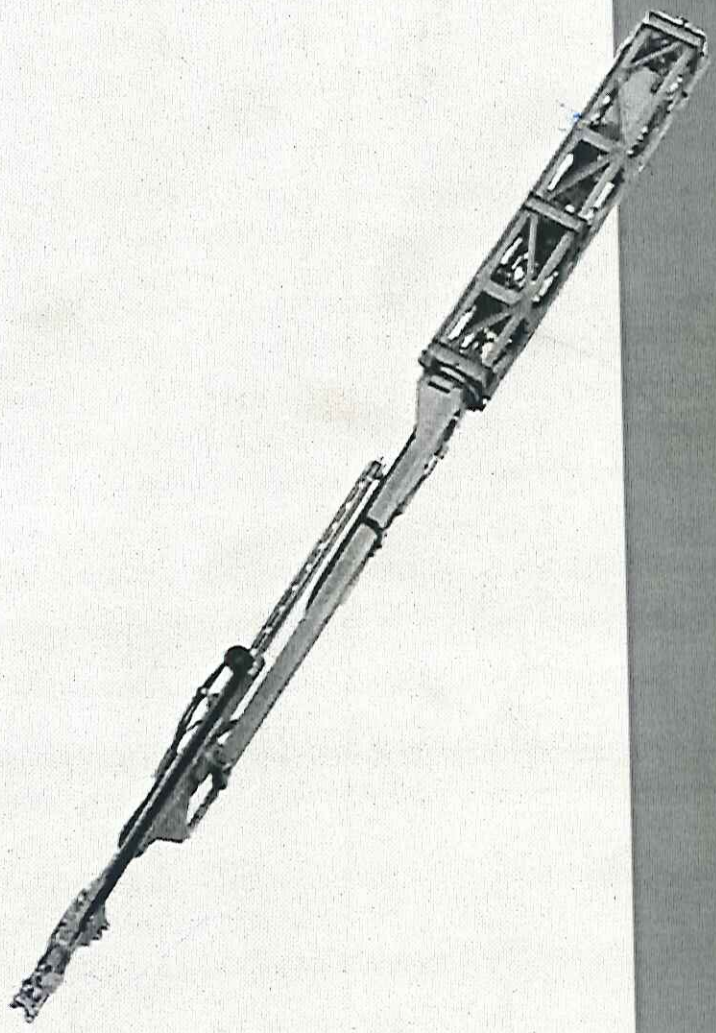
MINING TECHNOLOGIES INTERNATIONAL INC.

SHAFT JUMBO



OPERATION/SERVICE

25 Fielding Rd. PO Box 2845 Postal Stn."A", Sudbury, Ontario P3A 5J3 Canada
(705) 692-3661-tel (705) 682-1050-fax www.mti.ca

OPERATION/SERVICE
MANUAL

Contents

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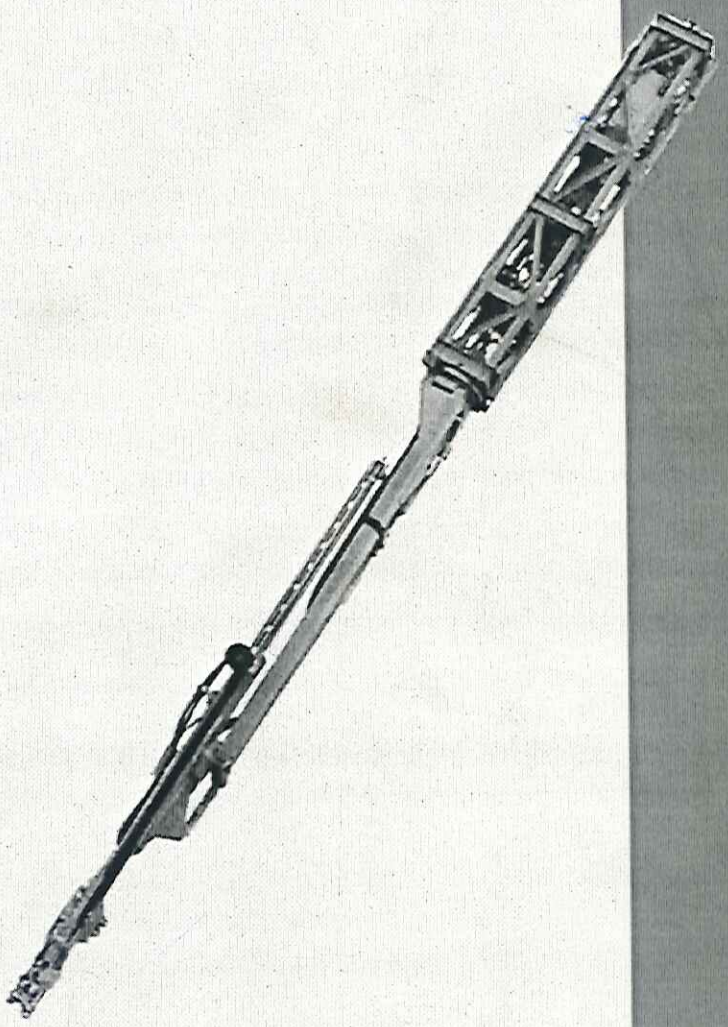

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Chapter 1
Technical Overview

Reference Manuals

This manual is designed to provide the technician with an overview of the mechanical, hydraulic and electrical systems of the MTI Shaft Jumbo. The purpose of this manual is to enable the technician to quickly diagnose system problems and perform a repair.

Overhaul of the HC105 Hydraulic Drifter, and IntelSense II hydraulic manifold control is covered in the manuals that are specific to them. These manuals, which are referred to throughout this repair manual, are listed below.

TABLE 1. Component Reference Manuals

ITEM	MANUAL REFERENCE #
HC105 Hydraulic Drifter	CPN86583168
IntelSense II Control	FG000043
Ansul Fire Suppression	A-1-1 Vehicle Fire Suppression Systems

Assumptions

The MTI Shaft Jumbo is a sophisticated machine, which employs high-pressure hydraulic systems, an air system, water system, lubrication system and high voltage electrical system.

This manual assumes that qualified technicians equivalent to a licenced journeyman mechanic/electrician or late-stage apprentice, will perform the diagnostic and repair procedures.

The technician must be able to do the following:

1. **Read and understand hydraulic schematic diagrams;**
2. **Read and understand electrical schematic diagrams;**
3. **Understand the fundamentals of hydraulic and electrical system theory; and**
4. **Understand the fundamental theory of powershift transmissions, drivetrain components and diesel engines.**

Composition of the Manual

This service manual is divided into chapters, which correspond to the logical grouping of the machines control & power systems. The Chapters are:

- Chapter 2: Mechanical, which describes the removal of the boom, rotation motor, and dismounting of the drifter;
- Chapter 3: Hydraulic, which includes a description of the hydraulic system, IntelSense and Drifter. A description of the theory of operation is included;
- Chapter 4: Electrical, which includes a description of the electrical schematic and an illustration of the component locations; and
- Chapter 5: Preventative Maintenance, which includes a listing of preventative maintenance procedures to be performed at scheduled intervals.

The manual features a detailed Table of Contents and a Table of Figures.

Copies of this manual can be ordered from MTI using Part # _____. The manual is also available as an electronic PDF file.

To order manuals, or to request an On-Site or Factory Located Service Training Course, Please contact MTI Service.

Naming Conventions

This manual uses the following naming conventions to describe the components and their interaction with each other:

- The machine is referred to as a Shaft Jumbo;
- The electric motor is referred to as a motor;
- The unit works in a mine shaft. UP is considered direction to the surface and DOWN is considered direction to the rock face;
- Hydraulic Symbols, which are shown on the hydraulic schematics, conform to ISO 1219-1 and 1219-2 standards for fluid power systems;
- Electrical Symbols, which are shown on the electrical schematics, conform to ISO _____ for use in electrical schematic diagrams;
- Both standard and metric equivalents are used to describe distance, e.g. 25.4 millimeters (mm) = 1 inch (‘“);
- Only standard units are used to describe pressure, which is described as pounds per square inch (psi); and
- Electrical units are volts (V), millivolts (mV), amps (A), milliamps (mA).

Safety & Responsibility

Cleanliness and good “shop practice” are the responsibility of the customer. This manual assumes that the customer has established shop practices and safety procedures, which conform to local regulations known by the customer. It is also assumed that the reader understands and knows these regulations and procedures.

It is beyond the scope of this manual to establish shop practices, regulation conformance, or safety policies.

Before any repair procedures are started, it is strongly recommended that the reader review the *shop practices, regulation conformance, or safety policies* of your working location and ensure they are understood and followed.

Machine Description

The MTI Shaft Jumbo is one of four identical units, which are each located within a moveable Shaft Sinking Framework. Each Jumbo is lowered into position using a cable hoist. Once in position the operator, using the pendant control located at the face, drills a defined hole pattern, which is later filled with blasting medium and ignited to break the rock. Together, three (3) Shaft Jumbo drills are able to drill off a completed pattern sufficient to blast a round and advance the shaft. The fourth unit is used as a spare backup, which allows regular maintenance of the Jumbo Drills to proceed without interrupting the drill cycle.

The Shaft Sinking Framework is designed to facilitate the drilling, blasting, muck extraction and shaft concrete liner installation operations. The Shaft Jumbo drills are located in a box and lowered down to the face to perform their work and, when work is completed, raised up into the Framework.

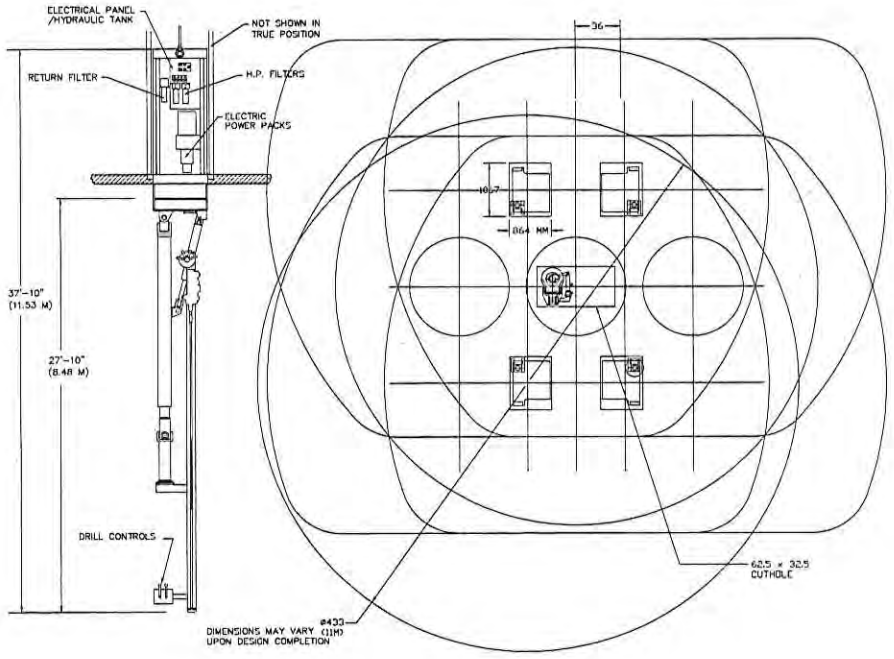


FIGURE 1. General Arrangement

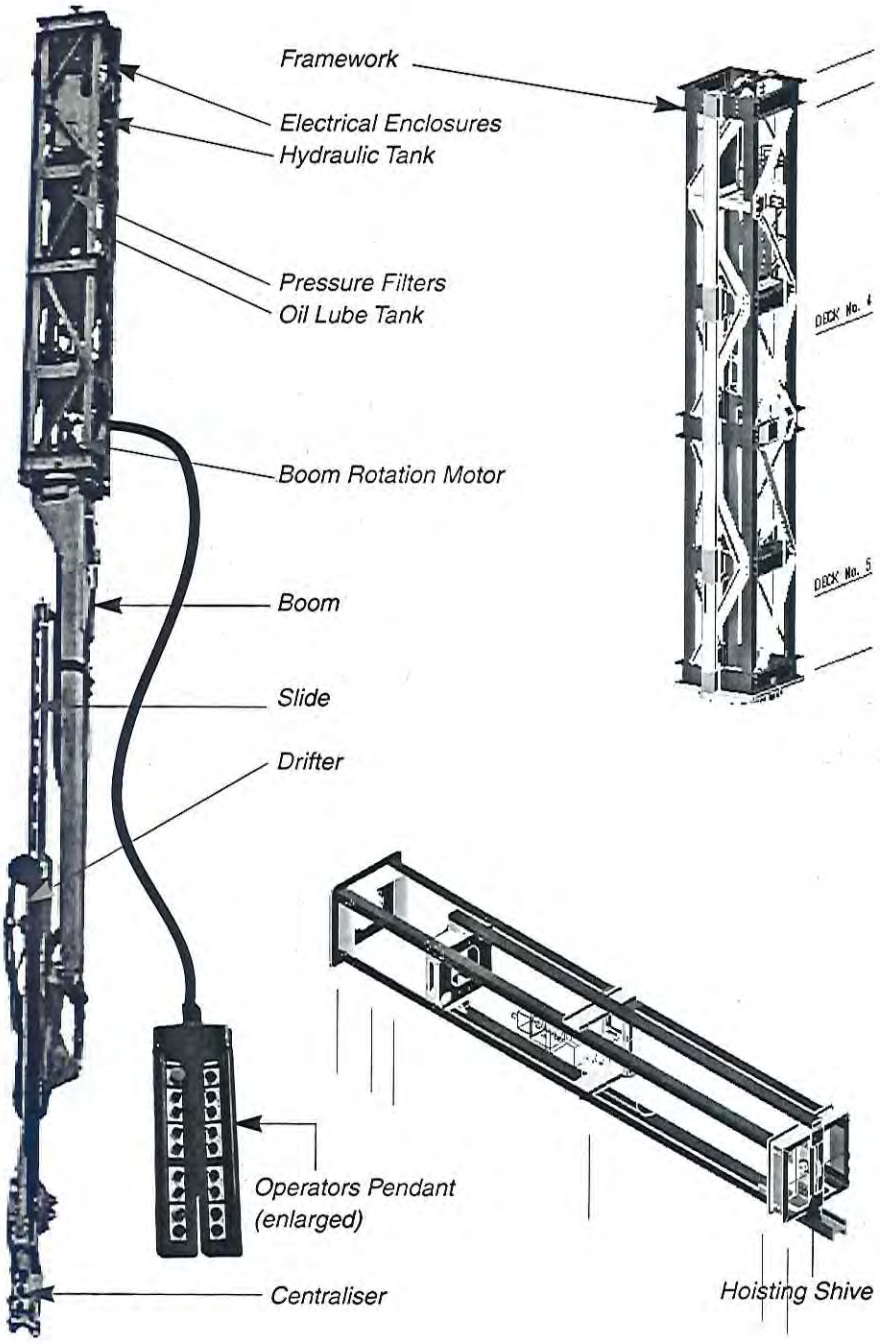


FIGURE 2. Mechanical General Arrangement

Operation

To operate the Shaft Jumbo the operator must first lower the unit into the drilling position. The raising and lowering of the unit is beyond the scope of this manual. Refer to the manufacture of the Shaft Development Gantry for correct operation of this procedure.

Before lowering the unit into the drilling position perform the checks described in table 2.

Pre-Checks

TABLE 2. Lubrication Specifications

ITEM	MANUAL REFERENCE #	
Hydraulic Oil	**NUTO 32** At the beginning of each shift check the sight glass and fill the tank using the electric filler pump provided.	
Rock Drill Oil	**EP 150** At the beginning of each shift fill the bowl to the "full" level.	
Lubrication Grease	**Lithium Based.** At the beginning of each shift, apply to all grease fittings. ***Caution*: ONLY 2 shots every shift are to be applied to the drifter rotation motor bearing.**	

After performing the checks, lower the unit into the drilling position.

Controls

The unit will be operated from a pendant console mounted on the drill boom adjacent to the drilling face. The operational controls are detailed in figure 3.

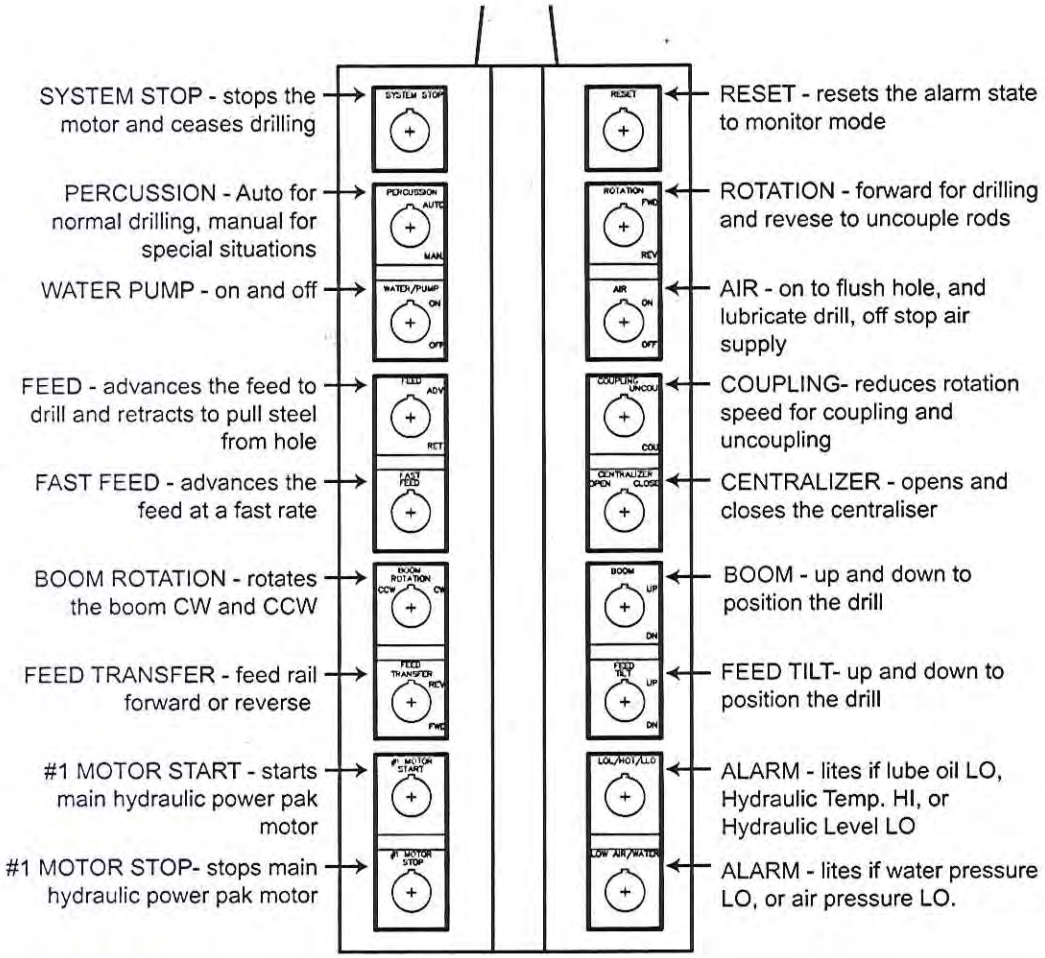


FIGURE 3. Pendant Controls

Start-up & Drilling

After performing the pre-checks and lowering the drill to the work face, perform the following steps to start drilling:

1 Depress the "#1 MOTOR START" button to start the hydraulic pak.
2 Using the boom controls, move the drill to the drilling position.
3 Using the slide controls, lower the slide to engage the stinger against the rock face.
4 Select "Percussion AUTO" to start drilling percussion and engage the Automatism features of the IntelSense II drilling control system.
5 Select "Rotation FWD" to start the drill rotation.
6 Select "Water Pump ON" to begin feeding water down the drill string.
7 Select "Feed ADVANCE" to feed the drill into the face.

The drill will automatically collar the hole and drill the hole to a depth equal to the drill string. Once the hole is competed:

8 Select "Percussion OFF (neutral joystick position)".
9 Select "Rotation OFF (neutral joystick position)".
10 Select "Feed OFF (neutral joystick position)".

Leaving the steel at the bottom of the hole,

11 Select "Air ON" to flush the cutting from the hole.
12 Select "Feed RETRACT" to pull the rod from the hole and return the drill to the ready position.
13 Reposition the boom to the next hole in the drill pattern and repeat the sequence until drilling is completed.

Alarms

During the drilling sequence the unit monitors:

- The lube oil level, hydraulic oil level and hydraulic oil temperature are indicated on one light, which is mounted in the pendant. If this light illuminates, one of the alarms has engaged and the drill will automatically shut down.
- Air pressure and Water pressure alarms are indicated on a second light, which is mounted in the pendant. If this light illuminates, one of the alarms has engaged and the drill will automatically shut down.
- To clear the alarms, the alarm problem must first be repaired. After repairs are completed, the operator will depress the "Reset" button to set the alarm circuits back into monitor mode. If the alarm condition has truly subsided, the machine can be restarted.

