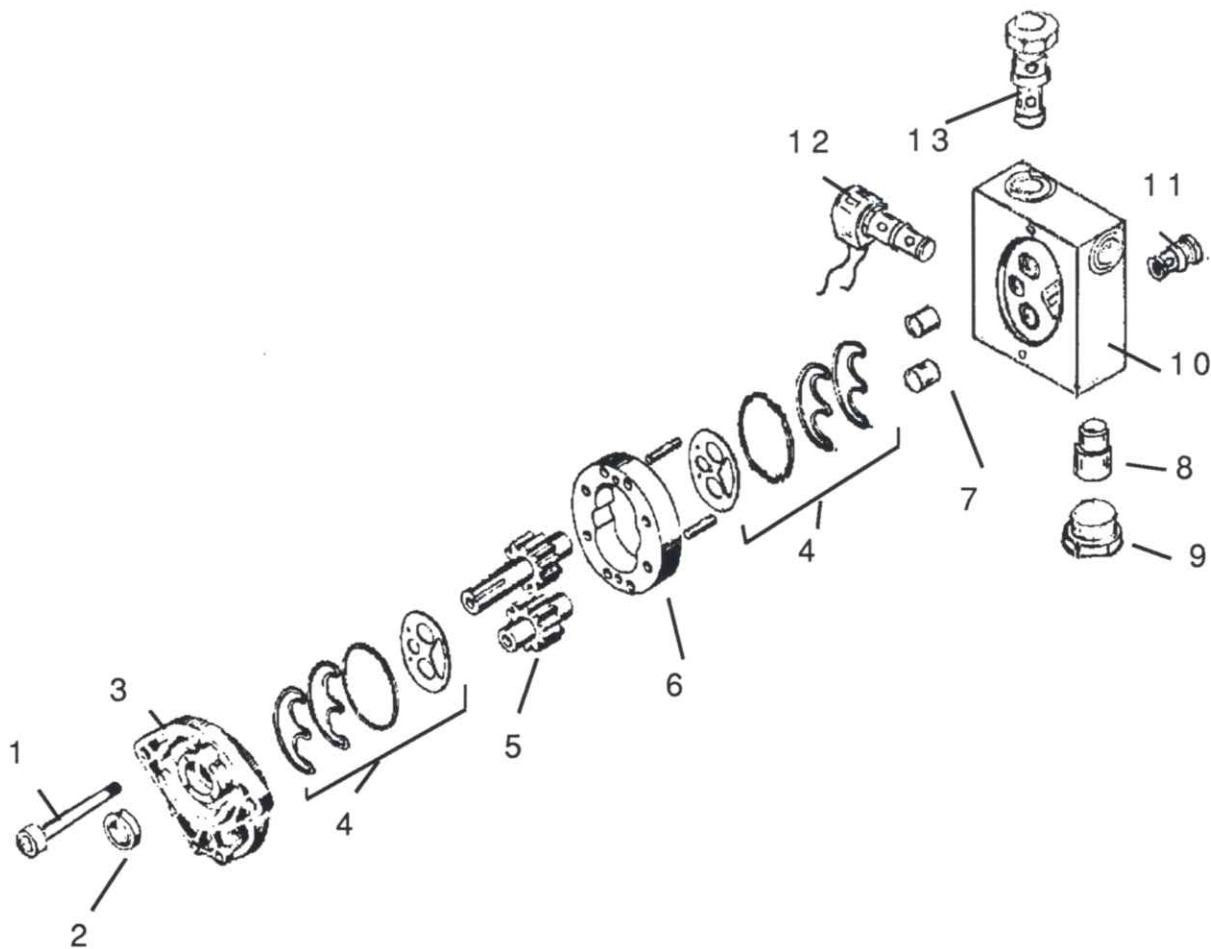
CAUTION

**DISCONNECT AMPHENOL
PLUG FROM MANIFOLD
BEFORE WELDING ON THE
TRUCK.**

**DO NOT OVER TIGHTEN
SOLENOID COIL NUT - THE
