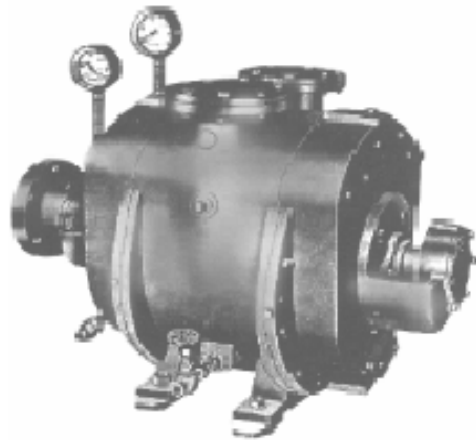


INSTRUCTION MANUAL
FOR
WATER RING VACUUM PUMPS &
COMPRESSORS



AVM SERIES MODEL

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MACHINE SPECIFICATIONS & OPERATING INSTRUCTIONS

Congratulations on purchase of Water Ring Vacuum Pump from Airvac Industries & Projects, Delhi. Please examine the machine for its completeness in all respect. If you want to install the machine later date, please be sure that all the opening are covered and machine is stored in a clean and dry place. If you keep the machine out doors, please be sure to protect it from weather and Corrosion.

Machine Specifications:

Application	:	<input type="checkbox"/> Pressure	<input type="checkbox"/> Vacuum
Fluid Medium	:	<input type="checkbox"/> Air	<input type="checkbox"/> Gas (Name.....)
Series	:	<input type="checkbox"/> AVM	<input type="checkbox"/> AV
Sr. No.	:		
Manufacturing Year	:		
Machine RPM	:		
Capacity	:		
Vacuum / Pressure	:		
Water Pressure	:		
Coupling Distance	:		
Required Water Quantity	:		

Operating Instructions:

- a. Starting** : (i) Turn the shaft by Hand
(ii) Start the Motor
(iii) Slowly open the main water inlet valve.
- b. Running** : (i) Regulate quantity of Water
(ii) Ensure dripping of water through glands
(iii) At high vacuum, if the machine starts rattling, open the air vent cocks provided on the discharge side of the main covers.
- c. Stopping** : (i) Close the main water inlet valve
(ii) stop the Motor
(iii) Ensure draining of water through automatic drain valve.

Important Note: It is advised to read the instruction manual before starting the erection work. It should be adhered for proper installation and operation of pump. Any deviation may result in damage / malfunctioning of pump and it may also cause serious accident.

ABOUT WATER RING VACUUM PUMP

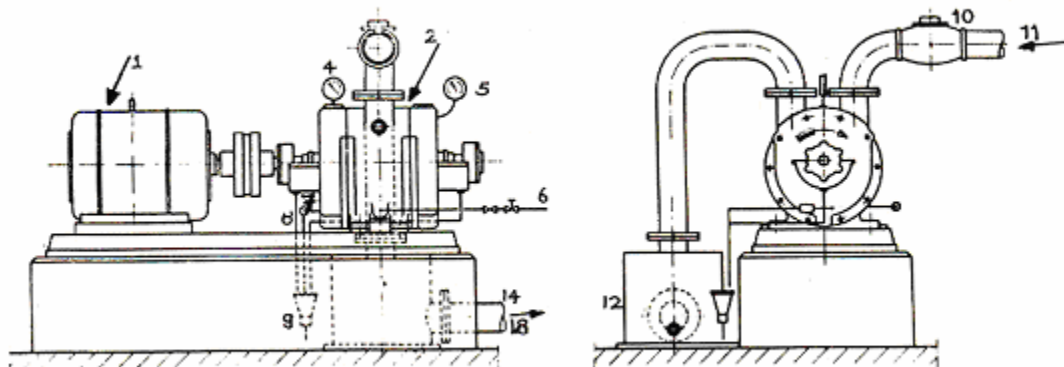
Water Ring vacuum Pumps are used to achieve high vacuum, this machine can also used as compressor for special duty conditions. Simple and trouble free operation is the main advantage of this machine and it can handle dust laden gases, moist air, aggressive gases and vapours. The material of construction should be properly selected considering the aggressiveness of media. Water Ring Vacuum pumps are 100% oil free and hence they do not contaminate the media passing through it. The ring liquid which acts as seal, absorbs most of the heat generated during compression.

The parameters governing the capacity, power consumption and vacuum achieved are broadly mentioned as under:

