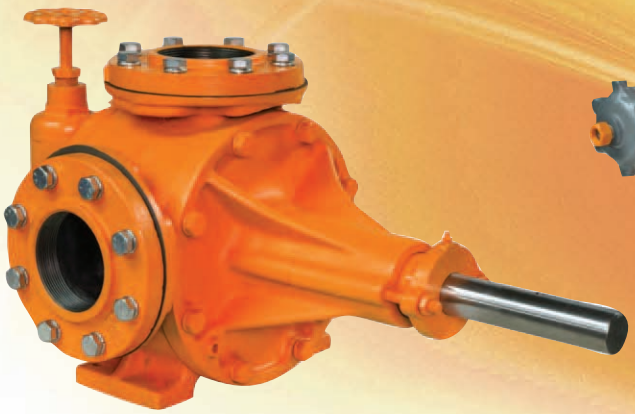
SERIES 200 & 220

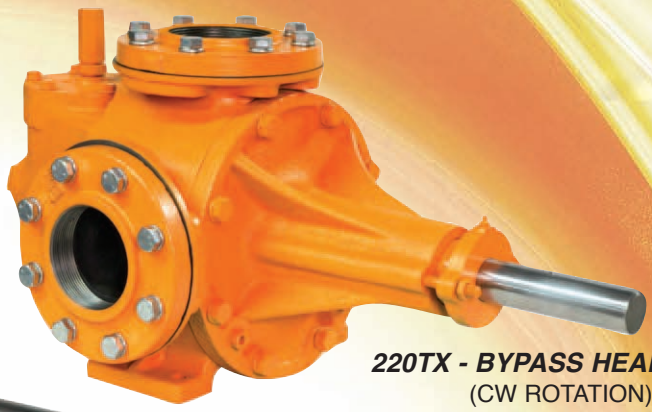
Positive Displacement Rotary Piston Pumps

INSTRUCTION MANUAL
WITH PICTORIALIZED PARTS LIST



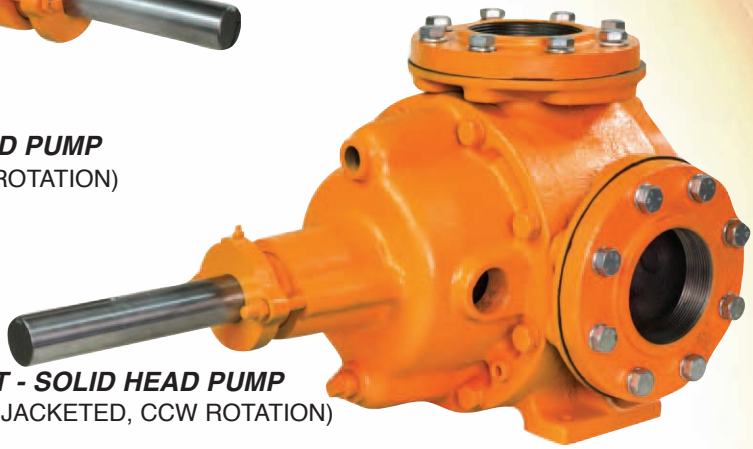
200AV - VARIABLE CONTROL HEAD PUMP
(WITH MANUAL FLOW CONTROL CCW ROTATION)

220TV - VARIABLE CONTROL HEAD PUMP
(WITH VERNIER FLOW CONTROL CW ROTATION)

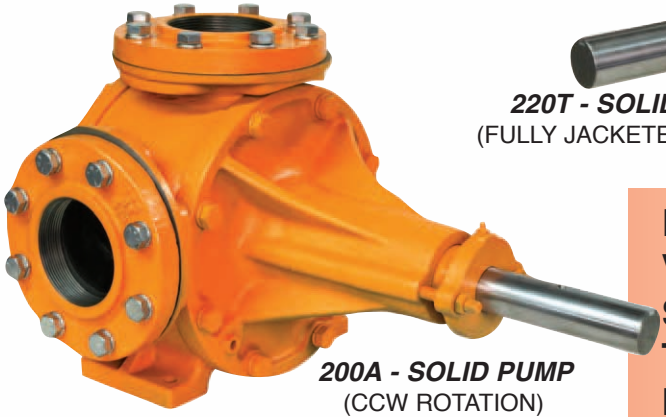


220TX - BYPASS HEAD PUMP
(CW ROTATION)

200AX - BYPASS HEAD PUMP
(FULLY JACKETED, CCW ROTATION)



220T - SOLID HEAD PUMP
(FULLY JACKETED, CCW ROTATION)



200A - SOLID PUMP
(CCW ROTATION)