Note: If the alarm condition has not been repaired, the Reset button will not clear the alarm and the unit cannot be restarted.

Replacing the Bit

To replace the drill bit:

1. **Select "Feed ADVANCE" and push the bit against the rock face.**
2. **Select "Water ON" and hold it on for 5 seconds.**
3. **Select "Rotation REV".**
4. **Select "Percussion MANUAL" for 2 seconds to break the threads loose.**
5. **The drill bit will now uncouple from the drill steel. Select "Feed RETRACT" to move the drill steel from the face and remove the drill bit.**
6. **Manually thread the new drill bit on to the drill steel and advance the bit against the face. Select "Rotation FWD" to fully make up the threads.**
7. **The drill is now ready resume drilling.**

Replacing the Drill Steel

To replace the drill steel:

1. **Remove the drill bit.**
2. **Using the FEED function, position the drill coupling into the centraliser.**

3 Select "centraliser CLOSE" to engage the centraliser on the drill coupling and secure the drill steel.

4 Select "Percussion MANUAL" for a short duration sufficient to loosen the threaded coupling.

5 Select "Coupling UNCOUPLE" to uncouple the rod. The drifters striking bar will uncouple from the drill steel.

6 Select "Feed RET" to move the drill to the top of the slide and clear the striking bar from the drill steel coupling.

7 Select "Centraliser OPEN" and remove the drill steel. Place the new drill steel into the centraliser and close the centraliser to secure it.

8 Select "Feed ADVANCE" and position the striking bar into the new drill steel coupling.

9 Select "Coupling COUPLE" to start the rotation and make up the coupling.

10 Select "Centraliser OPEN" to open the centraliser and release the drill still.

11 Replace the drill bit.

Shutting Down the Drill

To Shut Down the drill

1 Depress "SYSTEM STOP". This shuts down all functions and is used in the event of a Machine Stop requirement.

2 After depressing the SYSTEM STOP, to restart the machine, depress "RESET" and than depress "#1 MOTOR START" to start up the hydraulic power pak.

3 Alternatively, to shut down the Hydraulic Pak only, depress "#1 MOTOR STOP".

4 After shutting down the drill, raise the machine into the stored position.

Chapter 2
Mechanical

Overview

The Shaft Jumbo mechanical operation is described in Chapter 1, page 6 under the topic "Operations".

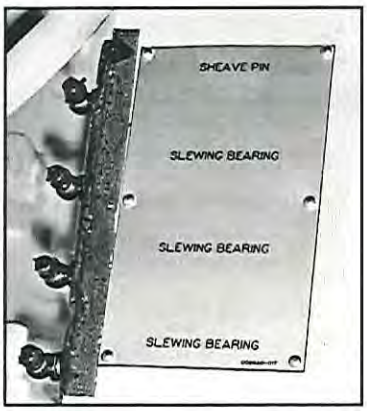
Disassembly & Assembly

The mechanical assemblies of the Shaft Jumbo are simple in construction. Assembly and disassembly are readily apparent to qualified technicians. The mechanical components require no periodical adjustments. For parts construction and part numbers, please refer to the MTI parts book for this machine.

Greasing

Preventative maintenance can be performed by applying grease to:

- Each of the grease fittings found on the boom. This should be performed at the beginning of each drilling cycle; and
- The grease fitting bulkhead for the main frame and hoisting device



Ansul Fire Suppression

The unit is protected against fire with an Ansul Checkfire Suppression System. In the event of a fire, the unit has a sensing cable that senses heat and, and in the event of a fire, will automatically discharge the fire suppression system. The unit has two Activation push-to-apply buttons, which can discharge the system upon depression of the button.

For servicing instructions, see the Ansul Service Manual number A-1-1 Vehicle Suppression Systems.

Drill

For maintenance on the HC-105 drifter, see Chapter 3, Page 40.

Chapter 3
Hydraulic Systems

Overview

The working implement on the Shaft Jumbo is a Montabert HC 105 hydraulic drill. To support the drill function the machines hydraulic system contains the following component groups:

- Hydraulic power-pak composed of a 600Vac motor driving three pumps. the pumps are used for Percussion, Rotation, and Feed/Implement circuits. Although the pumps are use a common drive shaft, they are actually separate units, which operate independently of each other;
- An electric bank valve for controlling the boom functions. This electrical solenoid is controlled in an off/on fashion, therefor the valve does not offer proportional control of the functions;
- IntelSense II control manifold, which provides automatic control of the hydraulic drifter when performing drilling functions. This is referred to as automatisms;
- Remote mounted relief valve for the adjusting the feed pressure and a secondary relief valve to limit the maximum feed pressure;
- High pressure filters for each pump circuit; and a
- Common return filter for all three pumps;

The percussion pump and rotation pump are load sensing. This means they will respond to the movement of the directional control valve spool and limit flow according the position of that spool. In this system the spools are wide open, therefor the pumps will move to full delivery as soon as the valves are shifted.

The feed/implement pump delivers full volume regardless of the valve position, until it reaches the pressure compensator setting of 2600 psi.

The figures on the following pages show the location of the various hydraulic components as they appear in the hydraulic schematic and than as they are mounted on the machine. The final drawing shows the hydraulic schematic.