COIL SPINDLE IS HOLLOW
AND EASILY DAMAGED**

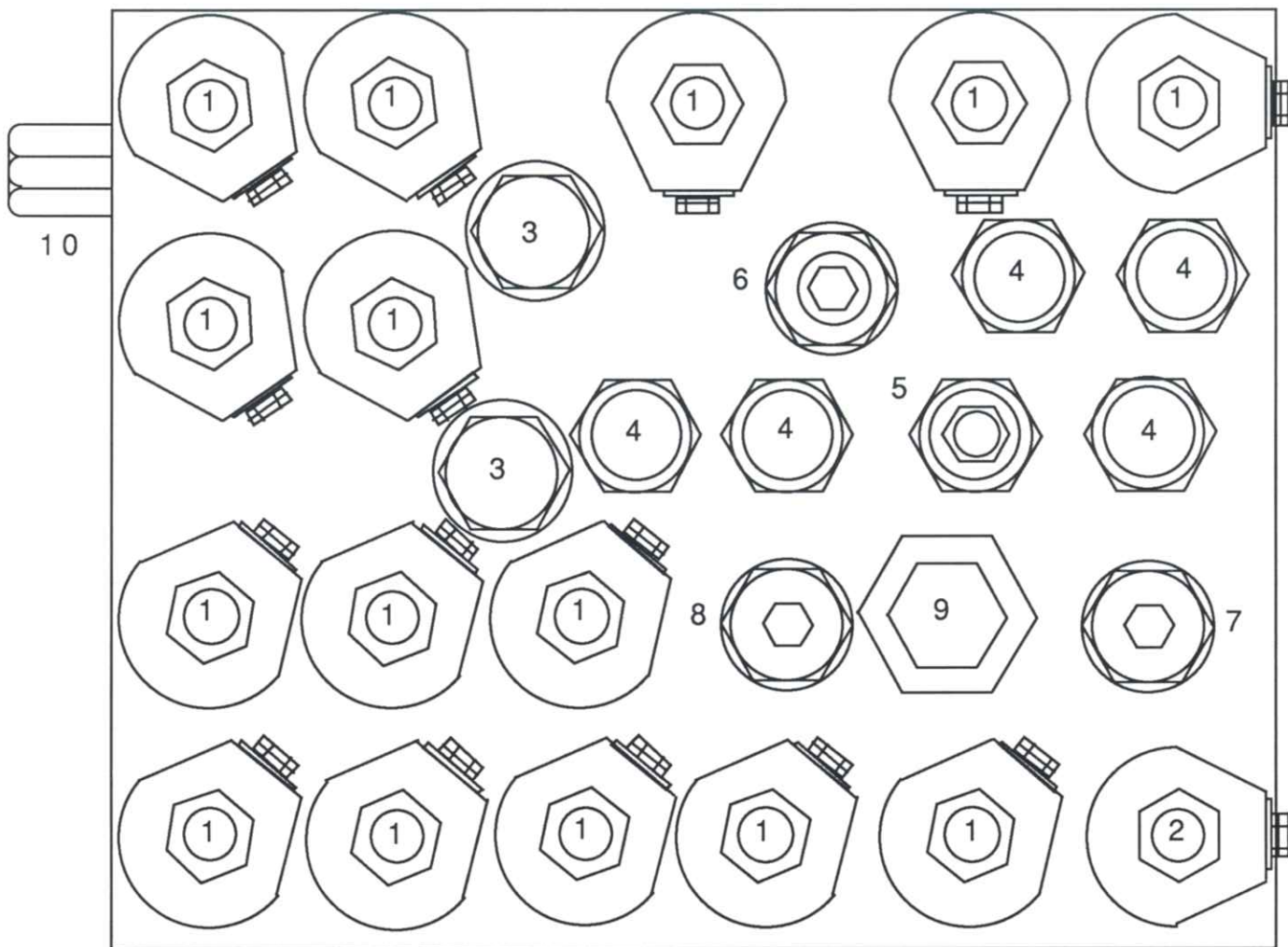
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PARTS DRAWING FOR AUTOSUCKER PUMP