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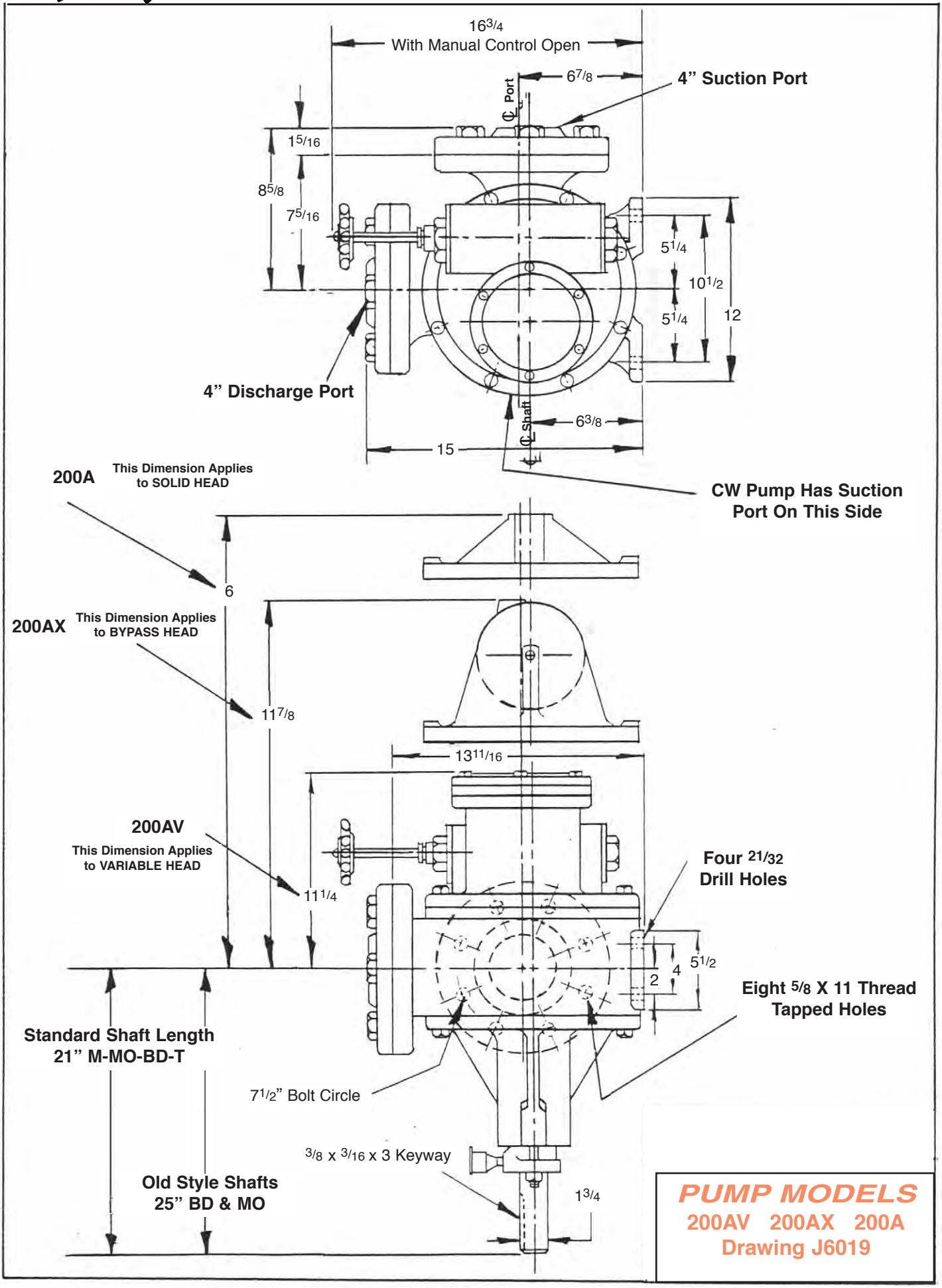
FAX: 860-482-8435

CCW PUMP SHOWN



PUMP MODELS

200AV 200AX 200A

Drawing J6019

PH: 860-482-8581
FAX: 860-482-8435

SERIES 200 AND 220 PUMPS

MODEL **200AV, 220TV** VARIABLE VOLUME PUMP,
200AX, 220TX BYPASS HEAD PUMP, **200A, 220T** SOLID HEAD PUMP,
SERIES 200 AND 220 RATED 240 GPM@ 520 RPM

Putting Pump Into Service

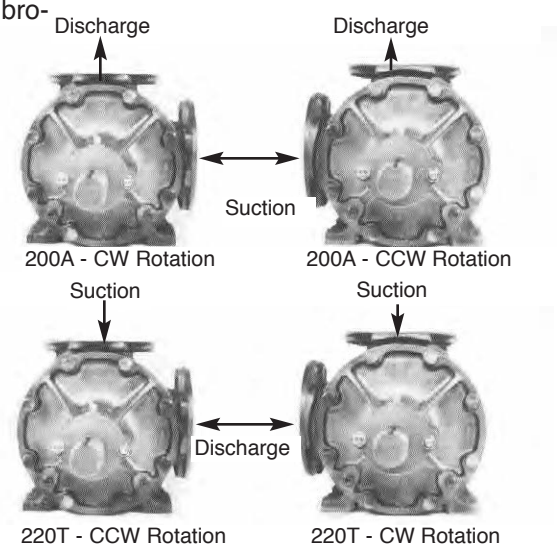
CAUTION: When receiving a pump, carefully check for damage, broken port seals, and any misalignment incurred during shipping.

CORRECT PIPING HOOK-UP: The series 200 and 220 pumps come with two 4" flanged ports designed for use with Schedule 40 steel pipe. Connect piping based on directions of shaft rotation.

SERIES 200 CW (CLOCKWISE) Rotation pump has the suction port on the right side and discharge port on the top (viewed with shaft end toward you). Series 220 CW has top suction and left side discharge.

SERIES 200 CCW (COUNTER CLOCKWISE) Rotation pump has the suction port on the left side and discharge port on top. Series 220 CCW has top suction and right side discharge.

• Any pump may be run in reverse temporarily for such purposes as stripping lines, etc.



Mounting and Alignment

The following will cause misalignment:

(1) Warped base plate – correct by shimming pump and drive components.
(2) Pipe strain – correct by using hangers or appropriate pipe supports.

If pump is connected to drive member by couplings, shim components until coupling halves are aligned.

To prevent misalignment of pump and drive components, fasten base securely in place using the foundation bolt holes provided.

• SHAFT SHOULD ALWAYS BE TURNABLE BY HAND.

• As a last check before starting pump: Remove gland nuts and slide packing gland out of housing. If gland does not slide back into housing without interference, pump is misaligned.

DIRECT MOTOR DRIVE UNITS AND GEAR DRIVEN UNITS: Abutting shafts must be at least 1/8 of an inch apart and coupling inserts and/or chains should be loose enough to prevent end thrust on pump shaft.

BELT DRIVEN UNITS: An outboard bearing must be used to prevent side thrust on pump shaft. Pump shaft must be free to slide longitudinally through outboard bearing, so that rotor group will not be forced against pump case components. Align sheaves using straight edge or stretched cord.

OPEN GEAR DRIVEN UNITS: Proper alignment and engagement of gear and pinion can be checked by passing foil or cellophane through them. An outboard bearing should be used to prevent side thrust on pump shaft. Pump shaft must be free to slide longitudinally through outboard bearing so that rotor group will not be forced against pump case components. **CAUTION:** Use gear and pinion set of same pressure angle such as furnished by factory, otherwise fibre motor pinion life will be short.

PACKING GLAND

The packing gland serves a dual function; first as packing follower and second as a bearing which, with the shaft housing bushing, forms a support for the rotor and shaft. As shipped from the factory, the gland is LOOSE ENOUGH TO BE ROCKED BY HAND. At first start-up DO NOT tighten gland until pump has run long enough for packing to expand from absorption of pumpage. Thereafter, to adjust, tighten nuts evenly one-quarter turn at a time, just enough to reduce leakage - NO MORE - a drop or two of the pumpage should normally drip from the gland every few minutes (except of course with mechanical seals, or external scavenging systems). SHAFT SHOULD ALWAYS BE TURNABLE BY HAND. (Keep shaft well lubricated with appropriate lubrication through fitting provided.)

