

INSTRUCTION MANUAL
FOR
ITO IRS TYPE ROOTS BLOWER

ITO ENGINEERING CO.,LTD.

2-12, SAIWAI-CHO, SHIMIZU-SHI, SHIZUOKA 424, JAPAN

HOBSON REF COPY

TABLE OF CONTENTS

	page
1. BRIEF SUMMARY	2
2. CONSTRUCTION	2
2-1. Rotors	2
2-2. Casing	3
2-3. Gears	3
2-4. Bearings	3
2-5. Shaft Seals	3
2-6. Lubrication	3
2-7. Examples of Construction	4
3. INSTALLATION	8
3-1. Place of Installation	8
3-2. Foundation Work	8
3-3. Silencers, Filters, etc.	8
3-4. Piping	8
3-5. Examples of Layout	9
4. OPERATION	10
4-1. Before Operation	10
4-2. Starting	11
4-3. During Operation	11
4-4. Stopping	11
5. MAINTENANCE	12
5-1. Daily Inspection	12
5-2. Inspection Every 2,000 Hours	12
5-3. Periodic Overhaul	12
5-4. Measures to Take at Time of Trouble	12
5-5. Disassembly	13
5-6. Reassembly and Adjustment	13
6. TROUBLESHOOTING	14
7. RELATION BETWEEN ATMOSPHERIC TEMPERATURE AND DELIVERY TEMPERATURE	15
8. LUBRICATION OIL AND GREASE	15
8-1. Lubricating Oil	15
8-2. Grease	16

1. BRIEF SUMMARY

Firstly we would like to thank you very much for purchasing our IRS blowers.

These are low-noise Roots blowers, well-known and reliable rotary blowers. They are also usable as vacuum pumps. The casing contains two rotors rotating in the directions opposite to each other. These have very small clearances between the internal surfaces of the casing and the rotors, also between the rotors themselves so that they do not contact with each other.

The two rotors are driven through gears provided outside the casing. Gas enclosed between the rotors and the casing are sent from the suction side to the delivery side, basically in the same way as in a gear pump.

Noise is reduced by the unique slits provided on the delivery side. Thus, our IRS blowers are the improved versions of the conventional Roots blowers.

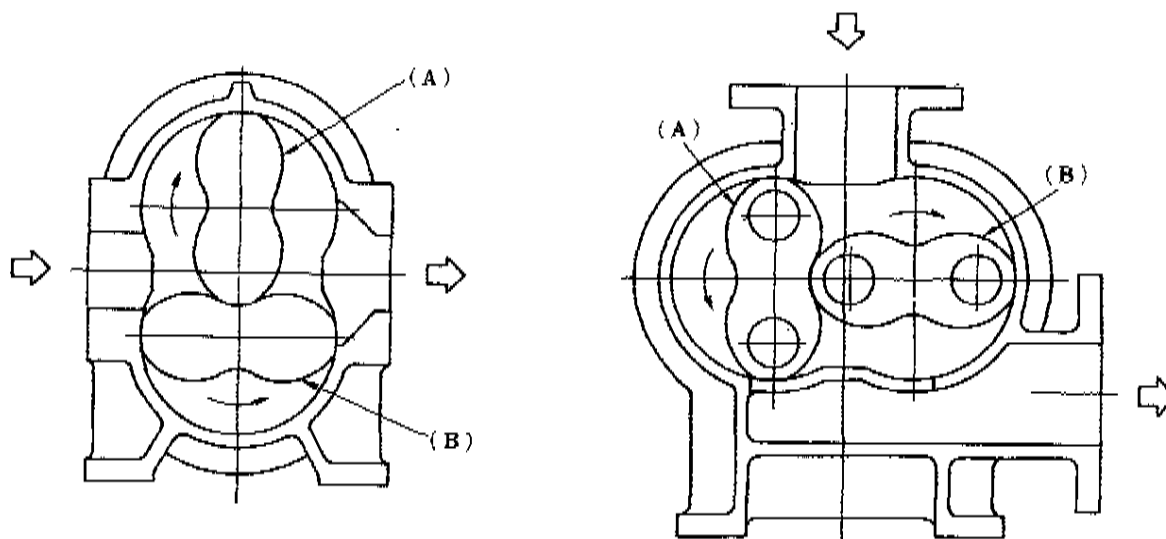
This manual describes the low-noise Roots blowers in detail. Hence we would like to advise our customers to read it through carefully in order to achieve the best performance with our blowers.

2. CONSTRUCTION

Gas enclosed between the rotors and the casing are sent from the suction side to the delivery side as shown in the figures by the rotation of the rotors. The rotor A is driven, either directly or through a belt, by an electric motor. The rotor B is rotated in the opposite direction through gears by the rotor A. Most of our blowers have an air cooling system, while special versions have an oil cooling system. In some of the latter, the casing comprises a jacket cooling system.

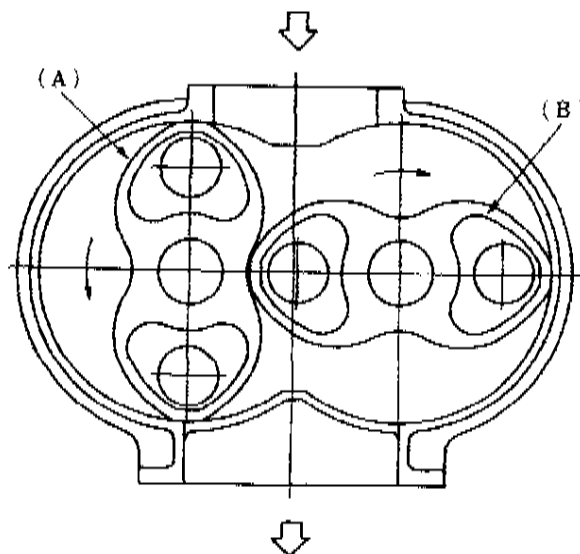
2-1. Rotors

Each of the rotors has segmental involute curves adopted for the first time by Ito Engineering Co., Ltd., and they much enhance the performance of the blower. The rotors are dynamically balanced to make vibration very small.



