

OPERATION AND MAINTENANCE MANUAL for MODELS 2X and 22 MULTI-VANE® DRILLS and MODEL 22N51 MOTOR

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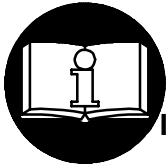


NOTICE

Close Quarter Multi-Vane® Drills, Nonreversible Models 2XJA1, 2XKA1 and 2XMA2, and Reversible Models 22JA1, 22KA1, 22MA2 and 22NA1, are designed for heavy steel fabrication and maintenance.

Ingersoll-Rand is not responsible for customer modification of tools for applications on which Ingersoll-Rand was not consulted.

⚠ WARNING



**IMPORTANT SAFETY INFORMATION ENCLOSED.
READ THIS MANUAL BEFORE OPERATING TOOL.**

**IT IS THE RESPONSIBILITY OF THE EMPLOYER TO PLACE THE INFORMATION
IN THIS MANUAL INTO THE HANDS OF THE OPERATOR.
FAILURE TO OBSERVE THE FOLLOWING WARNINGS COULD RESULT IN INJURY.**

PLACING TOOL IN SERVICE

- Always operate, inspect and maintain this tool in accordance with American National Standards Institute Safety Code for Portable Air Tools (ANSI B186.1).
- For safety, top performance, and maximum durability of parts, operate this tool at 90 psig (6.2 bar/620 kPa) maximum air pressure at the inlet with 1/2" (13 mm) inside diameter air supply hose.
- Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.
- Do not use damaged, frayed or deteriorated air hoses and fittings.
- Be sure all hoses and fittings are the correct size and are tightly secured. See Dwg. TPD905-1 for a typical piping arrangement.
- Always use clean, dry air at 90 psig maximum air pressure. Dust, corrosive fumes and/or excessive moisture can ruin the motor of an air tool.
- Do not lubricate tools with flammable or volatile liquids such as kerosene, diesel or jet fuel.
- Do not remove any labels. Replace any damaged label.

USING THE TOOL

- Always wear eye protection when operating or performing maintenance on this tool.

- Always wear hearing protection when operating this tool.
- Keep hands, loose clothing and long hair away from rotating end of tool.
- Note the position of the reversing lever before operating the tool so as to be aware of the direction of rotation when operating the throttle.
- Anticipate and be alert for sudden changes in motion during start up and operation of any power tool.
- Keep body stance balanced and firm. Do not overreach when operating this tool. High reaction torques can occur at or below the recommended air pressure.
- Tool shaft may continue to rotate briefly after throttle is released.
- Air powered tools can vibrate in use. Vibration, repetitive motions or uncomfortable positions may be harmful to your hands and arms. Stop using any tool if discomfort, tingling feeling or pain occurs. Seek medical advice before resuming use.
- Use accessories recommended by Ingersoll-Rand.
- This tool can exert strong forces on the operator. Use proper support to control these forces.
- This tool is not designed for working in explosive atmospheres.
- This tool is not insulated against electric shock.

NOTICE

The use of other than genuine Ingersoll-Rand replacement parts may result in safety hazards, decreased tool performance, and increased maintenance, and may invalidate all warranties.

Repairs should be made only by authorized trained personnel. Consult your nearest Ingersoll-Rand Authorized Servicenter.

Refer All Communications to the Nearest
Ingersoll-Rand Office or Distributor.

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WARNING LABEL IDENTIFICATION

⚠ WARNING


FAILURE TO OBSERVE THE FOLLOWING WARNINGS COULD RESULT IN INJURY.




⚠ WARNING
Always wear eye protection when operating or performing maintenance on this tool.




⚠ WARNING
Always wear hearing protection when operating this tool.




⚠ WARNING
Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.




⚠ WARNING
Air powered tools can vibrate in use. Vibration, repetitive motions or uncomfortable positions may be harmful to your hands and arms. Stop using any tool if discomfort, tingling feeling or pain occurs. Seek medical advice before resuming use.




⚠ WARNING
Do not carry the tool by the hose.



⚠ WARNING
Do not use damaged, frayed or deteriorated air hoses and fittings.



⚠ WARNING
Keep body stance balanced and firm. Do not overreach when operating this tool.

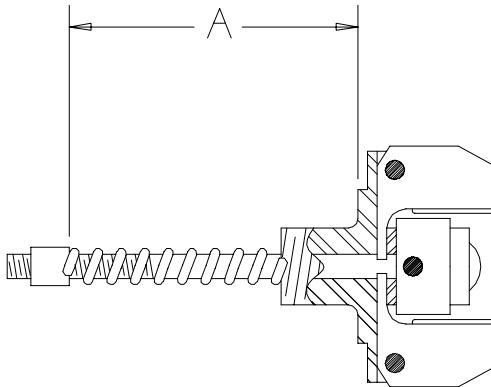


⚠ WARNING
Operate at 90 psig (6.2 bar/ 620 kPa) Maximum air pressure.

ADJUSTMENTS

GOVERNOR ADJUSTMENT

When installing a new Governor Assembly, screw the Adjusting Nut onto the Stem to **dimension "A"** shown in Dwg. TPD497. This will usually result in the proper governed free speed of the Spindle. However, this is only an approximate setting and, after checking with a tachometer, further adjustment may be necessary. Screw the Nut farther onto the Stem to increase the speed; back it off to decrease the speed.