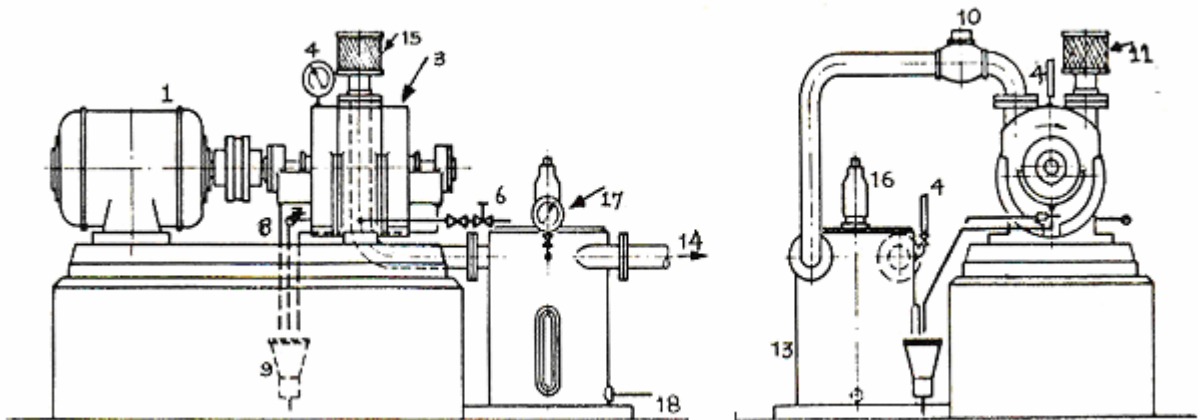
- a) Vapour Pressure:** Vapour pressure of the compressant liquid should be low. If the liquid ring reaches to the boiling at high vacuum, the vapours itself will take up the entire cell volume and thereby no further suction will take place and thus it will reduce the maximum vacuum attainable in the system.
- b) Specific Heat:** It affects the temperature rise of the liquid ring. Low specific heat results in higher temperature rise therefore it reduces the capacity.
- c) Specific Gravity:** Energy of the liquid ring is a function of the weight and velocity of the liquid. The specific gravity has an affect on differential pressure. Power consumption is proportional to the specific gravity of the compressant.
- d) Viscosity:** It has no affect on capacity. Maximum recommended viscosity is 20 Centipoises.
- e) Temperature of the seal Water:** Maximum attainable vacuum will be lower with high liquid ring temperature and vice-versa.
- f) High entry gas / air temperature:** It will increase the liquid ring temperature resulting in lower vacuum and reduction in capacity.
- g) Chemical Characteristics:** The Compressant to be selected should be compatible with gas being handled and with the material of construction for the components of the pump. It is advised to avoid combinations in which the gas may be highly soluble in the compressant liquid.

INSTALLATION OF MACHINE AS VACUUM PUMP & COMPRESSOR

a) As a Vacuum Pump:



b) As a Compressor:



1. Electric Motor
3. Water Ring Compressor
5. Vacuum Gauge
7. Automatic drain valve
9. Funnel for drain water
11. Air Inlet
13. Water Separator
15. Air Suction Filter
17. Pressure gauge

2. Water Ring Vacuum pump
4. Pressure gauge for water
6. Water inlet with main control cock
8. Drain pipe for leakage water
10. Non-Return valve
12. Silencer
14. Air Outlet
16. Safety valve
18. Water outlet.

OVERHAULING, DISMANTLING & ASSEMBLING OF MACHINE

The pump must be overhauled at least once in a year of operation. Only experienced technician should dismantle and re- assemble the machine in order to achieve accurate adjustments.

The half coupling must be taken from the shaft with the help of coupling removal tool before removing key. Remove the Dowel pins and remove the nuts holding down the casing covers. Remove the casing cover along with outer race of bearing; the bearing cover can be removed along with splash guard. Outer race of bearing can be removed carefully. Check for any damage to lip oil seals for replacing the same. Now, we can easily take out the impeller with shaft from casing. Take out splash guard from side casing cover.

Gasket for Casing Cover:

The axial clearance of the Impeller is determined by the thickness of the gasket for casing cover and hence the gasket if to be replaced should be of the same thickness.

Stuffing Box Glands:

Partial renewal of stuffing box, asbestos rings can be done by simply loosening of stuffing box gland and replacing the old joints with new ones. The asbestos rings have to be cut slant and the opening of each ring has to be placed opposite each other. Stuffing box is to be tightened so as to allow slight dripping of water which works as a lubricant and prevents excessive heat due to friction between joints and shaft protecting bushes fitted on the impeller shaft. Care should be taken while removing the stuffing box rings from the casing covers. Oil seal and grease nipple should be removed from the bearing bracket.

Control Discs:

After removing the closed nut fitted to the studs the control discs can be gently taken out from the casing cover. In case of high vacuum pumps, the control discs are provided with ball support and rubber balls. Please refer sketches for the same.

Roller Bearings (Recommended Grease – Multipurpose Grease or Its Equivalent):

If the bearings are to be replaced, the inner race of the bearing is to be taken out from the impeller shaft. Please refer sketch for fitment of new inner race on the shaft. Sketch also illustrates the bearing Adjustment as well as how to maintain the clearances of the pump.

Assembly of the Pump:

All the components should be thoroughly cleaned. Rust & Scale deposits should be removed and to be painted. Little grease to be applied to all the components during assembly. Utmost attention is to be paid while cleaning of Roller Bearings. The Bearings after cleaning should be dried thoroughly and little oil to be applied immediately. It should be noted that the grease should be of proper grade and applied in required quantity. Excess / lower grease quantity may result in bearing running hot. Grease nipples should be checked for proper functioning. The coupling must be mounted on pump shaft by using Coupling Mounting Tool.