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FAX: 860-482-8435

VARIABLE CONTROL HEAD MODELS 200AV, 220TV

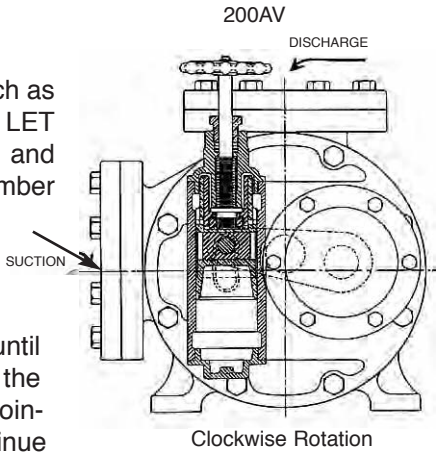
The Variable Volume Control Head mounted on a standard Tri-Rotor pump body allows for both automatic and/or manual changes in the flow rate of the pump. The automatic response occurs with changes in the operating pressure of the system, causing a spring-loaded hydraulic control mechanism to adjust internally, the stroke of the pump. By using flow controls, the operator can make manual adjustments to increase or decrease the discharge rate as desired.

MANUAL AND VERNIER FLOW CONTROLS

Two flow controls are available: The Manual Flow Control (MFC) for rough adjustments, or Vernier Flow Control (VFC), which is graduated for fine setting and metering. These enable the operator to vary the discharge rate infinitely from 100% down to zero without stopping the pump or changing speed. The plunger under the control stem and control lever assembly fix the stroke length, i.e. displacement of the pistons.

TO ADJUST CONTROL SPRING TENSION

(3 STEPS)



STEP 1 - STOP PUMP. Unbolt lettered spring cap and insert spring adjusting wrench as shown. Pull wrench toward "increase" and remove pawl pin. DO NOT LET WRENCH GET AWAY. NOTE alignment of holes between pawl plate and underlying top spring plate. Unwind to release spring tension, counting number of top spring plate holes passing hole originally containing pawl pin.

STEP 2 - To reset, pull wrench in direction of "increase" (note arrows on plate) until the spring begins to tighten against the control lever assembly. Note first coinciding set of holes. Thereafter, continue turning wrench until second top spring plate hole is seen. Insert pawl pin to lock top spring plate in this position. Pump will now develop approximately 35 PSI when running against a closed discharge line.

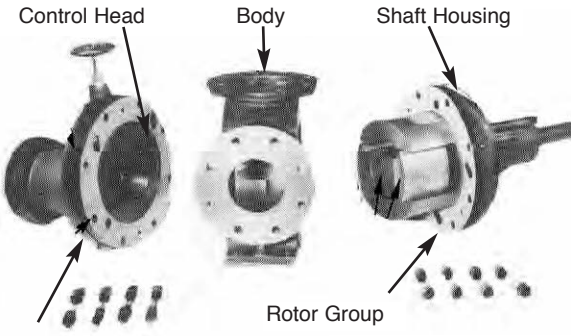
STEP 3 - For greater pressure, turn wrench to higher hole position. Each hole represents 20 PSI. DO NOT EXCEED 6 holes.

CAUTION - Spring adjusting wrench is designed to bend if operator exceeds the allowable tension.

TO REVERSE DIRECTION OF ROTATION

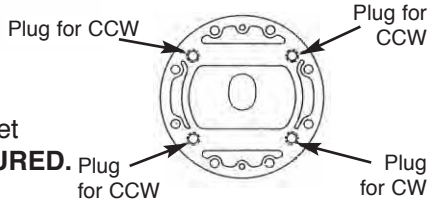
(6 STEPS)

CAUTION - After reversing rotation, variable head no longer automatically reduces discharge rate. A relief valve should be installed in the discharge line. For automatic operation, order a complete head of opposite rotation from the factory.



STEP 1 - Release spring tension as described above.

STEP 2 - Unbolt control head and remove together with pressure control plate and gaskets as one unit (pictured). Make sure gaskets are not damaged.



STEP 3 - Unbolt shaft housing and remove together with rotor group and gasket as one unit. **THIS LEAVES PUMP IN THREE SECTIONS AS PICTURED.**

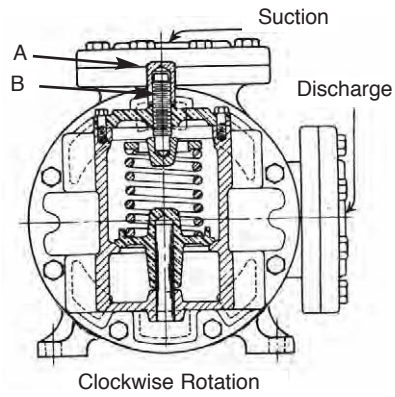
STEP 4 - Turn body "about face" and switch dowel pins.
STEP 5 - Bolt the three sections back together, making sure the shuttle pin enters the bore of the shuttle.
STEP 6 - Reverse the wiring to run motor in opposite direction. N**OTE:** Variable head no longer automatically reduces discharge rate. Refer to caution above.

PH: 860-482-8581
FAX: 860-482-8435

BYPASS HEAD MODELS 200AX, 220TX

This Tri-Rotor pump model has an integral dash pot relief valve in the head. The standard spring can be set up to 50 PSI at which setting it will bypass full volume; the heavy-duty spring can be set up to 100 PSI.

220TX



TO ADJUST BYPASS RELIEF PRESSURE

Remove hexagonal cap (A) and loosen locknut. Turn adjusting screw (B) in to increase pressure and out to decrease pressure.
Tighten locknut and replace hexagonal cap, making sure copper gasket is in place.

TO REVERSE DIRECTION OF ROTATION 200AX, 220TX

(5 STEPS)

CAUTION: After reversing rotation, bypass relief valve no longer functions. A relief valve should be installed in the discharge line. For automatic operation, order from the factory a complete head of opposite rotation.

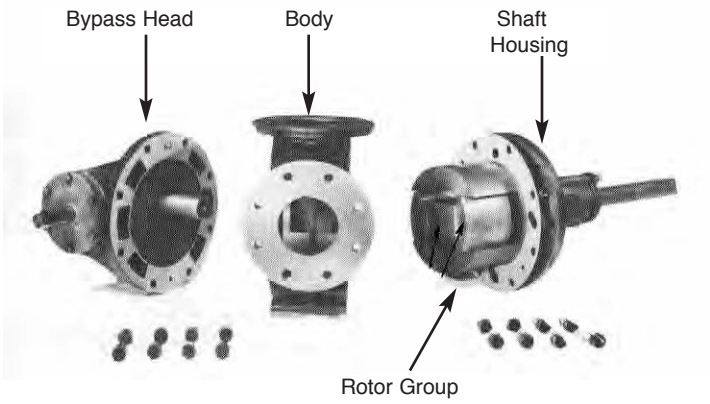
STEP 1 - Unbolt bypass head and remove with bypass head gasket as one unit, making sure gasket is not damaged.