A=1-31/32" for Drills with Standard Throttle
A = 1-7/8" for Motors equipped with Remote Control
(Dwg. TPD497)

The correct governed free speed for the various Models at the Spindle is:

Model	Speed, rpm
22JA1-EU, 2XJA1-EU	1 025
22KA1-EU, 22KWA1-EU, 2XKA1-EU	725
22MA2-EU, 2XMA2-EU	350
22NA1-EU	280

OILER ADJUSTMENT

To adjust oiler, remove the Backhead (12) and turn the Oiler Adjusting Screws (14). Turning the Screws in (clockwise) reduces the oil flow. Backing the Screws out increases the oil flow. The oil flow can be controlled by turning either Screw.

PLACING TOOL IN SERVICE

LUBRICATION



Ingersoll-Rand No. 50 **Ingersoll-Rand No. 28**

Always use an air line lubricator with this tool.
We recommend the following Filter-Lubricator-Regulator Unit:

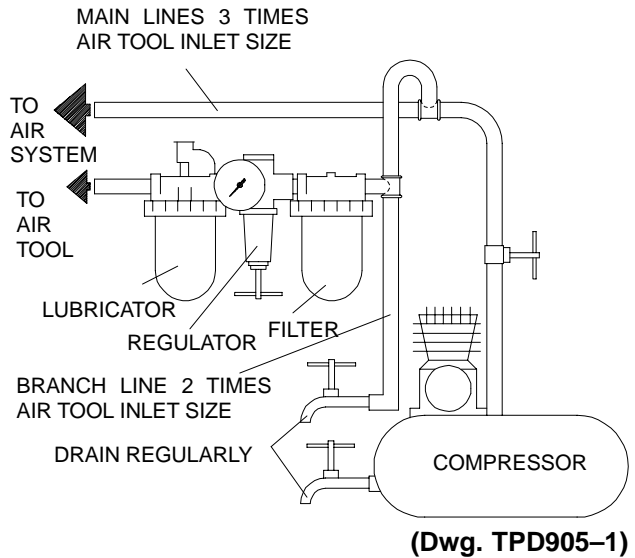
USA N° C28-04-FKG0-28

Before starting the tool and after each eight hours of operation, unless the air line lubricator is used, after detaching the air hose, unscrew the Oil Chamber Plug (18) and fill the chamber in the Backhead (12) with Ingersoll-Rand No. 50 Oil.

After each forty-eight hours of operation, or as experience indicates, inject about 1 to 2 cc of Ingersoll-Rand No. 28 Grease into the Grease Fitting (2 and 17).



Occasionally, inject 2 to 3 drops of Ingersoll-Rand No. 50 Oil into the oil hole in the Throttle Sleeve (83).



HOW TO ORDER A LARGE DRILL

NONREVERSIBLE ROLL THROTTLE

Model	Free Speed rpm	Capacity in Steel				Spindle	Spindle Attachment
		Drilling		Reaming			
		in.	mm.	in.	mm.		
2XJA1	1,025	9/16	14	3/8	10	0.703-16 thread	0-1/2" Chuck
2XKA1	725	9/16	14	7/16	11	0.703-16 thread	0-1/2" Chuck
2XMA2	350	7/8	22	5/8	16	No. 2 Morse Taper Socket	