PART LIST

<u>S. No.</u>	<u>Part Name</u>	<u>Material of Construction</u>
1.	Casing	Cast Iron
2.	Casing Cover	Cast Iron
3.	Control Disc (Cones in case of AV series) A-side	Cast Iron / Bronze / Stainless Steel
4.	Control Disc (Cones in case of AV series) B-side	Cast Iron / Bronze / Stainless Steel
5.	Impeller (Rotor) with Shaft	S.G. Iron / Bronze / Stainless Steel
6.	Distance Bush	Cast Iron
7.	Roller Bearing	SKF / FAG / ZKL Make
8.	Bearing Cover, A- side	Cast Iron
9.	Bearing Cover, B- side	Cast Iron
10.	Stuffing Box Gland	Cast Iron
11.	Stuffing Box Ring	Nylon / Teflon
12.	Asbestos Ring	Asbestos graphite Teflon
13.	Gasket for Casing Cover	Press-PAN
14.	Packing Ring (Felt)	Felt
15.	Lip Oil Seal	Rubber
16.	Screw Bolt for Bearing Cover	M.S.
17.	Stud for Control Disc	EN-8 / Stainless Steel
18.	Nut for Control Disc	M.S. / Bronze / Stainless Steel
19.	Gasket for Control disc Stud	Copper / Stainless Steel
20.	Dowel Pin	EN-8
21.	Splash Guard (Rubber)	Rubber
22.	Screw Plug to Cover (Side)	M.S. / Stainless Steel
23.	Gasket to Screw Plug	Copper / Stainless Steel
24.	Screw Plug for Casing	M.S. / Bronze / Stainless Steel
25.	Gasket to Screw Plug for casing	Copper
26.	Screw Plug to Cover (Top)	M.S. / Bronze / Stainless Steel
27.	Gasket to Screw Plug for Cover	Copper / Stainless Steel
28.	Screw Plug for Cover (Bottom)	M.S. / Bronze / Stainless Steel.
29.	Key	En-8
30.	Nut for Dowel pin	M.S.
31.	Grease Nipple	Bronze
32.	Special Nipple for pressure Gauge	M.S.
33.	Ball Support A & B	Cast Iron / Bronze / Stainless steel
34.	Fixing Screw for Ball Support	M.S. / Bronze / Stainless Steel
35.	Distance Ring for Ball support	M.S. / Bronze / Stainless Steel
36.	Set of Rubber / Teflon Ball (Big & Small)	Rubber / Teflon
37.	Automatic drain valve with Rubber / Ball	Plastic / Teflon.

Note: Please refer respective sketches for items 33 to 37.

LIST OF RECOMMENDED SPARE PARTS

List of spare parts to be kept in your stock:

S. No.	Spare Part Name	Quantity
1.	Roller Bearings	2 Nos.
2.	Distance Rings	2 Nos.
3.	Shaft Protecting Bush*	2 Nos.
4.	Stuffing Box Joints	8 Nos.
5.	Stuffing Box Ring	2 Nos.
6.	Casing Cover Joints	4 Nos.
7.	Leather Links	1 Set
8.	Rubber Balls	1 Set
9.	Lip Oil Seals	2 Nos.
10.	Splash Guard	2 Nos.

Normal configuration the pump is as hereunder:

Drive side : 'A' Side
Non-Drive Side : 'B' Side

* This spare part is not applicable in case of AVM – 4, 7 & 12.

DETAILS TO BE FURNISHED WHILE ORDERING FOR SPARE PARTS

Please refer cross-sectional drawing. It will be very helpful to us if the following information is furnished in your order / enquiry:

1. Series of Machine AVM AV
2. Size of Machine & its serial number
3. Motor, HP & RPM
4. Material of Construction whether Stainless Steel, Bronze or Cast Iron Impeller, Control Discs, Ball Support etc.
5. Balls – Whether Teflon or Rubber Balls
6. Part No. & Description of the components & quantity required. For this, please refer our cross-sectional drawing & part list.

ACCESSORIES LIST

List of Standard Accessories supplied with our make water ring vacuum pumps (Optional and not to be treated as packing list as it may vary):

When used as Vacuum Pump:

1.	Vacuum gauge	:	1 No.
2.	Pressure gauge	:	1 No.
3.	Coupling with Necessary Bolts or Set of V-belts with Pulleys	:	1 Set.
4.	Common Base Frame for Pump & Motor	:	1 No.
5.	Coupling or V-Belt Guard	:	1 No.
6.	Exhaust Silencer	:	1 No.
7.	Non-Return Valve	:	1 No.
8.	Main Water Inlet Valve	:	1 No.
9.	Suction strainer fitted on pump	:	1 No.
10.	Auto-drain Valve fitted on pump	:	1 No.
11.	Leather Links	:	1 Set.