STEP 2 - Unbolt shaft housing and remove together with rotor group and gasket as one unit.
THIS LEAVES THE PUMP IN THREE SECTIONS AS PICTURED.

STEP 3 - Turn body “about face” and switch dowel pins.

STEP 4 - Bolt the three sections back together, making sure the shuttle pin enters the bore of the shuttle.

STEP 5 - Reverse wiring to run motor in opposite direction.
NOTE: Bypass relief valve will not function. Refer to caution above.



SOLID HEAD MODELS 200A, 220T

The Model **200A, 220T** has a solid head with the shuttle pin set in a fixed position to give constant volume for simple transfer service. A relief valve should be installed in the discharge line for protection.

TO REVERSE DIRECTION OF ROTATION 200A, 220T

(5 STEPS)

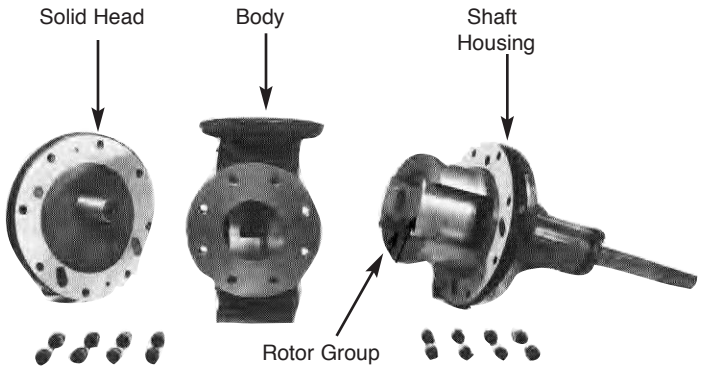
STEP 1 - Unbolt solid head and remove with head gasket as one unit, making sure gasket is not damaged.

STEP 2 - Unbolt shaft housing and remove together with rotor group and gasket as one unit.
THIS LEAVES PUMP IN THREE SECTIONS AS PICTURED.

STEP 3 - Turn body “about face” and switch dowel pins.

STEP 4 - Bolt the three sections back together, making sure the shuttle pin enters the bore of the shuttle.

STEP 5 - Reverse wiring to run motor in opposite direction.



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FAX: 860-482-8435

SERIES 200, 220 PUMPS

RATED 200 GPM @ 430 RPM

MAXIMUM RECOMMENDED PUMP SPEEDS FOR VARIOUS VISCOSITIES

SERIES 200, 220

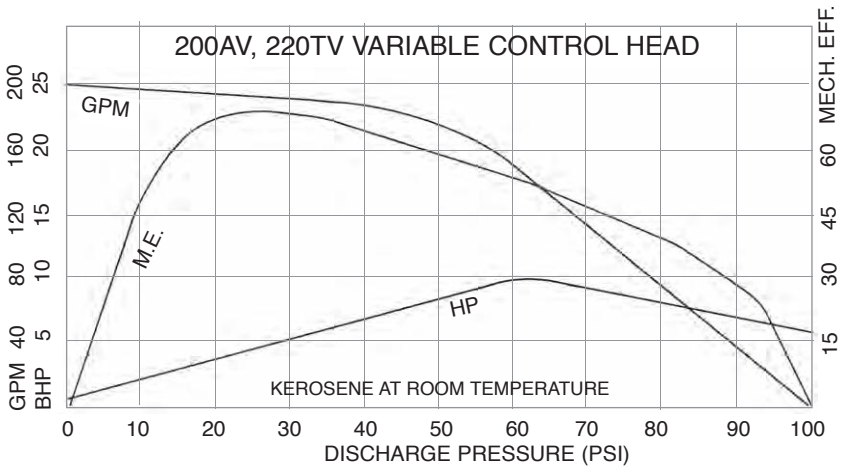
Rating Displacement Factor Port Size	200 GPM @ 430 RPM 46.5 GPM/100 Revs. 4" Flanged		
SSU / CPS	RPM	**GPM**	Suction
40 / 4	520	**240**	4
100 / 20	520	**240**	4
400 / 78	445	**205**	4
600 / 125	435	**202**	4
800 / 165	430	**200**	4
1,000 / 200	425	**197**	4
1,600 / 335	410	**190**	4
2,000 / 410	405	**188**	4
3,000 / 620	390	**181**	4
5,000 / 1,060	370	**172**	4
8,000 / 1,700	345	**160**	4
9,000 / 1,900	335	**156**	4

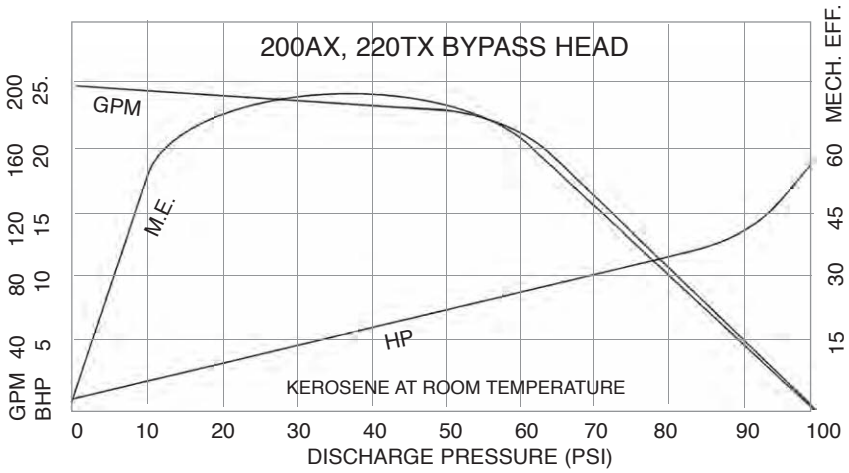
For Viscosities Below Pump Must Have Relieved Rotor Group