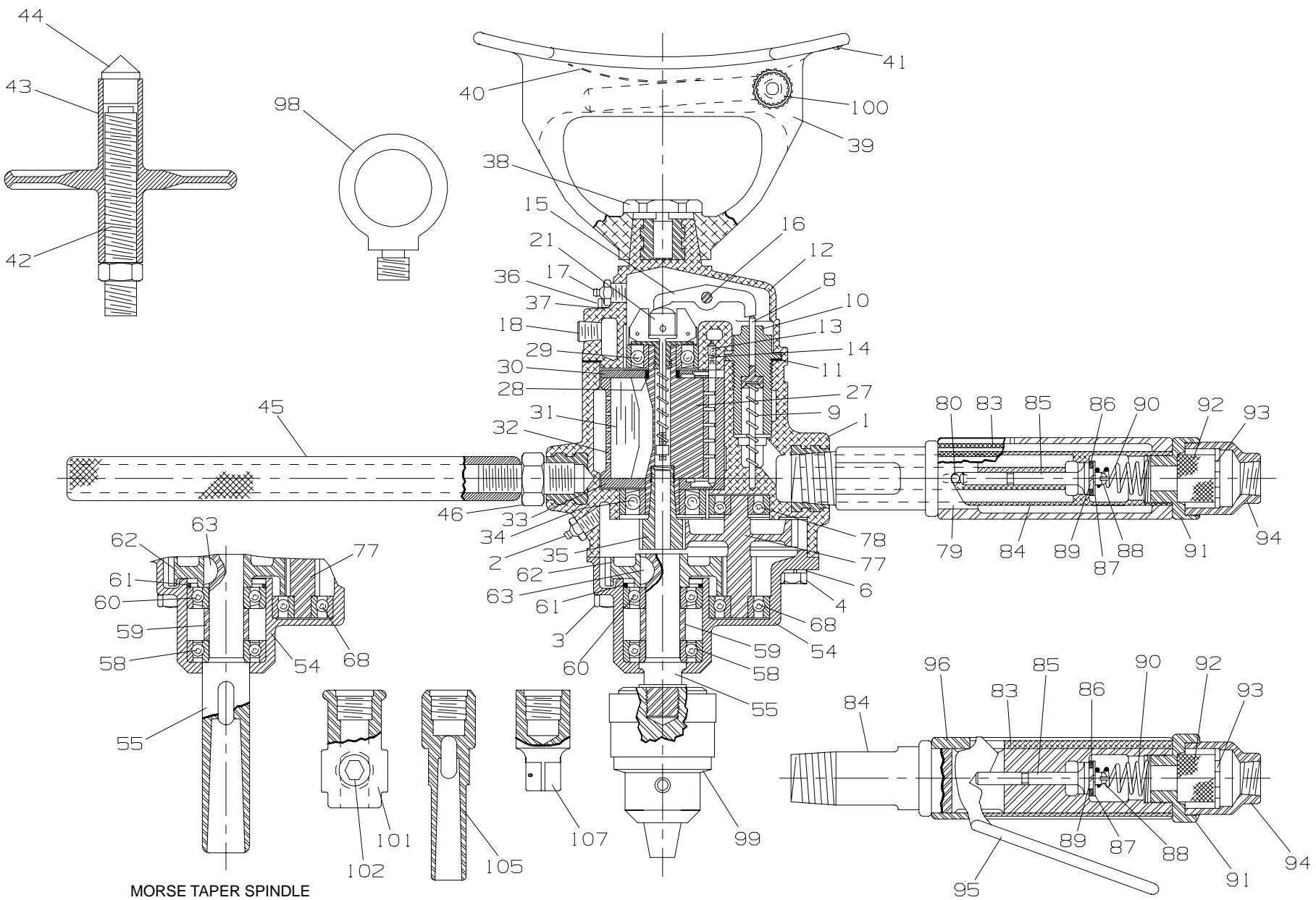
REVERSIBLE ROLL THROTTLE

22JA1	1,025	9/16	14	3/8	10	Stub Taper, Threaded	0-1/2" Chuck
22KA1	725	9/16	14	7/16	11	Stub Taper, Threaded	0-1/2" Chuck
22MA2	350	7/8	22	5/8	16	No. 2 Morse Taper Socket	
22NA1	280	7/8	22	5/8	16	Stub Taper, Threaded	5/8" Square Drive
22KWA1	725	—	—	—	—	Stub Taper, Threaded	1/2" Shank Wood, Bit Chuck

HOW TO ORDER A MOTOR

REVERSIBLE BASE-MOUNTED MULTI-VANE MOTOR

Model	Free Speed, rpm
22N51	280



MORSE TAPER SPINDLE

2X Series (Non-Reversible)

(Dwg. TPA121-2)

MAINTENANCE SECTION



PART NUMBER FOR ORDERING



		2XJ, 2XK and 2XM	22J, 22K, 22M, 22N and 22KW
1	Motor Housing		
	for 22N models	—	R22N-40
	for models ending in -EU	R2XH-EU-40	R22H-EU-K40
	for all other models	R2XH-40	R22H-K40
*	Warning Label		
	for models ending in -EU	EU-99	EU-99
	for all other models	WARNING-8-99	WARNING-8-99
*	Nameplate		
	for models ending in -EU	R2H-EU-99	R2H-EU-99
	for all other models	R2H-99	R2H-99
2	Grease Fitting	23-188	23-188
∅ 3	Housing Stud (for 22N) (4)	R2N-133	R2N-133
	Housing Long Cap Screw (for all others) (4)	R22H-68	R22H-68
∅ 4	Housing Short Cap Screw (2)	R3-7	R3-7
5	Stud Nut (1 for each stud)	T06-139	T06-139
6	Lock Washer (6)	8U-58	8U-58
7	Reverse Valve Bushing	—	R22H-330
8	Governor Valve	R3H-425	R3H-425
9	Governor Valve Spring	503-431	503-431
10	Governor Valve Bushing	R22H-429	R22H-429
• *	Air Port Gasket (1 for 2X Series and 2 for 22 Series)	R22H-210	R22H-210
• 11	Backhead Gasket	R22H-283	R22H-283
12	Backhead	R22H-102	R22H-102
13	Oiler Felt (2)	R1-75	R1-75
14	Oiler Adjusting Screw (2)	R1-71A	R1-71A
15	Governor Lever	R22H-436	R22H-436
16	Governor Lever Pin	T22-306	T22-306
17	Grease Fitting	23-188	23-188
18	Oil Chamber Plug	R2-227	R2-227
21	Governor Assembly	R2XJ-A424	R2XJ-A424

MAINTENANCE SECTION

- * Not illustrated.
- ∅ Listed Cap Screw can be used as a replacement for the previously used Stud.
- To keep downtime to a minimum, it is desirable to have on hand certain repair parts. We recommend that you stock one (pair or set) or each part indicated by a bullet (•) for every four tools in service.

PART NUMBER FOR ORDERING



		2XJ, 2XK and 2XM	22J, 22K, 22M, 22N and 22KW
27	Rotor	R22H-K53	R22H-K53
28	Rotor Bearing Spacer	R2H-65	R2H-65
• 29	• Rear Rotor Bearing	R2-22	R2-22
• 30	• Rear End Plate	R2J-12	R22H-12
• 31	• Vane Packet (set of 5 Vanes)	R2-42B-5	R2-42B-5
32	Cylinder	R2J-3	R22H-3
*	Cylinder Dowel	R22H-98	R22H-98
• 33	• Front End Plate	R2J-11	R22H-11
• 34	• Front Rotor Bearing	R2-24A	R2-24A
35	Rotor Pinion for 2XJ, 2XK, 22J, 22K and 22KW (15 teeth)	R2J-17	R2J-17
	for 2XM and 22M (9 teeth)	R2M-17A	R2M-17A
	for 22N (17 teeth)	R2N-17	R2N-17
36	Backhead Cap Screw (6)	R22H-68	R22H-68
37	Backhead Cap Screw Lock Washer (6)	8U-58	8U-58
38	Breast Plate Screw	T15-278	T15-278
39	Breast Plate	R22H-79	R22H-79
40	Chuck Wrench Clip	R2J-247	R2J-247
41	Clip Screw	R2J-248	R2J-248
	Feed Screw Assembly	T04-A3	T04-A3
42	Feed Screw	T04-3	T04-3
43	Feed Handle	T05-2A	T05-2A
44	Feed Handle Center	T05-244A	T05-244A

* Not illustrated.