When used as Compressor:

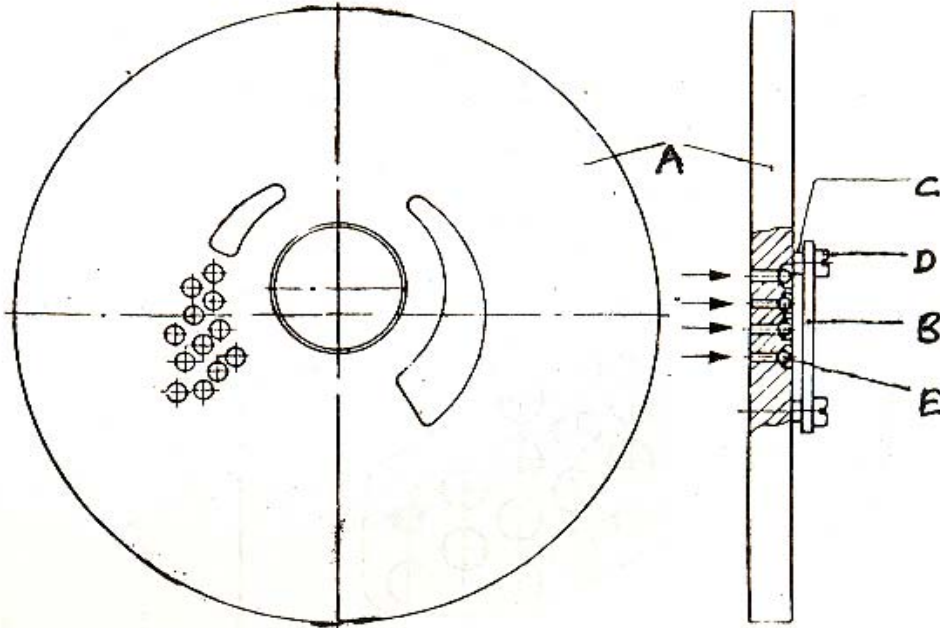
1.	Air Pressure gauge	:	1 No.
2.	Water Pressure gauge	:	1 No.
3.	Coupling with Necessary Bolts or Set of V-belts with Pulleys	:	1 Set.
4.	Common Base Frame for Pump & Motor	:	1 No.
5.	Coupling or V-Belt Guard	:	1 No.
6.	Silencer cum Water Separator	:	1 No.
7.	Non-Return Valve	:	1 No.
8.	Main Water Inlet Valve	:	1 No.
9.	Suction Filter	:	1 No.
10.	Auto-drain Valve fitted on pump	:	1 No.
11.	Leather Links	:	1 Set.

TROUBLE SHOOTING

<u>Troubles</u>	<u>Checks to be performed</u>
Vibrations on the Machine	<ol style="list-style-type: none">1) Alignment2) Damaged leather links3) Proper tightening of foundation bolts4) Damaged Bearings
Bearing running hot	<ol style="list-style-type: none">1) Bearings Damaged2) Improper quality of grease3) Starvation or Excess quantity of grease.4) Improper radial clearance of the bearings5) Poor quality of Bearings
Rattling Noise at High Vacuum	<ol style="list-style-type: none">1) Open the air vent cocks provide on the side of covers.
Leather Links Getting Damaged	<ol style="list-style-type: none">1) Improper alignment of the Machine & motor. Improve it by providing shims underneath the motor or machine legs.
Outlet temperature of Air And Water too high	<ol style="list-style-type: none">1) Clogging of discharge pipe connection.2) Clogging of Control plate holes due to deposition of rust etc.
Motor Overloading	<ol style="list-style-type: none">1) Excessive water quantity or pressure2) Clogging of discharge ports of Control disc or blocking of holes due to rust etc.3) Excessive tightening of the gland packing4) Any loose connection on the motor terminal.
The machine does not Develop sufficient Vacuum	<ol style="list-style-type: none">1) Malfunctioning of vacuum gauge.2) Improper water quantity being fed to the machine.3) Higher water inlet temperature than prescribed 30 °C inlet temperature.4) Higher Inlet temperature of Air / Gas/ vapours than room temperature, Normally 30 °C.5) Back pressure at the discharge point at control disc discharge port or discharge piping.6) Machine speed lower than rated Speed.7) Improper selection of size / Model of the machine.8) Barometric Pressure Low.9) Leakages in the suction pipe-line.

It is to be noted that maximum suction capacity as well as maximum attainable vacuum refers to ring fluid temperature at 30 °C and barometric pressure 760 mmHg at sea level.

