



RADIAL PISTON AIR MOTORS

Definition: A radial piston motor with 4 or 5 pistons that turns a shaft using compressed air as a power source.

SAFETY EXPLANATIONS

Two safety symbols are used to identify any action or lack of action that can cause personal injury. Your reading and understanding of these safety symbols is very important.



DANGER - Danger is used only when your action or lack of action will cause serious human injury or death.



WARNING - Warning is used to describe any action or lack of action where a serious injury can occur.

IMPORTANT - Important is used when action or lack of action can cause equipment failure, either immediate or over a long period of time.



WARNING: It is the operator's responsibility to read and understand the following safety statements,

- Only qualified operators should install, operate, adjust, maintain, clean, repair, or transport this machinery.

- These components are designed for general use in normal environments. These components are not specifically designed for lifting and moving people, agri-food machinery, and certain types of mobile machinery or special work environments such as: explosive, flammable or corrosive. Only the user can decide the suitability of this machinery in these conditions or extreme environments. T.S.A. will supply information necessary to help make these decisions.

These instructions are intended for end-user application needs. Most problems with new equipment are caused by improper operation or installation. Detailed service repair instructions or parts lists are listed in this document.

SAFETY PRECAUTIONS



WARNING

GENERAL OPERATION







- All WARNING statements must be carefully observed to help prevent personal injury.
- Before operating the motor, all air connections must be tightened with the proper tools. Do not over tighten. Consult manufacturer of parts (fitting, hoses, etc.) for proper installation instructions. Connections should only be tightened securely and leak-free. Over tightening can cause premature thread failure or high pressure fittings to split at pressures lower than their rated capacities.
- Should an air hose ever rupture, burst, or need to be disconnected, immediately shut off the air supply and release all pressure. Never attempt to grasp a leaking pressurized hose with your hands. The force of escaping air could cause serious injury.
- Do not subject the air lines to potential hazard such as fire, sharp surfaces, extreme heat or cold, or heavy impact. Do not allow the air line to be altered or kink, twist, curl, crush, cut, or bend so tightly that the air flow within the hose is blocked or reduced. Periodically inspect the air line for wear, because any of these conditions can damage the line and possibly result in personal injury.
- Do not use the air line to move attached equipment. Stress can damage air lines and possibly cause personal injury.
- Air line material and coupler seals must be compatible with the motor used. Air lines also must not come in contact with corrosive materials such as creosote-impregnated objects and some paints. Consult the manufacturer before painting a line. Air line deterioration due to corrosive materials can result in personal injury. Never paint the couplers.
- Inspect machine for wear, damage, and correct function before each use. Do not use machinery that is not in proper working order, but repair or replace it as necessary.
- Modification of a product requires written T.S.A. authorization.
- Use only components with the same pressure rating when assembling a system or machine.

Motor

- Do not exceed the air pressure rating noted on the motor data plate. Creating pressure beyond the rated pressure can result in personal injury.

Recommended Lubricants

For operation at normal ambient temperature 33 to 90° F (0 to 32° C)

	Crankcase		Airline			Crankcase		Air line	
	Shell	Tellus 100	Tellus 37			Regent	Regal PE.RO	Rando 'A'	
	B.P.	Energol HL175	Energol HLP65			Castrol	Hyspin 175	Hyspin 70	
	Esso	Nuto H.64 Heavy	Fanox 38 Heavy No. 1			Mobil	D.T.E. Extra	Almo Oil	

For extremes of ambient temperatures consult the manufacturers

Approximate Capacity

	Horizontal		Vertical	
	ml	in3	ml	in3
MP165	75 ml	4.5	150 ml	9.1
MP400	300 ml	20.1	450 ml	27.5
MP850	350 ml	21.3	600 ml	36.6
MP1450	500 ml	30.5	940 ml	57.3
MP2250	1.1 L	67	2.1 L	128
MP3000	1.1 L	67	2.1 L	128



WARNING: For operation in extreme ambient temperatures, consult T.S.A.

MAINTENANCE

Air Supply

The air filter should be drained regularly and examined for clogging of the element.

The air line lubricator should be replenished as required and set to give

3-4 drops per minute MP165

4-5 drops per minute MP400

5-6 drops per minute MP850

6-8 drops per minute MP1450

6-8 drops per minute MP2250

8-10 drops per minute MP3000

Double the above drip rate if intermittent operation.