- To keep downtime to a minimum, it is desirable to have on hand certain repair parts. We recommend that you stock one (pair or set) or each part indicated by a bullet (●) for every four tools in service.

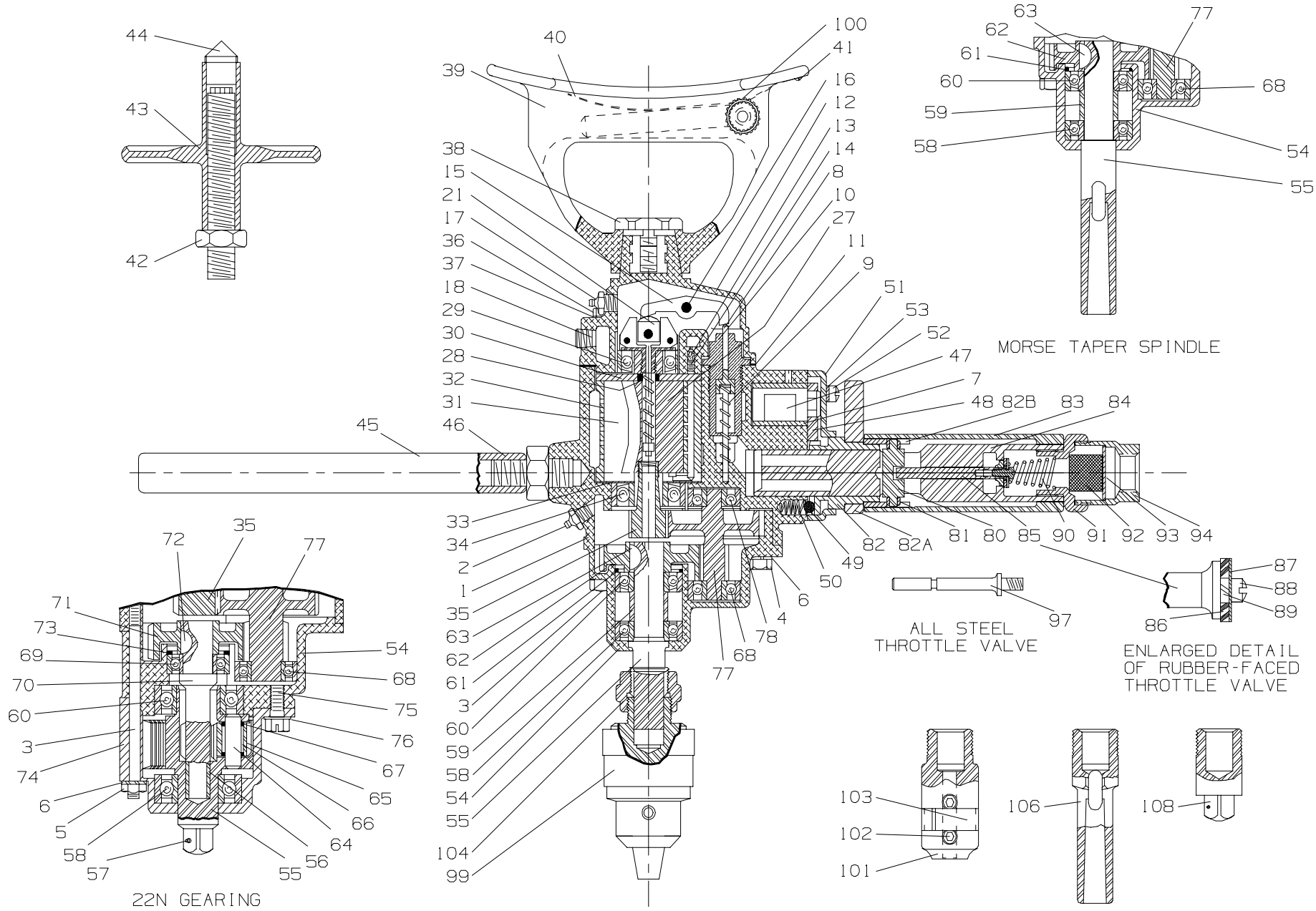
PART NUMBER FOR ORDERING



		2XJ, 2XK and 2XM	22J, 22K, 22M, 22N and 22KW
45	Dead Handle	R2K-48	R2K-48
46	Dead Handle Stud	R2K-364A	R2K-364A
47	Reverse Valve	—	R22H-329
48	Reverse Valve Sector	—	TCC-428
∇ 49	Stop Pin	—	R22H-491
∇ 50	Stop Pin Spring	—	5UT-759
51	Sector Cover	—	TCC-429A
52	Sector Cover Screw (4)	—	TCC-430
53	Sector Cover Screw Lock Washer (4)	—	T05-58
*	Throttle Body Set Screw	—	TCCW-433
*	Throttle Body Set Screw Lock Washer	—	D02-537

* Not illustrated.

∇ Used only with Manual-Closing Throttles. In compliance with the Williams-Steiger Occupational Safety and Health Act, Manual-Closing Throttle Assemblies and parts used exclusively for Manual-Closing Throttles will be furnished only on international orders.