CONTROL DISC FOR MODELS AVM- 4, 7 & 12



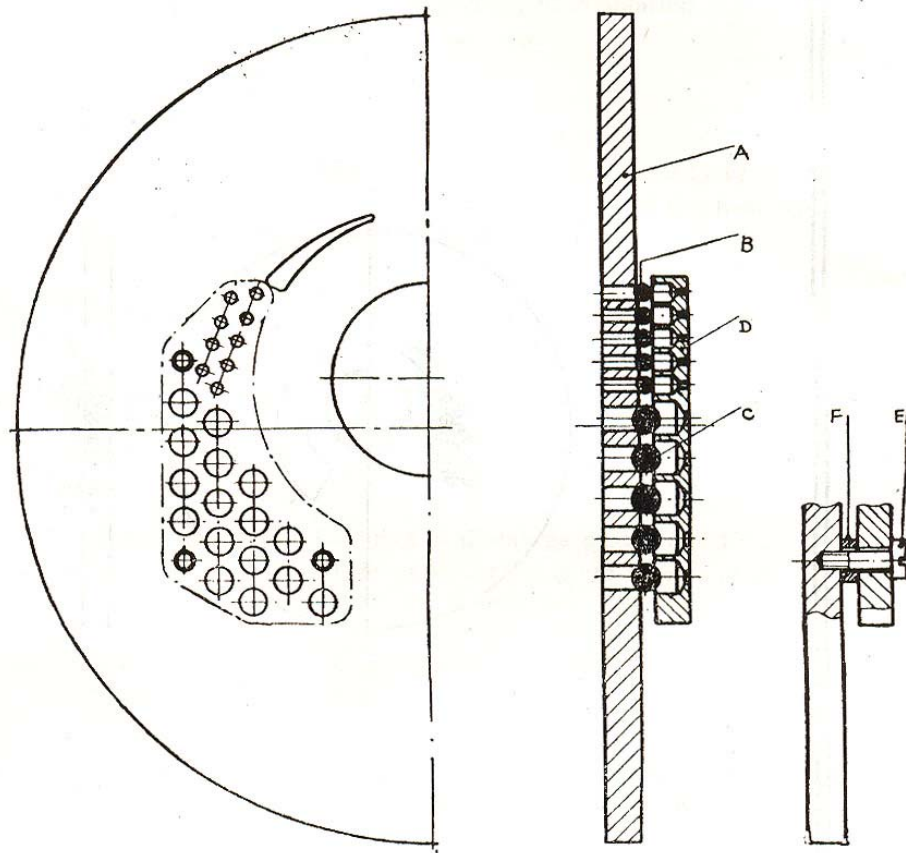
On the pressure side of the control disc A, relief valve has been provided to assure the proper working of the machine even if the vacuum is low. The valve consists of the following:

- | | | | |
|----|---------------|----|---------------------|
| A. | Control Disc | D. | Cheese headed screw |
| B. | Cover Plate | E. | Rubber Ball |
| C. | Distance Ring | | |

The cover plate B is fixed to the back of the control disc by means of screw D and distance Ring C in such a way to permit an unobstructed flow of the air through the holes of the disc and into the pressure chamber of the casing cover. The balls E must move freely between the disc and the cover and should never get stuck.

If the desired vacuum can not be obtained, the function of the relief valve has to be checked. At periodical inspections of the pump, the valve as well has to be checked and cleaned. Anything found defective is to be replaced.

CONTROL DISC FOR MODELS AVM- 15 & Above



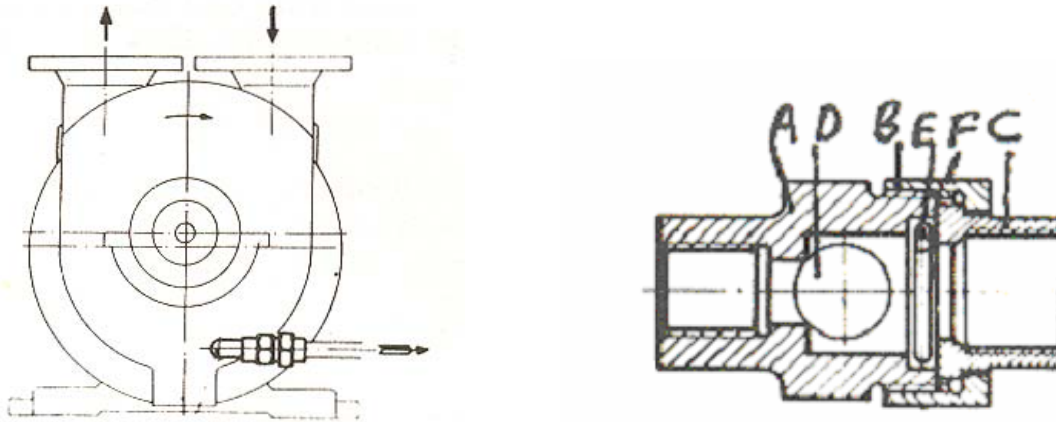
On the pressure side of the control disc A, relief valve has been provided to assure the proper working of the machine even if the vacuum is low. The valve consists of the following:

- | | | |
|------------------|--------------------|-----------------|
| A. Control Disc | B& C. Rubber Balls | D. Ball Support |
| E. Fixing Screws | F. Distance Rings. | |

The Ball support D is screwed to the back of the control disc A by means of the screws E and kept at proper distance from the disc by the distance rings F, so that the air which is flowing through the holes in the control disc can escape into the pressure chamber of the casing cover. The Rubber balls B and C must move freely between the control disc A and the ball support D. They should have a good closing seat on the holes of the disc and not stick to the support.

If the desired vacuum can not be obtained, the function of the relief valve has to be checked. At periodical inspections of the pump, the valve as well has to be checked and cleaned. Anything found defective is to be replaced.