INSTALLATION & SET-UP

Note: Numbers in parenthesis refer to exploded view drawing on page 8.

Mounting Positions

The motor is normally mounted in a horizontal position with the filler/breather plug towards the top (Fig. 1). It may also be mounted with the shaft vertically downwards (Fig. 2)/ As supplied the motors have been run up and tested using protective oil and then drained for transit. **It is vital that each motor is mounted in the correct orientation (vertically or horizontally) and re-filled to the correct oil level as shown below.** The MP165 — MP850 motors have a dipstick for vertical mounting (fig. 2) and the lower mark on this dipstick provides the oil level. Oil levels are achieved on motors in the horizontal position by filling to the plugs marked part 60 fitted in housing 3 (MP165 to MP1450) and plug (26) fitted to the top face of engine case (27) (MP2250 and MP3000). The MP1450, MP2250 and MP3000 motors have a combined horizontal drain and vertical level plug (add oil until this level has been reached) (26).

To fill motors with oil remove the combined breather and oil filler plug (46). Ensure breather plug is in the vertical position. It may be necessary to fit an elbow between the breather plug and the motor (see Fig. 2).



Note: Damage by lack of lubrication will occur if motors are mounted shaft up or at an angle Please consult T.S.A. for other mounting options.



Note: When first running the motor some light oil should be injected into the inlet connection to ensure adequate lubrication until the airline lubrication is established.

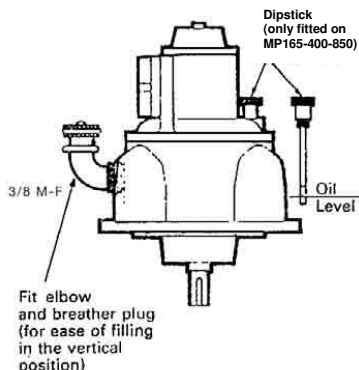
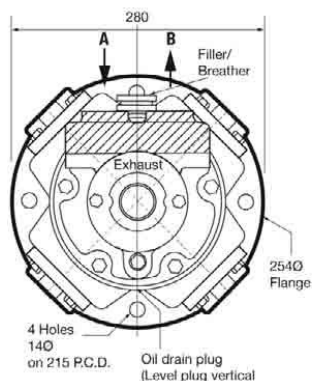


Fig. 2

Shaft rotation as shown with inlet at 'A'.

Reverse rotation is obtained with inlet at 'B'.



WARNING: If improperly used, pressurized equipment can be potentially hazardous. Therefore:

- Air line connections must be securely fastened before building pressure in the system.
- Release all system pressure before loosening any air line connections in the system.

Air Inlet

The motor is normally supplied with the inlet/exhaust adaptor plate (72). All motors are reversible.

Air Supply

Maximum Working Pressure 8 bar-120 psi.

The air supply must be clean and free from moisture. An air line filter and mist lubricator should be incorporated in the air supply line, located immediately before the motor. If the rated performance of the motor is to be obtained, all valves and pipe work must be of adequate size **Note: Consult factory for diameter sizes, however never use pipe's diameter smaller than the motor's port diameter.** Valves should be sited as close as possible to the motor. For short pipe runs, e.g. up to 2 metres, the supply line should be the same size as the motor ports and larger for longer runs. The exhaust flow must be free of any restrictions; this is critical for the motor's operation.

INSTALLATION

Mount motor in operating position. Check oil level. Before connecting to the air supply blow out air lines to remove any loose scale, swarf or abrasive dust which may be present. **Remove and dispose the red plastic dust-caps and the 'O' ring seal (45).**

For unidirectional operation check the required direction of rotation and connect the air supply line to the appropriate port on the inlet/exhaust adaptor plate (72) leaving the other port open or pipe downwards if exposed to the atmosphere. The motor should not be allowed to race. Always operate within the catalogue speed curves.



WARNING: When first running the motor, some light oil should be injected into the inlet connection to ensure adequate lubrication until the air line lubrication is established.



Maintenance Lack of maintenance will shorten the life of the motor and could cause failure.

Motor

The oil level in the motor casing must be maintained. The frequency of replenishment will depend upon the application and usage. The motor case should be drained and refilled after 25 hours of initial running and every 200 hours thereafter or sooner if found necessary e.g. (contamination of oil by water from the air line.)