IRS-32A ~ 65H

IRS-80H ~ 400A



IRS-300B

2-2. Casing

In the IRS-80H and larger models, the casing has a suction port at the top and a delivery port on the right side (seen from the driving shaft). In the models IRS-32A to IRS-65H, the suction port is on the left side and the delivery port is on the right side. Each model is easy to pipe and is more compact than blowers made by any other manufacturer.

2-3. Gears

The reliability of the low-noise Roots blowers depends upon gears. Therefore, the gears are made of material selected with the greatest care, and are precisely finished. Their teeth are subjected to induction hardening and polishing. Turbine oil is used for lubrication as described below.

2-4. Bearings

Precision bearings with large tolerable load are used to maintain the accurate clearances between casing and the rotors and between the rotors themselves. The bearings are lubricated by means of turbine oil or grease as described below.

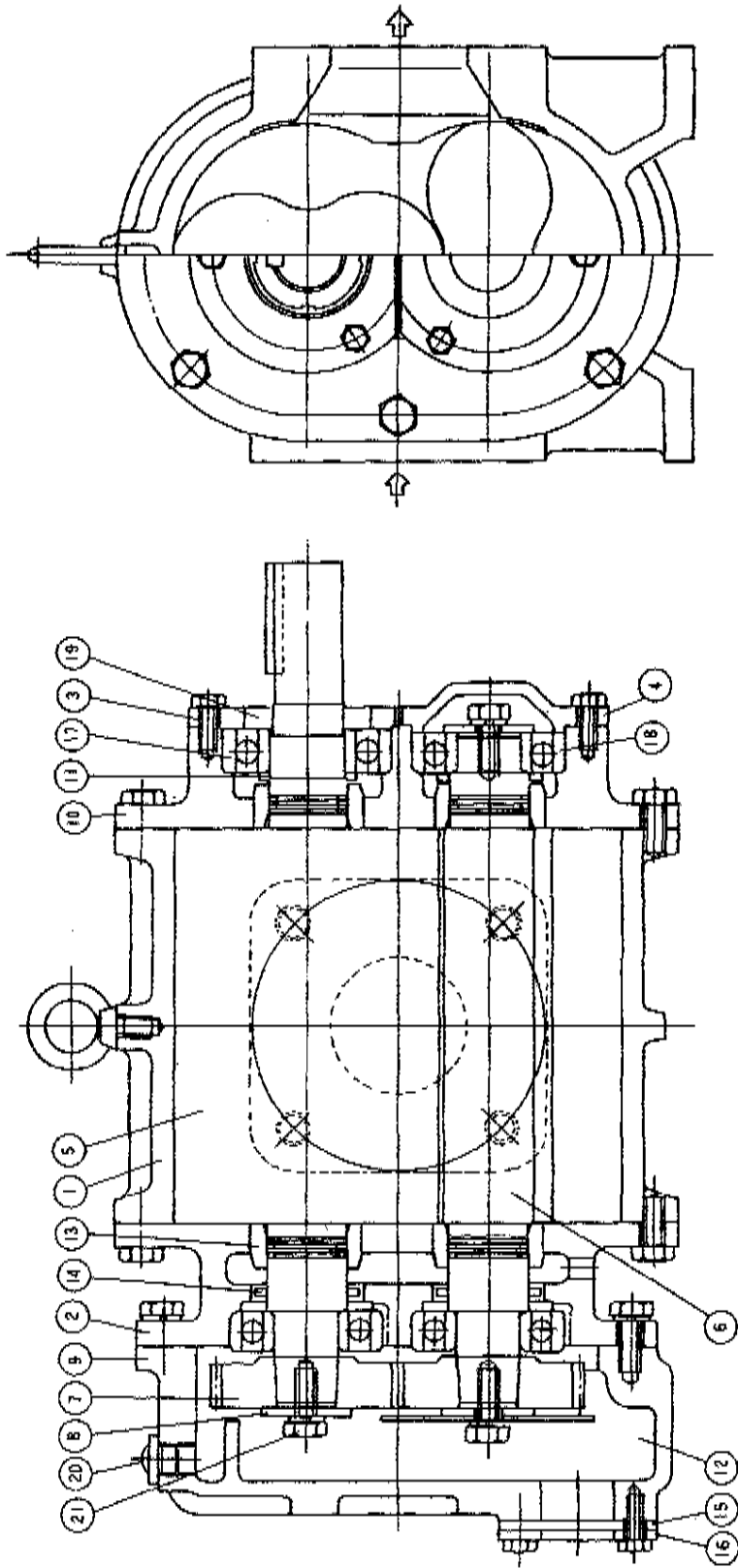
2-5. Shaft Seals

When the fluid to be used is air, labyrinth packings are used. When it is corrosive or dangerous gas, mechanical seal packings or rubber seal packings are used.