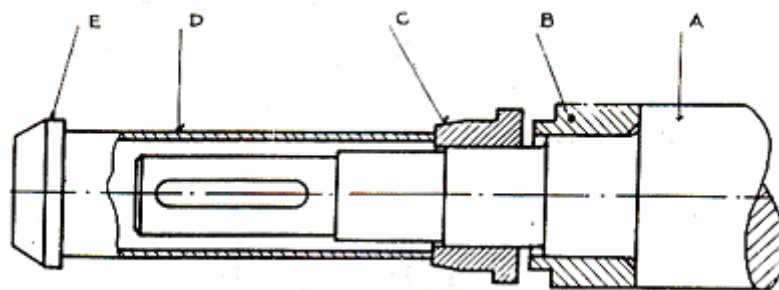
AUTOMATIC WATER DRAIN VALVE



Automatic water drain valve provided on the machine to drain the water automatically when the water ring is stopped. Therefore only a little water will be left in machine when starting again. It is installed on the casing cover of the A-side (in special cases on the B-side) and consists of the following:

- | | | |
|----------------|------------|----------------------|
| A. Casing | B. Cap nut | C. Connecting piece. |
| D. Rubber Ball | E. Wire | F. Joint. |

MOUNTING TOOL FOR INNER RACE OF BEARING



- | | | |
|------------------------|------------------|--------------------------|
| A. Impeller shaft | B. Distance Ring | C. Inner Race of Bearing |
| D. Hollow pipe of tool | E. Head of Tool | |

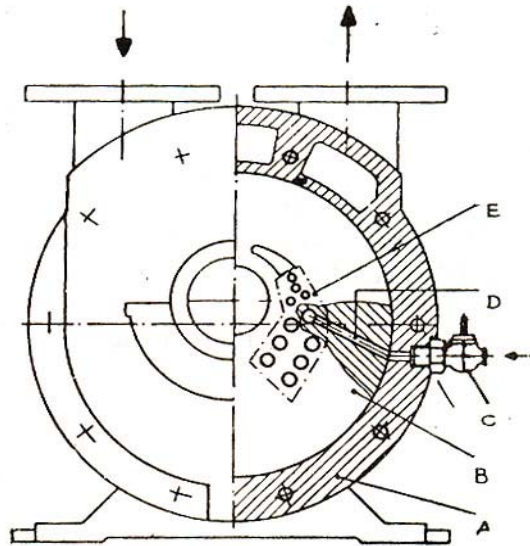
The distance Ring B is pushed onto the impeller shaft A. Then the inner race of the bearing C is driven on its seat by means of the special mounting tool. To do so the hollow pipe D is put over the impeller shaft to reach the inner race. By hitting with a hammer on the head of the tool E, the inner race is placed perfectly tight to the distance ring.

AVOIDING CAVITATION

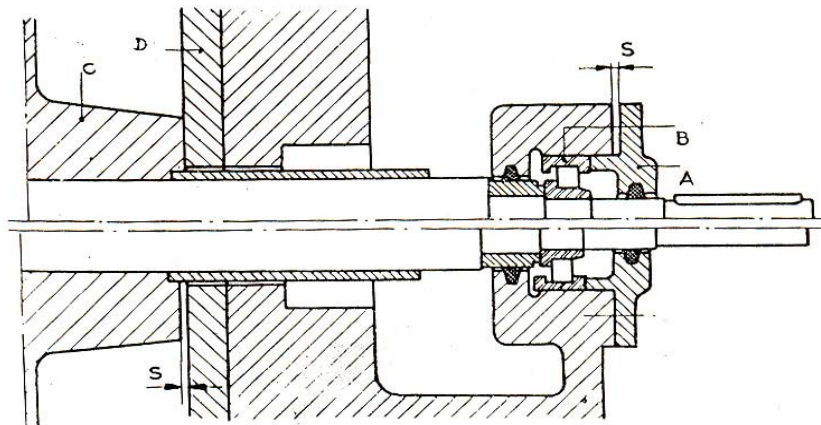
At high vacuum the water starts evaporating and the steam- bubbles start bursting against the surface of the internal components. This is cavitation and is indicated by rattling noise of the machine.

In all the machine sizes, AVM-15 and above, air supply cocks are provided on the discharge side of the casing covers. The air supplied to the machine through this cock reaches to the pressure side, thereby slightly reducing the inner pressure resulting into minimizing the rattling noise.

In case of Machines, AVM-4,7 & 12, a small passage is provided from atmosphere to control disc which services the above purpose.



“S” CLEARANCE ADJUSTMENT



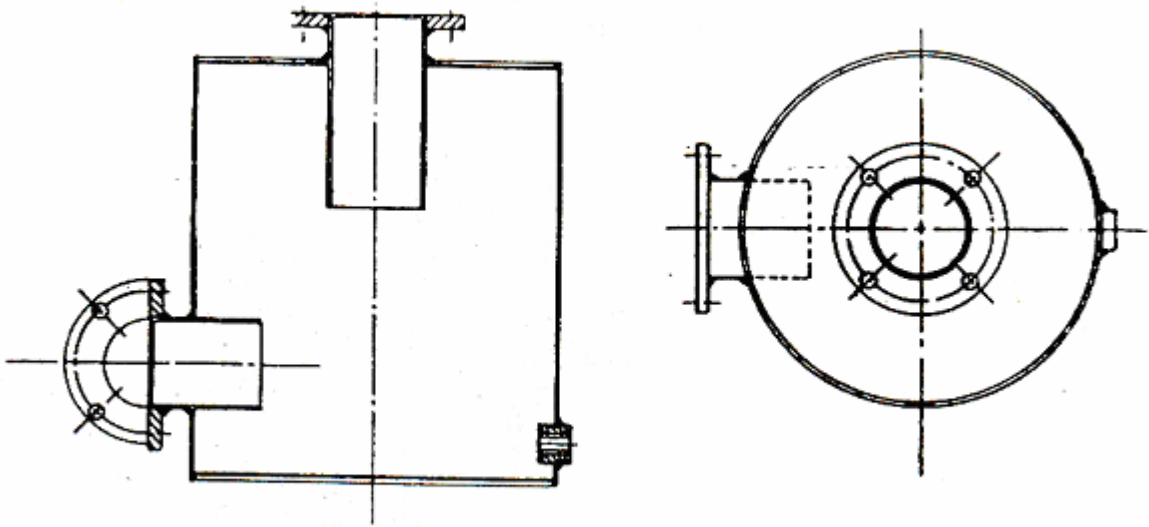
Replacing the roller bearings necessitates an adjustment as the bearing slightly differs in measurement. The position of Bearing B in the bearing chamber is fixed by the rim of the bearing cover A in order to keep the impeller C from running into the control disc D. When fitting a new bearing, either the rim or the calking surface of the bearing has to be equalized as to maintain the proper bearing clearances.