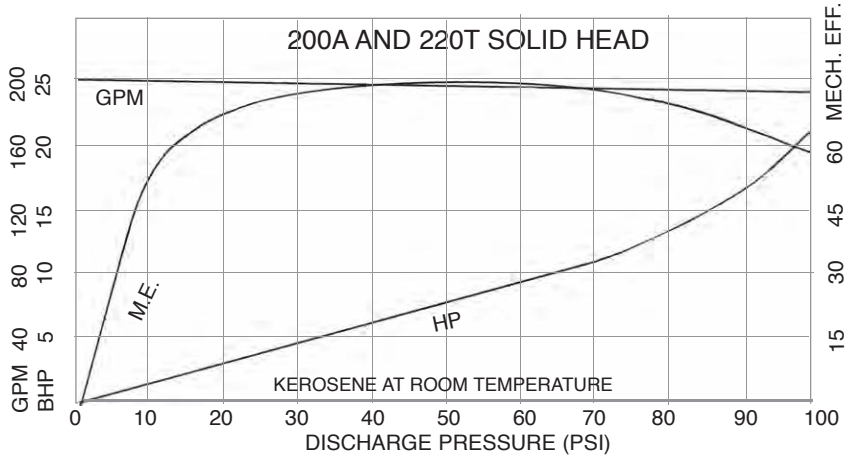
(For Sticky, Tacky Fluids)

Port Size	4" Flanged		
10,000 / 2,150	330	**153**	4
15,000 / 3,100	300	**140**	4
20,000 / 4,250	275	**128**	4
30,000 / 6,500	255	**118**	6
40,000 / 8,610	210	**98**	6
50,000 / 10,800	185	**86**	6
75,000 / 16,210	150	**70**	6
100,000 / 21,625	125	**38**	6

GENERAL RULE: Viscous fluids which retain their "slipperiness" or which readily thin out with slight temperature increase or agitation do not require a relieved rotor group.







CAUTION: Suction piping diameter and length must be separately determined, regardless of pump port size, where (1) volatile liquids or (2) viscous pumpages are concerned. The sizes shown in the above charts are for suction lines no longer than 10 feet and containing no more than 2 pipe fittings.