SERVICING

Disassembly Procedure

- Remove the motor from its operating position to a clean working surface ready for stripping. Prepare the motor for opening by externally cleaning the motor.
- Drain the oil from the motor casing by removing the drain plug (26).
- Disassembly and re-assembly will be simplified if the crankshaft (20 A/B) or output shaft (67) MP2250 and MP3000 is held vertically in a soft-jawed vice or supported on suitable packing to raise the shaft clear of the working surface.

Removal of Rotary Valve Housing Assembly

- Remove inlet/exhaust adaptor plate (72) or control valve (if fitted).
- Remove valve cover (51).
- Release bolts (38) and Rotary valve housing assembly (3) can be eased upward.
- On MP165 to MP1450 motors remove grub screw (49) together with the valve side balance weight (number 35).
- All motors — carefully remove rotary valve (2) from the housing (3). This is generally done from the inside outwards and inspect both the rotary valve and the housing for wear. The normal clearance at manufacture between these two components is .002-.003" (.05-.075). Excessive wear will cause air leakages and loss of efficiency of the unit.

Motors - MP165, MP400, MP850, MP1450

These units are of the king rod variety and again it is wise to slightly rotate the crankshaft (part no. 20A/B) in either direction to test any excessive wear on either the king rod bearing or the pivot pins (part no. 29).

Having first removed the outer spacing washer (31/34) withdraw pivot pins (part no. 29). This procedure is usually done with a bent rod withdrawing the pins from the inside outwards. Remove all cylinder cap bolts (part 37) and by pushing the queen rods (part 30) outwards the entire piston and rod assembly can be removed from the motor. Turn the motor unit over to extract the crank bearing or bearings (part no. 48). The main king rod (part no. 12) can then be lifted upwards and tilted over the top of the crankshaft. Remove the main king rod, piston and cylinder from the motor. Remove the output shaft circlip (14), spacer (15) and shims (16). Remove the countersunk bolts (52) holding the output flange (24A/B) on to the engine case (part no.27) can be removed.

Drift the crankshaft inwards from the flange plate (24A). To remove the outer shaft bearings (55 and 56) drift to their to their respective sides (needs to be removed from the inside out) as they are located inwardly on two circlips (part no. 18).

Motors - MP2250, MP3000

Remove bolts (58) holding the output shaft assembly. Remove bolts (57) and the output flange (24A/B). This will then expose the inside of the motor. Remove that cylinder, the retaining circlip and gudgeon pin. Push out from the piston and the entire assembly can be removed.

Repeat this procedure in turn until all the pistons and cylinders have been removed. On this motor the balance weight and crank assembly is built as one item and this can now be removed. Remove locking nut (22) and the tapered pin (21). Both balance weights (part no. 20A and 20B) can now be disengaged. This will expose the king rod and queen rod assembly. To remove the queen rod remove the pivot pin (29).

All Motors

Inspect for excessive clearance of the pivot pins (29) in queen rod (30) & king rod (12). Inspect the gudgeon pin in both the piston and all rods. Check for wear on the main crankshaft (20A, 20B) and on the main big end bearing (no. 48). Check for excessive wear in the cylinder bores, this can be checked by removing each compression ring (10) and pushing it into the cylinder bore (8). Bore wear will cause loss of power and inject high pressure air into the case & oil could be ejected from the breather plug (part no. 46). All other parts should be thoroughly cleaned and inspected for wear. Spare parts can be found from the list. The motor number and its code should be incorporated in any spares order.



WARNING: Each motor is supplied with a metal nameplate (Identification plate) located on the engine case (27) or rotary valve housing (3). Warranty will not be granted if the name late is removed.

ASSEMBLY PROCEDURE

The remaining build procedure is the reverse to initially dismantling. All parts should be clean and liberally coated with oil.



WARNING: When first running the motor, some light oil should be injected into the inlet connection to ensure adequate lubrication until the air line lubrication is established.

Motors - MP165, MP400, MP850, MP1450

Output shaft assembly. Ensure both circlips and bearing are fully home. Oilseal (19) lip must face inwards and be lubricated. MP1450 motor has also a spacer (47) fitted between bearings. Push crank shaft fully home and locate the spacer washer (15) and circlip (14). Check gap, shim up (16) for minimum end float. Fit new 'O' Ring seal (25) and output flange (24) to the engine case (27). Turn motor vertical (shaft downwards).