2-6. Lubrication

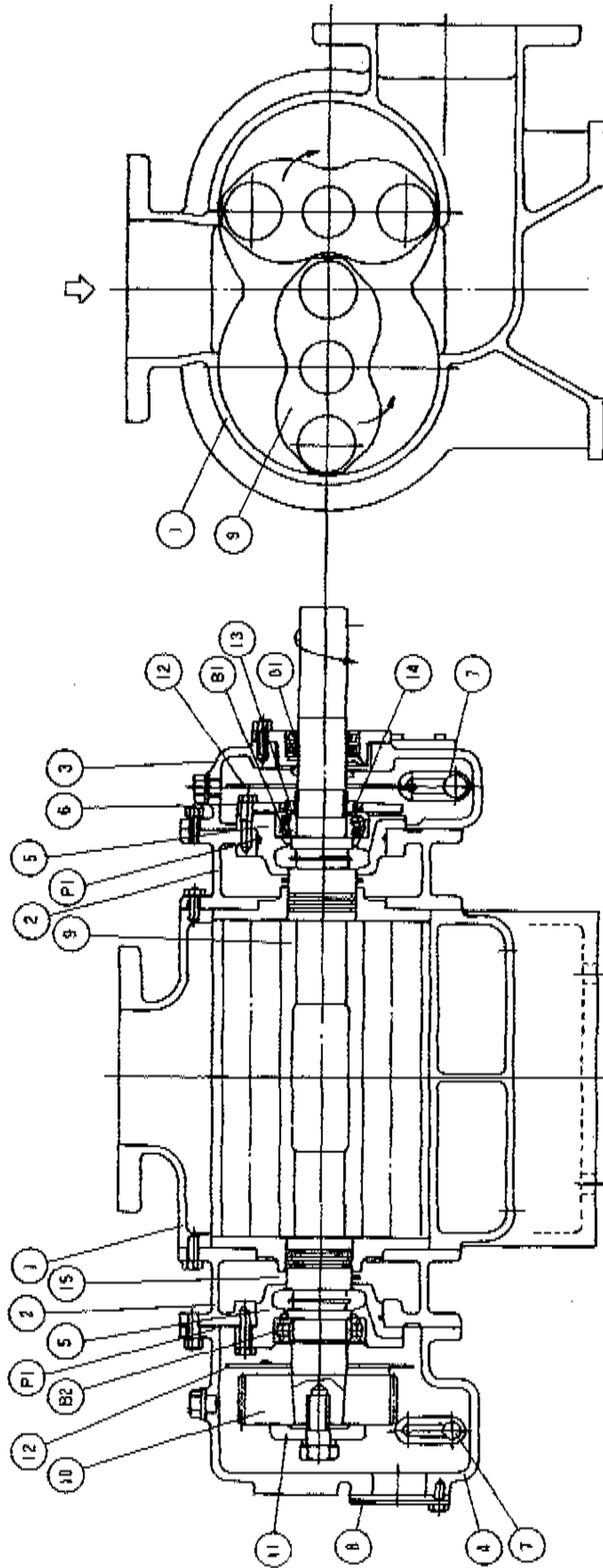
The bearings and gears are designed to be lubricated by means of good turbine oil (#180 or #200) which we recommend. In the models IRS-32A to IRS-80H, however, bearings on the driving side are lubricated by means of lithic grease. Lubrication is very important. See par. 8 "LUBRICATING OIL AND GREASE".

2-(7) EXAMPLES OF CONSTRUCTION SECTIONAL DRAWING (PART 1) IRS-65H



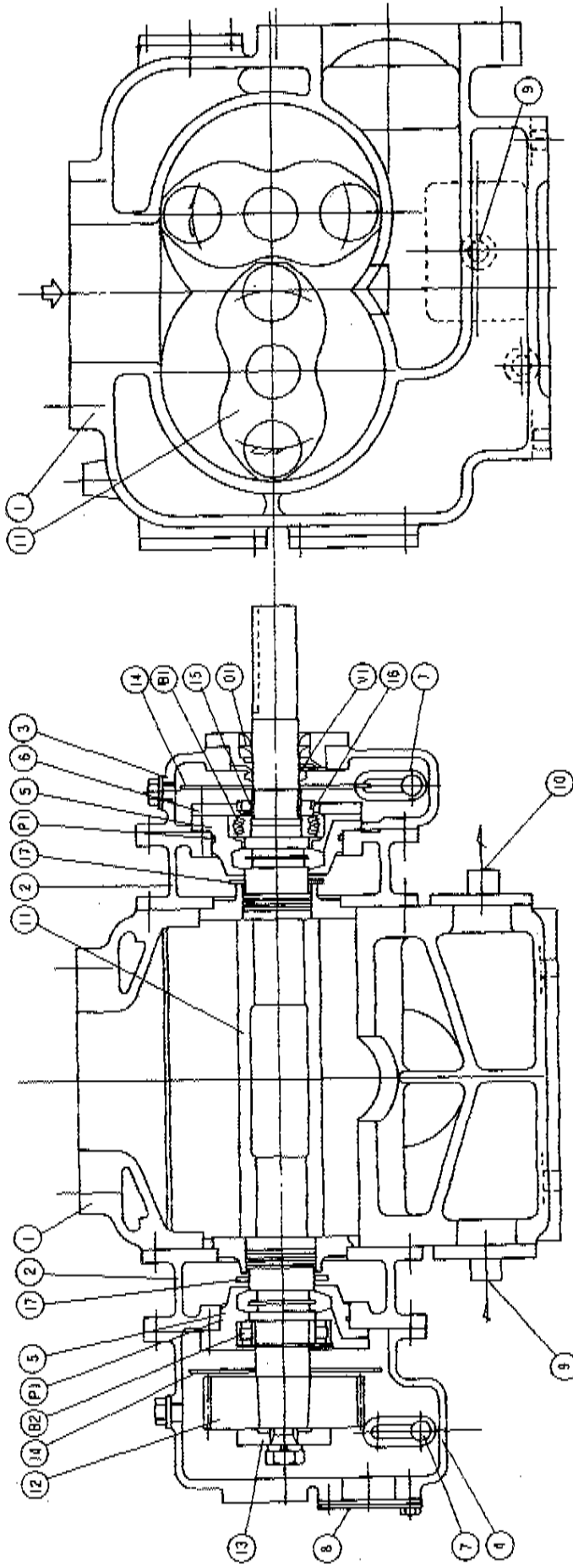
No.	PARTS NAME	MATERIAL	QTY	REMARKS	No.	PARTS NAME	MATERIAL	QTY	REMARKS
1	CASTING	FC	25	1	12	SPLATTER	SS	44	1
2	SIDE COVER	FC	25	1	13	BUSH	FC	25	4
3	BEARING COVER	FC	20	1	14	FLINGER	NBR		3
4	BEARING COVER	FC	20	1	15	OIL GAUGE	ACRYL		1
5	ROTOR	FC	45	1	16	GAUGE HOLDER	SS	41	1
6	ROTOR	FC	45	1	17	BEARING			1
7	GEAR	SCM	4	2	18	BEARING			3
8	GEAR WASHER	SS	41	3	19	BEARING NUT			1 AN07
9	GEAR COVER	FC	20	1	20	OIL FILLER			1 PF3/8
10	FRONT COVER	FC	25	1	21	GEAR BOLT			2
11	DISTANCE COLOR	S35C		1					