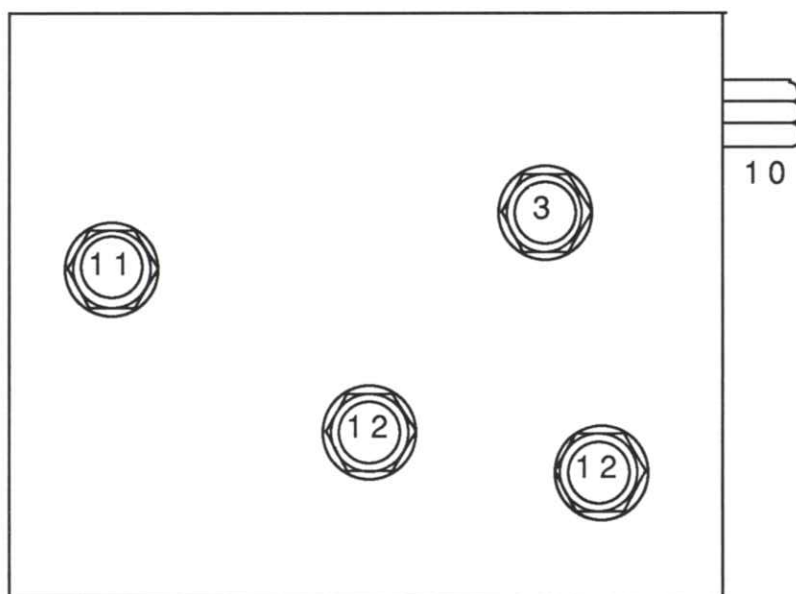


PARTS LIST FOR AUTOSUCKER PUMP

FLAG #	PART NO.	DESCRIPTION
1	A-237-10	Bolt Kit (8 pcs.)
2	A-20	Shaft Seal
3	A-LH-30	Front Cover
4	A-40	Wear Plate Kit
5	A-237-50	Gear Set
6	A-237-60	Gear Housing
7	A-70	Shaft Bearing Kit
8	A-80	Suction Poppet
9	A-90	Suction Poppet Cap
10	AS-100	Back Cover
11	A-110	Check Valve
12	A-120	Solenoid Valve Assembly
	A-125	Coil only
	A-126	Nut only
	A-127	Valve only
13	A-130	Compensator
2 & 4	A-140	Seal Kit



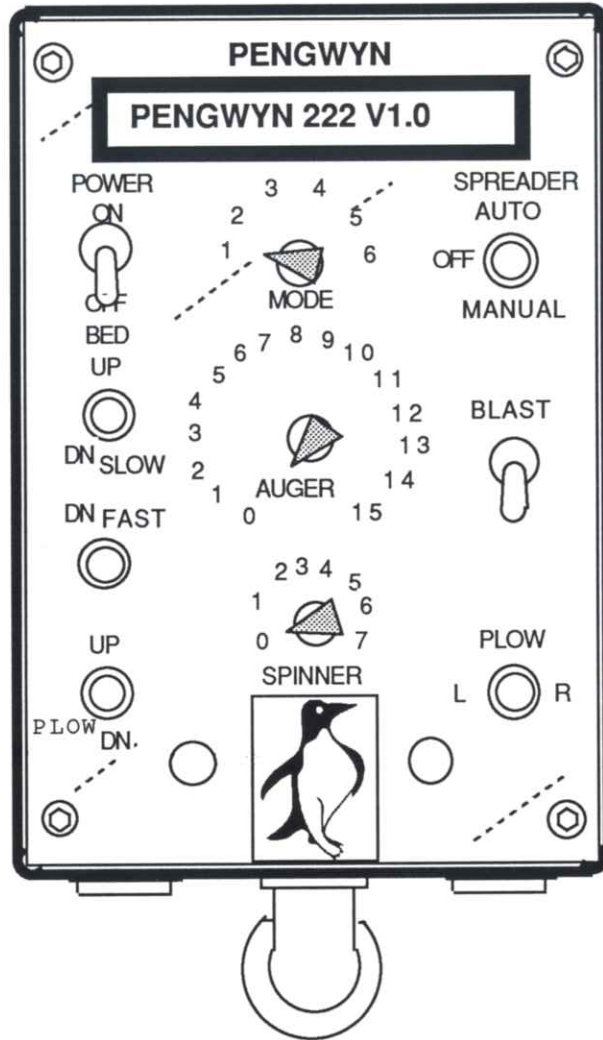
AS SEEN INSIDE THE CAB



AS SEEN OUTSIDE THE CAB

PARTS DRAWING AND PARTS LIST FOR MANIFOLD ASSEMBLY SERIES 222

FLAG #	PART #	DESCRIPTION	QTY
1	SV 101	Normally closed solenoid valve	15
2	SV 301	Normally open solenoid valve	1
3	CV 101	Check valve	3
4	LV 501	Logic valve - 40 size 10	5
5	LV 601	Logic valve - 40 adjust size 10	1
6	RV 401	Relief valve - 300 PSI	1
7	RV 301	Relief valve - 1700 PSI	1
8	RV 101	Relief valve - 2500 PSI	1
9	PC 301	Bed compensator	1
10	HO 101	Shuttle valve	1
11	CV 201	Check valve	1
12	LV 701	Logic valve - 80 size 10	2



MISCELLANEOUS PARTS LIST

PART NO.	DESCRIPTION
FA-101	FILTER ASSEMBLY - RETURN LINE
FE -101	REPLACEMENT FILTER ELEMENT
SA-101	SILENCER - PRESSURE LINE
MP-101	MOUNTING PLATE - MANIFOLD - CAB
CN-101	CONSOLE MOUNTING NUT KIT
CB-222	CONTROL CONSOLE
MA-101	MANIFOLD ADAPTER KIT
PA-101	PUMP ADAPTER KIT
TF-101	TANK FILTER
TG-101	TEST GAUGE KIT - "AUTOSUCKER PUMP"
LB-101	ILLUMINATION LIGHT FOR CONTROL CONSOLE
MS-101	MANIFOLD SUB ASSEMBLY
WP-202	WING PLOW SUB ASSEMBLY

PENGWYN SNOW CONTROL SYSTEMS

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