Crank Assembly Instruction for – RM110, RM210, and RM310

Fit the 3 queen rods (30) on to piston assembly (9) and assemble into the cylinder pot (8) complete with gasket (7). Fit piston assembly (9) on to the king rod (12) ensuring gudgeon pin clips are correctly positioned. (MP800 motor). Assemble a ring clamp (dimensions shown on the sketch provided on back page) on to the king rod piston.

Fit the crank spacer (13) to the crankshaft (20A/B). Rotate the crankshaft until the crankpin is in the vertical position (nearest the breather plug 46). Feed king rod (12) complete with its piston assembly through the aperture marked 'Z' on drawing. Twist and lift the rod over the end of the crank pin. Fit crank pin bearing or bearings. Feed the cylinder pot (8) complete with its gasket (7) on to the piston. The ring clamp is ejected inwards from the piston. Work clamp off sideways from the king rod. Bolt the cylinder pot into position and feed the remaining cylinders completely assembled through the various holes and locate the inner end of the connecting rods with the king rod fixing with pin (29). Rotate the motor 360 degrees to ensure correct fitting. Fit spacing washer (30/34) and refer to paragraph 10 for spacing the motor unit.

Assembly of 1450 Big End

Fit all connecting rods (30) & (12) on to gudgeon pins and pistons and using ring clamp assemble into cylinders. Ensure gudgeon pin clips are seated correctly. Rotate motor until crank is nearest to breather plug (46). Fit the crank spacer (13) push the piston to bottom dead center within the cylinder (8). Insert the king rod into the engine case (27) lifting and rotating the king rod (12) over the top of the crankshaft (20A/B). Bolt cylinder in position, fit the 2 crank bearings (48). Fit remaining cylinders/pistons and attach to king rod (12) with the pivot pin (29). Rotate 360 degrees to ensure parts are correctly fitted. Locate the spacing washer (31–34) and spacing as paragraph 10.

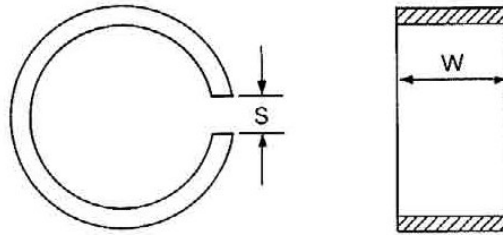
Valve Housing Assembly

This is reverse procedure to dismantling. Smear oil to external surface of valve (2) and to the bore of valve housing (3).

MP2250 and MP3000 motor only

Assemble the spacing washer (13) on to the crankshaft outer section locating the dowel pin (23). Assemble bearing (48) and the king rod (12). Assemble all four queen rods (part no. 30) into the king rod (12) locating with pivot pins (no. 29). Fit final location washer (13) to close the assembly. Ensure that the dowel pin (23) is fitted on to the inner balance weight (20 A/B). Mount or fit together and locate the 12 mm dia. holes. Once these holes are located, fit the locking dowel (21) and its nut can be assembled, Locate assembly into open engine case. Ensure each rod projects into its correct cylinder. Rotate the unit so that the main king rod comes to top dead center, fit the piston and gudgeon pin, ensure gudgeon pin circlip is correctly located. Fit gasket (7) to cylinder (8). Fit pistons into cylinder bore using a piston ring clamp. Bolt cylinder (8) on to engine case (27). Rotate the crank to the next top dead center position and repeat the procedure. Turn crank 360 degrees to check correct functioning. Fit gasket (28) and the output flange (24A/B). Turn motor over 180 degrees to allow the valve to be fitted. Lubricate Valve (2) & Inside Bore of Housing (3). Rebuild the valve assembly in the reverse order. Check it rotates freely. Fit valve assembly on to the motor ensuring the different size drive dowels (61) and (62) are located in the crank shaft.

PISTON RING CLAMP DETAILS



	W		S	
	mm	in.	mm	in.
MP165	13	(.5)	27	(1.0)
MP400	32	(1.25)	25	(1.0)
MP850	45	(1.75)	16	(.625)

Note: these items can be culled from an old cylinder (8)

Spacing MP165, MP400, MP800, MP1450 Motors

Please refer to (Fig. 3) Measure dimension (A) from the crank washer to the face of the engine case and also dimension (B) from the rotary valve face to the inside of the gasket. Select the correct shim washer from the list (31—34) to obtain clearance.