SECTIONAL DRAWING (PART 2) IRS-80B



No.	PARTS NAME	MATERIAL	No.	PARTS NAME	MATERIAL	No.	PARTS NAME	MATERIAL
1	CASTING	FC	25	ROTOR	FC	30	BEARING	
2	SIDE COVER	FC	25	GEAR	SCM	4	BEARING	
3	FRONT COVER	FC	25	GEAR WASHER	S35C	O1	OIL SEAL	SBXI 456812
4	GEAR COVER	FC	25	SPLATTER	SS41P	P1	O-RING	GI15
5	BEARING HOLDER	FC	25	BEARING NUT	AN10	V1	V-RING	V45
6	BEARING COVER	SS41P	14	BEARING WASHER	AW10			
7	COOLING PIPE	ACRYL	15	FLINGER	NBR			
8	OIL GAUGE	ACRYL						

SECTIONAL DRAWING (PART 3) IRW-100A (JACKET COOLING TYPE)



No.	PARTS NAME	MATERIAL	No.	PARTS NAME	MATERIAL	No.	PARTS NAME	MATERIAL
1	CASTING	FC	25	COOLING WATER INLET	SS	41	FLINGER	NBR
2	SIDE COVER	FC	25	COOLING WATER OUTLET	SS	41	BEARING	
3	FRONT COVER	FC	25	ROTOR	FC	30	BEARING	
4	GEAR COVER	FC	25	GEAR	ScM	4	OIL SEAL	(SBXI)
5	BEARING HOLDER	FC	25	GEAR WASHER	SS	41		456812)
6	BEARING COVER	SS41P	14	SPLATTER	SS	41	O-RING	(G115)
7	COOLING PIPE	CUT	15	BEARING NUT	(AN10)		V-RING	(V45)
8	OIL GAUGE		16	BEARING WASHER	(AW10)			

3. INSTALLATION

3-1. Place of Installation

- (A) It is desirable to install the blowers in a large space in a light room so as to facilitate the assembly, disassembly, maintenance, etc. of the blowers, particularly to make it easy to check the oil gauge beside the gears.
- (B) If the blowers are installed in a tightly closed room, it is necessary to prepare an air intake which can take in enough air to operate all the blowers at the same time. When a filter net or filter cloth is fixed to the air intake, it must have a sufficient filtration area so as not to cause clogging.
- (C) If there is any possibility of drain appearing in the suction side of the blower, be sure to provide an airwater separator and drain remover.
- (D) In case of large blowers, attach a chain block to the ceiling.

3-2. Foundation Work

It is to be understood that we are free from any liability for any accident or trouble attributable to improper foundation, installation, piping, etc. or to careless handling.

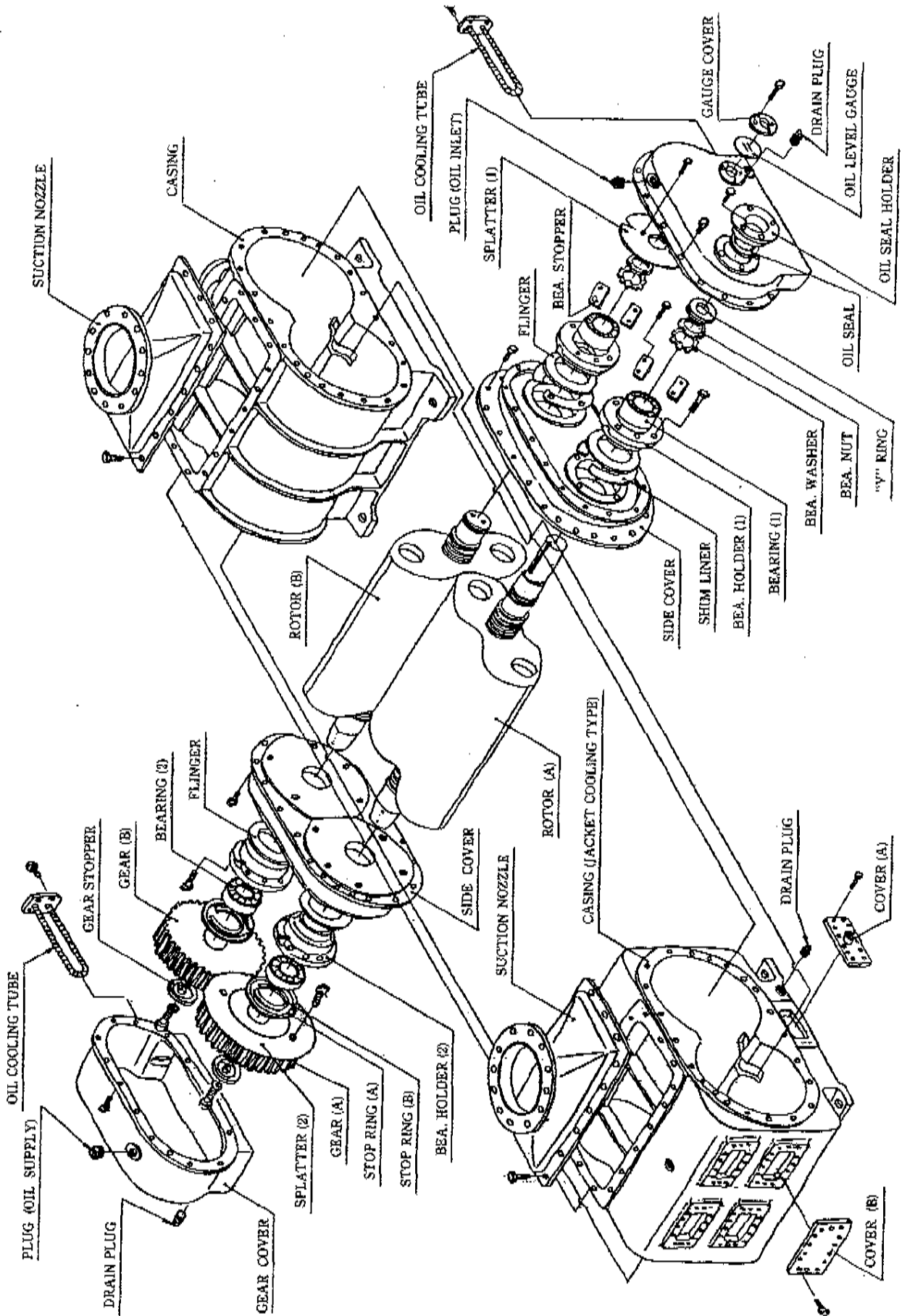
- (A) The blower foundation must have a space of more than 400 mm around the blower bed. The foundation should be thick enough to be 3 to 5 times as heavy as the assembled blower. (Concrete has a specific gravity of about 2.3) If the foundation is not thick enough, the blower may sink or cause vibration.
- (B) The degree of levelness must not exceed 1 mm per meter.
- (C) It is advisable to put in anchor bolts by means of a template. If it is necessary to bore anchor holes first and pour mortar (grout) into them, the holes must be large and deep enough.
- (D) If the lower surface of the bed is not in perfect contact with the foundation, make adjustment by inserting chock liners between them. If this adjustment is not properly made, the bed may be twisted and therefore the blower may be distorted. After tightening up the nuts of the anchor bolts, pour grout between the bed and the foundation.