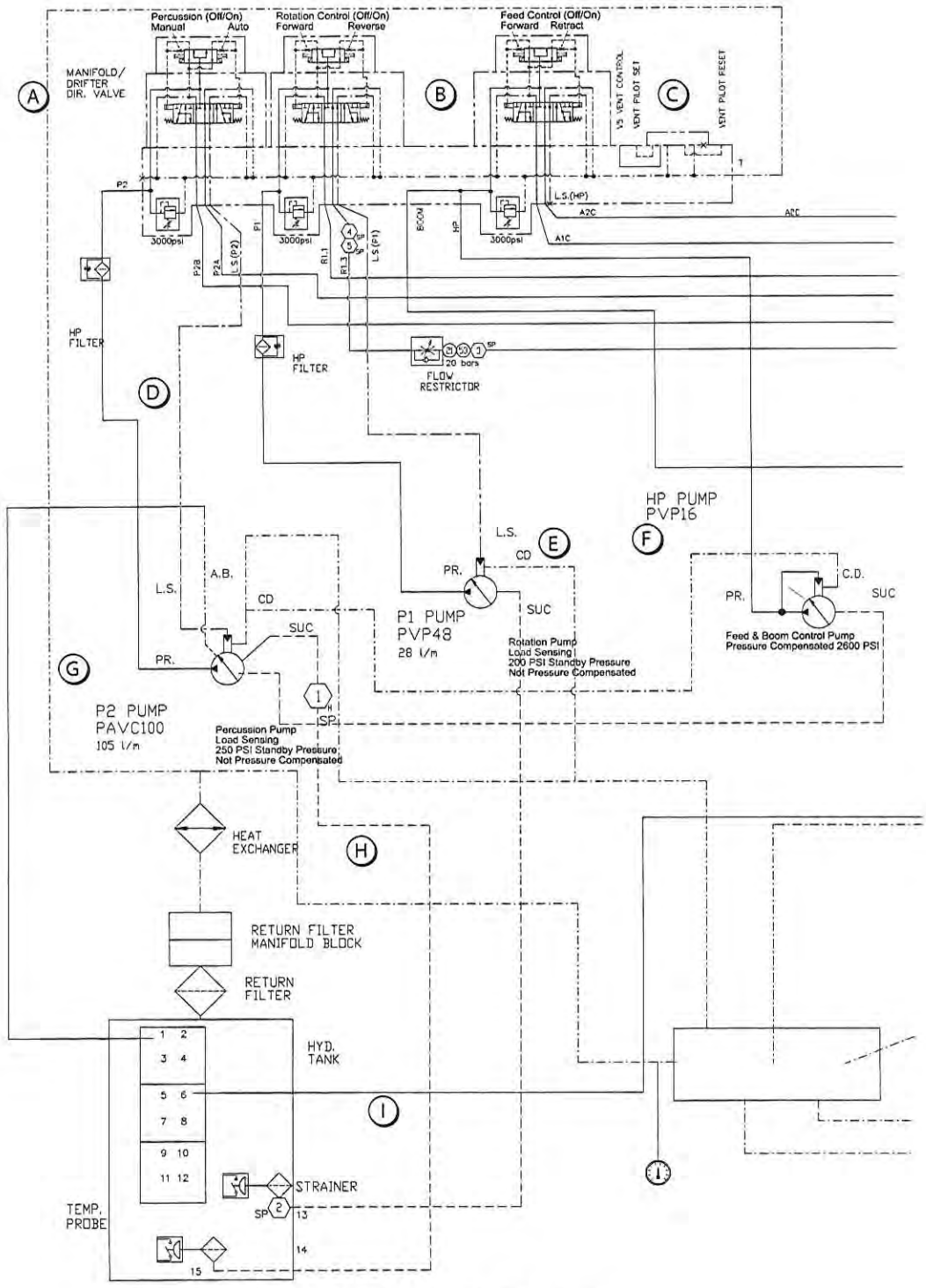


FIGURE 4. Hydraulic Schematic Parts Layout 1

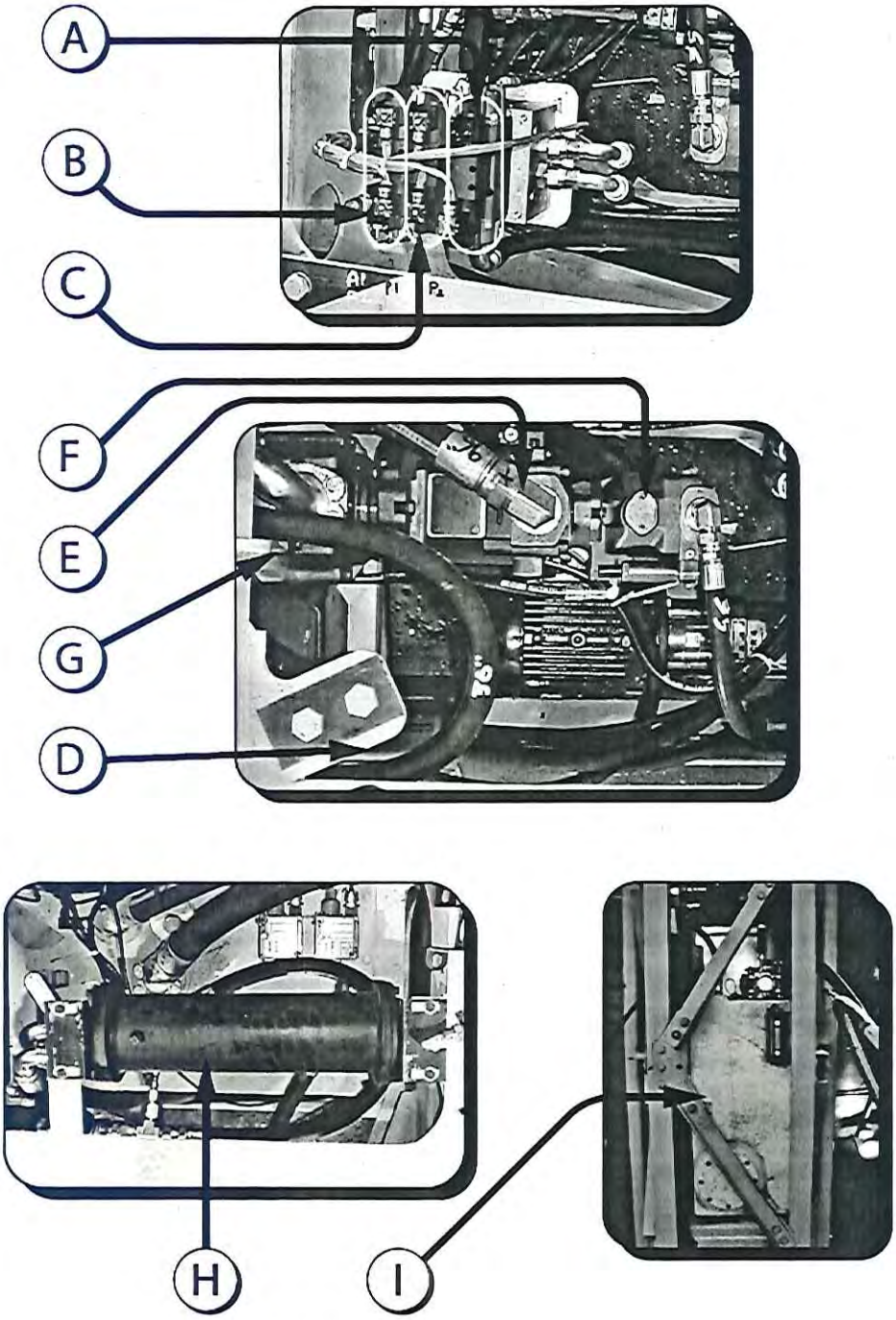


FIGURE 5. Hydraulic Parts Layout 1

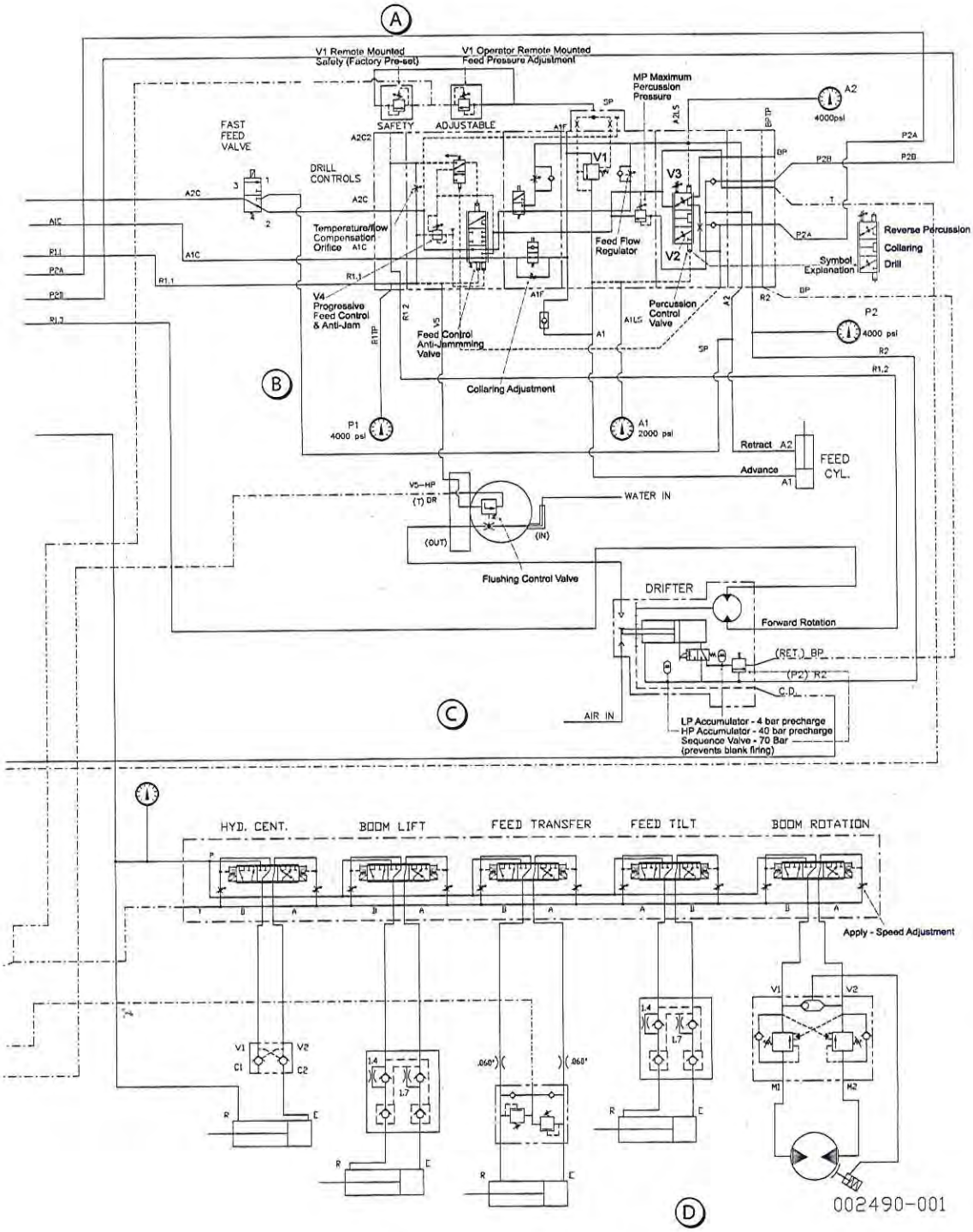


FIGURE 6. Hydraulic Schematic Parts Layout 2

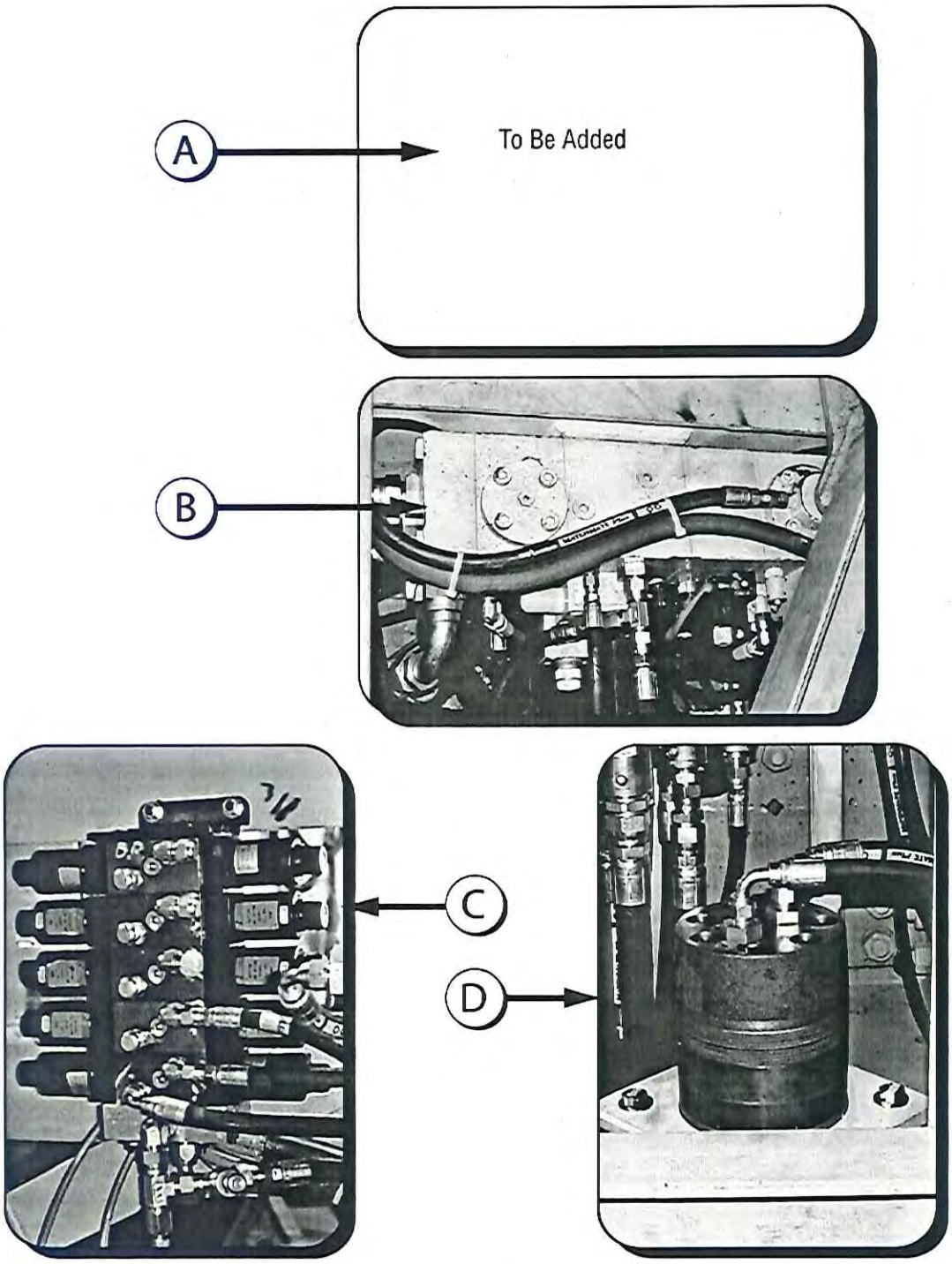


FIGURE 7. Hydraulic Parts Layout 2

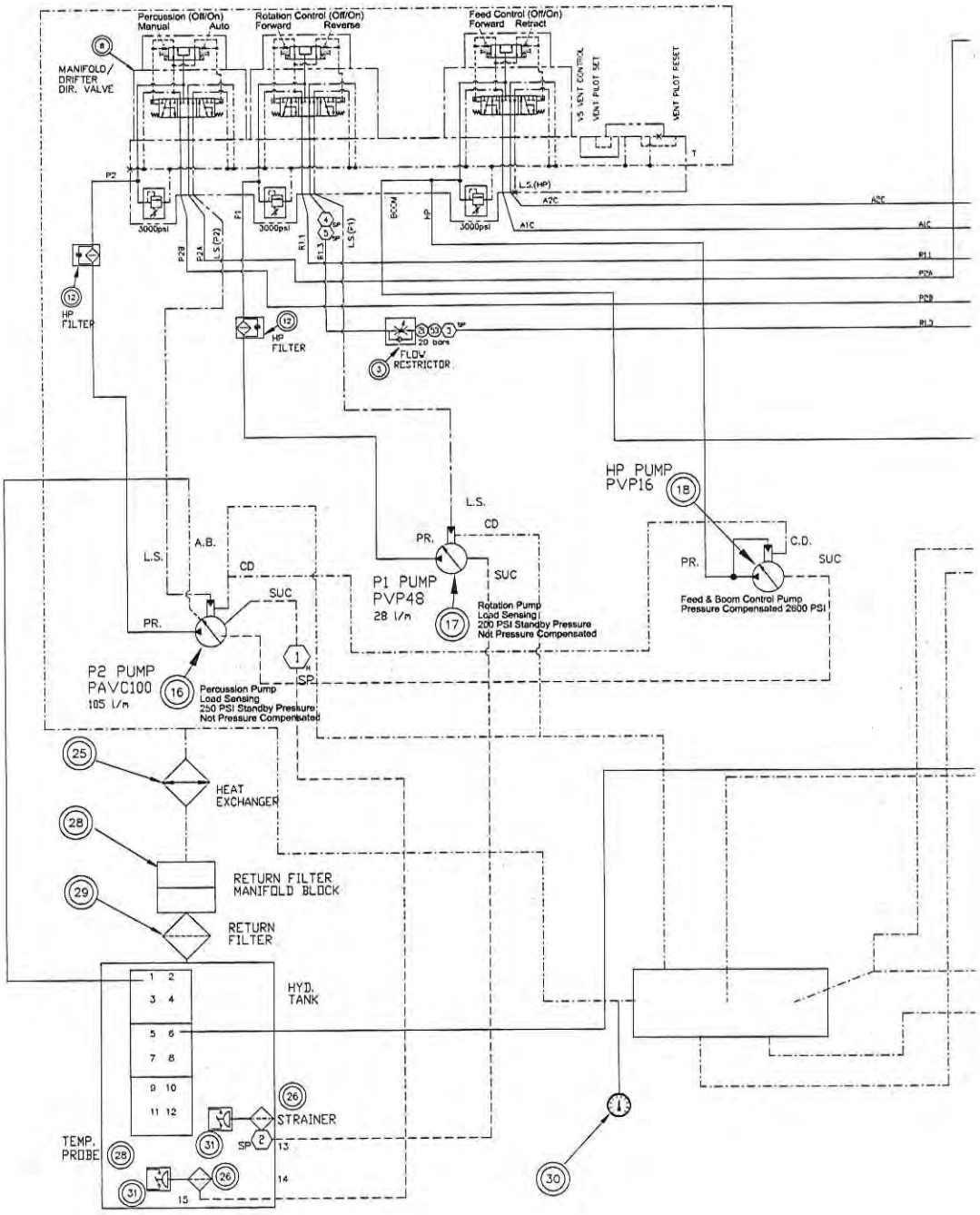


FIGURE 8. Hydraulic Schematic 1

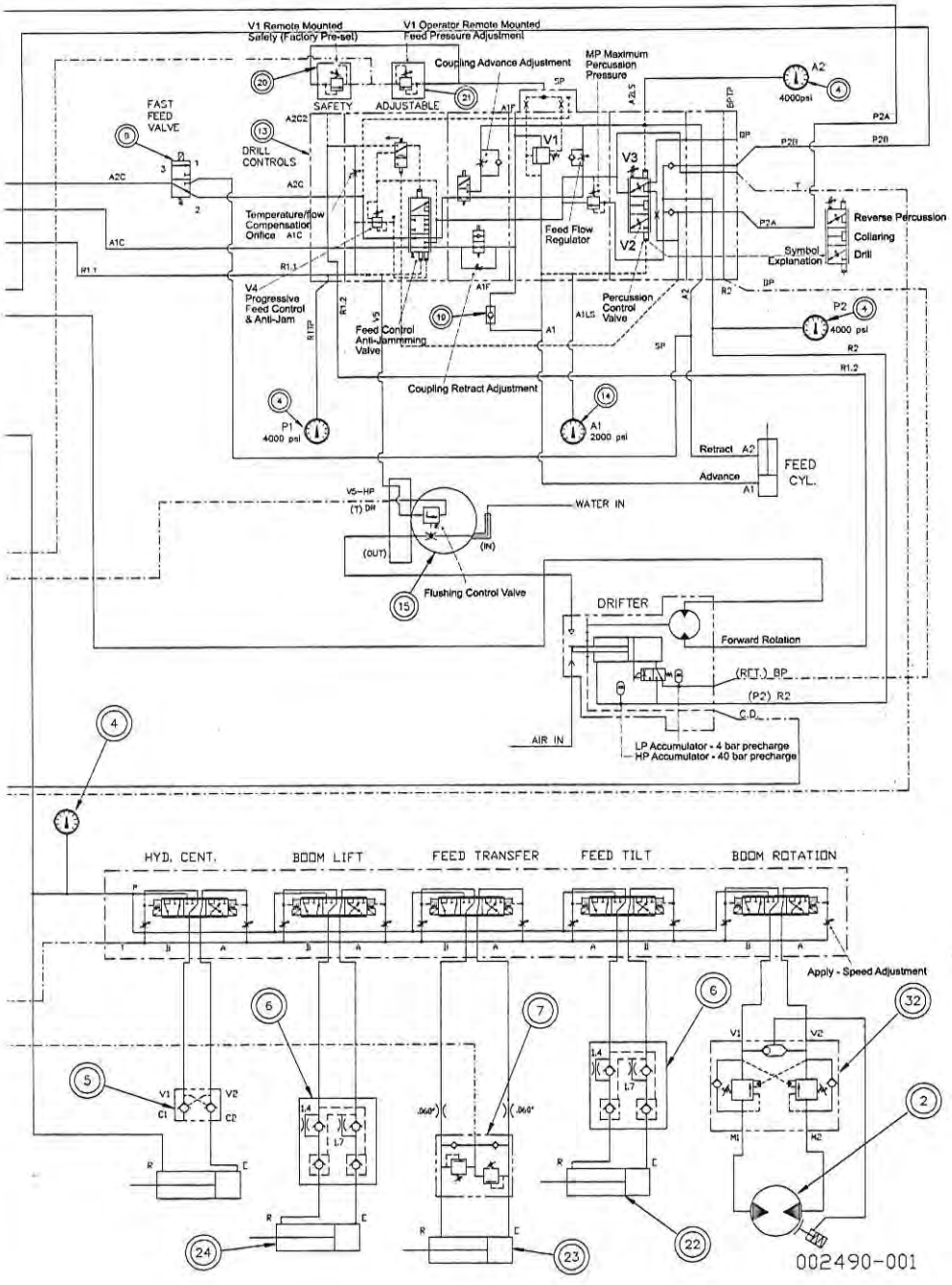


FIGURE 9. Hydraulic Schematic 2

Percussion Pump / Valve Operation

To operate the drilling functions and boom functions, the unit uses three separate pumps, which are mechanically bolted together and have a common drive shaft. The inlet sections of P2 and HP pumps use a common inlet line. The output lines of the P1, P2 and HP pumps are separate and operate independently of each other.

Referring to figure 4, item "G" shows the P2 Percussion pump. This pump requires a load sensing line to provide a hydraulic signal to cause the pump to stroke and produce full flow when the Percussion directional valve (A) is shifted. Because the directional valve is operated as a discrete valve, it is fully shifted and the pump flow operates at full rated volume. The standby pressure for the load sensing line is 250 psi.

The oil is directed from the pump to a high pressure filter (D) and into the drifter directional valve manifold. A pressure relief valve limits the system pressure to 3000 psi. The directional valve (A) uses a sub-plate mounted solenoid pilot valve to operate a larger directional control valve. The standby pressure of 250 psi provides pilot pressure to shift the large spool of the directional valve. The solenoids are energized with 24Vdc and fully shift to direct pressure to the spool end, which is then fully shifted. The positions of the valve are:

- Percussion Manual - pump oil is directed to the P2B port of the IntelSense manifold. The P2A port is connected to tank.
- Percussion Auto - pump oil is directed to the P2A Port and P2B is connected to tank.
- Neutral - the pump flow is blocked and the load sense signal is tank return pressure (close to 0 psi), which causes the pump to destroke and maintain the standby pressure of 250 psi.

Rotation Pump / Valve Operation

Referring to figure 4, item "E" shows the P1 Rotation pump. This pump requires a load sensing line to provide a hydraulic signal to cause the pump to stroke and produce full flow when the Rotation directional valve (B) is shifted. Because the directional valve is operated as a discrete valve, it is fully shifted and the pump flow operates at full rated volume. The standby pressure for the load sensing line is 250 psi. The oil is directed from the pump to a high pressure filter (D) and into the drifter directional valve manifold at entry P1. A pressure relief valve limits the system pressure to

3000 psi. The directional valve (B) uses a sub-plate mounted solenoid controlled pilot valve to operate a larger directional control valve. The standby pressure of 250 psi provides pilot pressure to shift the large spool of the directional valve. The solenoids are energized with 24Vdc and shift to direct full pressure to the spool end, which is then fully shifted. The shift positions of the valve are:

- Rotation Forward - pump oil is directed to the R1.1 port of the IntelSense manifold. The R1.3 port is connected to tank. Oil returning from R1.3 to tank passes through a flow control valve which limits the maximum flow and thus the rotation speed.
- Percussion Reverse - pump oil is directed to the R1.3 Port and R1.1 is connected to tank.
- Neutral - the pump flow is blocked and the load sense signal is tank return pressure (close to 0 psi), which causes the pump to destroke and maintain the standby pressure of 250 psi.

Feed Pump / Valve Operation

Referring to figure 4, item "F" shows the Feed pump. This pump is pressure compensated and will output full flow, destroking to minimal flow when system pressure reaches 2,600 psi.

Oil is directed from the pump into the drifter directional valve manifold (C) at entry A1C. It is also connected with a tee to the boom directional control valve, figure 7 (A).

A pressure relief valve in valve C, limits the system pressure to 3000 psi, which is above the pump's compensator setting. The valve uses a sub-plate mounted solenoid controlled pilot valve to operate a larger directional control valve. The A1C line pressure provides pilot pressure to shift the large spool of the directional valve. The solenoids are energized with 24Vdc and shift to direct full pressure to the spool end, which is then fully shifted. The shift positions of the valve are:

- Feed Control Forward - pump oil is directed to the A1C port of the IntelSense manifold. The A2C port from the Fast Feed valve is connected to tank.
- Feed Control Retract - pump oil is directed to the A2C Port and R1.1 is connected to tank.
- Neutral - the pump flow is blocked at the directional valve and the pump raises to 2600 psi and destrokes volume to maintain this pressure.

The boom directional control valve, figure 7 (A), is shifted by solenoids located at each end of the spool. The valve contains flow limiters, which are adjusted to restrict the movement of the various functions. The schematic (figure 9) shows that in the neutral position, the valve is closed centered, stopping pump flow, and has open centered A and B ports connected to tank. The implements are held in position by piloted operated check valves, and restricting orifices.

The boom rotation circuit uses a counterbalance valve to control movement of the rotation motor shown in figure 7, (D). A hydraulically applied brake mechanism is applied to fix the boom in place.

IntelSense II

The three pumps all connect to the IntelSense hydraulic manifold control block, which controls the operation of the drill, feed rate of the drill and rotation of the drill bit. This block, shown in figure 7 (B), is key to operation of the drill and a complete understanding of it's operation and adjustment will be required if the technician is to obtain optimum drilling results.

The IntelSense block has five controls, known as automatisms, which are incorporated to drill at a maximum speed whatever the ground. These terms are referred to in all schematics and their purpose is described as:

- V 1: feed thrust is adapted to ground nature. Maximum drifter speed is controlled when meeting water pockets etc.;
- V2: sets maximum drilling pressure;
- V 3: percussion force is automatically regulated when the bit does not meet any resistance when collaring or meeting ground faults etc.;
- V 4: anti-jamming device automatically regulates thrust on the drifter in relation to resisting torque opposed by bit. Beyond a preset value, the thrust is progressively decreased. If necessary, the drifter even retracts until the obstacle is overcome.
- Drifter stops or retracts for lack of flushing air or water.

The V 4 automatism makes drilling truly automated. It is particularly valuable when drilling in faulted or very heterogeneous grounds. It avoids rod seizing and allow max. drilling speed.

The various automatisms are operated through a direct action on the high pressure lines, this action being itself regulated depending on the instantaneous pressure that develops. Correct adjustment of these automatisms contributes to long life of the drill components and consumables.

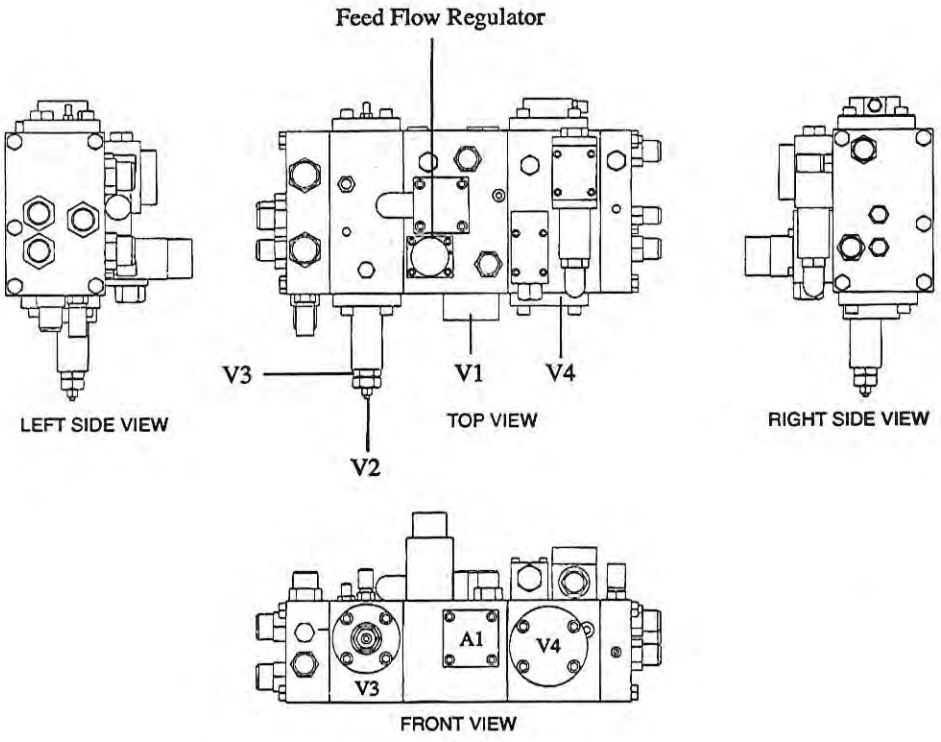


FIGURE 10. IntelSense II

The adjustment position of the automatisms is shown in Figure 10. The hydraulic schematics and explanations found in figures 11 and 12 detail the hydraulic operation of the circuit and the meaning of the symbols. The correct adjustment procedure is described in the section titled "IntelSense II Adjustments" on Page 32.

Percussion Automatisms

With the Percussion directional valve set to the AUTO position, oil is directed to part P2A of the IntelSense block. Referring to the indicated flow diagram in figure 11, we see the oil is applied against:

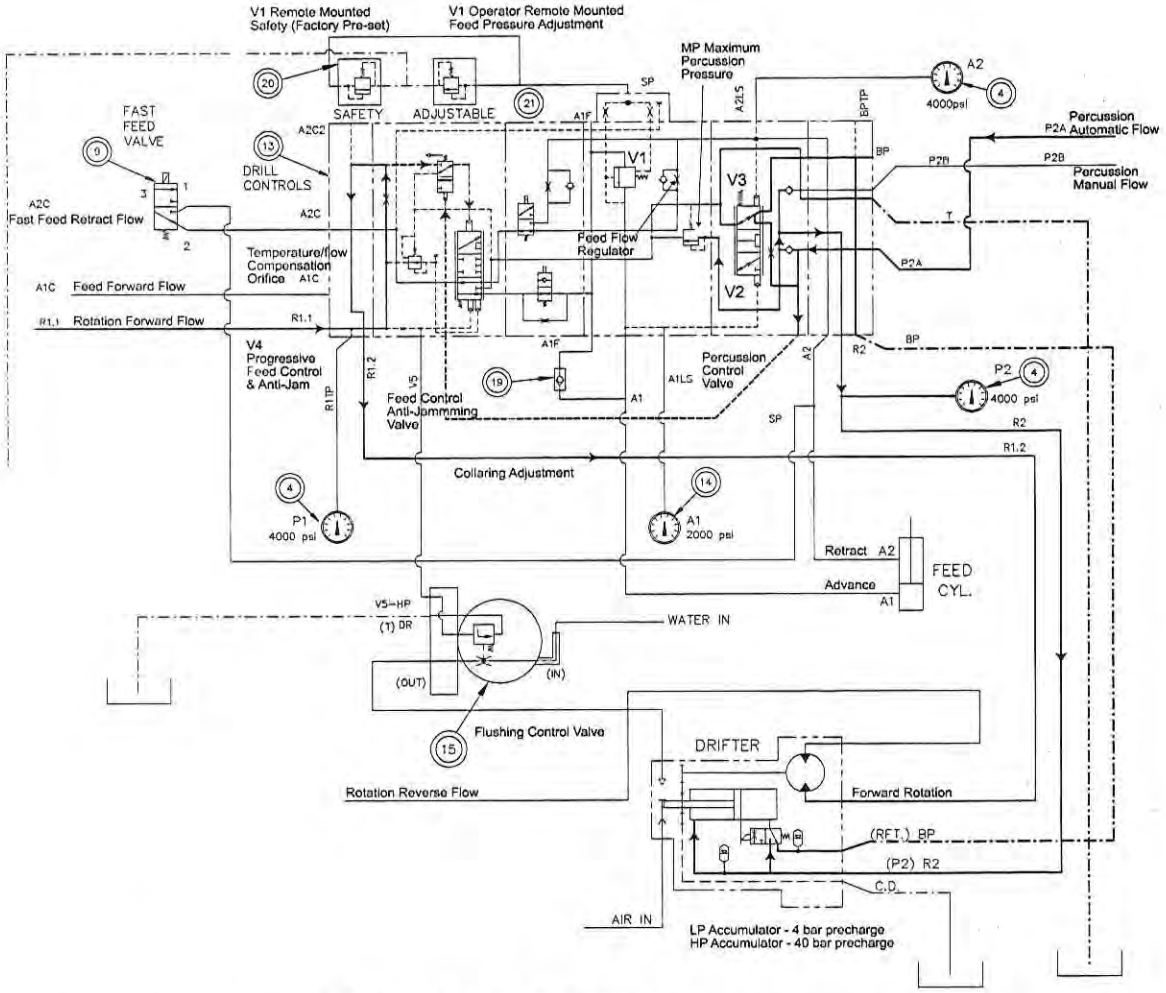
- The MP relief valve, which sets maximum hydraulic pressure.

WARNING This valve is factory pre-set and must not be tampered with!

- The R2 line directing flow to the drifter;
- A small orifice before the Percussion Control Spool, which dampens the action of the hydraulic circuit; and
- The Anti-Jamming pilot valve, which directs a pilot signal to the Anti-Jamming valve to allow feed to begin.

The drifter percussive force is controlled by modulating back pressure on the return line (BP) of the drifter. Increasing the back pressure increases the percussive force. Back pressure is controlled by shifting the percussion control valve spool in response to:

- Feed Advance pressure applying against one side of the spool. As Feed Advance pressure increases, the valve tends to keep maximum back pressure and thus maximum percussive force.
- Feed Retract back pressure against the opposite side of the spool. The feed retract line circuit (A2) will increase in pressure if a void, such as faulty ground or water deposits within the drilled hole, is encountered. A void allows the feed to extend at an increased penetration rate causing back pressure to build up in the A2 line due to an increased pressure drop across the metering orifice of the Feed Flow Regulator valve.
- The V3 control spring biases the spool to the drifter idling position. Adjusting this spring increases the bias and changes the regulation of the percussion force during fast feed advance situations (voids in the rock). This will reduce the drifter power level to 870 psi as rock resistance decreases;
- The V2 control orifice is pre-set is adjustable to change the maximum value (psi) of back pressure and thus set the drilling pressure suitable for rock hardness and maximum bit life. This setting should be 1715 to 1850 psi.