MAINTENANCE SECTION

22N GEARING

MORSE TAPER SPINDLE

ALL STEEL THROTTLE VALVE

ENLARGED DETAIL OF RUBBER-FACED THROTTLE VALVE

22 Series (Reversible)

(Dwg. TPA122-3)



PART NUMBER FOR ORDERING



		2XJ, 22J	2XK, 22K, 22KW	2XM, 22M	22N
54	Gear Case				
	for threaded Stub Taper or No. 2 Morse Taper Spindle	RM2J-37	RM2J-37	RM2J-37	—
	for No. 3 Morse Taper Spindle	—	—	R2M-137	—
	for 5/8" Square Drive or Stub Taper Spindle	—	—	—	R2N-37
	Spindle Assembly				
	Threaded Spindle (for Series 2X)	R2J-A8	R2K-A8	R2K-A8	—
	Stub Taper Spindle (for Series 22)	R22J-A8	R22K-A8	R22K-A8	—
	Stub Taper Spindle	—	—	—	R22N-A8
	No. 2 Morse Taper Spindle	R2H-A108	R2M-A108	R2M-A108	—
	No. 3 Morse Taper Spindle	—	—	R2M-A208	—
	5/8" Square Drive Spindle with Pin-Type Retainer	—	—	—	R22N-AP108
	5/8" Square Drive Spindle with Ball-Type Retainer	—	—	—	R22N-AB108
55	Spindle				
	Threaded (703-16 thd.) (for Series 2X)	R2H-8	R2H-8	R2H-8	—
	Stub Taper (for Series 22)	R22H-8	R22H-8	R22H-8	—
	Stub Taper	—	—	—	R22N-8
	No. 2 Morse Taper	R2M-108	R2M-108	R2M-108	—
	No. 3 Morse Taper	—	—	R2M-208	—
	5/8" Square Drive with Pin-Type Retainer	—	—	—	R22N-P108
	5/8" Square Drive with Ball-Type Retainer	—	—	—	R22N-B108
56	Spindle Gear Shaft Bushing	—	—	—	T06-110
57	Socket Retaining Plunger (for 5/8" Square Drive Spindle)				
	Pin-Type	—	—	—	808-716
	Ball-Type	—	—	—	8U-715

PART NUMBER FOR ORDERING



		2XJ, 22J	2XK, 22K, 22KW	2XM, 22M	22N
	Plunger Retaining Spring (for 5/8" Square Drive Spindle)	—	—	—	5UHD-718
58	Spindle Bearing	R2H-510	R2H-510	R2H-510	D01-616
59	Spindle Bearing Spacer	R2H-111	R2H-111	R2H-111	—
60	Thrust Bearing	R2H-97	R2H-97	R2H-97	G7-24
61	Bearing Retainer	R2H-118	R2H-118	R2H-118	—
62	Spindle Gear	R21-9	R2K-9	R2K-9	—
63	Spindle Gear Key	TC-18	TC-18	TC-18	—
64	Planet Gear Shaft (3)	—	—	—	R2N-191
65	Planet Gear (3)	—	—	—	R2N-10
66	Planet Gear Roller (63)	—	—	—	R2N-152
67	Roller Retaining Plate (6)	—	—	—	R2N-655
68	Intermediate Gear Front Bearing	T06-33	T06-33	T06-33	T06-33
69	Spindle Gear Bearing	—	—	—	T06-24
70	Spindle Gear Shaft	—	—	—	R2N-16
71	Spindle Gear	—	—	—	R2J-9
72	Spindle Gear Key	—	—	—	TC-18
73	Bearing Retainer	—	—	—	R2H-1 18
74	Gear Case Cover	—	—	—	R2N-378
75	Gear Case Cover Cap Screw	—	—	—	R2N-103
76	Cover Cap Screw Lock Washer	—	—	—	8U-58
77	Intermediate Gear for 2XJ and 22J (13/45 teeth)	R2J-82	—	—	—
	for 2XK, 22K and 22KW (10/45 teeth)	—	R2K-82	—	—
	for 2XM and 22M (9/50 teeth)	—	—	R2M-82A	—
	for 22N (13/43 teeth)	—	—	—	R2N-82
78	Intermediate Gear Rear Bearing	R1L-24	R1L-24	R1L-24	R1L-24

PART NUMBER FOR ORDERING



		NONREVERSIBLE DRILLS		REVERSIBLE DRILLS
		Roll Throttle	Lever Throttle	Roll Throttle
	Throttle Assembly	R2XH-A417	R2XH-AL401	R22H-A518-2
79	Throttle Cam	T01-317A	—	—
80	Throttle Valve Lift Pin	TCC-306B	—	R4H-306
81	Throttle Valve Lift Pin Roller (2)	—	—	TAA-426
82	Throttle Sector	—	—	R33P5-1487
82A	Reverse Lever (for reversible models only)	—	—	R55H-314
*	Reverse Lever Set Screw (2)	—	—	R2J-561
82B	Throttle Cam (for reversible models only)	—	—	22MA2-317
83	Throttle Sleeve	TCL-305	R2J-269	R4H-305
× 84	Throttle Body	R3H-401	R3H-401	22B518-409
⊕ 85	Rubber-Faced Throttle Valve	R3H-402	R3H-402	R3H-402
• 86	Throttle Valve Face	8000-159A	8000-159A	8000-159A
87	Throttle Valve Face Cap	8000-157	8000-157	8000-157
88	Throttle Valve Face Retaining Screw	R4-158	R4-158	R4-158
89	Retaining Screw Lock Washer	H54U-352	H54U-352	H54U-352
• 90	Throttle Valve Spring	TAA-418	T01-308	TAA-418
	Air Strainer Assembly	R22H-A565	R22H-A565	R4H-A565
91	Air Strainer Cap	R3H-566	R3H-566	R4H-566
92	Air Strainer Screen	R3H-61	R3H-61	R3H-61
93	Air Strainer Screen Support	R3H-567	R3H-567	R3H-567
94	Air Strainer Body	R22H-565	R22H-565	R3H-565
95	Throttle Lever	—	R2J-273	—
96	Throttle Lever Spacer	—	R2J-270	—
*	Rotational Label	R2H-100	R2H-100	R3H-565
97	All Steel Throttle Valve	T01-302	T01-302	T01-302