3-3. Silencers, Filters, etc.

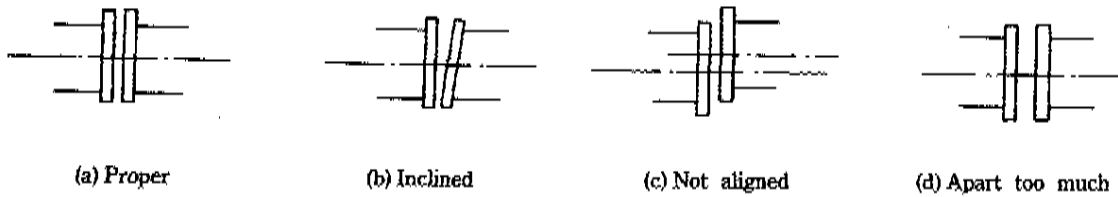
- (A) Each blower must be provided on the suction side with a silencer. On the delivery side, it is recommended to attach another one as close as possible to the blower.
- (B) If much moisture or dust is contained in air or gas sucked in, it is necessary to attach a filter to the suction side of the blower.
- (C) The blower must be provided on the delivery side with a safety valve, the relief pipe of which should be connected with the suction side. However, if the blower is for air and there is no danger, the safety valve may just release air into the atmosphere.

3-4. Piping

It is advisable to use an expansion joint halfway in the suction or delivery pipe of each blower. If it is not used, attach a suitable pipe bracket so that the blower is not subjected to welding distortion or placed under the weight of the piping and that vibration and noise are reduced.



When an expansion joint is used, a check valve must be provided after it (in the direction of flow).



When the suction and delivery flange clamping bolts are removed,

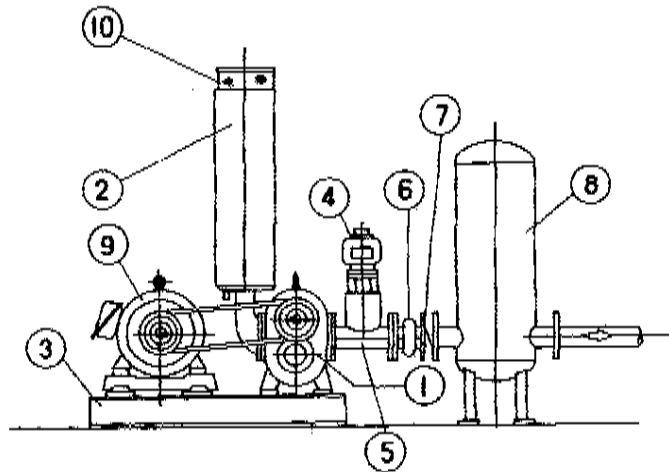
(a) is proper and has a clearance suitable for the insertion of packing, and (b), (c) and (d) are improper.

Moisture may enter the blowers and cause rust therein in a period after they are delivered to the user and before they are installed or operated. Therefore, it is necessary to check them carefully through the suction and delivery ports, and to remove welding waste, dust, moisture, etc. completely from the piping before operation. These may scratch the blower rotors or even cause them to seize.