PERCUSSION CONTROL VALVE SYMBOL

The control of the percussive force of the DC 105 drifter is obtained by applying backpressure to the BP return line of the drifter. This symbol shows the relationship between feed rate versus control of backpressure, which is applied to the HC 105 drifter tank return line.

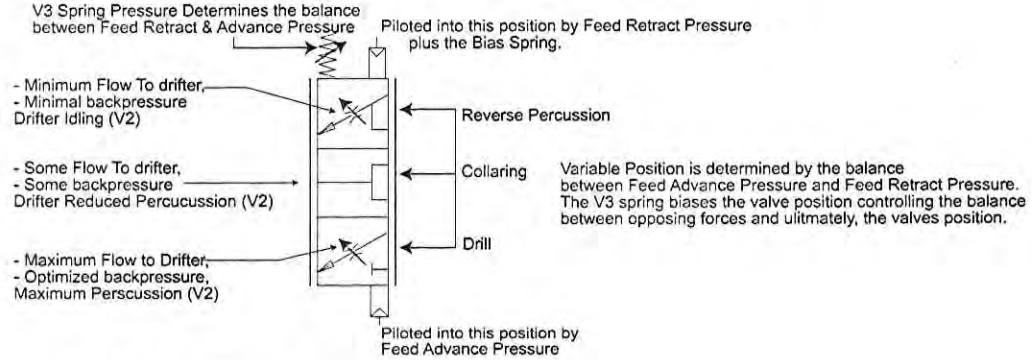


FIGURE 11. IntelSense Percussion

Feed Automatisms

We see that Feed Advance and Feed Retract pressure are used to control the percussive force of the drill. To further control the drill percussion in special situations, the Feed Advance signal is controlled by the Anti-Jamming valve shown in figure 12. The percussion force is raised and lowered in relationship to the energy expended trying to rotate the bit while it is forced into the rock by the Feed Advance. This energy is measured by the Rotation hydraulic pressure.

With the Percussion direction valve in the AUTO position, the Feed Control directional valve in the ADVANCE position, and the Rotation Control directional valve in the FORWARD position, oil from the HP pump is directed to A1C Feed Forward port and on to the Anti-Jamming valve.

Rotation pressure exerted against both sides of the valve as shown in the diagram.

As the spool shifts, oil from the Feed Pump is directed to either the Feed advance or Feed Retract positions. The purpose of this valve is retract the feed cylinder and prevent the bit from jamming into the rock.

Pilot pressure from the "Rotation Forward full pressure" line balances the spool against the "Flushing Control" line. Because these lines are joined, the forces are equal and rise and fall according to the flushing valve setting, or rotation pressure. To the "Flushing Valve" pilot signal force, is added the Bias Control Spring and a further force, which is the "Rotation Forward Reduced Pressure" signal. This is obtained by running the Rotation Pressure Forward signal through a pressure reducing valve (PRV) which results in a lower signal value. The output of the PRV is a constant value, and only lowers when the input signal is below the PRV setting.

If the drill is operating properly: Rotation Forward Full Pressure balanced against Bias Control Spring + Flushing Control Valve + Rotation Forward Reduced Pressure = spool shifted to Feed Advance Position.

If the flushing water pressure rises above the preset spring value, which indicates a plugged bit, the pressure relief valve (15) bypasses oil to tank at low pressure. This causes a flow across the sensing orifice, creating a pressure drop between the Rotation Forward Full Pressure line and the Flushing Control valve pilot line. This unbalances the pilot line signals and causes the valve to shift to the Feed Retract position.

As the Rotation Forward Full Pressure signal increases, it will become greater than the combination of the opposing signals, causing the valve to shift to the retract position. This prevents stalling of the drill as the rotation increases beyond the capacity of the bit.

Feed pressure exerted by the Feed Anti-Jamming Valve, is sensed by the Percussion Control Valve. In this manner both feed pressure and percussion energy are both modulated to respond to ground conditions.

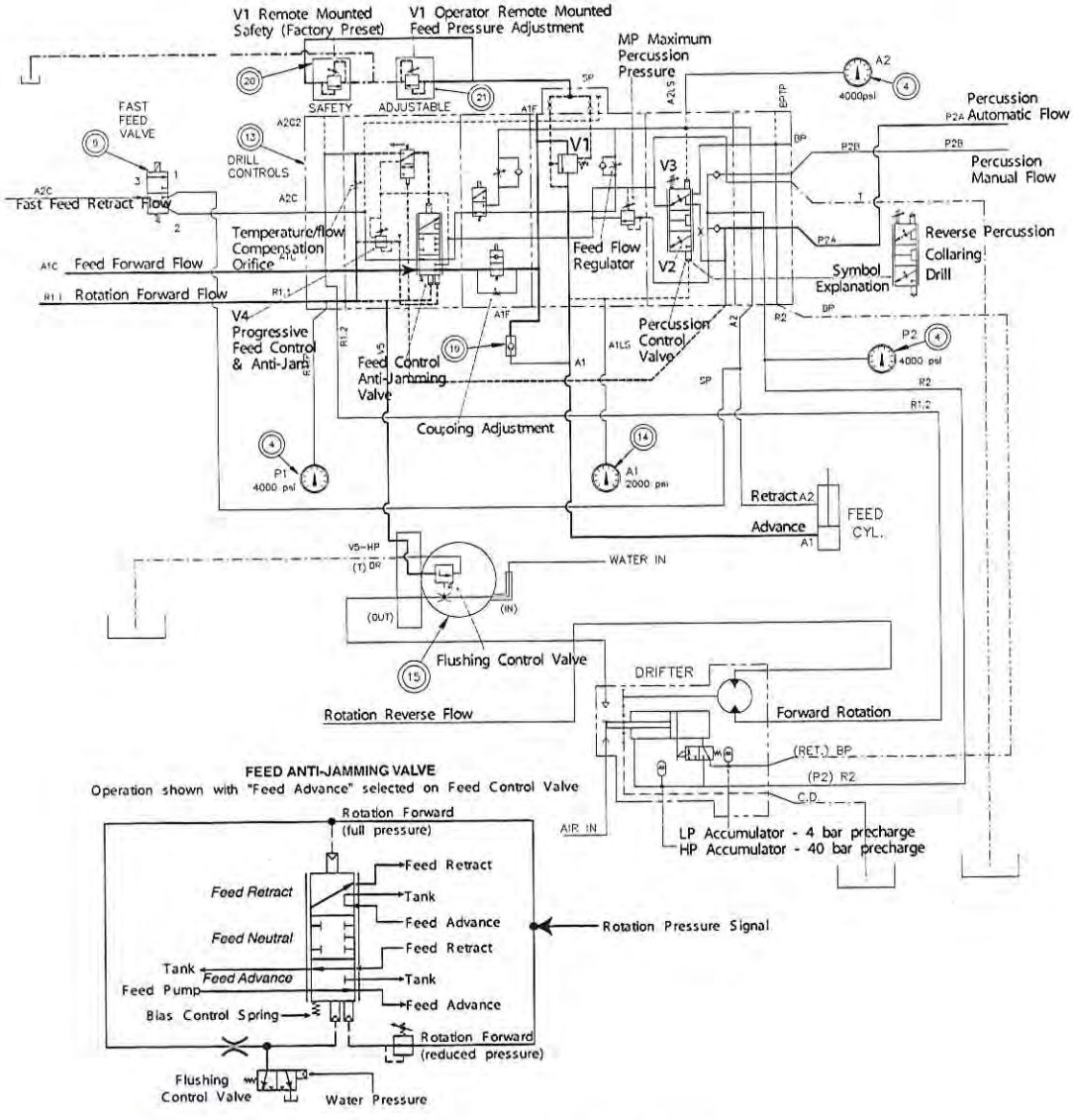


FIGURE 12. IntelSense Anti-Jamming Feed Control

Feed Advance & Retract

With the Feed Control directional valve set to FORWARD (Advance) oil is directed to the A1C port through the Anti-Jamming valve, the Feed Retract coupling synchronization regulator valve, and is applied against V1, which is the feed pressure regulator valve.

V1 is controlled by controlling the pilot line from the pressure reducing valve VI to the manually adjustable pressure relief. A second pressure relief valve is factory pre-set to protect the feed against overpressure and must not be tampered with.

Oil exits V1 at a reduced pressure setting and enters the Feed cylinder or motor (optional), which starts the drill advancing into the face.

The oil exiting the Feed Cylinder (motor) follows line A2 and is applied against the Percussion control valve, the Feed Flow regulator and the Feed Advance coupling synchronization flow control valve. As discussed in the Feed Automatisms section, the Feed Flow regulator controls the speed of the Feed Advance and, if a void is encountered in the rock, produces a pressure drop which is sensed by the Percussion Control valve.

By energizing the Fast Feed Valve, oil is sent directly to the Feed cylinder producing a fast retract speed.By selecting the Feed Retract Position on the directional valve, oil is directed through the IntelSense block, retracting the Feed cylinder and producing a return flow, which is applied against the Feed Retract Coupling valve described below.

When the operator is changing steel, to allow the drill steel to stay in place as the rotating drill shank is introduced into it, the rotation rate must be synchronized with the feed advance. The thread pitch and the rate of rotation of the shank determine the advance rate, which is adjusted in both retract and advance positions the by Feed Advance Synchronization valves.

When Coupling "Couple" is selected, the solenoid of the CA valve is energized, blocking return flow from the Feed Regulator valve and applying the flow over the CA flow regulator. This regulator is adjusted to synchronize the feed advance rate with rotation rate and couple the drill steel to the shank.

When Coupling "Uncouple" is selected, the solenoid of the CR valve is energized, blocking the return flow from the Feed cylinder and forcing it over a flow regulator valve. This regulator is adjusted to synchronize the feed retract rate with rotation rate and uncouple the drill steel from the shank.

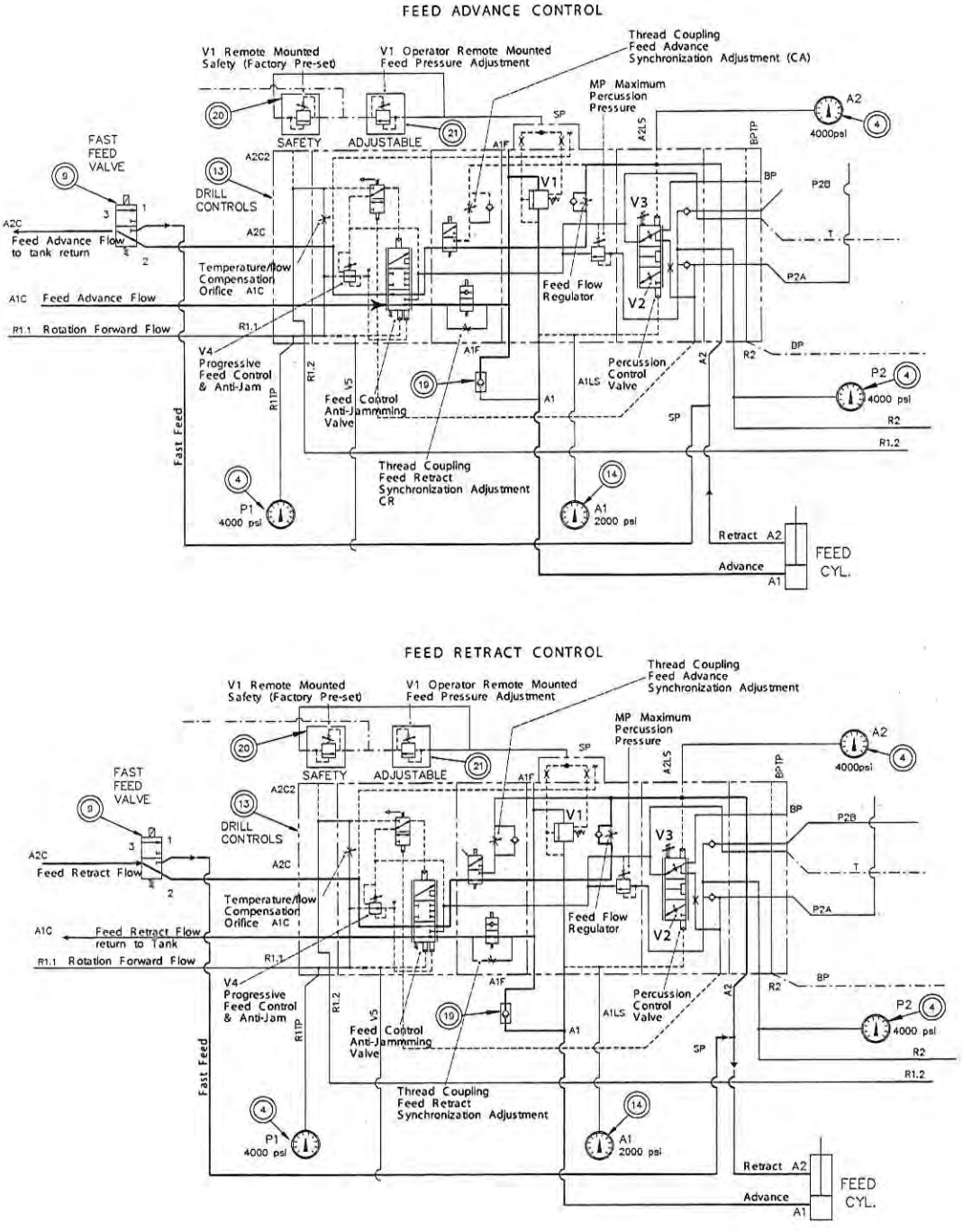


FIGURE 13. Feed Advance & Retract

Hydraulic Specifications

To monitor proper operation of the drill functions, two (2) sets of gauges are provided on the Shaft Jumbo.

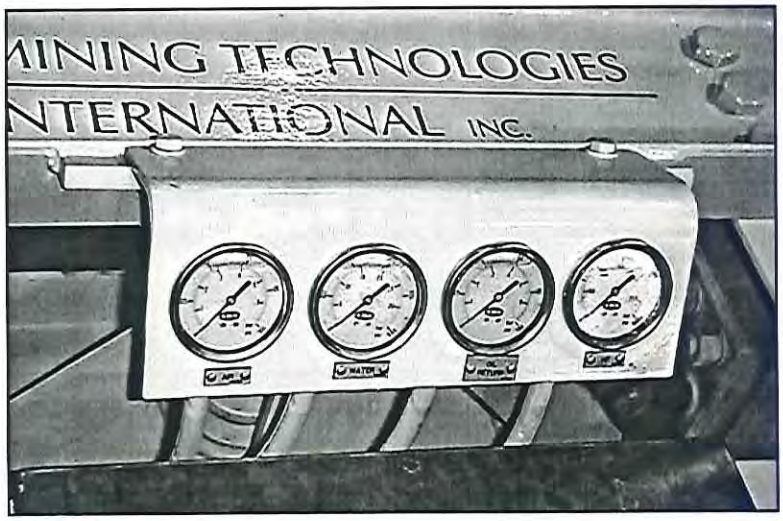


FIGURE 14. Air, Water, Oil Return & High Pressure Gauges

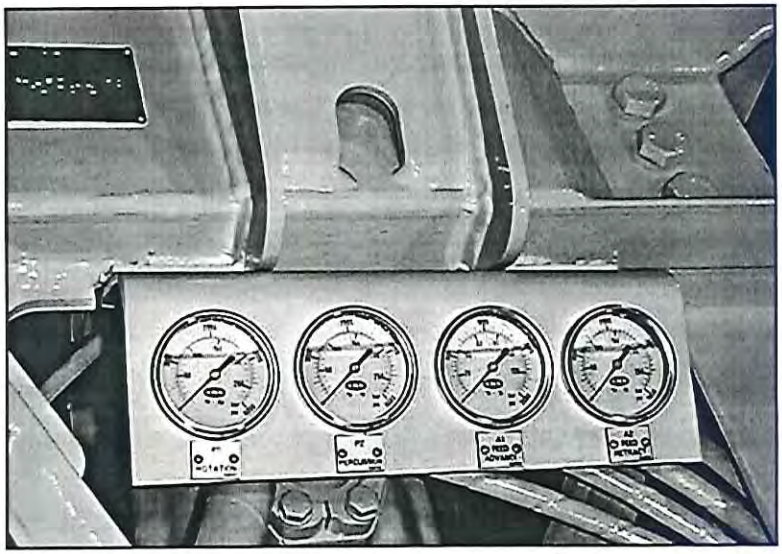


FIGURE 15. Rotation, Percussion, Feed Advance, Feed Retract Pressure Gauges

The Normal working pressure for these gauges are

TABLE 3. Gauges

Item	Value
Water Pressure	300 psi (21 bar)
Air Pressure	25 psi (2 bar)
Hydraulic Oil Return Filter (on cold startup this value is higher)	15-20 psi (1-2 bar)
HP (High Pressure)	2000 psi (138 bar)
Rotation	600-950 psi (40-65 bar)
Percussion	1450-2000 psi (100-135 bar)
Feed Advance	1160-1450 psi (80-100 bar)
Feed Retract	2600 psi (180 bar)

TABLE 4. Hydraulic Specifications

Item	Value
Percussion Pump (P2) Flow Rating	28 USGPM @ 2000 psi 105 LPM @ 138 bar
Relief Valve Setting	3000 psi (206 bar)
Standby Pressure for Load Sense	250 psi
Rotation Pump (P1) Flow Rating	10 USPGM @ 2000 psi 37 LPM @ 138 psi
Relief Valve Setting	3000 psi (206 bar)
Standby Pressure for Load Sense	250 psi
Feed / Implement Pump (HP) Flow Rating	8 USGPM @ 2000 psi 30 LPM @ 138 bar
Pressure Compensator Setting	2600 psi (179 bar)
Relief Valve Setting	3000 psi (206 bar)

IntelSense Adjustment

Adjustment Descriptions

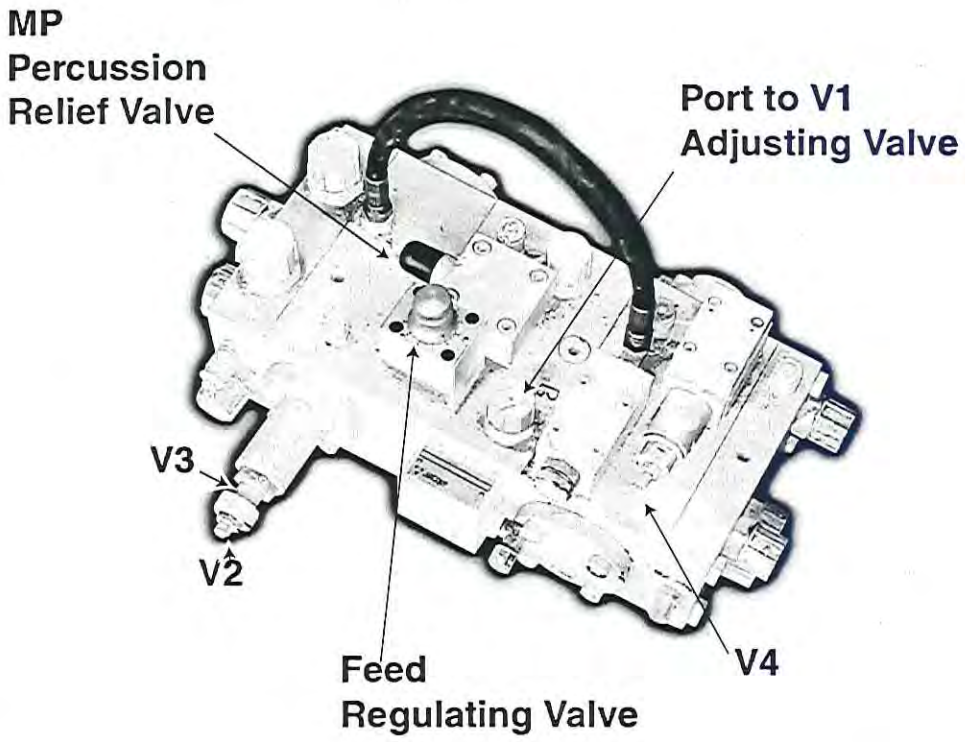


FIGURE 16. Location of Adjusting Screws

1) - V1 Feed pressure

This valve setting is made while setting up the machine on sites, to suit bit type and diameter, Presetting can be made in a static mode prior to drilling by feeding the bit against some resistance. Final setting is made at full percussion power while drilling in the hardest, most homogeneous competent rock encountered.