- * Not illustrated.
- × If ordered as a replacement for a Throttle Body equipped with an All-Steel Throttle Valve also order the Rubber Faced Throttle Valve (85). The Throttle Body for use with the All-Steel Throttle Valve is discontinued.
- ⊕ Cannot be used as a replacement for the All-Steel Throttle Valve.
- To keep downtime to a minimum, it is desirable to have on hand certain repair parts. We recommend that you stock one (pair or set) of each part indicated by a bullet (•) for every four tools in service.



MAINTENANCE SECTION

PART NUMBER FOR ORDERING



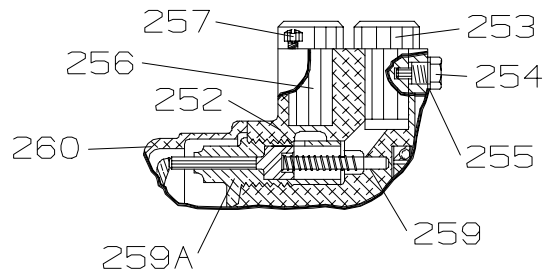
		2XJ, 2XK and 2XM	All Series 22
98	Suspension Ring	T05-365	T05-365
99	Drill Chuck		
	1/8" to 5/8" capacity	R2H-99	—
	0 to 1/2" capacity	T05-99A	—
	5/64" to 1/2" capacity	—	DE-99C
100	Drill Chuck Wrench		
	for 1/8" to 5/8" chuck	T05-J253	—
	for 0 to 1/2" chuck	T05-J253	—
	for 5/64" to 1/2" capacity	—	R1T-J253
101	Wood Bit Chuck	R2H-151	R22W-151
102	Wood Bit Chuck Screw		
	(1 for R2H-51; 2 for R22W-151)	R33W-150	R33W-150
103	Chuck Screw Retainer	—	R33W-149
*	Wood Bit Chuck Wrench (5/16" x 6" long hex wrench)	K-27	K-27
104	Chuck Nut	—	DE-347A
105	Use-Em-Up Socket (No. 2 Morse Taper Socket)	T05-294-2	—
106	Morse Taper Socket		
	No. 1 Morse Taper Socket	T05-323-1	DE-323A-1
	No. 2 Morse Taper Socket	T05-323-2	DE-323A-2
	No. 3 Morse Taper Socket	T05-323-3	DE-323A-3
107	Socket Adapter (1/2" square drive) (Pin-Type Retainer)	R2J-212B	—
• *	Socket Retaining Plunger	804-716	—
*	Retaining Plunger Spring	5UHD-718	—
108	Socket Adapter (Overall length 1-3/4")		
	1/2" Square Drive	—	DE-215A
	5/8" Square Drive	—	DE-215B
*	Hose Nipple (1/2" hose to 3/8" male pipe)	A01-46	A01-46

* Not illustrated.

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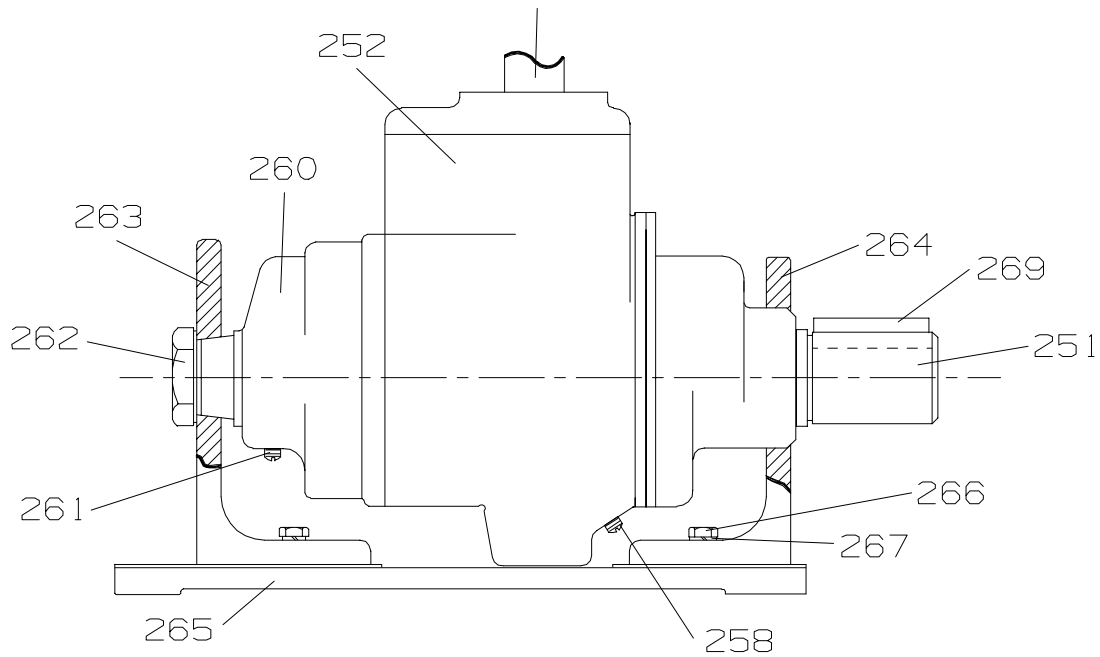
MAINTENANCE SECTION

MODEL 22N51-W/RC BASE-MOUNTED MULTI-VANE MOTOR



REMOTE CONTROL PARTS

NOTE:
SEE DRILL ILLUSTRATIONS AND
LIST OF THROTTLES AVAILABLE



(Dwg. TPB152-2)

MAINTENANCE SECTION

Parts used on Model 22N51–W/RC Base Mounted Motors are illustrated in the accompanying view and from the list below. All others are the same as corresponding parts for Drills illustrated on page 20 and should be ordered accordingly.