3-5. Examples of Layout

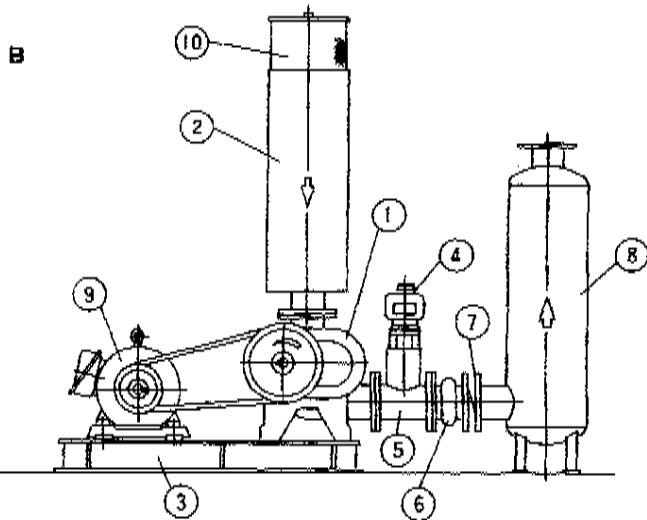
IRS TYPE

A

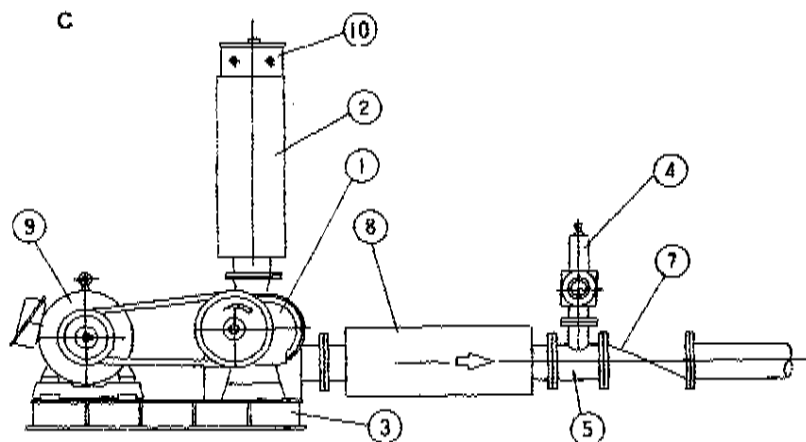


No.	PARTS NAME
1	BLOWER
2	SUCTION SILENCER
3	COMMON BASE
4	SAFETY VALVE
5	APPEND PIPE
6	EXPANSION JOINT
7	CHECK VALVE
8	DISCHARGE SILENCER
9	MOTOR
10	AIR CREAMER

When a KT silencer is used on the delivery side



When a KSL silencer is used on the delivery side



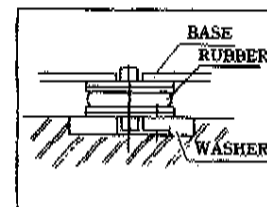
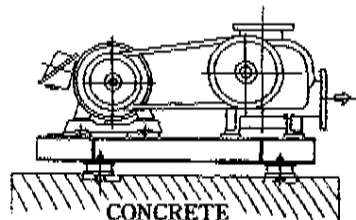
When a KS silencer is used on the delivery side

Instructions for Attaching Accessories

1. The weight of the piping must not bear on the blower delivery elbow, etc.
2. Make sure that the silencer flow is proper.
3. When a means for preventing vibration is used, connect the piping with the blower by an expansion joint. In this case, a check valve must be provided after the expansion joint.
4. A safety valve must be provided between the check valve, sluice valve, etc. and the blower.
5. Each blower above 150φ should be installed on its own independent foundation. (This will help to prevent resonance.)
6. The intake of the pressure gauge must be in a position where delivered air flow is uniform.
7. When vibration preventing rubber or the like is used, the blower should be installed as illustrated below.

4. OPERATION

4-1. Before Operation



(A) Make sure that the blower was not damaged or affected during transportation or installation. Before connecting the blower with the electric motor, make sure that the clamping bolts and anchor bolts are tight enough. Also before the connection, electrify the electric motor to check the direction of its rotation. If it rotates in the reversed direction, please correct it.

(B) It must be made sure that,

* pipes are properly arranged,

- * there are no loose portions,
 - * packing is properly inserted,
 - * blind covers are removed, and
 - * valves are properly set.
- (C) Please make sure that the lubricating oil and grease are sufficient. If there are any leakage, please remedy it.
- (D) If there is piping on the suction side, welding waste, etc. may remain therein even after cleaning. Attach a filter, comprising a 30- to 40-mesh wire net sandwiched between about 8-mesh wire nets, temporarily to the suction port of the blower. Check the filter several times every five minutes after the blower is started. Remove the filter when it has come to catch no such waste, etc.
- (E) In case of the belt drive type, make sure that the pulleys are aligned with each other and that the belt is properly attached to them.

4-2. Starting

- (A) After the aforesaid inspection, fully open the valves on the suction piping and delivery piping. In case of the oil cooling or jacket cooling type, fully open the valves and cocks of the cooling system.
- (B) Turn the pulley or coupling of the blower by hand to see if it turns easily. If it does, start no-load running.
- (C) Make sure that there is no abnormal sound particularly in the first several minutes. If no abnormality has been found in the first 10 minutes, put load on the blower.
- (D) Be very careful of various portions for 30 minutes after load is put on the blower. If there are any abnormal sound or heat, stop the blower at once, investigate the cause and remove it.

4-3. During Operation

- (A) Check various points and record the results periodically during the operation of the blower. In case of trouble, such record will make it easy to investigate the cause.
- (B) Points to check during the operation of the blower are as follows :
- * Voltage and amperage of the power source
 - * Delivery pressure and suction pressure of the blower
 - * Delivery temperature and suction temperature of the blower
 - * Quantity and cleanness of lubricating oil
 - * Vibration and noise
 - * Belt tension (in case of the belt drive type)
- (C) It must be noted that the blind drain plug for lubricating oil may become loose during operation due to vibration, and it may leak oil.
- (D) The quantity or pressure of air should be adjusted by changing the rotational frequency of the blower or by means of a relief valve. It should not be adjusted by means of the valve provided at the suction port or delivery port of the blower. In such a case, it is recommended to contact our technical dept.

4-4. Stopping

- (A) After stopping the blower, completely close the valves on the suction and delivery sides (and the valves and cocks

of the water cooling system if this system is used).