2) - MP Maximum Percussion Pressure

It sets the drifter maximum percussion pressure when drilling with cold oil while starting up.

3) - V2 Operating Percussion Pressure

It sets the drifter percussion power to a suitable level for bit size and rock hardness. The setting should be approximately 120-130 bar or (1715-1850 psi) for the HC 105 Drifter

4) V3 Drifter Power Regulation

V3 measures actual feed force by sensing both forward and return feed pressures. The V3 adjustment sets the feed pressure limit below which the drifter power will be reduced. This control will continue to reduce the drifter power level to a 60 bar (870 psi) preset minimum as rock resistance decreases.

5) Feed Flow Regulator

This flow regulator adjusts the feed maximum flow to slightly above the drill rate in the hardest rock encountered. If the feed flow while drilling softer rock conditions reaches the preset maximum, the resulting back pressure decreases the feed force decrease that acts on V3. This acts as both and anti-void (faults, fractures, water pockets in the ground) and collaring control.

6) V4 Progressive Feed Control and Anti-Jam

V4 is an adjustable regulator, which senses the pressure differential across the rotation motor and acts directly upon feed flows. As drilling torque exceeds the presetting, V4 spool begins to shift reducing the feed flows. These restricted feed flows result in a lower feed force and the feed motion slows down. As a second step and separate from the V4 adjustment described, V3 lowers the drifter percussion pressure in response to the reduction in feed force.

Far above the V4 setting, feed motion will first stop and then reverse before the bit gets stuck.

To avoid reaction in homogeneous rock, V4 is set above the hydraulic pressure experienced in normal drilling conditions.

7) Flushing Control Valve

A flushing control valve will fully shift the V4 spool causing reverse feed motion when the bit is plugged. Drifter cycle operation clears the bit while the bit is retracting.

This feature is fully operative with reverse percussion drifters.

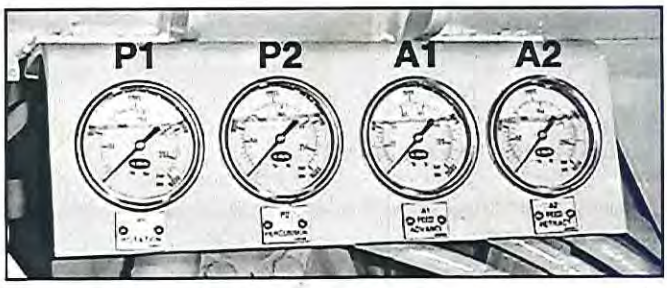


FIGURE 17. Pressure Gauge Indicators

Check that the delivered flows and pressures correspond to table4. The gauges shown in figure 15 correspond to the following adjustments shown in figure 16:

- A1 - Feed Advance (Forward)
- A2 - Feed Retract (Reverse)
- P1 - Rotation (Drifter)
- P2 - Percussion (Drifter

Presetting Before Drilling

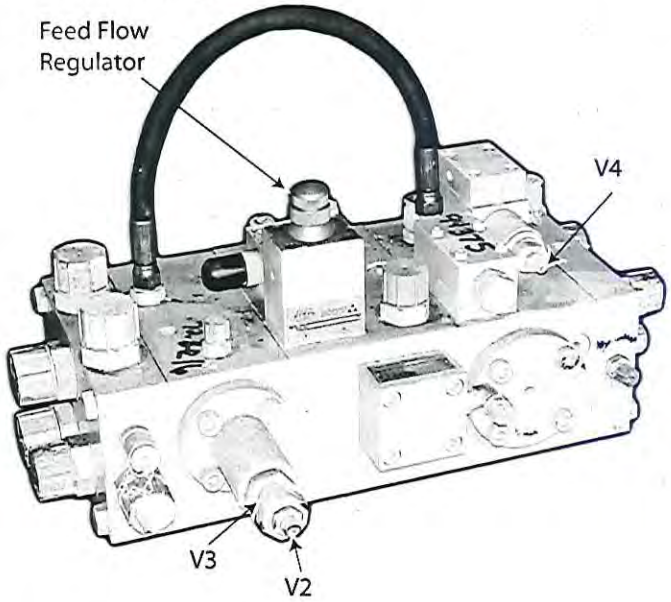


FIGURE 18. Presetting Before Drilling

With the machine shut down:

1 **Unlock safety nut and loosen V3 screw until the internal spring becomes free.**
2 **Unlock safety nut and fully tighten V2 screw (hold V3 screw to prevent re-tightening).**
3 **Set the feed flow regulator (5) on position 10.**
4 **Remove V4 Cap and fully tighten the V4 setting.**

Start the machine.

5 **Press the bit against the rock by acting on the Feed control.**
6 **Preset drilling feed pressure (V1) pressure to 80-100 bar (1140-1430 psi).**
7 **Start drilling (flushing, rotation, percussion, feed) in homogeneous, non-fractured with drifter percussion control set in the "Auto" position.**
8 **Set the operating percussion pressure to120-130 bar (1715-1860 psi) by loosening V2 screw. Check the pressure on the Percussion (P2) gauge.**
9 **By acting on the V1 screw, reset the Feed pressure for correct coupling motion: approximately 1mm sideways vibration and a Coupling temperature not exceeding 100° C. If the Coupling temperature is above the limit, although coupling vibration is correct, reduce the operating Percussion pressure by tightening the V2 screw.**

Setting While Drilling

Adjust Flow Regulator on Feed Retract

10 **While drilling the starter rod (or the rod drilled at the highest drilling rate), progressively close the flow regulator (5) until the feed back pressure reaches 5 bar (71 psi) on the Feed Retract gauge (A2).**
11 **Re-open the flow regulator (5) by one division. For example: if position six creates 5 bars of back pressure, re-open the regulator to position seven.**

V3 Drifter Power Regulator Setting

This setting must be carried out when drilling condition allow maximum percussion pressure and actual feed force such as encountered in hard, non fractured rock, feed back pressure A2=O bar.

12 **With a wrench, hold V2 screw in position.**

13 **Tighten V3 until percussion pressure drops as displayed on the Drifter percussion P2 gauge.**

14 **Loosen so as to recover the initial pressure plus an additional 1/4 turn.**

15 **While drilling with the Drifter percussion directional control valve alternatively in the "Auto" and "Manual" positions, verify that the percussion pressure remains the same.**

16 **Secure all locking nuts.**

V4 Progressive Feed Control Setting

17 **While drilling the last rod in homogeneous ground, loosen V4 setting until the Feed back pressure slightly increases on gauge A2, Feed Retract.**

18 **Re-tighten the V4 setting by one turn.**

Water Flushing Valve

While drilling with the Percussion control in the "Auto" position, switch off the air flushing and check that the Drifter reverses direction.

Exceptional Adjustments

These adjustments are made only in the event of a parts replacement.

Reverse Percussion Pressure

Reverse Percussion Pressure Adjustment

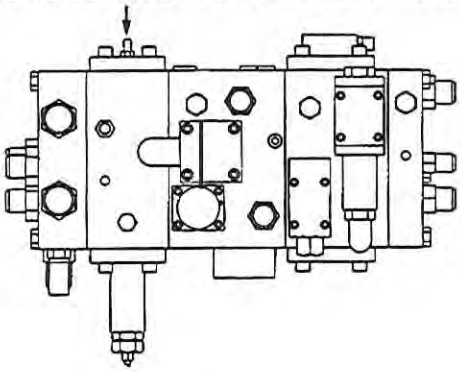


FIGURE 19. Reverse Percussion Pressure Setting

!

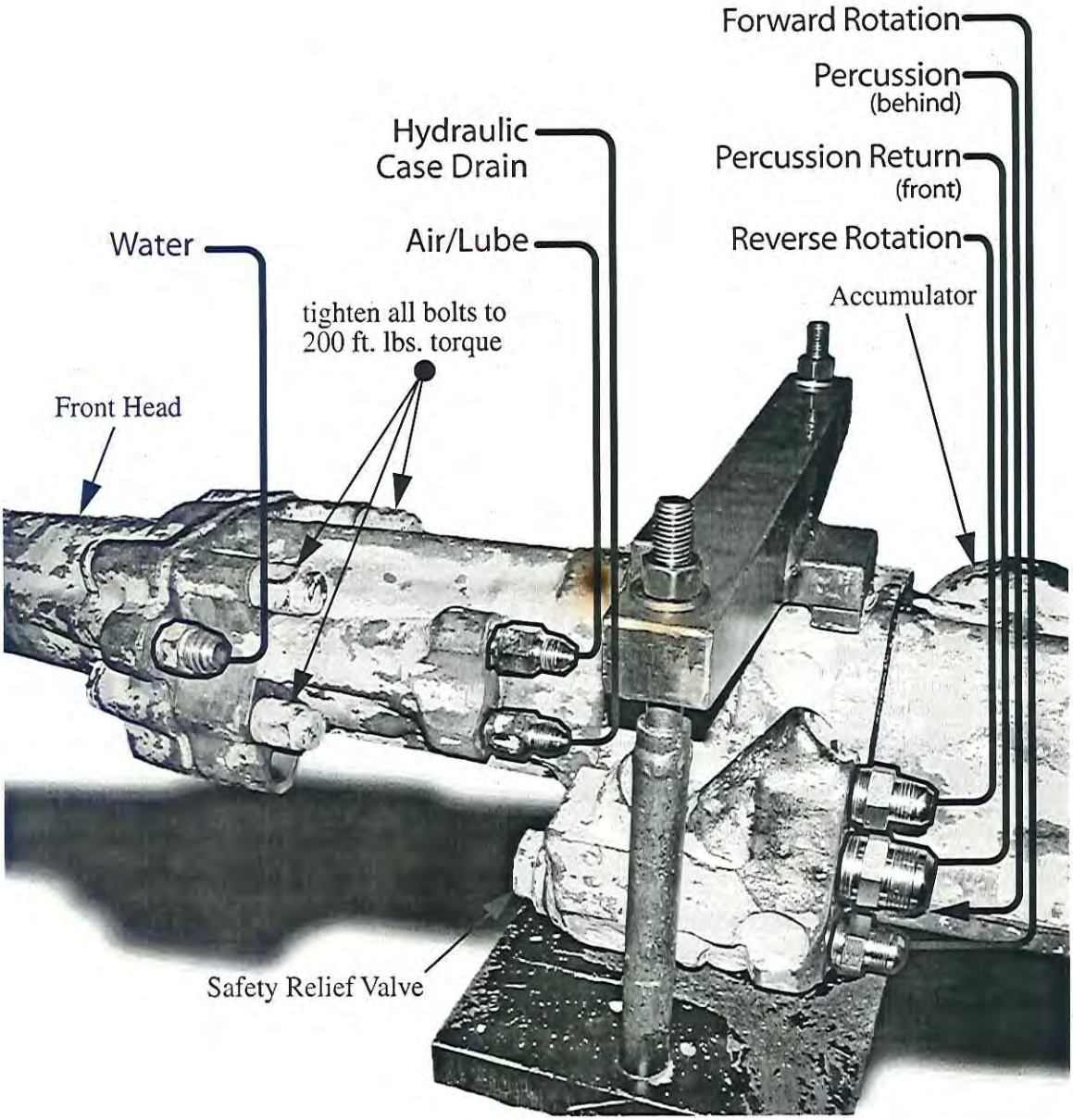


FIGURE 23. HC-50 Port Configuration

Tooling

The following tools will be required for field service:

TABLE 5. Tooling

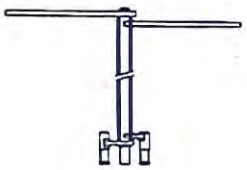
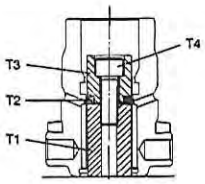
Tool	Part#	View
Seal Assembly Tool	73125	
Seal Assembly Tool	73124	
Hoisting Ring	44675	
Accumulator Wrench	59833	
Accumulator Charging Valve with Nitrogen Bottle and Carrying Support. Or optional E.59832 (see next item)	E62910	

TABLE 5. Tooling

Tool	Part#	View
Accumulator Charging Valve. Customer to supply nitrogen bottle and adapter.	E.59832	
Guide Ring Extraction Tool	T1 - 86324563 T2 - 86324605 T3 - 86324571 T4 - 96717202	
Guide Ring Installation Tool and	86324555	
Bronze Ring driving tool	86324555	
Torque Wrench capable of 1200 ft. lbs. torque.	Customer Supplied	
Loctite Nickel Anti-Sieze compound.	Loctite #77164	
Grease Gun with High Pressure Gear Grease.	Customer Supplied	

Servicing the HC-105 Drifter

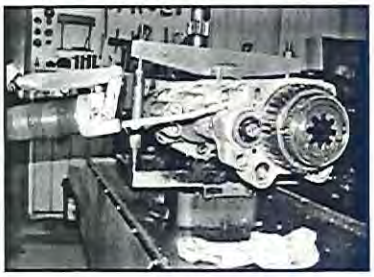
In preparation for servicing the drifter, the Technician should:

- Shut down the drill and tag it "Out Of Service" using the correct method for your company;
- Shut down the water feed and air feed. Remove the water and air/lube feed lines from the drifter (see figure 23) and plug all fittings and hoses;
- To remove and prevent dirt from entering the drifter when it is disassembled, wash down the drifter with a suitable solvent;

The service items, which are explained below, are:

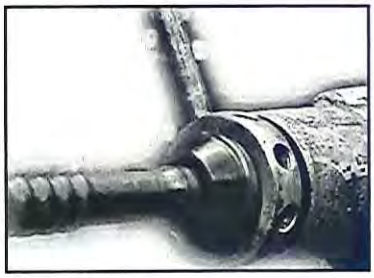
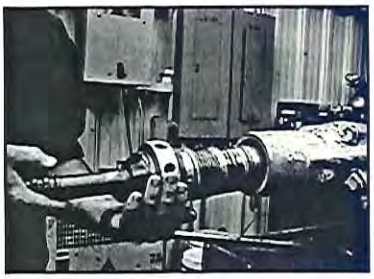
- Servicing the Drifter - Table 6;
- Servicing the Flushing Nozzle & Shank - Table 7; and
- Servicing the Accumulators - Table 8.

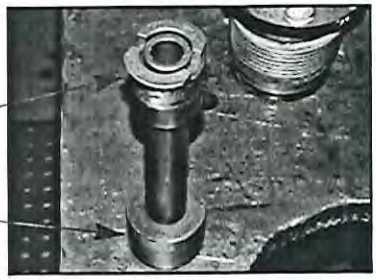
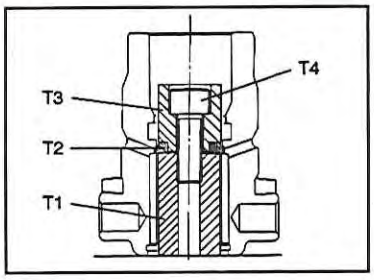
TABLE 6. Servicing The Drifter

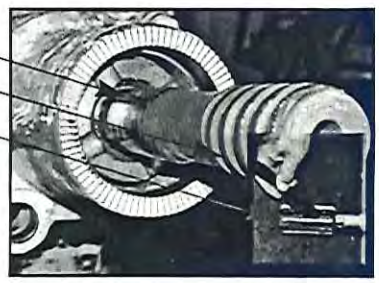
Step	Description	Visual
1	Apply 2 shots of grease every drilling shift to the Rotation Bearing of the drifter. **WARNING** Overgreasing the bearing will damage the front head of the drifter. Do not overgrease.	
2	At the rear of the drifter, while operating the drifter, check the 2 air bleed holes for a steady stream of air and oil mixture exiting the holes. If no air is exiting, the drifter must be removed and examined before extensive internal damage results.	

Step	Description	Visual
3	During drilling operations, if the hydraulic lines connected to the drifter are whipping or jerking, or a loss of percussion power is evident, the high pressure Accumulator may have failed. See table 8 for servicing Accumulators.	
4	If water is exiting the holes on the front of the drill, Water Seal failure has occurred. The Drill may be operated until the end of the shift and then repairs should be completed. See table 7 for repair procedures.	
5	Examine the Shank for pits and burrs on the threads and side play. It should have no more than 1/8" (3mm) of side play. If this is excessive, the guide ring is worn and should be replaced. To replace the Shank or Guide Ring, see table 7 for repair procedures.	
6	Retorque all the retaining bolts on the drill, and Drill Cradle to 200 ft. lbs. of torque at every service or at least once per forty drilling shifts.	

TABLE 7. Servicing the Flushing Nozzle and Shank

Step	Description	Visual
1	Remove the Shank protection. Using a 5/8" round bar by 16" long, insert it into the retainer and turn CCW to remove the Flushing Nozzle and the packing.	
2	Grasping the Shank and Retainer, pull out the Flushing Nozzle and Packing.	
3	Slide the Shank Retainer, Flushing Nozzle, Packing, and Shank Protector off of the Shank.	
4	Check the guiding ring for wear. If the ovalization is greater than 46mm, remove the lock ring and prepare for replacement of the guide ring (bushing) If the guide ring is within acceptable wear limits go to step 5 and than to step 12 for replacement of the water seals.	

Step	Description	Visual
5	Remove the water seal. Go to step 12 for replacement of the water seals.	
6	To remove the Guide Ring, a special removal tool is required. Note the following items: - Expansion tabs to insert behind the guide ring ridge - Mandrel to push the ring out.	
7	Insert the Expansion tabs against the guide ring ridge, and insert the mandrel to secure them in place. (see instruction below)	
8	Put the ring T1 flat on the bench. Slide the flushing nozzle on the ring. Place the 2 half segments T2 on the ring. Put the centering ring T3 into position. Tighten the screw T4 to hold the parts. With a press extract the worn bushing.	
9	Place the housing in a press and remove the guide ring. **WARNING** : The bushing is very tight. Do not attempt to hammer it out. Damage to the housing will result.	

Step	Description	Visual
10	Apply anti-seize compound to the bore of the housing	
11	Using the correct Mandrel, re-install the bushing into the housing and install the snap ring.	
12	Using the correct Seal Installer tool, re-install the seal into the housing. Check the Packing for wear and replace if it is cracked or chipped. Apply grease to the seals.	
13	Remove and reinstall seals in the Shank Retainer. Apply grease to the seals.	
14	Examine the Shank for: - Wear on the seal rubbing surfaces; - Nicks and Burrs on the threads; - Even wear on the striking surface; - Even wear on the splines. If any of these items are evident, replace the Shank.	

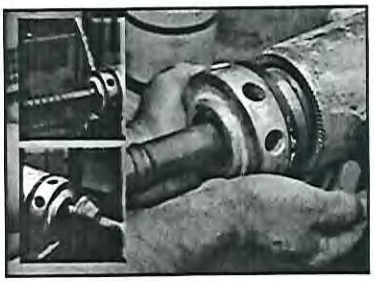
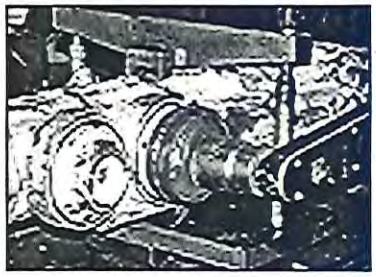
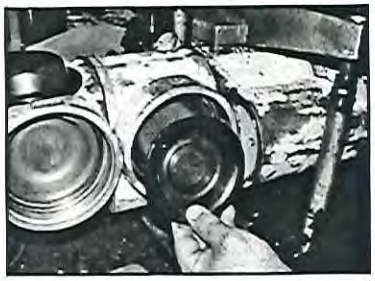
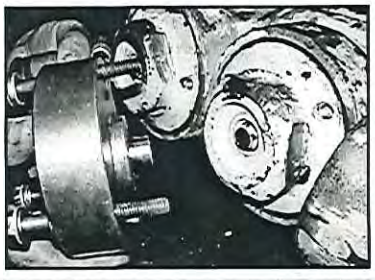
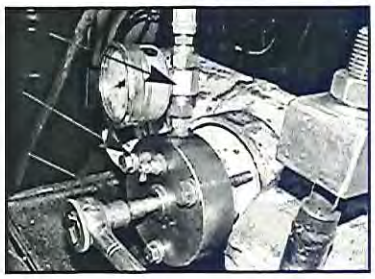
Step	Description	Visual
15	Insert the Shank and Shank Retainer into the Front Head. Seat the Shank into the splines and the Shank Retainer against the Front Head ridge. Apply grease to the Shank Retainer face and Shank seal rubbing area.	
16	Install the Flushing Nozzle into the Front Head and seat it against the Shank Retainer. Screw in the Flushing Nozzle and reinstall the Shank Protector.	