Rotate the crankshaft until the balance weight is at the bottom dead center position, rotate the rotary valve until the balance weight is at the bottom position. Assemble the valve housing (3) on to the engine case (27). Rotate the output shaft in both directions and viewing the rotary valve (2) through the exhaust cover (51) ensure that the valve is correctly following the output shaft direction, this checks that both crank and valve slot are correctly engaged.

Replace all drain plugs and refill with oil. Spray some light oil into the inlet and exhaust ports and connect the unit to a low pressure supply and allow the unit to run on the bench for a short period of time prior to refitting the unit into full service.

SPACING DIAGRAM

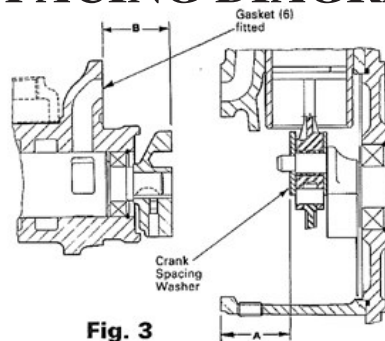


Fig. 3

Crank Spacing Washers

Fit spacing washer such that
 $A - B = 0.25 \text{ to } 0.50 \text{ mm}$
 (0.01" to 0.02") clearance

MP165	MP400	MP850	MP1450
1.85 (.073)	2.64 (.104)	3.24 (.128)	2.5 (.099)
2.03 (.080)	3.25 (.128)	3.66 (.144)	3.0 (.120)
2.34 (.092)	3.66 (.144)	4.06 (.160)	4.0 (.157)
2.64 (.104)			

Dimensions are in millimeters (and inches)

TROUBLE SHOOTING

The RM series motors are designed to perform at their rated capacities for long periods of time. Faults can develop for the following reasons:

(A) Lack of lubrication. This will lead to rapid wear, internal seizure, loss of power or excessive air leakage.

(B) Faults in the air supply system:

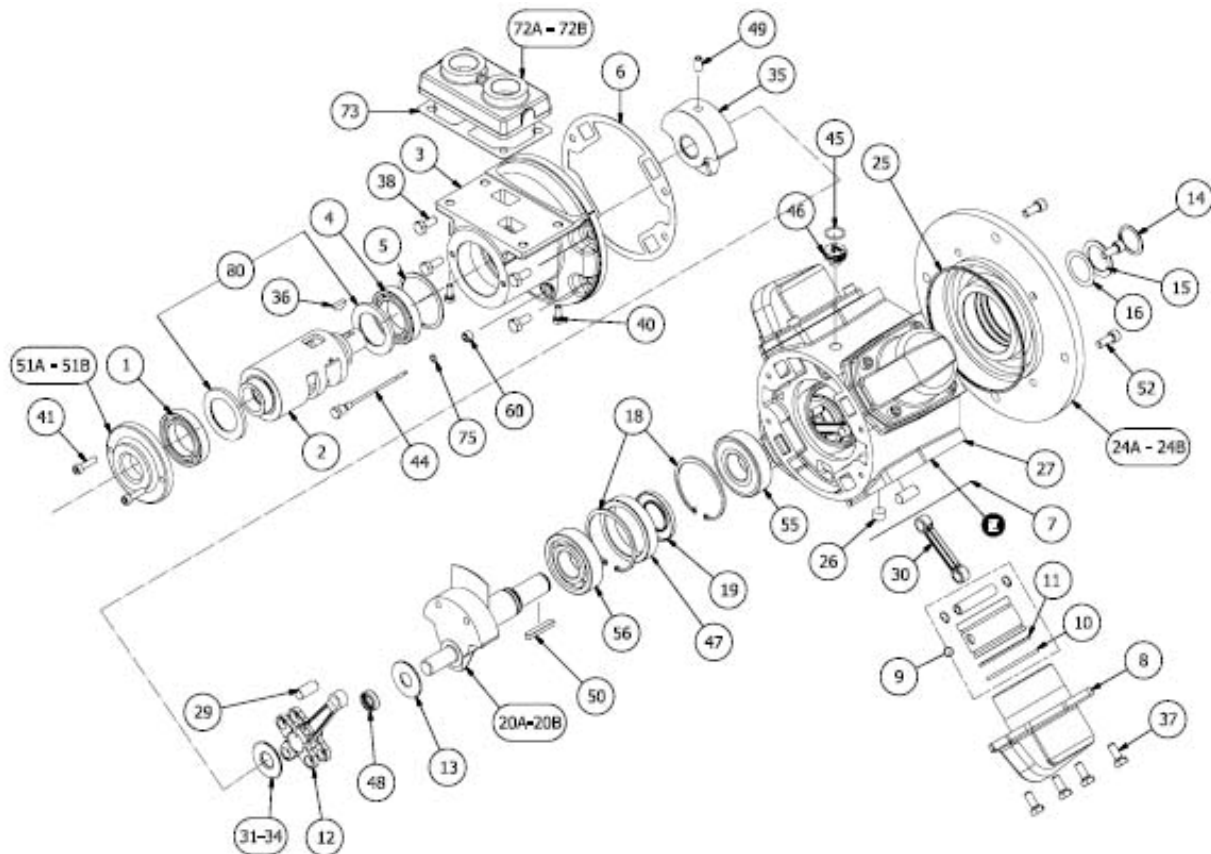
1. Failure to remove the plastic protective dust caps.
2. Insufficient air pressure at the motor caused by (a) supply pipe line or valve too small (b) if the exhaust is piped away excessive back pressure due to small bore pipes (c) compressor of insufficient capacity (d) clogged airline filter (e) the air pressure should remain at the required pressure when the motor is operating at full potential.