- (B) If the blower is repaired when it is stopped, be very careful that other person does not actuate the motor starter on the switchboard.
- (C) If the blower is stopped for a long period of time, turn it by hand from time to time to prevent it from seizing. In case of the water cooling type, completely remove the cooling water.

5. MAINTENANCE

To keep the proper operation of the blower, it is necessary to perform inspection and overhaul periodically.

5-1. Daily Inspection

- (A) Make sure that the ampere meter, voltmeter or thermometer does not indicate any abnormal value.
- (B) Make sure that the oil level of the oil gauge is proper and that there is no leakage of oil. Replace all oil after 500 hours of installation. (See par. 8 "LUBRICATING OIL AND GREASE".)
- (C) Make sure that the blower does not make an abnormal sound during operation.
- (D) Make sure that all bolts are tight enough.
- (E) Make sure that air in the blower chamber are clean and its temperature is normal. Make sure that the blower chamber is not vacuous. It becomes vacuous if the air intake is clogged up.

5-2. Inspection Every 2,000 Hours

- (A) Make sure that the filter on the suction side is not clogged up.
- (B) Make sure that bolts and blind plugs of oil are tight enough.
- (C) Make sure that the belt tension is proper.
- (D) Make sure that the blower does not make or abnormal sound during operation.
- (E) Replace lubricating oil. (See par. 8 "LUBRICATING OIL AND GREASE".)

5-3. Periodic Overhaul

Disassemble the blower every year for cleaning and inspection. In such a case, please contact our office.

- (A) Consumables of the blower includes bearings, gears, oil and belt (in case of the belt drive type).
- (B) Bearings wear only a little. However, if they are damaged, a serious trouble may occur. As a precautionary measure for safe operation, it is recommended to replace the bearings and oil seals about every 10,000 hours (about one year) and gears about every 45,000 hours (about five years).
- (C) Dirtiness of lubricating oil differs according to how the blower has been used. Usually, it is necessary to replace all the lubricating oil about every 2,000 hours (about three months). (See par. 8 "LUBRICATING OIL AND GREASE".)

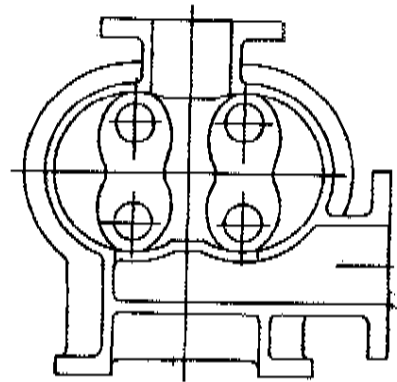
5-4. Measures to Take at Time of Trouble

If any abnormality has been found during the operation of the blower, stop the electric motor at once. When the cause is judged to exist inside the blower, remove the suction port. Inspect the inside of the blower. Make sure that

the pulley or coupling can be easily turned by hand. Check for the existence of seizure at the inside of the casing, rotors and bearings, and the existence of damage to gear teeth. If seizure is found or the rotor shafts cannot be turned by hand, the blower must be disassembled. In this case, let us know the trouble in detail.

5-5. Disassembly

- (A) Before starting disassembly, be sure to turn off the motor starter on the switchboard and be very careful that other person does not turn on the motor starter. For this purpose, it is advisable to stick a bill on the switchboard, which says that the motor starter must not be actuated because the blower is being disassembled.
- (B) Remove the suction port, and record the clearances between the rotors and the casing and between the rotors themselves. Such records are necessary for reassembly.
- (C) Remove the pulley or coupling. Remove lubricating oil from inside the front and rear covers. Then remove the cover clamping bolts.
- (D) Remove the gears.
- (E) Remove the splatter, front bearing clamping nuts, and bearing holders.
Be not to loose the shim liners on adjusting the rotor clearances.
- (F) Remove the bearing holders beside the gears.
- (G) Make both of the two rotors stand as shown in the figure at right.
Remove one of the two side covers. Then, the rotors can be pulled out.
- (H) Remove the rotors. Clean the chamber.
- (I) Wash all parts with light oil, and inspect them. Repair them if necessary. Replace bearings and seals if they are worn.



5-6. Reassembly and Adjustment

- (A) The blower can be reassembled by substantially reversing the order mentioned above. Packings relating to the axial clearances between the rotors and casing must be replaced by new ones of the same thickness, if they are torn. They do not have to be replaced if they are not torn.
- (B) Return the shim liners to their original positions on the front bearing holders.
- (C) Tighten up the nuts, etc. of the side cover, bearing holders and bearings. Attach the gears and fasten them a little. Measure the rotor clearances, and adjust them to the same values as before disassembly.
- (D) The clearances between the rotors and the side covers can be adjusted by the thickness of the shim liners on the front bearing holders. The clearance between the rotors should be made uniform by refastening the gears.
- (E) After adjusting the clearances, tighten up the clamping bolts and nuts again.
- (F) Attach the splatter, etc. Attach the front and rear covers. Tighten up the drain plug. Then, pour lubricating oil up to the proper level.
- (G) Return all other parts to their original positions. Start the blower in the same manner as described above.
- (H) Adjustment of Safety Valve

The safety valve is adapted to operate at a pressure 10 % higher than the prescribed pressure. The safety valve needs readjustment if it operates at a pressure under the prescribed pressure or if it fails to operate even at a pressure more than 10 % higher than the prescribed pressure. The readjustment can be made by tightening or loosening the spring.