The upper half of the sketch shows the position of the impeller, with shaft moved in axial direction towards the bearing, before the bearing cover bolts are tightened. The lower half of the same sketch illustrates the position of the impeller after tightening of the bearing cover bolts.

The adjustment, which has to be made on the A and B side, should preferably be checked with the help of a micrometer. For an easy axial movement it is necessary to loosen the stuffing box.

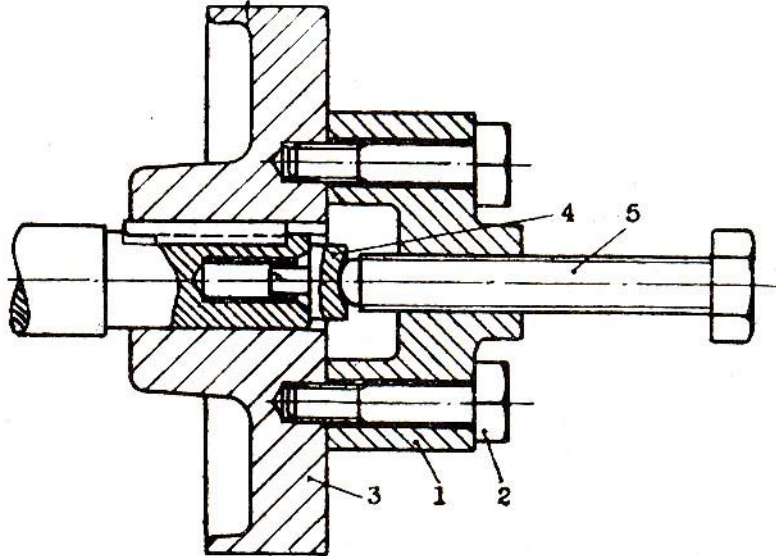
SILENCER CUM WATER SEPARATAOR

The silencer is connected to the discharge flange of the machine through pipe bend. The silencer level should always be lower than the machine discharge level, otherwise back pressure will be exerted on the machine which will result in overloading of the machine & motor.



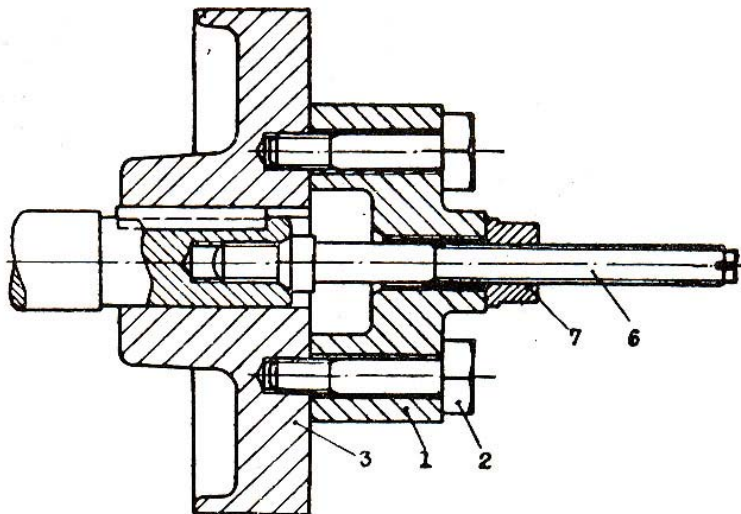
COUPLING REMOVING & MOUNTING TOOL

Coupling Removing Tool:



1. Yoke
2. Bolt
3. Coupling
4. Pressure disc.
5. Dismantling Screw
6. Spindle
7. Nut

Coupling Mounting Tool:



ALIGNMENT OF MACHINE WITH MOTOR

ALIGNMENT OF PUMP WITH MOTOR.

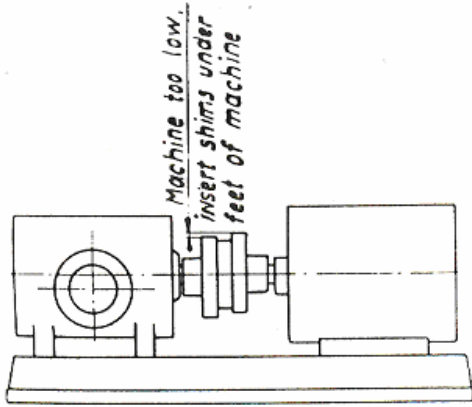


Figure - 1.