If the air pressure reduces considerably from the stationary to the rotating conditions then the supply line or the compressed air available is inadequate for the service operation of the motor.

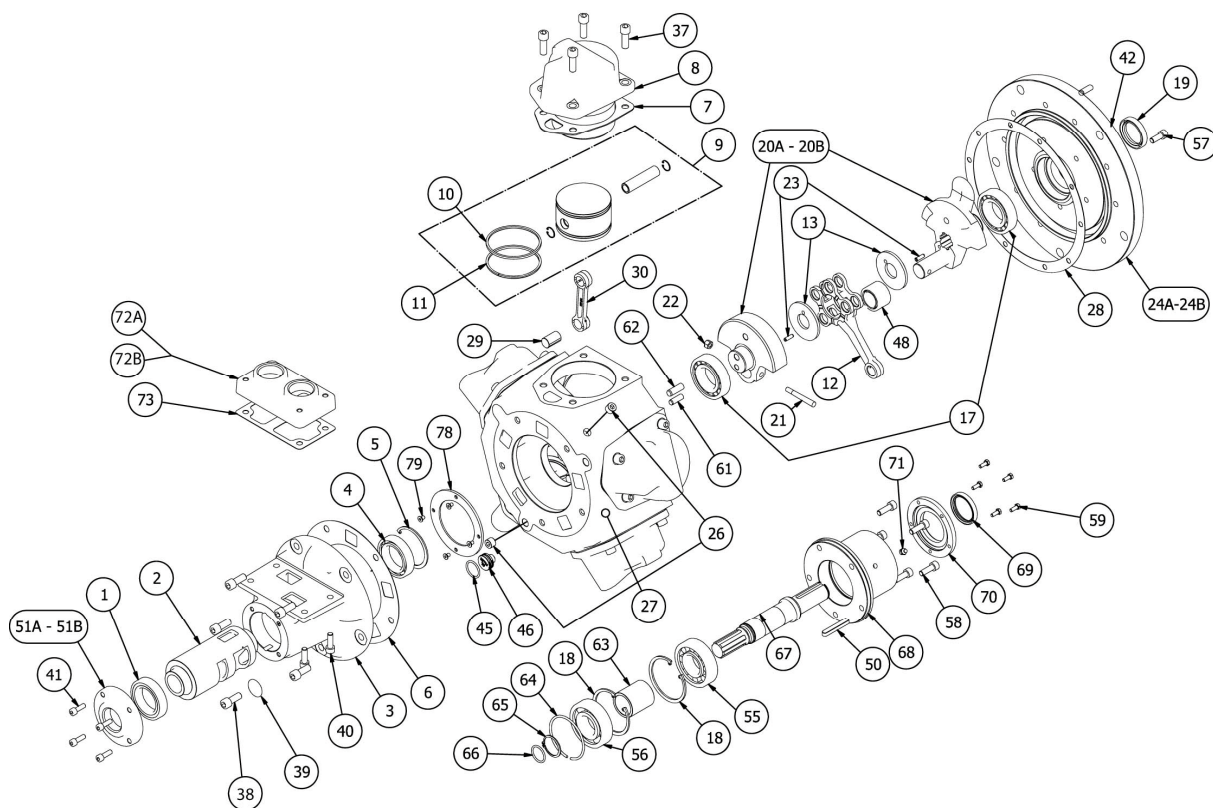
The motor should always be supplied with clean moisture-free and lubricated air. The better the quality of air, the less attention will be required to the motor unit.