TABLE 8. Servicing The Accumulator

Step	Description	Visual
1	The Drifter has two Accumulators. **Low Pressure - marked LP** **High Pressure - marked HP** Locate the High Pressure Accumulator.	
2	Remove the Gas Charge plug and vent the Nitrogen (if any) to the atmosphere.	
3	Using the wrench provided with the Accumulator Charger kit, turn the Accumulator cap CCW and remove it.	
4	Remove the broken diaphragm and clean the accumulator cavity. Check the diaphragm's sealing surface for nicks and scratches and, if necessary, deburr the surface with fine emery paper. If the nick or gouge is deep, the housing must be replaced and the drill should be removed for servicing.	

Step	Description	Visual
5	Grease both sealing sides of the diaphragm and insert it into the cavity seating the diaphragm evenly.	
6	Apply never-sieze compound to the threads of the accumulator cap, and thread the cap into the housing.	
7	Using a torque wrench, tighten the cap to 2000 ft. lbs.	
8	Assemble the charging plug making sure to replace the ring seal with the seal lip facing the bolt head. Loosely screw the plug in until the seal begins to seat into the housing.	
9	Using an M10 x 125mm tap, clean out the threaded holes for attaching the accumulator charging adapter. Fasten the adapter to the accumulator face.	

Step	Description	Visual
10	Attach the nitrogen charging line and close the tools vent, Unscrew the charging plug CCW to vent the accumulator diaphragm to the nitrogen charging tank.	
11	Open the nitrogen charging valve until the precharge pressure of 40 bar is reached.	
12	Wait until the tool's gauge stabilizes at 40 bar.	
	Using the tools adapter, tighten the charging plug to seal the nitrogen precharge into the accumulator.	
	Shut off the Tanks Nitrogen Valve and then open the tools vent valve to drain nitrogen out of the attachment line.	

Troubleshooting the Drill System

After reviewing the operation of the hydraulic system, the technician is competent to analyze and troubleshoot problems. The chart shown below is a compilation of problems, which factory trained technicians have viewed. It is provided only as a guide and is not meant to replace the analytical skills that a competent technician with understanding of the circuit will apply to problem solving.

TABLE 9. Troubleshooting the Drill Hydraulic

Problem	Cause	Solution
Drill will not advance or the feed lever always reverses.	No water flowing through the drill control.	Check the water system circuit.
	Water diaphragm leaking.	Remove the water pilot valve, check the diaphragm, replace if necessary.
	Bit mudded up.	Clean or replace bit.
	Water pressure is low.	Ensure that the water pump is operating, make sure that the Y - strainer is clean.
	Broken or stuck spring in the automatic drill return valve, HC-40.	Replace or repair the spring.
The drill will not advance, but the booms function properly.	Feed cylinder by-passing.	Test the cylinder.
	V1 spring broken or not adjusted properly.	Replace the broken spring and re-adjust.
	Foreign material on the feed rail.	Clean the feed rail.
The drill will not return, but the booms function properly.	Feed cylinder by-passing.	Test the cylinder and replace or repair if necessary.
	Drill stop missing or not adjusted properly.	Replace or adjust valve as required.
	Cable broken.	Replace the cable.

Problem	Cause	Solution
	The accumulator is faulty on the feed control.	Replace the accumulator.
The drill will not advance or return and the booms do not function.	Faulty high pressure relief valve.	Repair or replace the relief valve and adjust to 245 bars or 3600 psi.
	Faulty pump.	Replace the pump, clean the system and ensure that there is no contamination.
	Broken hose.	Repair hose.
The drill reverses while drilling.	By-pass in the drifter control.	Flow test control, repair as required.
	Oil leak in P1 circuit.	Repair leak.
	Faulty P1 relief valve.	Repair or replace the relief valve, re-adjust to 220 bar or 3200 psi.
	Faulty P1 pump.	Flow test the pump, adjust if possible, replace if necessary.
	P1 HP filter.	Change the element.
Drifter drills slow, but has full rotation speed.	P2 relief valve is faulty.	Repair or replace the relief, adjust to 220 bar or 3200 psi.
	Faulty pump.	Flow test pump, change if necessary.
	P2 HP filter	Change element.
	Faulty drill accumulator.	Test the accumulator, change the diaphragm if necessary: HP – 40 bar, LP – 4 bar.
Drill has no rotation.	Faulty P1 relief.	Replace the relief and adjust to 220 bar or 3200 psi.

Problem	Cause	Solution
	Faulty Pump.	Flow test pump, replace if necessary.
	Bit removal valve is in the wrong position.	Place the bit removal valve in the drilling position.
	Broken striker bar.	Replace striker bar.
	Drifter rotation motor faulty.	Remove the drifter and rebuild.
	HP filter.	Change the element.
P1 and P2 pressure are too high.	Wrong flow setting on the pump.	Reset P1 and P2 flows.
	Return hose is restricted.	Clean and check the return line.
	Return filter.	Change the element.
	V5 pressure regulator.	Re-adjust the regulator.
Drifter rotates with partial speed and power.	Low flow.	Flow test the P1 pump, flow test the drifter control, flow test the drifter.
	Faulty drifter rotation motor.	Rebuild drifter.
Drifter lacks power / P2 gauge is lower than normal.	V2 out of adjustment.	Re-adjust.
	Broken V2 spring.	Replace the spring and re-adjust the pressure.
	V3 out of adjustment.	Re-adjust.
	Feed cylinder by-passing.	Check and repair.
	Cable pulleys on feed slide are seized.	Remove and replace.
	Check V5 pressure regulator.	Adjust the regulator.
Automatic collaring is too severe.	V3 out of adjustment.	Re-adjust.
	Broken V3 spring.	Replace the spring and adjust.

Chapter 4
Electrical Systems

Description

Overview

The electrical system is composed of;

1. One 600Vac hydraulic pump motor;
2. One 600Vac water pump motor;
3. One 120Vac filler pump motor;
4. One 24Vdc motor for the lube pump;
5. An electrical control panel containing two starters for the 600 vac motors, a phase voltage relay to detect improper supply, and, the basic power distribution terminals, relays and fuses; and
6. An operators console in the form of a pendent.

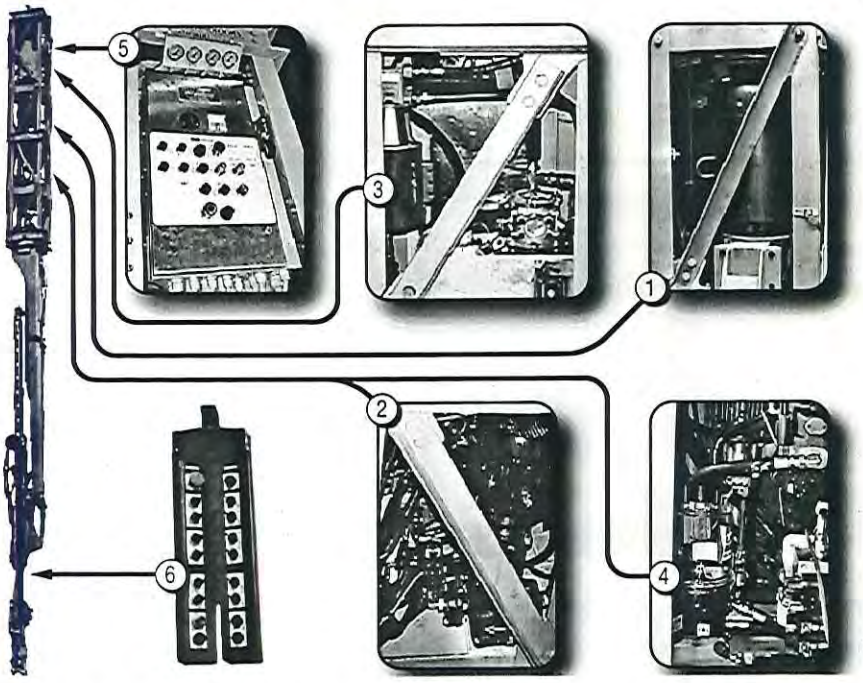


FIGURE 24. Placement of Electrical Components

600Vac Motors

The main motor is mounted one meter below the Control panel and supplies power to the hydraulic power pack. The second 600Vac motor drives the water pump. This motor is located below the main motor.

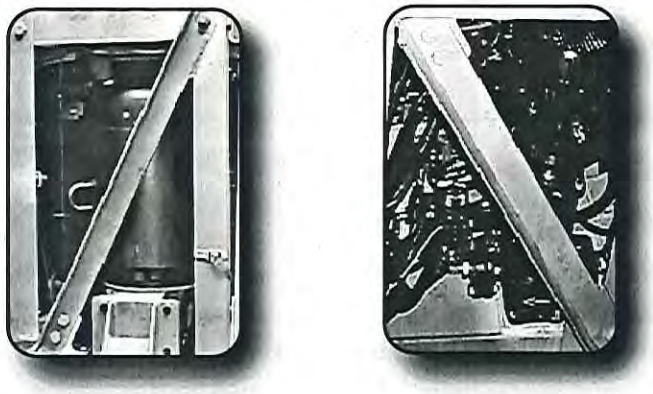


FIGURE 25. 600 Vac Motor

120Vac Filler Pump Motor

The filler pump motor drives the pump, which fills the main hydraulic tank.

FIGURE 26. 120Vac Motor

24Vdc Lube Pump Motor

The 24Vdc motor runs the lubrication pump. It is located beside the water pump motor.

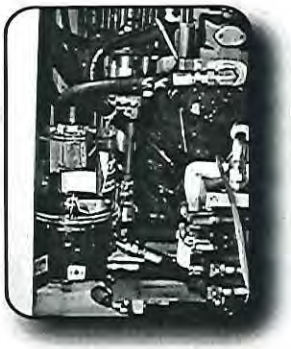


FIGURE 27. Lube Pump Motor

Electrical Control Panel

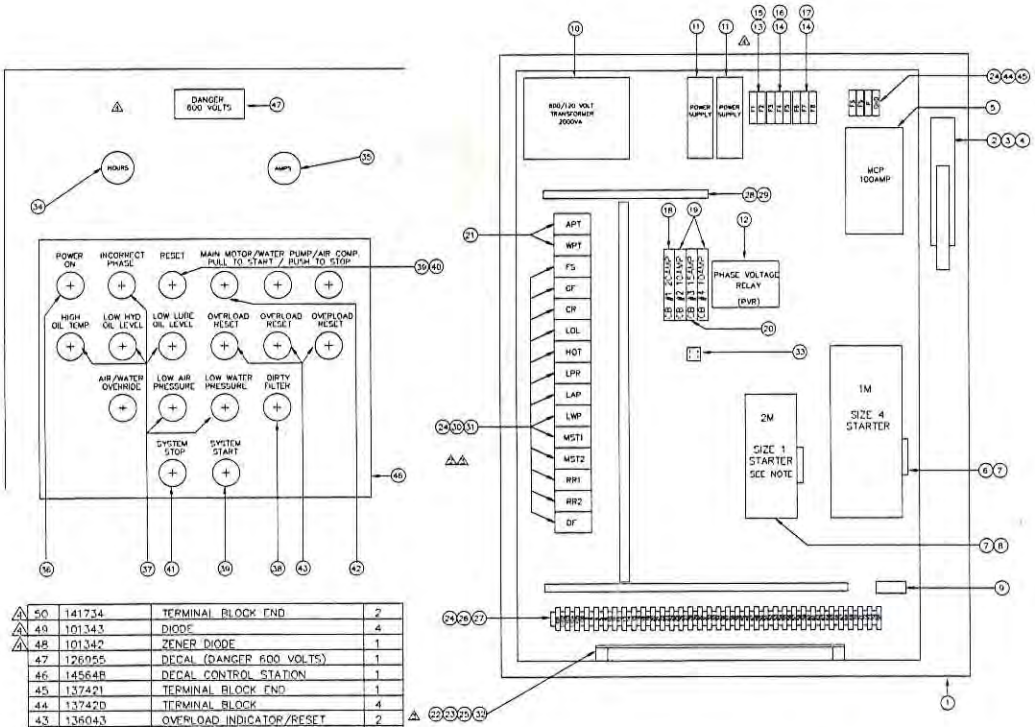
The Control Panel Operates:

- Power on;
- Main motor start and stop;
- Water pump start and stop;
- Air compressor start and stop;
- Over load resets; and
- System start and stop.

The Control Panel displays:

- Incorrect phase on main power;
- High oil temperature;
- Low hydraulic oil level;
- Low lubrication oil level;
- Motor overloads;
- Air/water over ride;
- Low air pressure, low water pressure; and
- Dirty filter.

FIGURE 28. Electrical Control Panel



ITEM	PART No.	DESCRIPTION	QTY.
50	141734	TERMINAL BLOCK END	2
49	101343	DIODE	4
48	101342	ZENER DIODE	1
47	126955	DECAL (DANGER 600 VOLTS)	1
46	14564R	DECAL CONTROL STATION	1
45	137421	TERMINAL BLOCK END	1
44	13742D	TERMINAL BLOCK	4
43	136043	OVERLOAD INDICATOR/RESET	2
42	13897R	PUSH/PULL BUTTON 24 VOLT	1
41	136191	PUSH BUTTON (STOP)	1
40	135095	CONTACT BLOCK 2NO	3
39	136196	PUSH BUTTON BLACK	2
38	140296	PILOT LAMP YELLOW	1
37	136697	PILOT LAMP RED	6
36	136696	PILOT LAMP GREEN	1
35	106394	AMMETER	1
34	105701	HOURMETER	1
33	107548	RECTIFIER	1
32	128253	BUSS BAR SCREWS	20
31	001404-001	RELAY - 4 POLE 24V	13
30	001404-002	RELAY BASE - 4 POLE	13
29	101146	TROUGH COVER	6'
28	101145	TROUGH	6'
27	124701	TERMINAL BLOCK END	1
26	001138-001	TERMINAL BLOCK	45
25	128254	BUSS BAR MOUNT	2
24	100583	MOUNTING CHANNEL	5'
23	128252	BUSS BAR CLAMP	2
22	128251	BUSS BAR	1.5'
21	002293-001	TIMER 24 VOLT	2
20	106493	CIRCUIT BREAKER - 15A	1
19	100569	CIRCUIT BREAKER 10 AMP	2
18	136858	CIRCUIT BREAKER 20 AMP	1
17	138427	FUSE 10 AMP	3
16	102109	FUSE 1/2 AMP	3
15	138428	FUSE 15 AMP	2
14	132175	FUSE BLOCK 3 GANG	2
13	132176	FUSE BLOCK 2 GANG	1
12	119117	PHASE VOLTAGE RELAY	1
11	134499	POWER SUPPLY	2
10	109948	TRANSFORMER 2000VA	1
9	106395	CURRENT TRANSFORMER	1
8	135332	MOTOR STARTER SIZE 1	1
7	135550	AUXILLIARY CONTACT	1
6	135334	MOTOR STARTER SIZE 4	1
5	109710	MOTOR CIRCUIT PROTECTOR 150A	1
4	117098	ROD 6"	1
3	112079	OPERATOR FLANGE	1
2	127989	OPERATOR HANDLE	1
1	002185-001	ENCLOSURE - 30 X 18 X 8 SS	1

FIGURE 29. Electrical Control Box

Operators Pendant Console

The operator console is the main point of operational control.

The console controls;

- Motor 1 Start and Stop;
- Feed transfer Forward / Reverse and Tilt;
- Boom Rotation Clockwise and Counter Clockwise;
- Up or Down;
- Feed Direction and Speed;
- Water pump On and Off;
- Percussion Auto and Manual;
- Rotation of drill bit Forward or Reverse;
- Centraliser Open and Closed;
- Coupling;
- Air On and Off;
- Reset and System Stop.

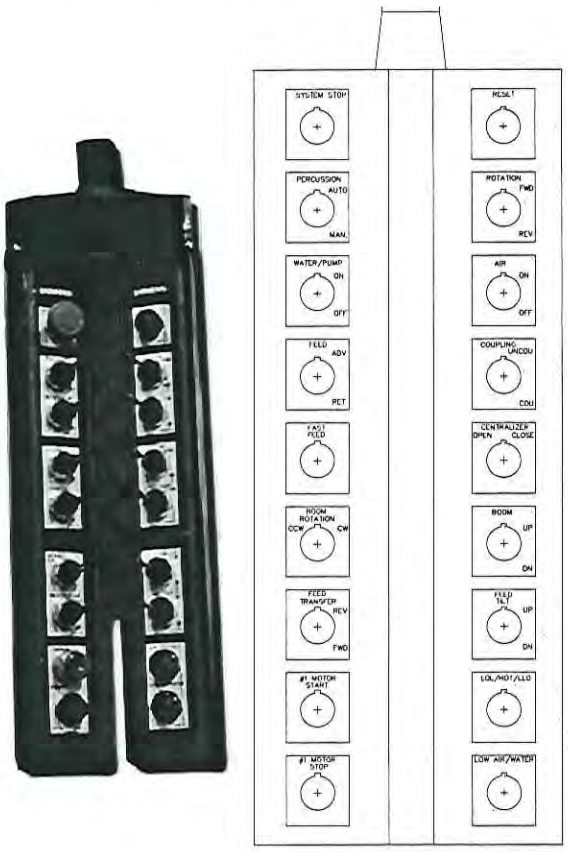
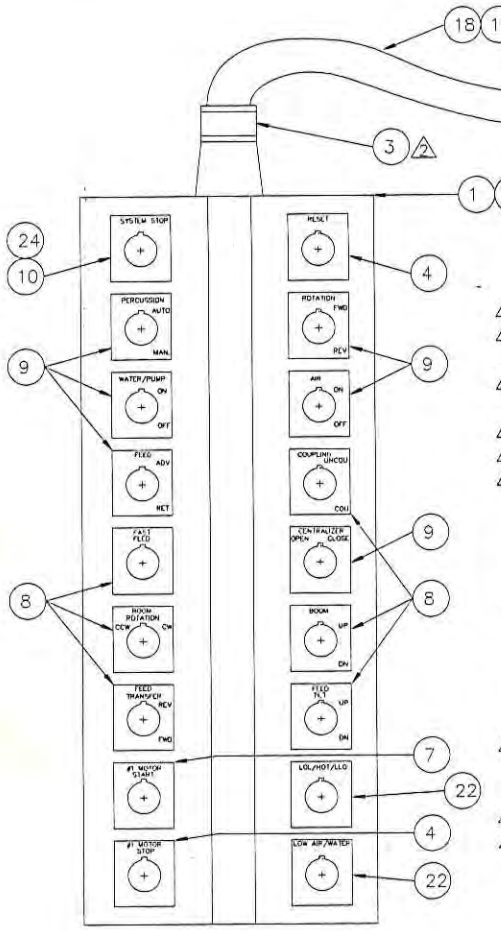


FIGURE 30. Pendant Control Layout

The Console Lights indicate;

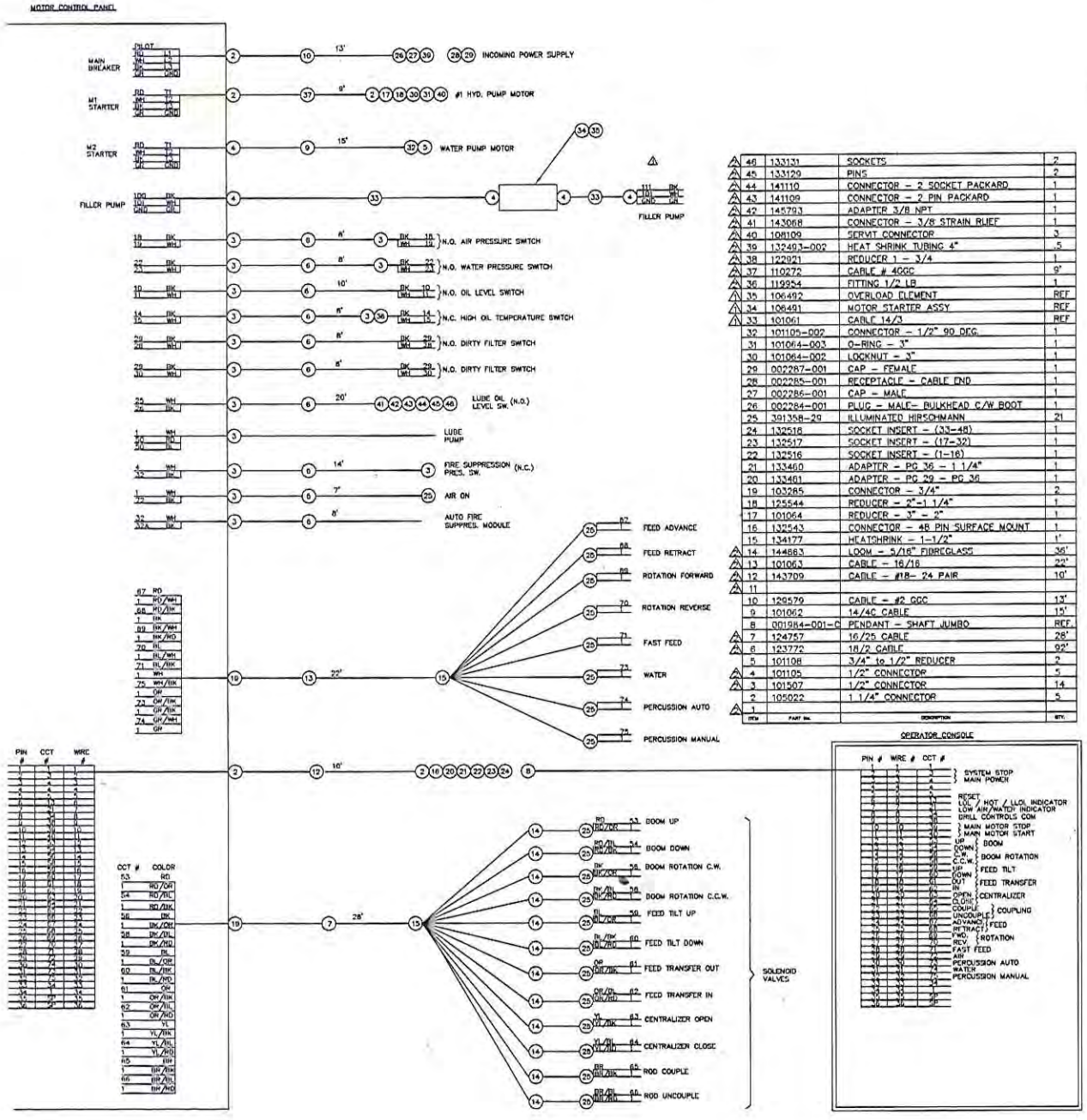
- Low air or water;
- Low oil level / high oil temperature / low lube level;

The operators pendant is connected with a tethered cable to the main control panel. It is attached to the boom and is raised and lowered with the Jumbo. The pendant is a sealed unit and has no field serviceable parts in it. If a failure occurs, send the unit back to MTI for repair.