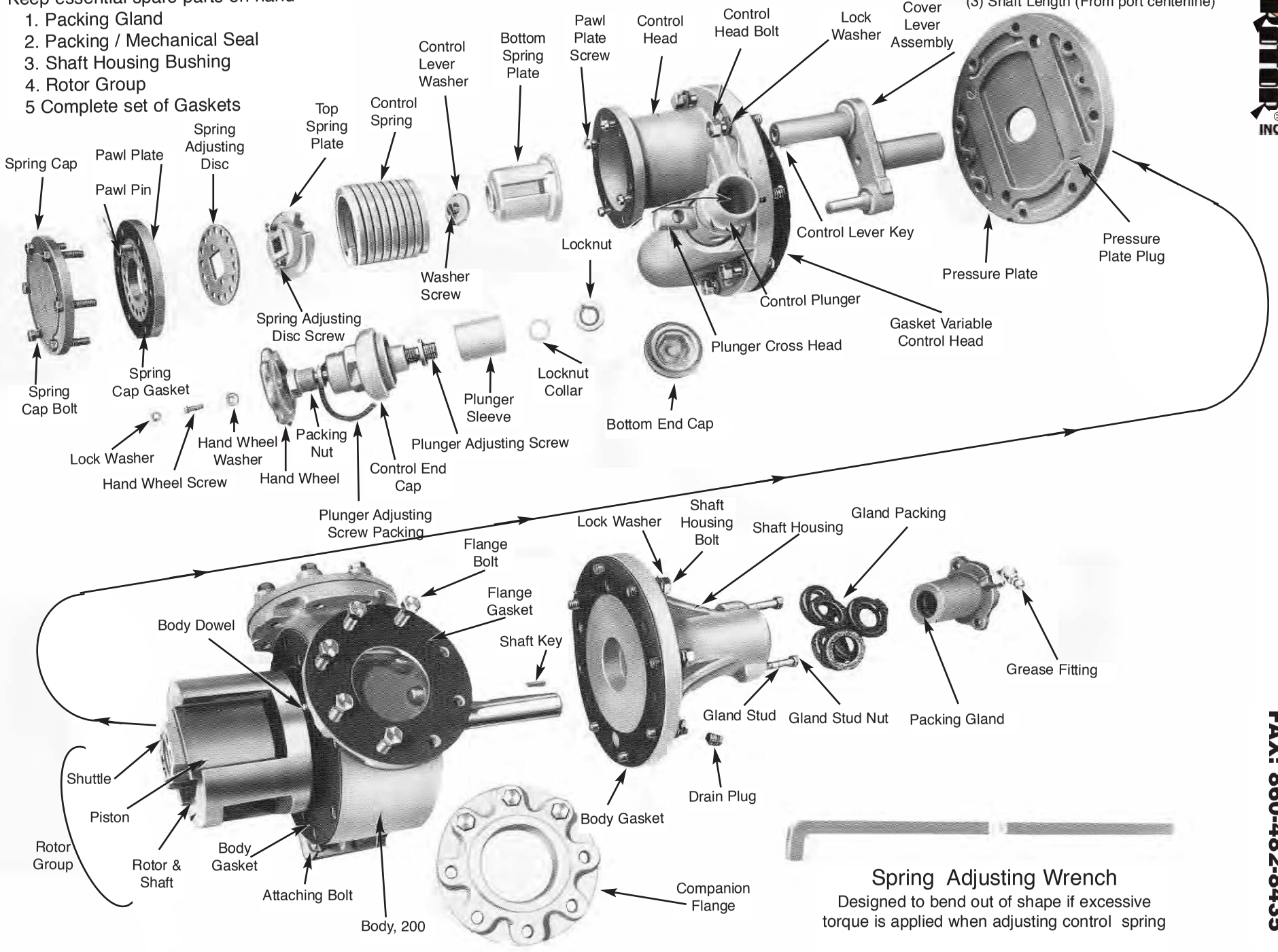
TROUBLESHOOTING GUIDE

TROUBLE	TYPE OF PUMP VARIABLE HEAD	BYPASS HEAD	SOLID HEAD	LOOK FOR
NO FLOW	●	●	●	CW pump running counter clockwise or visa versa (1)* Motor wiring reversed Piping to wrong ports
	●	●	●	Discharge head too high Piping too small, too long (4)* Viscosity too high (4)*
	●			Flow control turned down to zero
	●			Pawl Pin missing Control Spring - not adjusted - wound backwards - distorted - broken out of top or bottom spring plates
		●		Relief Valve Spring - not adjusted - not in correct position (3)* spring broken
	●			Plunger frozen in bottom position (2)* - corroded parts - pumpage shear sensitive - dirt accumulation preventing movement
		●		Relief Valve - not fully seated (3)* - stuck on valve guide pin - needs lapping into seat - spring adjusting plate missing
	●	●	●	Inadequate Priming Conditions such as - suction line air leak - foot valve stuck - lift too great - altitude too high - vapor lock
	●	●	●	Rotor Group Worn: Mechanical seal worn or broken
CAVITATING, VIBRATING, HIGH AMP, DRAIN	●	●	●	Starved Suction Line Due To - suction line restricted - viscosity too great for piping - RPM too high for viscosity (4)*
PUMP RUNNING HOT	●	●	●	Packing too tight (1)* Misaligned pump (1)* Insufficient lubrication of shaft (1)*
	●	●	●	Too long running in full bypass cycle
	●	●	●	Overspeeding: (4)* Cavitation
PUMP FROZEN CAN'T TURN SHAFT	●	●	●	Packing too tight (1)* Misalignment (1)* Obstruction in rotor group - rotor group part broken Rusted Parts: blush rust causing parts to seize together
	●	●	●	Pumpage - shear sensitive - congealed - carmelized - solidified Temperature of all bronze or bronze-fitted pump exceeding 140°F, Rotor group not relieved
NOISY PUMP	●	●	●	Cavitation Worn rotor group Air leak into suction line
	●	●		Plunger or Valve bouncing due to - suction line restriction - relief valve in discharge line reacting with spring setting - Piping Resonance
EXCESSIVE LEAKAGE FROM PACKING GLAND	●	●	●	Packing Nuts incorrectly adjusted Packing worn Mechanical Shaft Seal worn or broken Shaft scored
REDUCTION OF FLOW OR PRESSURE	●			Pawl Pin broken Control Spring setting incorrect (2)* Control Plunger stuck (2)*
		●		Bypass Spring setting incorrect (3)* Valve unseated or worn (3)*
	●	●	●	Pump worn Restriction or too high viscosity in suction line (4)*
PREMATURE WEAR: SHORT PUMP LIFE:	●	●	●	Misalignment - end or side thrust on shaft (1)* Packing too tight or adjusted incorrectly (1)* Dirty or abrasive pumpage Running pump dry - repeated suction lift Overspeeding (4)* Non-lubricating pumpage operating above 30 PSI and 350 RPM
	●			Flow control set below 25% capacity for too long a period Suction line restricted causing plunger "bounce"
RAPID WEAR OF PINIONS	●	●	●	Misalignment - excessive side thrust on gear Pressure angle not same as gear

*** Numbers in parenthesis pertain to page numbers where more information can be found.**

WHEN ORDERING PARTS ALWAYS GIVE:
(!) Pump Serial Number
(2) Rotation of Pump (CW or CCW)
(3) Shaft Length (From port centerline)

AVOID SYSTEM DOWN TIME
Keep essential spare parts on hand
1. Packing Gland
2. Packing / Mechanical Seal
3. Shaft Housing Bushing
4. Rotor Group
5 Complete set of Gaskets



Spring Adjusting Wrench

Designed to bend out of shape if excessive torque is applied when adjusting control spring

PH: 860-482-8581
FAX: 860-482-8435

TRI-ROTOR® INC

WHEN ORDERING PARTS ALWAYS GIVE:
(1) Pump Serial Number
(2) Rotation of Pump (CW or CCW)
(3) Shaft Length (From port centerline)

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INTERCHANGEABLE PARTS FOR PUMP SERIES 200 AND 220

NOTE: Always give pump serial number when ordering parts


GJ424


J434


GJ640


J427


J4464 (Series 220 - Top Suction)


J472


J470

J460


GJ425


J441


J30-267


J474


J471

J457

J50-43


GJ3063


J435


J438


J447


J428
J639


J422 (Series 200)

CAUTION: Part numbers under pictured part represent examples only. For exact identification of required part for your pump select part number from list below.

BODY PARTS

Part No.	Part Name	
J30-267	Alemite Grease Fitting	
J50-43	Gland Stud Nut	2 / set
J100-50	Drain Plug	2 / set
J422	**Body 200 4" Ports**	
GJ424	Shaft Housing*	
GJ425	Gland, Packing /Fitting (Bronze)	
J434	**Shaft Housing Bushing (Bronze)**	
J435	Gasket, Body	
J438	Gasket Flange	2 / set
J441	**Packing Standard**	**set**
J447	4" Companion Flanges	2 / set
J448	Body Dowel	2 / set
J457	Gland Studs	2 / set
J460	Shaft Key	
J470	Lockwasher	8 / set
J471	Shaft Housing Bolt	8 / set
J474	Flange Bolt	6 / set
J474	Attaching Bolt	4 / set
J741	Packing, Food	4 / set
J4464	Body 220 (Top Suction) 4" Ports	
J6015	Packing, Teflon	set
J6051	Packing, Teflon Impregnated	set
GJ6239	**Gland, Packing/Fitting (Bronze Bushed)**	
J6263	Packing, Zero Leak #3	set
J6267	Packing, Zero Leak #30	set

ALL IRON PARTS

GJ3175	Gland, Packing / Fitting (Iron)
J4240	Shaft Housing Bushing (Iron)

STEAM JACKETED PARTS

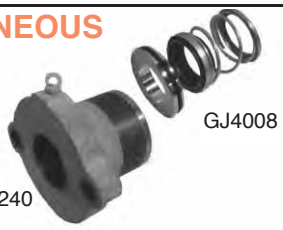
J1212	Heat Packing (set)
J1228	Gasket, Body (HR)
GJ3063	Shaft Housing*

ROTOR GROUP PARTS

Part No.	Part Name	
J427	Piston Iron	
J6117	Piston Bronze	
J428	Shuttle Bronze	
GJ428	Shuttle Bronze/ Bronze Bushed	
J639	**Shuttle Iron**	
GJ639	Shuttle Iron/ Bronze Bushed	
GJ4052	Shuttle Iron / Carbon Bushing	
GJ426	Rotor & Shaft Bronze**	
GJ640	**Rotor & Shaft Iron****	
GJI-459	Rotor Group Iron	T,M or BD
GJB-459	Rotor Group Bronze	21"
GJI-482	Rotor Group Iron	Old Style
GJB-482	Rotor Group Bronze	MO or BD 25"

MISCELLANEOUS


GJ481


GJ4008

GJ6240

GJ481	Outboard Bearing Complete
GJ4008	Mechanical Seal, Type 1
GJ6240	Gland, Mechanical Seal/Fitting/Bronze Bushed
GJ6241	Gland, Mechanical Seal/Fitting/All Iron

ADVISE WHEN FOLLOWING PARTS ARE RELIEVED
Shuttle
Piston
Rotor and Shaft
Rotor Group

* Shaft Housing furnished with Bushing, and Drain Plug
** Furnished with following shaft lengths: T or M 21", MO or BD 25"
NOTE: ALWAYS GIVE PUMP SERIAL NUMBER WHEN ORDERING PARTS

200
220

PH: 860-482-8581
FAX: 860-482-8435

200AV AND 220TV VARIABLE CONTROL HEAD PARTS

NOTE: Always give pump serial number when ordering parts


J423CW
J433CCW


J432


J709
J606


GJ622


J443CW
J462CCW


J449CW
J451CCW

CAUTION: Part numbers under pictured parts represent examples only. For exact identification of required part for your pump select part number from list below.