6. TROUBLESHOOTING

Troubles	Causes	Remedies
Blower does not rotate.	<ol style="list-style-type: none"> 1. Power source system or motor is out of order 2. There is a foreign matter in blower. 3. Blower bearings are out of oil, clogged with dust or rusty. 4. Rotor contacts side cover or casing because bearings are damaged and shaft is inclined. 5. Inside of blower has seized. 	<ol style="list-style-type: none"> 1. Remedy the electric trouble. 2. Disassemble blower and remove foreign matter. 3. Clean and oil bearings. 4. Replace bearings and repair contacting portions. 5. Disassemble and repair blower.
<p>Performance has reduced. (Pressure is insufficient.)</p> <p>Quantity of air is insufficient.</p> <p>Temperature is too high.</p> <p>Electric current is too large.)</p>	<ol style="list-style-type: none"> 1. Strainer on suction side is clogged with dust. 2. Suction piping is clogged up. 3. Blower or its delivery piping including flanged portion leaks air or gas. 4. Safety valve is kept open. 5. Clearances in blower are too large. 6. Rotational frequency of rotors is reduced because they are liable to contact each other and produce large resistance. 7. Ampere meter is out of order. 8. Water flow is stopped in case of water cooling type. 	<ol style="list-style-type: none"> 1. Clean strainer. 2. Clean suction piping. 3. Repair leakage as by replacing packing. 4. Adjust safety valve. 5. Adjust clearances. 6. Disassemble and repair blower. 7. Repair ampere meter. 8. Repair water system at once.
<p>Delivery pressure is too high. (Large electric current flows, and vibration and abnormal sound are produced.)</p>	<ol style="list-style-type: none"> 1. Valve on delivery side is closed. 2. Delivery piping is clogged. 3. Safety valve is out of order. 4. Pressure gauge is broken. 	<ol style="list-style-type: none"> 1. Open valve. 2. Clean delivery piping. 3. Repair safety valve. 4. Replace pressure gauge.
Abnormal sound is produced.	<ol style="list-style-type: none"> 1. There is foreign matter in blower. 2. Clamping bolts are loose. 3. Bearings are loose. 4. Clamping bolts of silencer are loose, or the silencer leaks air or gas. In this case, large sound of air would be produced. 5. Engagement of gears are improper. 	<ol style="list-style-type: none"> 1. Remove foreign matter. 2. Tighten up clamping bolts. 3. Replace bearings. 4. Check piping. 5. Correct backlash.
Vibration is serious.	<ol style="list-style-type: none"> 1. Anchor bolts or blower clamping bolts are loose. 2. Piping support is improper. 3. Belt vibrates because V-pulleys of blower and motor are not aligned with each other. 4. There is drain in blower. 5. Delivery pressure is too high. 	<ol style="list-style-type: none"> 1. Tighten them up. 2. Correct support. 3. Align pulleys with each other. Reattach belt. 4. Remove drain. 5. See above.

7. RELATION BETWEEN ATMOSPHERIC TEMPERATURE AND DELIVERY TEMPERATURE

Delivery Pressure	Delivery temp. when atm. temp. is 30 °C	Delivery temp. when atm. temp. is 40 °C	Delivery temp. when atm. temp. is 50 °C
0.1 kg/cm ²	38.0 °C	48.4 °C	58.7 °C
0.2	45.7	56.3	66.8
0.3	53.0	63.7	74.4
0.4	59.7	70.7	81.7
0.5	66.3	77.4	88.6
0.6	72.4	83.8	95.2
0.7	78.2	89.9	101.5
0.8	83.9	95.8	107.6
0.9	89.4	101.4	113.4
1.0	94.5	106.9	119.0
1.1	99.7	112.1	124.4
1.2	104.2	117.2	129.7
1.3	109.0	112.1	134.7
1.4	113.6	126.9	139.7

This table show theoretical values. In practice, delivery temperature is 10°C to 20°C higher than them.

8. LUBRICATION OIL AND GREASE

Lubrication is very important for the proper operation of the blower. Please make sure to Use lubricating oil and grease that we recommend, or equivalents.

Replace all the lubricating oil and grease it 500 hours (20 days) after the blower is first operated subsequently to installation or disassembly, and every about 2,000 hours (about three months) thereafter.

For the aforesaid replacement, see par. 8-1 (B) and 8-2 (B).

8-1. Lubricating oil

(A) In the IRS 100A and larger models, the bearings on the gear side are splashed with oil by means of a splatter attached to the end of the shaft, and they are not dipped in oil.

If the oil level is too high, the temperature may get abnormally high because of the heat agitation. If the oil level is too low, a serious trouble may occur. Supply a proper quantity of oil in accordance with the indication of the oil gauge.

Check the oil level frequently, and add oil whenever necessary. It is possible to add oil when the blower is being operated, but care must be taken not to touch the pulleys or belt.

(B) To replace all the oil, please follow the instruction : Stop the blower and remove all the oil by detaching the oil drain plugs. Carefully remove metal powder, etc. from inside. Attach the plugs. Then, supply new oil, through each oil intake at the top, up to the indication line of each oil gauge. Be very careful that dust does not enter with the oil.

(C) Quantity of oil to be supplied

(in liter)

Blower models	Front bearings (driving)	Rear bearings (gear side)	Gear teeth
IRS-32A IRS-40A	Grease, sealed		
50H	Grease 50 cc		Oil 0.3
65H <i>65C</i>	" "	Grease	Oil 0.4
80H	" 80 cc	"	"
80C	" "	"	Oil 0.8
100C	" "		Oil 2.2
125C	" "		"
125D	" "		"
80B	Oil 1.8		Oil 2.2
100A	"		"
125A	"		"
125B	"		"
150A	Oil 2.2		Oil 4.2
200A	"		"
200B	"		"
200C	Oil 3.5		Oil 5.7
250A	"		"
300A	"		"
300B	"		Oil 6.5
350A	"		"
400A	"		"
400C	Oil 10		Oil 18
400D	"		"
450A	"		"
500B	"		"

(D) Brands of lubricating oil

Use an equivalent turbine oil set forth in JIS K2213.

Some of the typical brands we recommend are as follows.

Mobile	Esso	Shell
DTE Oil Heavy Medium	Telesso 68	Turbo Oil T68

With respect to oil for blowers used for special purposes (very cold districts, superhigh temperature gas, etc.) please ask for our advice.