	ITEM	PART No.	DESCRIPTION	QTY.
1	24	131330	CONTACT BLOCK	1
1	23	102214	SPIRAL WRAP 1"	60'
	22	002184-001	INDICATING LIGHT - 24V RED	2
1	21	002627-003	PENDANT HARDWARE KIT	1
	20	002282-001	DECAL KIT - PENDANT	1
1	19	002647-001	PENDANT CABLE 16/36C	70'
1	18	002647-002	PENDANT STRAIN RELIEF CABLE	60'
1	17	002647-006	THIMBLE	1
	16	133461	ADAPTER - PG29 - PG36	1
	15	133460	ADAPTER - PG 36 - 1 1/4"	1
	14	132515	PIN INSERT - (33 - 48)	1
	13	132514	PIN INSERT - (17 - 32)	1
	12	132513	PIN INSERT - (1 - 16)	1
	11	132512	CONNECTOR-48 PIN CABLE END	1
	10	131329	PUSHBUTTON - SYSTEM STOP	1
	9	122780	JOYSTICK - 3 POS. MAINTAINED	6
	8	122781	JOYSTICK - 3 POS. MOMENTARY	6
	7	141280	ILLUMINATED PUSHBUTTON - GREEN	1
1	6	142957-002	CONNECTOR C/W WIRE MESH GRIP	1
	5	002183-001	PENDANT BUFFER	1
	4	140526	PUSHBUTTON	2
2	3	114836	GEAR CLAMP	1
1	2	002180-001	PENDANT COUPLING	1
	1	002179-001	PENDANT - 9 BUTTON	2

FIGURE 31. Pendant Console Parts List



ITEM	PART No.	DESCRIPTION	QTY.
46	133131	SOCKETS	2
45	133129	PINS	2
44	141110	CONNECTOR – 2 SOCKET PACKARD	1
43	141109	CONNECTOR – 2 PIN PACKARD	1
42	145793	ADAPTER 3/8 NPT	1
41	143068	CONNECTOR – 3/8 STRAIN RLIEF	1
40	108109	SERVIT CONNECTOR	3
39	132493-002	HEAT SHRINK TUBING 4"	.5
38	122921	REDUCER 1 – 3/4	1
37	110272	CABLE # 4GGC	9'
36	119954	FITTING 1/2 LB	1
35	106492	OVERLOAD ELEMENT	REF
34	108491	MOTOR STARTER ASSY	REF
33	101061	CABLE 14/3	REF
32	101105-002	CONNECTOR – 1/2" 90 DEG	1
31	101064-003	O-RING – 3"	1
30	101064-002	LOCKNUT – 3"	1
29	002287-001	CAP – FEMALE	1
28	002285-001	RECEPTACLE – CABLE END	1
27	002286-001	CAP – MALE	1
26	002284-001	PLUG – MALE– BULKHEAD C/W BOOT	1
25	391358-29	ILLUMINATED HIRSCHMANN	21
24	132516	SOCKET INSERT – (33-48)	1
23	132517	SOCKET INSERT – (17-32)	1
22	132516	SOCKET INSERT – (1-16)	1
21	133460	ADAPTER – PG 36 – 1 1/4"	1
20	133461	ADAPTER – PG 29 – PG 36	1
19	103285	CONNECTOR – 3/4"	2
18	125544	REDUCER – 2"–1 1/4"	1
17	101064	REDUCER – 3" – 2"	1
16	132543	CONNECTOR – 48 PIN SURFACE MOUNT	1
15	134177	HEATSHRINK – 1–1/2"	1'
14	144883	LOOM – 5/16" FIBREGLASS	36'
13	101063	CABLE – 16/16	22'
12	143709	CABLE – #18– 24 PAIR	10'
11			
10	129579	CABLE – #2 GGC	13'
9	101062	14/4C CABLE	15'
8	001984-001-C	PENDANT – SHAFT JUMBO	REF.
7	124757	16/25 CABLE	28'
6	123772	18/2 CABLE	92'
5	101108	3/4" to 1/2" REDUCER	2
4	101105	1/2" CONNECTOR	5
3	101507	1/2" CONNECTOR	14
2	105922	1 1/4" CONNECTOR	5
1			

FIGURE 32. Wiring Harness

Electrical Circuit Explanation

The circuits in the electrical system are grouped into voltage applied components. When reading the circuit descriptions refer to:

- 600 Vac, 120 Vac circuits shown in Figure 33;
- 24 Vdc power supply shown in Figure 33;
- 24 Vdc control circuits shown in Figures 33, 34; and
- Pendant Control circuits shown in Figure 35.

600 Vac

Referring to Figure 33, we see the 3 phase 600Vac applied power enters the system through the 100A *main breaker.* The 600Vac is then applied to a step down power *transformer*, a phase voltage relay, and through the contacts of two motor starters, the two 600Vac motors. Both motors have internal over load contacts.

The 120Vac step down *transformer* is protected by F1 and F2, which are 8A fuses. The phase voltage relay is protected by F3, F4, and, F5, which are 1/2A fuses; and, the *water pump motor* is protected by F6, F7, F8, which are 10A fuses. The hydraulic pump motor also known as the *#1 motor* is protected by the *main breaker.*

The neutral line has a momentary normally open switch connected in parallel with two sets of normally open contacts; one from the *fire suppression relay*, and one from the *ground fault relay.* All these circuits are conected in series with a ground fault zener diode.

120 Vac

Referring to figure 33, we see the 120 Vac is derived from phases B and C through the step down power *transformer.* The hot side of the secondary of this *transformer* supplies CB1, which is a 20 Amp circuit beaker and feeds CB2 and CB5, which are 10A and 15A respectively.

CB2 provides 120Vac to the 1M and 2M *motor starters* through the normally closed contacts of the EM STOP MCP switch, and the normally open contacts of MST1, and MST2. The *hourmeter* is connected across 1M.

CB2 also provides power to two 24Vdc power supplies connected in parallel.

CB5 provides 120Vac to the *filler pump motor* through the *filler pump switch*, and *overload relay.*

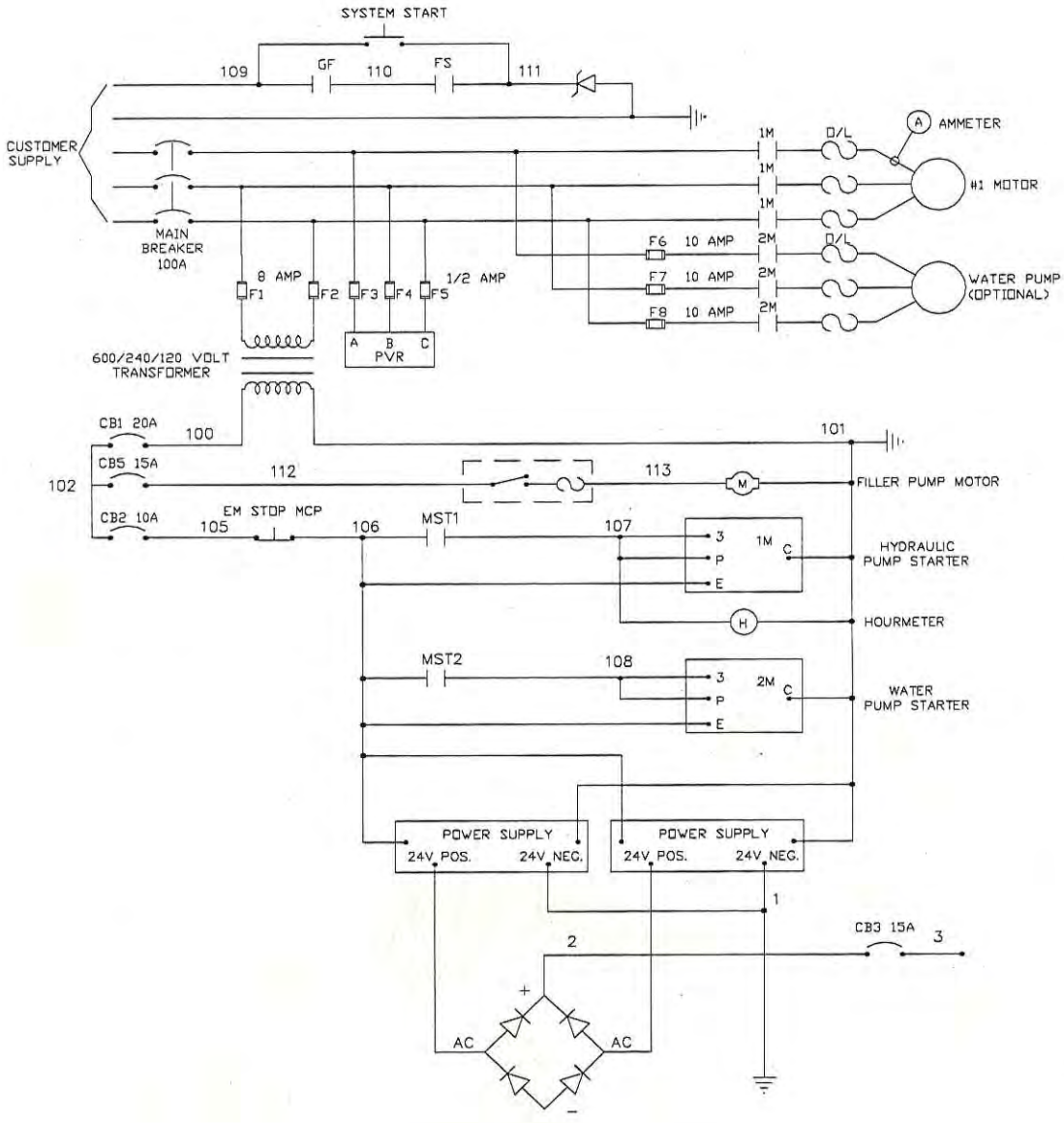


FIGURE 33. 600 Vac, 120 Vac and 24 Vdc output

24 Vdc

The positive output terminals of the 24Vdc *power supplies* are connected to the AC terminals of a bridge rectifier. The forward diodes of the bridge provide isolation. The negative output terminals of the *power supplies* are joined. The forward terminals provide 24Vdc to CB3, which is a 15 A breaker. CB3 in turn provides 24 Vdc to the *system stop switch* and CB4, which is a 10 A breaker.

The *system stop switch* provides power to the entire 24Vdc control system including the operators console.

CB4, which is a 10 A circuit breaker, provides 24Vdc to the *fire suppression relay*, the *ground fault relay*, and the *lube pump motor.*

24 Vdc Alarms & Indicators

The motor control panel contains the electrical distribution components.

The *fire suppression* and *ground fault relays* are able to shut down the system by causing a ground fault condition through contacts GF or FS in the 3 phase neutral.

In the closed condition, the *system stop switch* lights the *power on* green light and provides 24Vdc to the rest of the control system.

The *reset switch* located on the *motor control panel* has two sets of normally open contacts connected in parallel, which control two relays RR1 and RR2 also connected in parallel. These relays provide the ability to reset corrected alarm conditions. For example: if the *oil level relay* has entered the alarm state, the *oil level switch* has opened, the normally open self sealing contacts LOL between wires 4 and 10 and the normally open LOL contacts between wires 7 and 8 have opened. This releases the *oil level relay* and the *control relay.* The normally closed contacts LOL between wires 4 and 12 and wires 4 and 13 have been closed lighting the *low oil level* light and the LOL/HOT/LLO light. This action de-energizes the *control relay* shutting down the *main motor.*

Once the oil level has been corrected the *reset switch* can be engaged to energize the *oil level relay* through the *oil level switch,* thus engaging the normally open self sealing contacts LOL and re-energizing the *control relay;* which then energizes the *main motor.*

The other sensor switches (*oil temp. switch, air pressure switch, water pressure switch, lube oil level switch, and, dirty filter switches 1&2*) operate in the same fashion. The water and air pressure relays are replaced with timed relays.

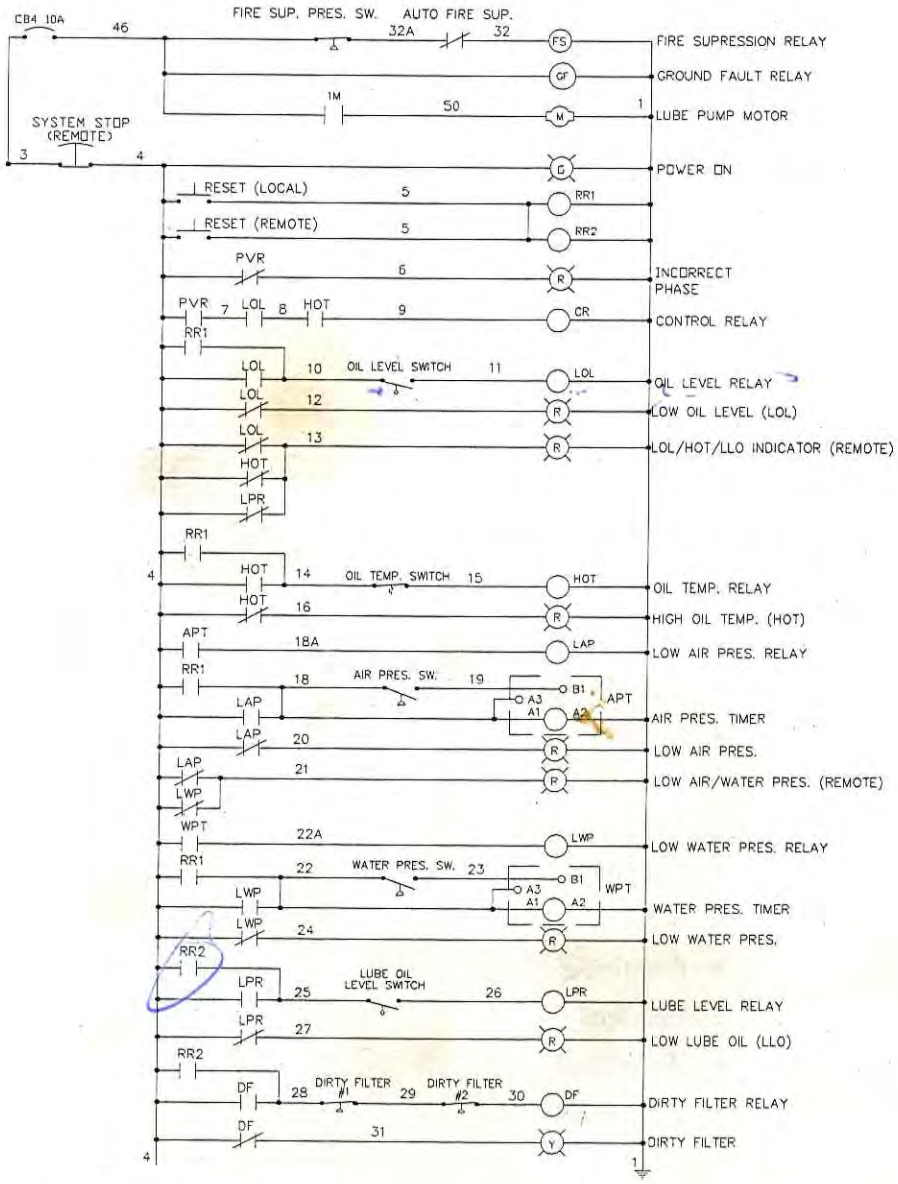


FIGURE 34. Motor Control Logic (Motor Control Panel)

Referring to figure 35, we see the components of the *operators pendant console* are arranged into three groups.

Group One begins with the normally open contacts between wires 4 and 37.

Group two begins with the three position joystick between wires 4 and 53.

Group three begins with the normally open contact LAP between wires 4 and 35.

Group one consists of;

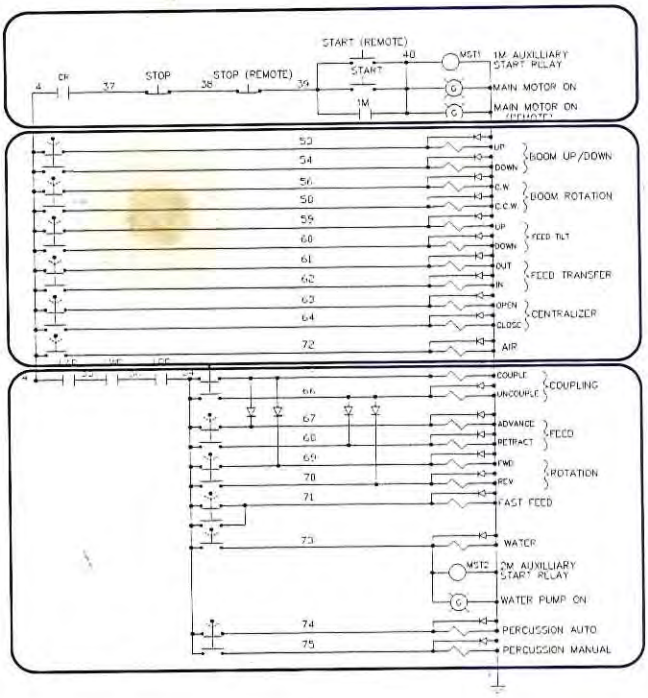
- Start (remote);
- Stop (remote);
- main motor; and
- On (remote) indicator lamp.

Group two consists of;

- Boom up / down;
- Boom rotation;
- Feed tilt;
- Feed transfer;
- centraliser; and
- Air.

Group three consists of;

- Coupling;
- Feed;
- Rotation;
- Fast feed;
- Water; and
- Percussion.