J468
J50-60


J442


J6095


J454
J465
J446


J448

J463
J470
J467


J435
J1228(HR)


J436
J1229(HR)


J430


J445

J466


J453


GJ429

J50-34

NOTE: WRENCH J469 DESIGNED TO BEND OUT OF SHAPE IF EXCESSIVE TORQUE IS APPLIED WHEN ADJUSTING CONTROL SPRING.


J469


J6269


J437

200AV AND 220TV VARIABLE CONTROL HEAD PARTS

Part No.	Part Name	
J50-34	Control Lever Key	
J50-60	Spring Cap Bolt	6/set
J423	Control Head CW**	
GJ423	Control Head Complete CW	
GJ429	**Control Lever Assembly**	
J430	Spring Cap	
GJ432	Pressure Plate / Plugs*	
J433	Control Head CCW**	
GJ433	Control Head Complete CCW	
J435	Gasket Body	
J436	**Gasket Control Head**	
J437	**Gasket Spring Cap**	
J442	Bottom End Cap	
J443	Control Spring (Std.) CW 100 PSI	
J445	Pawl Plate	
J446	Pawl Pin	
J448	Control Head Dowel Pin	2/set
J449	Top Spring Plate CW	
J451	Top Spring Plate CCW	

Part No.	Part Name	
J453	Spring Adjusting Disc	
J462	Control Spring (Std.) CCW 100 PSI	
J463	Control Head Bolt	8/set
J464	Control Lever Washer	
J465	Control Lever Washer Screw	
J466	Pawl Plate Screw	4/set
J467	Spring Adjustment Disc Screw	2/set
J468	Plunger Cross Head	
J469	Spring Adjusting Wrench	
J470	Lockwasher	8/set
J606	Control Plunger (Bronze)	
J1228	Gasket, Body (HR)	
J1229	Gasket, Control Head (HR)	
GJ1764	Control Head Complete/MFC CW	
GJ1765	Control Head Complete/MFC CCW	
J4054	Control Plunger Iron / ENP	
J4938	Bushing Bronze** (Not Shown)	
J6095	Top End Cap	
J6251	Bushing Iron** (Not Shown)	
J6269	**Bottom Spring Plate (Universal) CW/CCW**	

MANUAL FLOW CONTROL PARTS

J538	Handwheel	
J605	Manual Flow Control End Cap	
GJ608	Plunger Adjusting Screw Assembly	
GJ622	Manual Flow Control Complete	
J1195	Packing, Adjusting Screw (MFC)	set

VERNIER FLOW CONTROL PARTS

GJ4036	Vernier Flow Control Complete	
J4037	Packing, Adjusting Screw (VFC)	set

* Specify whether CW and CCW Pump
** Includes J4938 Bronze Bushing or J6251 Iron Bushing

PH: 860-482-8581
FAX: 860-482-8435

BYPASS HEAD PARTS AND SOLID HEAD PARTS FOR SERIES 200 AND 220

200AX AND 220TX BYPASS HEAD PARTS

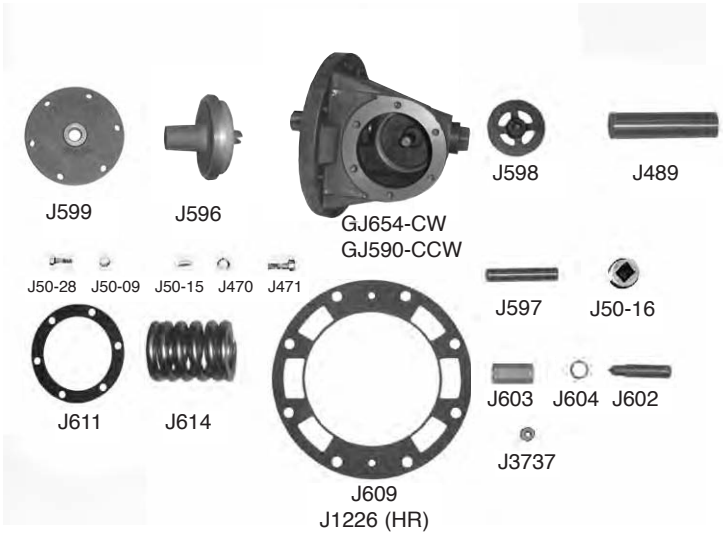
NOTE: Always give pump serial number when ordering parts

Part No	Part Name	
J50-09	Lockwasher	6/set
J50-15	Bypass Head Dowel Pin	2/set
J50-16	Pipe Plug	
J50-28	End Cap Bolt	6/set
J470	Lockwasher	8/set
J471	Bypass Head Bolt	8/set
J489	Shuttle Pin	
GJ590	Bypass Head / Pins CCW	
J596	**Valve (Bronze)**	
J597	Valve Pin	
J598	Spring Adjusting Plate	
J599	Adjusting Screw End Cap	
J602	Spring Adjusting Screw	
J603	Adjusting Screw Cap	
J604	**Gasket, Screw Cap**	**2/set**
J609	**Gasket, Bypass Head**	
J611	**Gasket, End Cap**	
J614	Valve Spring (Std) 50 PSI	
GJ654	Bypass Head / Pins CW	
J1798	Valve Spring (HD) 75 PSI	
GJ1822	Bypass Head Complete CW*	
GJ1823	Bypass Head Complete CCW*	
J4053	Valve (Iron)	

CAUTION: Part numbers under pictured parts represent examples only. For exact identification of required part for your pump select part number from list below.