PART NUMBER FOR ORDERING



	Spindle Assembly	R2XN51–A8
251	Spindle (All other parts included in the Spindle Assembly are the same as those included in the Spindle Assembly of Drills.)	E22N–8
252	Motor Housing	
	for models ending in –EU	R22N51–EU–RC40
	for all other models	R222N51–RC40
*	Warning Label	
	for models ending in –EU	EU–99
	for all other models	WARNING–10–99
*	Nameplate	
	for models ending in –EU	R2H–EU–99
	for all other models	R2H–99
253	Forward Inlet Stud	R22H–471
254	Forward Inlet Stud Lock Screw	TCCW–433
255	7/16” Lock Washer	D02–537
256	Reverse Inlet Stud	R22H–472
257	Reverse Inlet Stud Lock Screw	T05–44
258	1/8” Pipe Plug	R2–227
259	Governor Valve Spring	R22F61–431
259A	Governor Valve Bushing	R22F61–429
∅	Housing Long Stud (4) (All other parts included in the Motor Housing are the same as those included in the Motor Housing of Drills.)	R22N51–133
⊗	Cylinder	R22H61–3
260	Backhead	R22H–102
261	1/8” Pipe Plug (All other parts included in the Backhead are the same as those included in the Backhead for Drills) (See illustrated part 12)	R2–227
262	Motor Mounting Screw	T15–278
263	Rear Motor Mounting Bracket	R22N51–304
264	Front Motor Mounting Bracket	R22N51–303
265	Motor Mounting Base	R22N51–564A
266	Base Cap Screw (4)	D02–506
267	Base Cap Screw Lock Washer (4)	D02–321
269	Spindle Key	R2XH51–768

* Not illustrated.

∅ See illustration No. 3 for Drills. Order by Part Number shown above.

⊗ See illustration No. 32 for Drills. Order by Part Number shown above.

MAINTENANCE TOOLS

DESCRIPTION	OPERATION	TOOL NO.
Grease Gun	Lubrication.	P25–228
Throttle Body Puller	Pulling the Throttle Body (84) from the Motor Housing (1) on Series 22 Drills.	10203
Reverse Valve Bushing Reamer	Reaming the Reverse Valve Bushing (7) after pressing it into the Motor Housing (1) on Series 22 Drills.	22733

MAINTENANCE SECTION

WARNING

Always wear eye protection when operating or performing maintenance on this tool.

Always turn off air supply and disconnect air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.

LUBRICATION

Each time the Models 2XJ, 2XK, 2XM, 22J, 22K, 22M, 22N and 22KW Drills and Model 22N51-W/RC Motor are disassembled for maintenance, repair or replacement of parts, lubricate the tool as follows:

1. Inject 1–2 cc of Ingersoll–Rand Impactool No. 28 Grease through the Grease Fitting (2) and (17).
2. Unscrew the Oil Chamber Plug (18) and fill the oil chamber with Ingersoll–Rand No. 50 Oil.
3. Occasionally, inject 2 – 3 drops of Ingersoll–Rand No. 50 Oil into the oil hole in the Throttle Sleeve (83).

DISASSEMBLY

General Instructions

1. Do not disassemble the tool any further than necessary to replace or repair damaged parts.
2. Whenever grasping a tool or part in a vise, always use leather–covered or copper–covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members and housings.
3. Do not remove any part which is a press fit in or on a subassembly unless the removal of that part is necessary for repairs or replacement.
4. Do not disassemble the tool unless you have a complete set of new gaskets and O–rings for replacement.

Maintenance Procedure

1. Keep the air strainer clean. Periodically, as experience indicates, unscrew the Air Strainer Body (94) from the Air Strainer Cap (91) and wash the Air Strainer Screen (92) in a clean, suitable, cleaning solution. Push the prongs on the Air Strainer Screen Support (93) into one end of the Screen and insert the Screen, support end first, into the Body when assembling the strainer.
2. **For Reversible Tools**, remove the throttle body set screw from the side of the Motor Housing (1 or 252) before attempting to pull the Throttle Body (84) from the Housing.

3. The thread on the Governor Assembly (21) is a **left–hand thread**; turn it **clockwise** to unscrew it from the Rotor (27)

WARNING

Never clamp the Cylinder (32) in a vise.