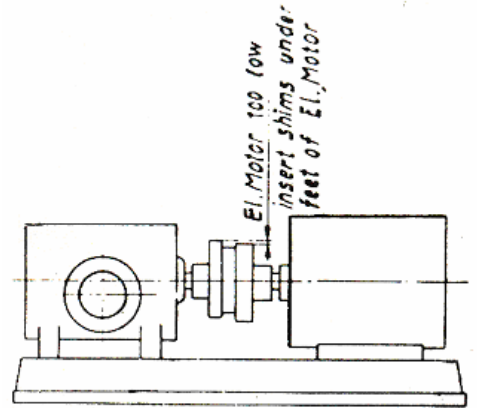


Figure - 2.

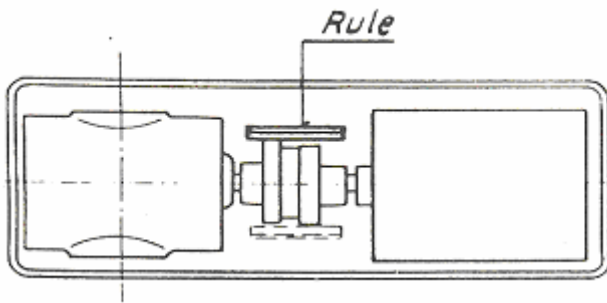


Figure - 3.

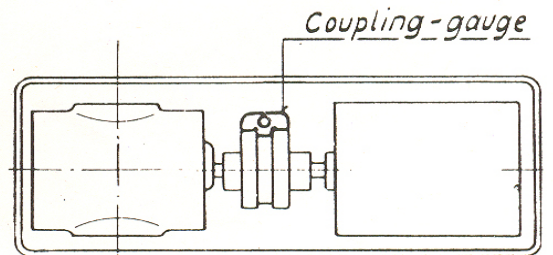
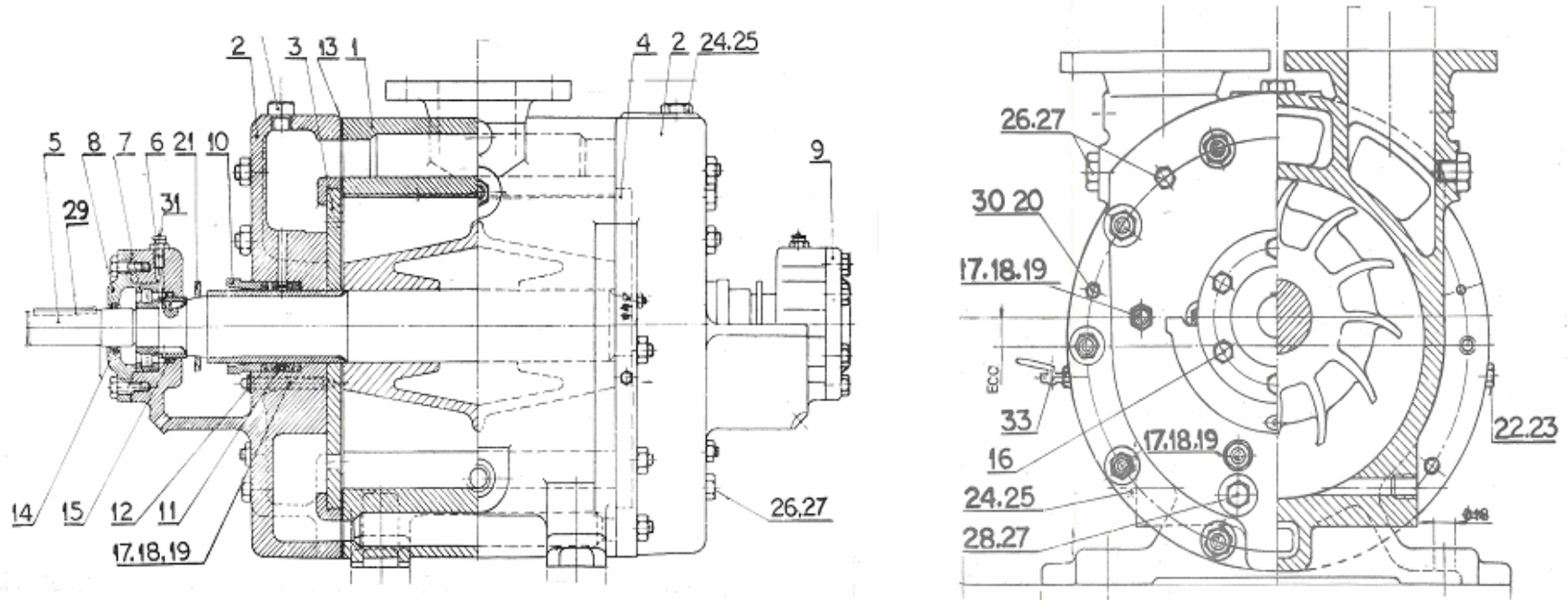


Figure - 4.

ANNEXURE – I: CROSS SECTIONAL DRAWING SHOWING DIFFERENT PARTS



Cross – Sectional View of AVM Series Machine