MOTOR EXPLODED VIEWS

MP165-1450



MP2250 & 3000



PARTS LIST

Item	Description	No	165	400	850	1450	2250	3000
1	Rotary Valve Bearing (outer)	1	807-020	807-020	807-002	807-006	807-006	807-056
2	Rotary Valve	1	130-006	230-059	330-059	430-006	520-006	620-006
3	Rotary Valve Housing	1	130-011	230-011	330-011	430-011	520-011	620-011
4	Rotary Valve Bearing (inner)	1	807-021	807-021	807-001	807-005	807-005	807-055
5	Rotary Valve Bearing Circlip	1	804-051	804-051	804-054	804-066	804-066	804-070
6	Rotary Valve Housing Gasket	1*	100-001	200-001	300-001	430-001	510-001	620-001
7	Cylinder Gasket	4-5*	110-030	210-030	310-030	430-030	510-030	510-030
8	Cylinder	4-5	110-082	210-082	310-082	430-082	510-082	510-082
9	Piston Assembly	4-5	130-902	230-902A	330-902A	430-902A	520-902A	520-902A
10	Compression Ring	4-5*	100-024	200-024	300-024	430-024	520-024	520-024
11	Oil Control Ring	4-5*	100-022	200-022	300-022	430-022	520-022	520-022
12	King Rod	1	140-077	230-077	320-077	430-077	520-077	520-077
13	Crankshaft Spacer	1	140-013	230-013	320-013	430-053	520-052	520-052
14	Crankshaft Circlip	1	804-006	804-009	804-012	804-016	—	—
15	Crankshaft Spacer	1	100-035	300-035	310-035	430-035	—	—
16	Crankshaft Spacer Shim	5	100-049	300-049	310-049	430-049	—	—
17	Crankshaft Bearing	2	—	—	—	—	807-062	807-062
18	Crankshaft Bearing Circlip	2	804-051	804-058	804-062	804-068	804-068	804-068
19	Crankshaft Oilseal	1*	808-043	808-044	808-045	808-048	808-047	808-047
20A	Std Crankshaft Assembly	1	110-901	230-915	330-911	430-901	520-901	520-901
20B	SAE Crankshaft Assembly	—	—	—	—	430-904	520-904	520-904
21	Crank Bolt	1	—	—	—	—	510-088	510-088
22	Crank Nut	1	—	—	—	—	801-009	801-009
23	Spring Dowel	2	—	—	—	—	806-013	806-01 3
24A	Std Flange Plate	1	130-076	230-076	330-076	430-076	520-076	520-076
24B	SAE Flange Plate	1	—	—	—	430-097	520-113	520-113
25	Flange Plate Seal	1*	808-033	808-028	808-026	808-018	—	—
26	Plug	1-3	816-074	816-071	816-071	816-071	816-071	816-071
27	Engine Case	1	130-012	230-012	330-012	430-012	520-012	620-012
28	Engine Case Gasket (520)	1*	—	—	—	—	510-090	510-090
29	Queen Rod Pivot	3-4	140-081	230-081	320-081	430-081	520-081	520-081
30	Queen Rod	4	140-078	230-078	330-078	430-078	520-078	520-078
31	Crank Spacer SELECT	1▲	140-052	230-052	320-052	430-052	—	—
32	Crank Spacer ON	1▲	140-053	—	320-053	430-053	—	—
33	Crank Spacer ASSEMBLY	1▲	140-054 /055	230-054	320-054	430-054	—	—
34	Crank Spacer	1▲	140-056	230-056	—	—	—	—
35	Balance Weight	1	130-010	230-010	330-010	430-010	—	—
36	Woodruff Key	1	811-016	811-010	811-010	811-009	—	—
37	Cylinder Bolts	16-20	802-020	802-032	802-053	802-054	809-035	809-035