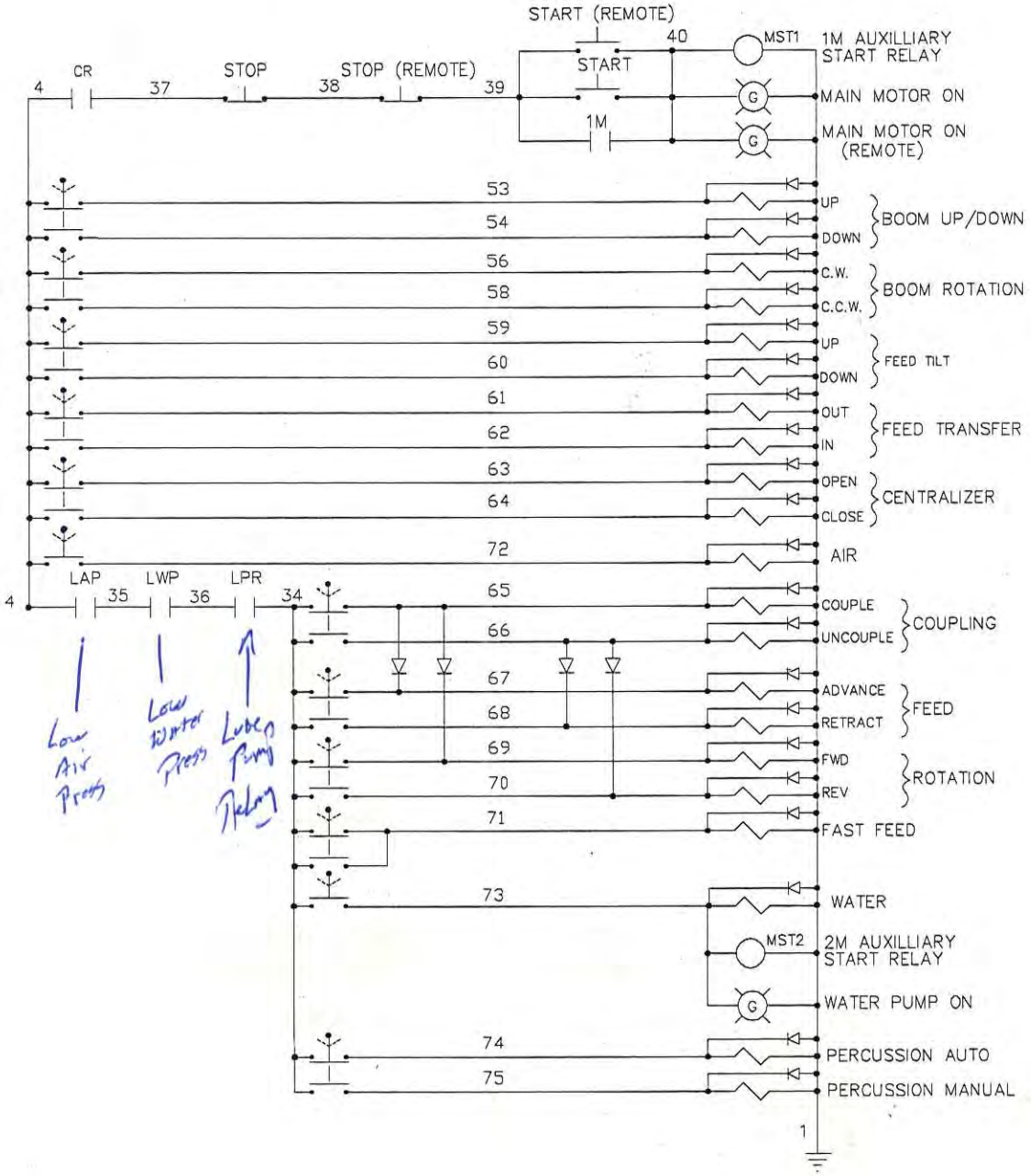


FIGURE 35. Operators Pendant Console

Group One

The normally open contacts of the motor control *control relay*, which are between wire 4 and wire 37, provide 24Vdc to the stop switch of the *motor control panel*, which in turn provides 24Vdc to the stop and start switches, main motor on light of the *operators console*, the start switch, MST1 relay coil, and main "Motor On" light of the *motor control panel*.

Group Two

Group Two consists of five, 3 position dual function joy sticks and one, 3 position single function joystick.

Each of the dual function joysticks will operate one of two mutually exclusive function coils on the drill. These coils are;

- Boom up / down;
- Boom rotation clockwise / counter clockwise;
- Feed tilt up / down;
- Feed transfer out / in; and
- centraliser open / closed.

The single function joystick controls the air system with one valve coil.

Group Three

Group Three receives power through the normally open contacts LAP, LWP, LPR, which are located in the *motor control panel*.

Group three consists of; four, 3 position dual function joy sticks; two, 3 position single function joy sticks; and, four diodes D1,D2,D3 and D4, which enact the function logic required for the coupling function

Each of the dual function joy sticks will operate one of two value coils on the drill. These coils are;

- Coupling couple / uncouple;
- Feed advance / retract;
- Rotation forward / reverse; and
- Percussion auto / manual.

D1 and D2 enable the coils for feed advance and rotation forward when the function coupling couple is selected.

When the function coupling "Uncouple" is selected, D3 and D4 enable the coils for the feed retract and rotation reverse functions.

In all position except neutral, the fast feed joy stick will enable the fast feed valve coil.

The water control joy stick in it's "On" position, enables the water valve coil, the MST2, M2 auxiliary start relay coil, and the water pump "On" light.

Basic Trouble shooting

Before proceeding with these checks be sure the main power is shutdown, the control panel is locked out, and the unit is tagged out.

The following items are in the order a qualified Electrician should check before analyzing and isolating problematic components.

1. **Open the *motor control panel* and check for loose wires or contacts.**
2. **Check for continuity across all eight fuses.**
3. **The *main breaker* should have no shorts, and have continuity from the input to the output of each phase.**
4. **Check breakers CB1, CB2, and, CB5 for continuity.**
5. **Check to see that the zener diode is not shorted or open.**
6. **Lift the negative terminals of the 24Vdc *power supplies* and check to see that there is an open circuit from all four output terminals to the chassis.**
7. **Check the diode bridge from each AC terminal to the positive output terminal to confirm the diodes have not opened or shorted.**
8. **Reconnect the negative terminals of the power supplies.**
9. **After engaging the System Start function, check for 600Vac at the main breaker.**
10. **Check for 120Vac at the secondary of the power transformer and than check for 24Vdc at the output of the two DC power supplies.**
11. **If these checks do not solve the problem, review the electrical schematics and isolate circuits until the problematic circuit is found.**

Chapter 5
Air & Water

Overview

The Shaft Jumbo uses air, water and lube oil to:

- lubricate the flushing head of drill
- lubricate the slider rail through the vent holes at the back of the Drifter
- Air to flush the hole of drill cuttings
- Water at 300 psi pressure to flush the hole of drill cuttings

The air and water are combined into a common stream and injected into the flushing head of the drill, where they are directed into the drill steel and exiting at the bit's flushing hole.

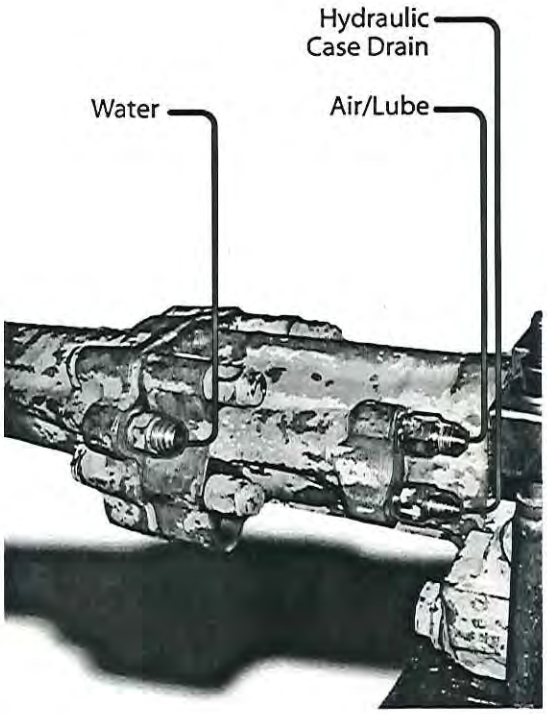


FIGURE 36. Flushing Head

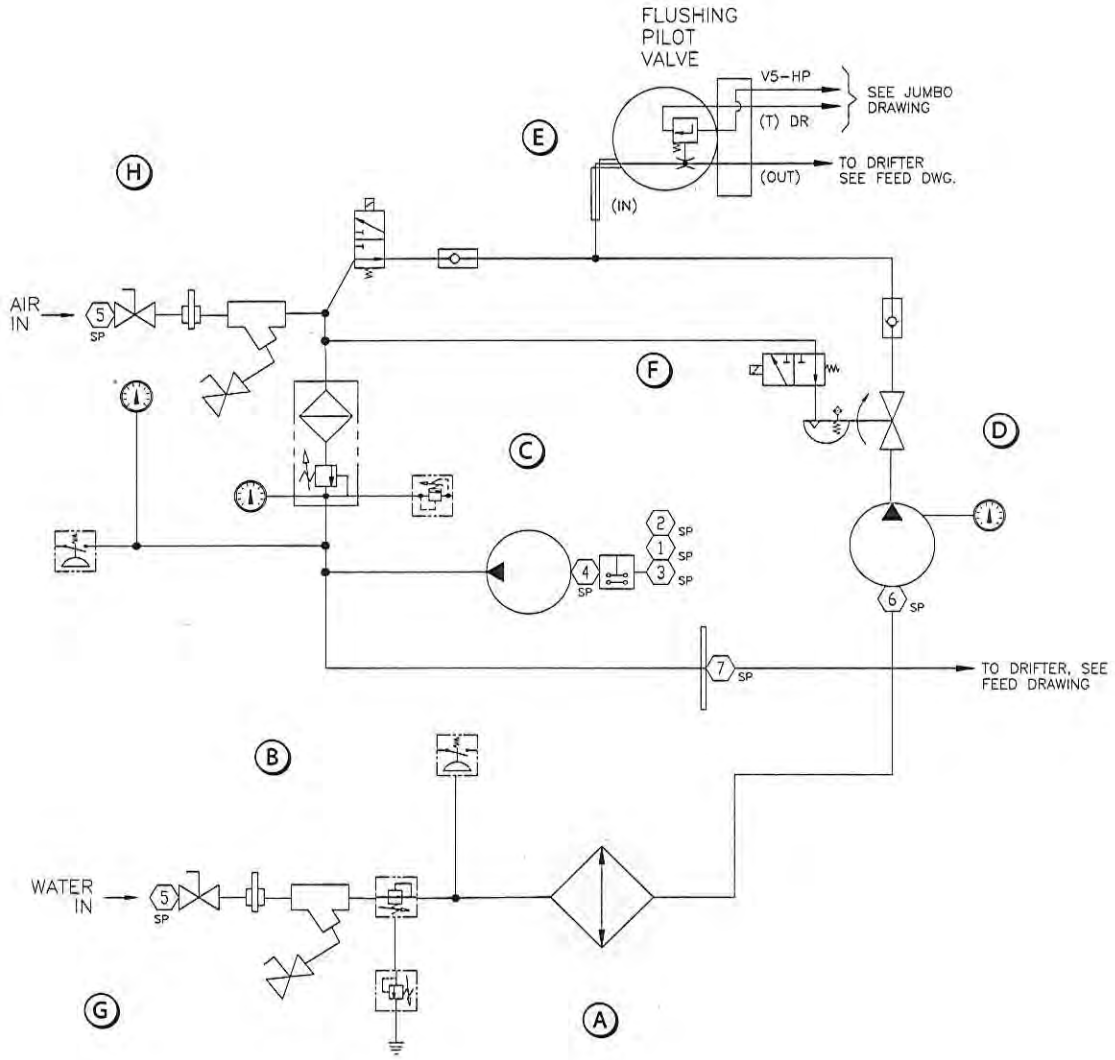


FIGURE 37. Air & Water Component Location

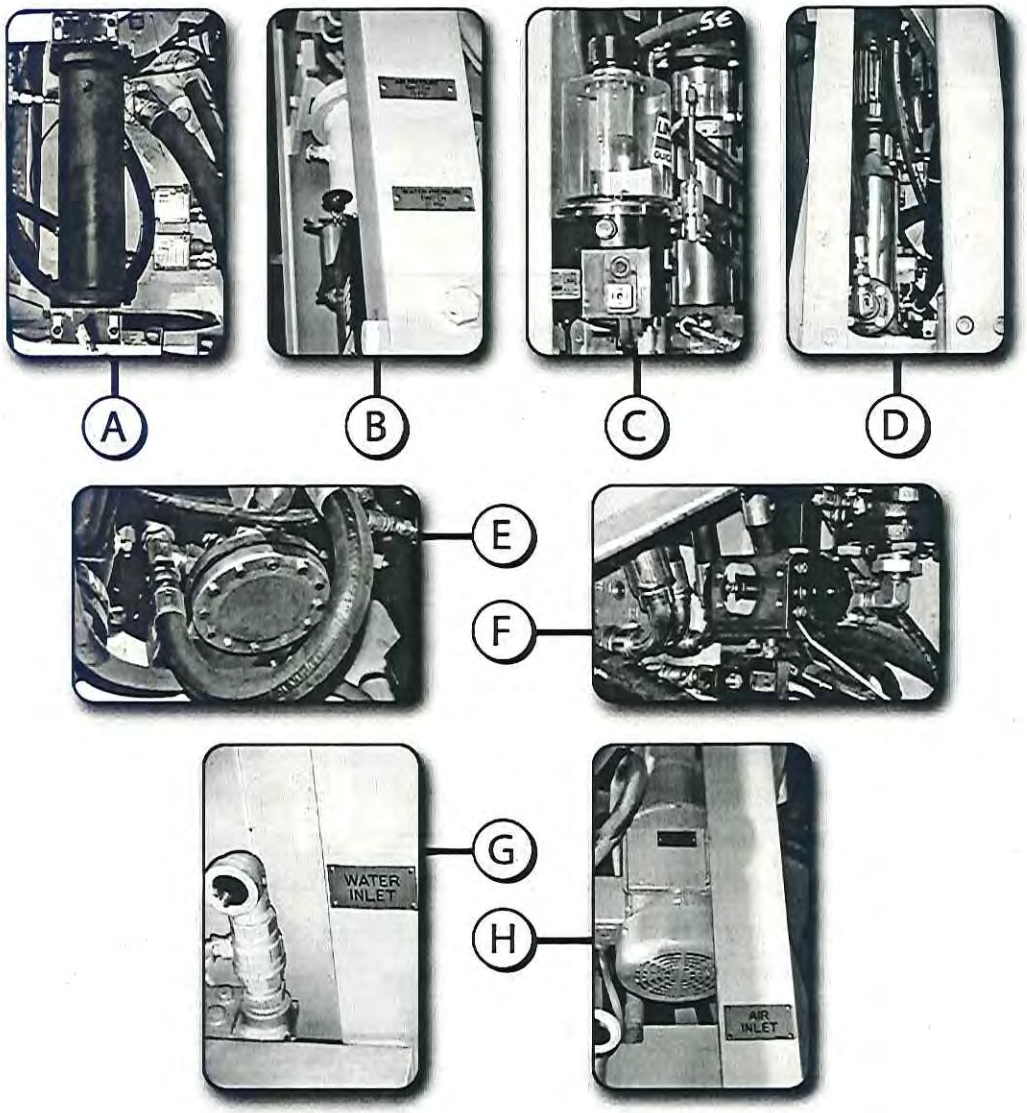
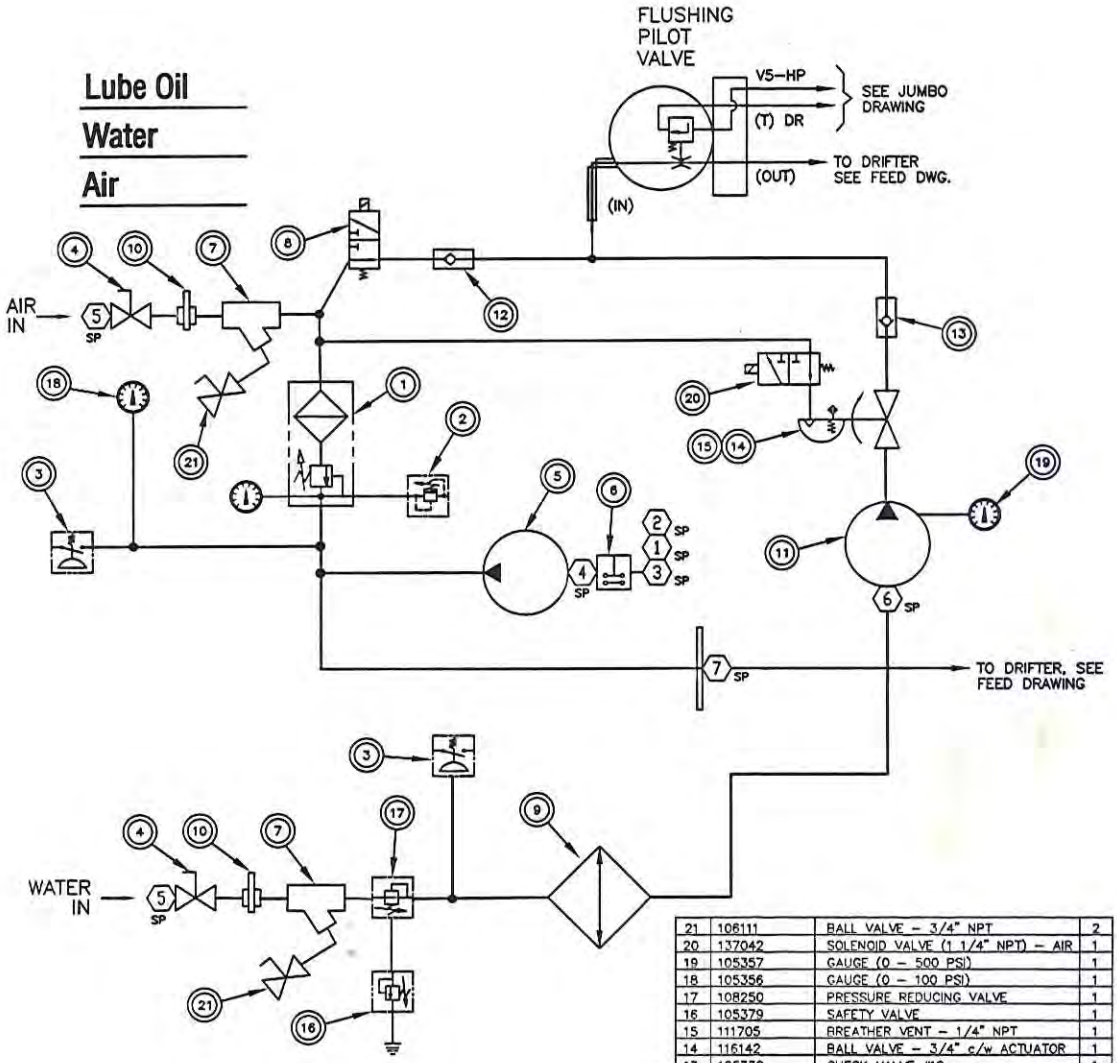


FIGURE 38. Air & Water Component Location 2



ITEM	PART NO.	DESCRIPTION	QTY
21	106111	BALL VALVE - 3/4" NPT	2
20	137042	SOLENOID VALVE (1 1/4" NPT) - AIR	1
19	105357	GAUGE (0 - 500 PSI)	1
18	105356	GAUGE (0 - 100 PSI)	1
17	108250	PRESSURE REDUCING VALVE	1
16	105379	SAFETY VALVE	1
15	111705	BREATHER VENT - 1/4" NPT	1
14	116142	BALL VALVE - 3/4" c/w ACTUATOR	1
13	105332	CHECK VALVE #12	1
12	119771	CHECK VALVE #8	1
11	105217	WATER PUMP (5HP)	1
10	106085-B	WATER INLET WELDMENT	2
9	105331	HEAT EXCHANGER - HYD.	1
8	136559	SOLENOID VALVE (24V) - AIR	1
7	123631	Y-STRAINER - 1 1/4" NPT	2
6	139644	LEVEL SWITCH	1
5	133562	LUBE PUMP (24V)	1
4	140698	BALL VALVE - 1 1/4" NPT	2
3	105369	PRESSURE SWITCH	2
2	105450	PRES. / RELIEF SAFETY VALVE	1
1	105187	FILTER / REGULATOR	1

FIGURE 39. Air & Water Schematic

Air & Water Circuit Explanation

Refer to figure 39 for details on ( ) numbers and circuit connections.

Air

Mine air enters the Y strainer air inlet and is applied against a solenoid valve (8) and over a check valve (12). The check valve isolates the water and air circuits. The two circuits are combined before entering the drifter's flushing head, which is shown in figure 36. Air is also applied against solenoid valve (20), which is used to actuate the water control valve. Normal working air pressure should read 25 psi (2 bar) at the gauge shown on figure 14, page 30.

Air is also applied against the flushing pilot valve, which controls the feed advance of the drill.

Lube Oil

Lube oil is contained in the reservoir shown in figure 38, item 3. It is also shown in figure 39 item (5). The correct lube oil is EP 150. The lube pump is rotated by an electric motor and the oil delivery is self regulating. The pump injects a pre-measured amount into the air line whenever the drill is running.

Water

Water enters the system at the inlet (4) and goes through a strainer and across the hydraulic oil cooler (9). Water is the cooling medium for the cooler. The water then enters the inlet section to the water booster pump . The pump boosts the water pressure to 300 psi, which is suitable to flush cuttings from the drilled hole. High pressure water is applied against an air operated gate valve, which opens according to an electrical signal activating the air valve attached to the gate valve driving mechanism. Water then flows across a check valve and combines with the air/lube oil stream. The combined flows are injected into the flushing nozzle. The check valve isolates the water and air systems.

For details on the flushing nozzle, refer to figure Table 7 on page 46.