4. When disassembling the motor, grasp the Cylinder in one hand. Insert a 5/16" diameter rod into the bore of the Rotor (27) and drive the rotor hub out of the Rear Rotor Bearing (29). Unscrew the Rotor Pinion (35) from the Rotor and screw a 3/8"–24 thread bolt in its place. Support the Front End Plate (33) and press the rotor front hub out of the Front Rotor Bearing (34).
5. The front hub of the Rotor contains a tapered socket. The rim of the Front End Plate is flatted, one flat on Series 2X; two on Series 22. When assembling the motor, slip the Front End Plate, crescent grooved side first, over the rotor front hub and retain it by pressing the Front Rotor Bearing shielded side first, onto the rotor hub as far as possible without binding the End Plate against the rotor face. Clean and dry the tapered surfaces of the Rotor and Rotor Pinion and screw the Pinion tightly into the Rotor. Insert a Vane (31) into each vane slot in the Rotor. Place the Cylinder over the Rotor and onto the End Plate. Align the air ports and dowel hole in the Cylinder and End Plate. If they cannot be aligned, invert the Cylinder. Install the Rear End Plate (30), crescent grooved side first, and Rear Rotor Bearing (29), shielded side first.
6. When applying the Backhead (12 or 260), draw it evenly against the Backhead Gasket (11) on the face of the Motor Housing (1 or 252) by turning each Backhead Cap Screw (36) a little at a time until all are tight.

For All Models Except 22N

1. Insert a small screwdriver through one of the holes in the Spindle Gear (62) and pry the Bearing Retainer (61) out of the groove in the Gear Case (54) before attempting to withdraw the Spindle Assembly from the Gear Case.
2. Press the Spindle (55) out of the Spindle Gear and remove the Spindle Gear Key (63) from the Spindle before attempting to press the Spindle out of the Thrust Bearing (60), Spindle Bearing Spacer (59) and Spindle Bearing (58).
3. Press the Intermediate Gear Front Bearing (68) into the Gear Case before installing the Spindle Assembly.
4. In the order named, press the Spindle Bearing, sealed side first, Spindle Bearing Spacer and Thrust Bearing, shielded side first, onto the Spindle.
5. Lay the Bearing Retainer on the web of the recessed hub side of the Spindle Gear and press the Spindle into the Spindle Gear.

MAINTENANCE SECTION

6. Slide the Spindle Assembly into the Gear Case and install the Bearing Retainer in the groove in the Gear Case with a small screwdriver inserted through one of the holes in the Spindle Gear.

For Model 22N

1. Rotate the Spindle Gear (71) until one of the holes in the gear web aligns with the notch in the gear case wall. Insert a small screwdriver into the notch and pry the Bearing Retainer (73) out of the groove in the Gear Case before attempting to remove the Spindle Gear Shaft (70) from the Gear Case.
2. Press the Spindle Gear Shaft out of the Spindle Gear and remove the Spindle Gear Key (72) from the Shaft before attempting to press the Shaft out of the Spindle Gear Bearing (69).
3. Support the short hub end of the Spindle (55 or 251) and press on the front end of the Planet Gear Shafts (64) when removing the Shafts from the spindle gear head. The Planet Gear Rollers (66) and Roller Retaining Plates (67) are free to drop out when the Gears are removed from the Spindle. Use care to prevent loss of these small parts.
4. When assembling the Spindle, coat the inner wall of the Planet Gears (65) with the recommended grease and insert a Planet Gear Shaft through each gear bore. Slide twenty-one Planet Gear Rollers into the space between the gear wall and Shaft. Slip a Roller Retaining Plate over each end of the Shaft and against the Rollers. Carefully withdraw the Shafts and insert the Gears into the gear frame on the Spindle.
5. Install the Spindle Bearing shielded side first on the Spindle. On the shielded side, the face of the bearing inner ring is slightly lower than that of the outer ring. On the opposite side of the Bearing the faces are flush.
6. Press the Intermediate Gear Front Bearing into the Gear Case before installing the assembled Spindle Gear Shaft.
7. Lay the Bearing Retainer on the web of the recessed hub side of the Spindle Gear and press the Spindle Gear Shaft into the Spindle Gear. Slide the assembled Spindle Gear Shaft into the Gear Case. Insert a small screwdriver through the holes in the Spindle Gear and install the Bearing Retainer in the gear case groove.

MAINTENANCE SECTION

TROUBLESHOOTING GUIDE

Trouble	Probable Cause	Solution
Low power or low free speed	Dirty Inlet Bushing or Air Strainer Screen and/or Exhaust Silencer	Using a clean, suitable, cleaning solution in a well-ventilated area, clean the Air Strainer Screen, Inlet Bushing and Exhaust Silencer. Allow to air dry.
	Worn or broken Vanes	Replace complete set of Vanes.
	Worn or broken Cylinder and/or scored End Plates.	Examine Cylinder and replace it if it is worn or broken or if bore is scored or wavy. Replace End Plates if they are scored.
	Dirty motor parts.	Disassemble the tool and clean all parts with a clean, suitable, cleaning solution, in a well-ventilated area. Reassemble the tool.
	Improper positioning of Reverse Valve.	Make certain Reverse Valve is fully engaged to left or right.
Motor will not run	Incorrect assembly of motor.	Disassemble motor, replace worn or broken parts and reassemble as instructed.
Rough operation	Worn or broken Rear Rotor Bearing Assembly or Front Rotor Bearing	Examine each bearing. Replace if worn or damaged.
	Worn or broken Bevel Gear or Bevel Pinion	Examine the Bevel Gear and Bevel Pinion. If either is worn or damaged, replace both the Gear and the Pinion because they are a matched set and must not be used separately.
Air leaks	Worn Valve Face or Valve Face Cap	Replace worn parts.
	Oil Chamber Plug worn or not tight	Tighten the Plug. If the problem persists, replace the Plug.
Gear Case gets hot	Insufficient grease	Clean and inspect the Gear Case gearing parts and lubricate as instructed in LUBRICATION .
	Worn or damaged parts	Clean and inspect the Gear Case and gearing. Replace worn or broken components.

NOTICE

SAVE THESE INSTRUCTIONS. DO NOT DESTROY.