Note 1 Items marked thus ▲ select on assembly

Note 2 Please note Item 76 (Seal Kit) includes all items marked thus: *

PARTS LIST

Item	Description	No	165	400	850	1450	2250	3000
38	Valve Housing Bolts	4-10	802-020	802-033	802-053	802-054	802-073	802-054
39	Washer for item 38	4-10	—	—	—	—	803-015	803-001
40	Adapter Plate Bolts	4	802-020	802-020	802-032	802-054	802-054	809-002
41	Exhaust Cover Bolts	2-4	802-016	802-016	802-032	802-033	802-033	802-033
42	Flange Plate Plugs	5	—	—	—	—	815-008	815-008
44	Dipstick (vertical mounting)	1	100-040	200-040	300-040	—	—	—
45	Seal (transit only)	1	808-004	808-004	808-004	808-004	808-004	808-004
46	Breather Plug	1	130-066	130-066	130-066	130-066	130-066	130-066
47	Oil Seal Carrier	1	—	—	—	430-083	—	—
48	Needle Bearing	1-2	807-042	807-048	807-065	807-045	807-047	807-047
49	Grub Screw	1-5	815-012	815-001	815-002	815-003	—	—
50	Key	1	811-002	811-001	811-003	811-005	811-030	811-030
51A	Rotary Valve Exhaust Cover BSP1	1	130-005	230-005	330-005	430-005	520-005	620-042
51B	Rotary Valve Exhaust Cover NPT1	1	130-105	230-105	330-105	430-105	520-105	620-042N
52	Flange Bolts	4-8	810-003	810-001	810-002	809-001	—	—
55	Output Shaft Bearing (outer)	1	807-007	807-008	807-009	807-013	807-063	807-063
56	Output Shaft Bearing (inner)	1	807-007	807-008	807-009	807-012	807-012	807-012
57	Flange Plate Cap Screws	10	—	—	—	—	809-001	809-001
58	Output Housing bolts	5	—	—	—	—	809-002	809-002
59	Output Housing Cover Bolts	5	—	—	—	—	802-016	802-016
60	Oil Level Plug	1	816-063	816-063	816-063	816-074	—	—
61	Drive Pin (dia. 10mm)	1	—	—	—	—	806-001	806-001
62	Drive Pin (dia. 12mm)	1	—	—	—	—	806-002	806-002
63	Output Shaft Bearing Spacer	1	—	—	—	—	518-001	518-001
64	Output Shaft Spring Ring	1	—	—	—	—	518-004	518-004
65	Output Shaft Circlip	1	—	—	—	—	804-017	804-017
66	Output Shaft Seal	1*	—	—	—	—	808-004	808-004
67	Output Shaft	1	—	—	—	—	518-003	518-003
68	Output Shaft Housing	1	—	—	—	—	518-005	518-005
69	Output Shaft Oil Seal	1*	—	—	—	—	808-042	808-042
70	Output Shaft Housing Cover	1	—	—	—	—	518-002	518-002
71	Output Shaft Grease Nipple	1	—	—	—	—	816-015	816-015
72A	Inlet Adapter Plate BSP	1	130-003	230-003	330-003	430-003	520-003	620-046
72B	Inlet Adapter Plate NPT	1	130-103	230-103	330-103	430-103	520-103	620-046N
73	Inlet Adapter Plate Gasket	1*	130-004	130-004	330-004	430-004	430-004	620-047
75	Dipstick Seal	1*	808-008	808-008	808-008	—	—	—
76	Seal Kit	1	139-911	239-911	339-911	439-910	529-911	629-912
78	Bearing Cap	1	—	—	—	—	—	620-045
79	Bearing Cap C'sk Screw	4	—	—	—	—	—	810-016
80	Rotary Valve Spacer	2	—	230-060	330-060	—	—	—
	Connecting Rod (slipper type)	1	149-920	CONVERSION KIT				

Note 1 Items marked thus ▲ select on assembly

Note 2 Please note Item 76 (Seal Kit) includes all items marked thus: *

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