STEAM JACKETED PARTS

J1226	Bypass Head Gasket(HR)
GJ3060	Bypass Head/Pins CCW
GJ3061	Bypass Head/Pins CW
GJ6150	Bypass Head Complete CW*
GJ6151	Bypass Head Complete CCW*



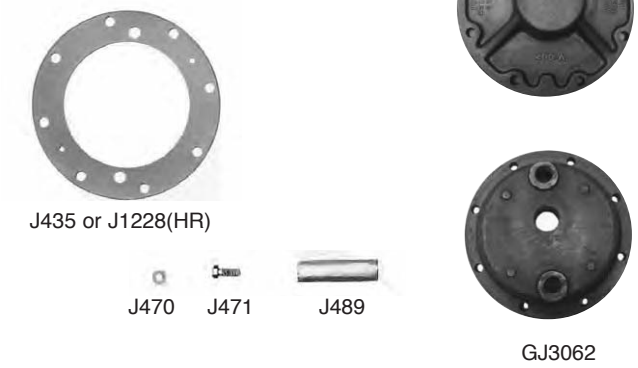
200A AND 220T SOLID HEAD PARTS

SOLID HEAD PARTS

Part No.	Part Name	
J50-15	Solid Head Dowel Pin	2 / set
J435	**Gasket, Solid Head**	
J470	Lockwasher	8 / set
J471	Solid Head Bolt	8 / set
GJ478	**Solid Head/Pin CW or CCW**	
J489	Shuttle Pin	
GJ6223	Solid Head / Offset Pin CW or CCW	

STEAM JACKETED PARTS

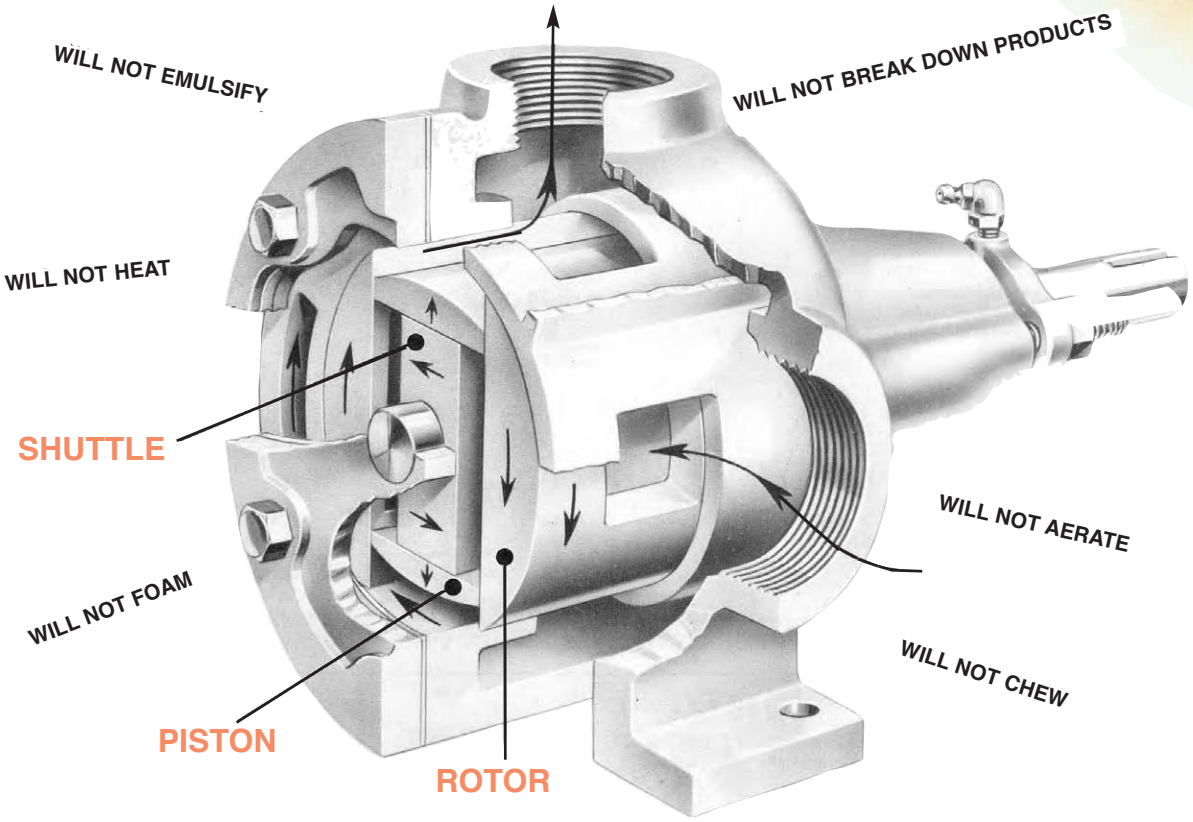
J1228	Gasket, Solid Head (HR)
GJ3062	Solid Head / Pin CW or CCW



* Specify whether Standard or Heavy-Duty Valve Spring

NOTE: ALWAYS GIVE PUMP SERIAL NUMBER WHEN ORDERING PARTS.

PUMPING PRINCIPLE



The mechanical principle of the Tri-Rotor Pump is explained as follows and incorporates the pump casing, the rotor, the piston, and the shuttle.

The rotor is a liquid-tight fit within the casing, with the piston and shuttle being equally liquid-tight in their fit to each other and to the rotor. In operation, the piston slides back and forth in the rotor slot, drawing liquid from one end of the rotor slot and discharging from the opposite end. At the same time, the shuttle slides back and forth within the piston slot (picture), drawing liquid through one rotor port, which functions as a rotating valve, channels the liquid from the intake port around through the casing and out the discharge port.

This action, while rotary, actually accomplishes the same type of pumping principle as a direct-acting piston pump. There are, therefor, two direct-acting pistons pumping through two cylinders, being valved by the rotary action of the rotor.

The reciprocating piston action is accomplished by the center bearing of the shuttle which rotates on a shuttle pin eccentric to the rotor shaft. Since the rotor is concentric with the shaft, and the shuttle bearing is eccentric to the shaft, a reciprocating action of the piston and shuttle within their respective cylinder slots is created by revolving the rotor. Four overlapping strokes of the piston and shuttle for each revolution of the rotor create a smooth discharge with pulsation reduced to a minimum. An extremely high volumetric efficiency is obtained because of the piston-type action and the liquid-tight fit of the moving members.

Highly viscous materials are easily handled with exceptionally high volumetric efficiency while thin, volatile materials are handled with little loss in slippage through the pumping members. Materials critical to agitation are handled with little or no mechanical beating, since the product is carried through the pump by piston action without being subjected to the combination centrifugal and gear or paddle agitation.

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